Grand Bend Wind Farm

Construction Plan Draft Report

Grand Bend Wind Limited Partnership,

c/o Northland Power Inc.

NORTHLAND POWER

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0	August 24, 2012	Initial Submission to the Ministry of Environment, Municipalities, and Aboriginal Communities
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Executive Summary

Grand Bend Wind Limited Partnership, c/o Northland Power Inc. ("Northland") is proposing to develop, construct and operate a 100 MW wind facility located north of Grand Bend, Ontario. An application for approval is being prepared under Ontario Regulation 359/09 of the *Environmental Protection Act*. The project is classified as a Class 4 Wind facility under the Regulation. The Grand Bend Wind Farm ("the Project") is located in Huron County, spanning the lower-tier municipalities of Bluewater and Huron South. Portions of the transmission line also traverse the municipality of Huron East and municipality of West Perth in Perth County.

This Construction Plan Report describes Project construction activities, timing, materials, traffic, and potential negative environmental effects with associated mitigation, monitoring and contingency measures.

Construction of the Project is estimated to take fifteen months, from September 2013 to December 2014. Within this timeframe, specific construction activities have been scheduled to protect natural resources and municipal infrastructure, in particular, the condition of local roads.

Construction-related activities of the Project generally involve:

- Survey for Layout;
- Geotechnical Investigation;
- Site Preparation and Clearing;
- Watercourse Crossings;
- Agricultural Tile Drain Modifications;
- Turbine Foundations;
- Local Road Improvements;
- Access Roads;
- Underground Collector Lines (36 kV);
- Transformer Substation;
- Overhead Transmission Line (230 kV);
- Crane Delivery and Erection;
- Delivery of Turbine Components;
- Turbine Tower, Nacelle and Rotor Assembly;
- Parts and Storage Building;
- Switchyard & Interconnection;
- Commissioning; and,
- Site Restoration.

The majority of construction activities will be completed using standard equipment, materials, and methods utilized in Ontario for electricity generation, distribution, transmission, and land development projects. Turbines will be delivered and installed using custom delivery trucks, cranes, and methods utilized for other wind projects in Ontario and worldwide.

Each potential negative environmental effect during construction has been analyzed with the following key considerations:

- the magnitude of the effect both in intensity and spatial scale;
- the proximity of the effect in relation to the Project;
- the likelihood of occurrence and reoccurrence of the effect;
- the timing and duration of the effect; and,
- the permanence or irreversibility of the effect.

For each potential negative effect, appropriate mitigation, monitoring, and contingency measures were developed. These typically involve setbacks from environmental features, modified construction procedures, timing restrictions, and rehabilitation measures.

During detailed design, the proposed mitigation, monitoring, and contingency measures described in this report will be translated into construction contract specifications as appropriate to fulfill the obligations of Renewable Energy Approval.

This Construction Plan Report has been prepared in accordance with O.Reg. 359/09, and is one component of the REA application for the Project.

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1.0 Introduction

1.1 Project Overview

Grand Bend Wind Limited Partnership, c/o Northland Power Inc. ("Northland") is proposing to develop, construct and operate a 100 MW wind facility located north of Grand Bend, Ontario. An application for approval is being prepared under Ontario Regulation 359/09 of the *Environmental Protection Act*. The project is classified as a Class 4 Wind facility under the Regulation. The Grand Bend Wind Farm ("the Project") is located in Huron County, spanning the lower-tier municipalities of Bluewater and Huron South. Portions of the transmission line also traverse the municipality of Huron East and municipality of West Perth in Perth County.

The basic project components will include up to 48 turbines (Siemens SWT-2.3-113 direct drive wind turbine generators with a total name plate capacity of 100 MW), turbine access roads, a 36 kV electrical collection system, substation, a new transmission line within municipal road right-of ways ("ROWs") along Rodgerville Road, Line 17 and Road 183 with connection to the provincial power grid at the 230 kV transmission line south of the Seaforth Transformer Station. During construction temporary components will include access roads and work/storage areas at the turbine locations and transmission connections.

1.2 Report Requirements

Activities related to the construction of the Project as well as associated potential negative environmental effects are described within the Construction Plan Report.

This Construction Plan Report is one component of the REA Application for the Project, and has been prepared in accordance with Item 1, Table 1 of O.Reg. 359/09 which sets out specific content requirements as provided in **Table 1.1**.

O.Reg. 359/09 and its corresponding Table 1 requirements were amended on July 1, 2012, with project transition provisions. As this Project's notice of proposal and first public meeting was issued on February 29, 2012, this Project is subject to the requirements of O.Reg 359/09 as they existed on December 31, 2011. Under provisions of the Regulation, Northland may also choose to submit in accordance with the July 1, 2012 provisions. A final decision will be made prior to the next formal public notice.

Table 1.1 Construction Plan Report Requirements

Requirements	Completed	Section Reference
Details of any construction or installation activities.	Yes	Section 2.0
The location and timing of any construction or installation activities for the duration of the construction or installation	Yes	Section 2.0
Any negative environmental effects that may result from construction or installation activities.	Yes	Section 3.0
Mitigation measures in respect of any negative environmental effects, as identified above	Yes	Section 3.0

2.0 Construction and Installation Activities

The construction methods, equipment, material types and quantities described in this report are provided as an estimate of project scope for the purpose of identifying and mitigating potential negative environmental effects. Approvals from authorities having jurisdiction will be required in addition to Renewable Energy Approval administered by the Ministry of the Environment. As such, the details described in the following sections are subject to change during the course of detailed design and permitting.

For context, an outline of the construction timing and methodology for each Project component is summarized below. Further detail on construction materials, equipment, traffic, and other considerations are then outlined in the remaining portions of this Section.

2.1 Timing and Operational Plan

Subject to the approval from all applicable regulatory agencies, construction of the Grand Bend Wind Farm is planned to commence in September 2013. Construction (excluding pre-construction activities) is estimated to take place over approximately a 15 month period according to the schedule outlined in **Table 2.1**. Some aspects of the work schedule (for example, the geotechnical investigation) will start prior to September 2013 in order to inform the development of contractual and construction design details.

The schedule provided in **Table 2.1** is intended for construction duration and phasing, and may be modified to accommodate the requirements of Northland and the applicable approval agencies.

Table 2.1 Construction Schedule

Activity	Duration	Start Date	End Date
Geotechnical Investigation	12 weeks	October 2012	January 2013
Survey for Layout	6 weeks	September 2013	October 2013
Site Preparation and Clearing	8 weeks	October 2013	November 2013
Culvert Crossings	10 weeks	October 2013	December 2013
Agricultural Tile Drain Modifications	10 weeks	October 2013	December 2013
Underground Collector Line (36 kV)	10 weeks	October 2013	December 2013
Access Roads	12 weeks	October 2013	January 2014
Transmission Line (230 kV)	24 weeks	April 2014	September 2014
Local Road Improvements	8 weeks	May 2014	June 2014
Transformer Substation	16 weeks	May 2014	August 2014
Turbine Foundations	12 weeks	June 2014	August 2014
Delivery of Turbine Components	10 weeks	August 2014	October 2014
Erect Turbine Tower, Nacelle and Rotor	10 weeks	August 2014	October 2014
Switchyard and Interconnection	12 weeks	August 2014	October 2014
Parts and Storage Building	16 weeks	August 2014	November 2014
Commissioning	12 weeks	September 2014	November 2014
Site Restoration	8 weeks	April 2015	May 2015

2.1.1 Natural Heritage Timing Restrictions

As outlined in the Natural Heritage Assessment Environmental Impact Study under a separate cover, wildlife habitats are susceptible to potential negative effects during construction. As such, construction timing restrictions will be utilized to bolster mitigation techniques. Construction timing restrictions associated with specific habitats are described below.

Fish Habitat
Where access roads are required to traverse a watercourse, culverts will be installed according to the requirements of the authorities having jurisdiction. Where in-water work is involved, culvert installations will take place outside of the designated timing windows governed by Fisheries and Oceans Canada and the Ausable Bayfield Conservation Authority. For further information on fish habitat and timing windows, refer to the Water Assessment and Water Body Report.

Amphibian Habitat
Construction works within 120 m of amphibian breeding habitats will not occur after dusk during the breeding season (April to June).

Bird Habitat
Vegetation removal during site clearing and all construction activities within 120 m of bird habitats will not occur prior to three hours after dawn during the breeding season (May to July).

Bat Habitat
Turbine construction within 30 m of significant bat habitat will be limited, where possible to daylight hours during the period of May 1 to August 31.

2.1.2 Local Road Timing Restrictions

The County of Huron may not issue oversize/overweight permits for travel during certain periods of the spring due to the susceptibility of the roads to damage. Also, heavy loads are not recommended on the local municipal roads during this time period, due to soft subgrade conditions and the reduced design standards of these roads.

2.1.3 Winter Construction

Depending on climate conditions, winter construction may affect the supply and placement of aggregates and concrete. It is assumed that local aggregate and concrete suppliers will remain operational during the winter months as required to supply construction materials for the Project. Due to additional concrete construction procedures during cold weather, additional crews may be required to satisfy Project requirements.

2.2 Pre-Construction Activities

Pre-construction activities for the Project generally involve investigative, design, and layout work that will be required prior to construction of Project infrastructure. These activities are described in further detail below.

2.2.1 Survey

Lands to be used during construction of the Project include access roads and work/storage areas at the turbine locations and collection/transmission connections. These areas will be surveyed and staked prior to any ground breaking works. Once staked, all construction and installation activities will be conducted within the defined area. For further detail on the location of Project components and construction areas, refer to the Site Plan in **Appendix A**.

2.2.2 Geotechnical Investigation

A geotechnical investigation will be performed to obtain subsurface information of the soils. This information will inform the design of project infrastructure such as the wind turbine foundations, access roads, and underground watercourse crossings.

The investigation will consist of a strategic layout of boreholes and test pits at various depths to determine the subsurface stratigraphy across the study area. Soil samples will be collected and laboratory tested to determine the physical and structural properties of the soil. In locations where creek crossings are proposed, boreholes will be taken on one or both sides of the creek, outside the ordinary high water level to avoid disturbance of the watercourse.

2.2.3 Erosion and Sediment Control

Erosion and sediment control measures will be designed to minimize displacement of soil and impacts on receiving watercourses during construction. A combination of Ontario Provincial Standard Specifications and Drawings (OPSS and OPSD), and industry best management practices will be utilized. Typical erosion and sediment control measures anticipated to be employed include the following:

- Silt Fence (OPSD 219.110);
- Straw Bale Barrier (OPSD 219.100);
- Rock Flow Check Dam (OPSD 219.210);
- Excavated Sediment Trap (OPSD 219.220);
- Dewatering Filter Bags;
- Erosion Control Blankets (i.e., Terrafix RECPs); and,
- Seeding / Hydroseeding/Terraseeding.

Additional Erosion and Sediment Control details will be required to satisfy the requirements of the Fisheries and Oceans Canada Operational Statements outlined in Section 2.3.5.

Once construction is complete in each area of the project, temporary construction areas will be restored to pre-development conditions to minimize the residual effects of erosion and sedimentation during construction.

2.2.4 Safety Measures

Construction site and traffic safety measures will be designed and included in the construction contract documents. Certain measures will require detailed design such as a Traffic Management Plan, whereas others will be standard prescriptive measures. The

construction contract documents will outline all details necessary to construct the project in accordance with the Ontario Occupational Health and Safety Act. Provincial, county, and municipal road and entrance permits will also be obtained, outlining further detail on safety measures and design requirements.

2.3 Construction Activities

Construction activities for the Project generally involve:

- site works to prepare the lands and facilitate access for construction;
- electrical works and equipment installation for electricity generation and transmission; and,
- restoration works to reinstate temporary construction areas to predevelopment conditions.

A more detailed description of these activities is outlined for each Project component below.

2.3.1 Site Preparation and Clearing

Prior to any other construction activity, lands designated for Project infrastructure will need to be prepared and cleared of obstructions and debris. Generally, site preparation will include the installation of construction fencing, safety features, and erosion and sediment control features as defined in the construction contract documents. Site clearing will include the removal of fences, trees, shrubs, foreign objects, and other debris that would interfere with the construction of the Project. The access roads and turbine sites have been designed to minimize the removal or relocation of trees where possible. Further details on tree displacement will be outlined in the road user agreements with the authorities having jurisdiction.

2.3.2 Tile Drain Modifications

Tile drain modifications will be made to preserve agricultural drainage during and after construction. They will be completed by a licensed drainage Contractor, which will ensure proper equipment and methods are utilized. In general, water will be directed around excavations and under access roads such that agricultural drainage is preserved and construction areas are protected. A licensed drainage Contractor will ultimately be responsible for the design and construction of the tile modifications, but conceptual designs are detailed in **Figures B1** and **B2** of **Appendix B** for the purpose of identifying potential negative effects associated with the work.

The construction phasing of tile drain modifications will be sequenced to divert tile drainage around excavations during construction. This will protect the structural integrity of access roads and minimize the requirement of water taking in the form of dewatering during construction.

2.3.3 Local Road Improvements

Existing provincial, county, and municipal roads will be used for delivery of Project equipment. Due to the size and weight of the wind turbine delivery trucks, existing road geometry, condition, and strength must be considered. As such, an assessment of the existing roads anticipated to be used was performed to identify access and loading constraints. The Ministry of Transportation and the County of Huron were consulted and the Municipalities of Bluewater and South Huron attended field surveys of the roads. Each authority provided available input and considerations on the design and condition of their roads. This investigation provided the necessary detail to identify potential impacts on local roads and structures, and develop associated mitigation measures, as outlined in **Table 3.6**. Further discussion and analysis of the investigation will be required to develop road user agreements and obtain necessary permits from each authority.

The road assessment outlined above indicated that local road improvements will be required to accommodate the turning requirements of custom wind turbine delivery trucks. These improvements will typically involve temporary culvert extensions and placement and compaction of Granular 'A' and 'B' at intersections. Further details on local road improvements will be outlined in the road user agreement and/or applicable permit with each road authority.

2.3.4 Access Roads and Turbine Installation Areas

Access roads and turbine installation areas will be constructed to facilitate the delivery of Project equipment to the site. The access road layout illustrated in **Appendix A** incorporates wide turning radii required by wind turbine delivery trucks during construction. Construction access roads will vary from five to 11 m wide during construction, depending on the passing lane and crane movement requirements of the laneway. Permanent access laneways will be approximately 5 m wide, with the exception of entrances off local roads and all turning areas which require wider turning radii.

Truck turnaround areas have been designed to encircle the turbine installation areas, and will be designed to withstand the same loads as the access roads. In addition to a truck turnaround area, the turbine installation area has been designed to accommodate stockpiled topsoil and subsoil, turbine equipment staging, construction and rotor

assembly areas, and a crane pad. A conceptual layout of the turbine installation area is detailed in **Figure B3** of **Appendix B**.

Crane pads will be approximately 18 m x 35 m, and will be designed to support the loading imparted by the crane during construction. Subject to the results of the geotechnical investigation, it is anticipated that an appropriate granular foundation design will be suitable to support the crane. Assembled cranes will be required to crawl between all turbine sites that can be accessed from the same site entrance off a local road. Access roads for these segments will be 11 m wide, and will be designed to support the loads imparted by the assembled crane.

The construction phasing of access roads will be required to accommodate the construction of other Project infrastructure such as underground collector lines and fiber optic cable. It will also be scheduled outside wet conditions in March and April to protect the condition of local roads used as haul routes.

In general, standard road construction techniques will be used to construct the access roads and turbine installation areas. Prior to grading works, tile drainage modifications will be made by a licensed drainage Contractor to preserve agricultural drainage during and after construction. Topsoil and subsoil will then be stripped and stockpiled separately, and the underground 36 kV collector line and fiber optic cable will be installed. Prior to the placement of aggregate, a geotextile material may be required to reinforce the subsurface soils. Granular 'A' and 'B' will then be placed and compacted to form the base and sub-base structure of the road, allowing surface water to drain freely across the access road. The thickness of granular material will be approximately 0.3 m to 0.7 m to facilitate the movement of heavy construction equipment. Further accuracy of the access road granular composition will be developed during detailed design, after a geotechnical investigation of the subsurface soils has been performed.

2.3.5 Watercourse Crossings

Where access roads are required to traverse a watercourse, culverts will be required. Culverts will be installed according to the design and procedures approved by the authorities having jurisdiction. A preliminary culvert design has been developed and submitted to the Ausable Bayfield Conservation Authority (ABCA) for review. The preliminary design is detailed in **Figure B4** of **Appendix B**, and includes the use of rip-rap and geotextile materials to minimize erosion of the watercourse banks. Further development and approval of this design by the ABCA will be required prior to construction.

Where in-water work is required, culvert installations will have to take place outside of the designated timing windows governed by Fisheries and Oceans Canada and ABCA.

For further information on fish habitat and timing windows, refer to the Water Assessment and Water Body Report.

Collector line and transmission line watercourse crossings will not involve in-water work, and will be installed according to the applicable Fisheries and Oceans Canada Operational Statements. It is anticipated that a combination of Punch & Bore, Horizontal Directional Drilling, and Overhead Line Construction will be employed for watercourse crossings. A brief summary of these operational statements is provided below. For further detail, refer to the Operational Statements available online at www.dfo-mpo.gc.ca/regions/central/habitat/os-eo/provinces-territories-territoires/on/index-eng.htm.

Horizontal Directional Drilling requires a geotechnical assessment of the soils to design a drill path at an appropriate location and depth to minimize the potential for a "frac-out" to occur. A "frac-out" is caused when excessive drilling pressure results in drilling mud propagating toward the surface. A frac-out response plan and a contingency crossing plan will need to be developed by the Contractor to mitigate negative environmental effects in the event of a frac-out should this method of drilling be selected. Erosion and Sediment Control measures will also be designed to mitigate any potential negative environmental effects associated with the drilling and dugout work areas.

Punch and Bore requires the design of a punch and bore path at an appropriate location and depth to prevent the cable from becoming exposed due to natural scouring of the stream bed. Erosion and Sediment Control measures will be designed to mitigate any potential negative environmental effects associated with the bell holes and work areas. A response plan will need to be developed by the Contractor to mitigate negative environmental effects in the event of a spill of sediment-laden water or other deleterious substances to the watercourse.

Overhead Line Construction requires the design of crossing approaches that minimize disturbance to riparian vegetation. Erosion and Sediment Control measures will be employed to mitigate any potential negative environmental effects associated with the disturbed areas during construction.

2.3.6 Turbine Assembly

Foundations

Turbine foundations will be designed based on the results of the geotechnical investigation. At this time, based on soils in the area and preliminary discussions with geotechnical engineers, the turbines will likely be supported by shallow spread footings. The footings will be constructed of reinforced concrete, and will be poured in-place on

site. Approximate dimensions of the turbine footings are anticipated to be 3 m in depth and 18 to 22 m in diameter.

To prepare the turbine foundation sites, topsoil and subsoil will be stripped and stockpiled separately. Excavation of the foundation sites will be accomplished with a backhoe as bedrock and blasting is not anticipated. At the appropriate depth, a thin layer (approximately 0.05 to 0.15 m) of lean concrete will be poured to create a level and protected foundation pad. After setting of the lean concrete base, outer formwork, ground wiring, and rebar assembly for the foundation will then take place. With the formwork, rebar, and ground wiring in place, high-strength concrete will then be poured to form the foundation. After setting of the concrete, the formwork will be removed, and the foundation will cure for up to 28 days to achieve its design strength. Once sufficiently cured, the foundation will be backfilled and compacted.

Tower, Nacelle and Rotor

The turbine tower, nacelle and rotor will be delivered to the site in components. The 99.5 m high turbine tower will be delivered to the site in five sections: the base, three mid-sections, and the top section. The nacelle will be pre-assembled and delivered to the site in one component. The rotor will be delivered in four components: the three blades and the hub. After sufficient curing of the reinforced concrete foundation, the wind turbine will be erected with the use of cranes. The turbine tower and nacelle will first be installed, and the blades will be connected to the hub on the ground for rotor assembly. The assembled rotor will then be lifted into place and installed again with the use of cranes.

2.3.7 Electrical Lines

36 kV Collection System

Underground 36 kV collector lines will be installed to connect each turbine to the Project's transformer substation. On private land, the underground collector lines will be installed in a trench alongside access roads at an approximate depth of 0.5 m to 1.6 m with bedding, compacted backfill, and overlain with marker tape according to the authorities having jurisdiction. On public land, the underground collector lines will be installed in the gravel shoulder at an approximate depth of 0.5 m to 1.6 m with bedding, compacted backfill, and overlain with marker tape according to the authorities having jurisdiction.

In areas where the collector line intersects a watercourse, the line will be installed according to the Operational Statements outlined in Section 2.3.5.

230 kV Transmission Line

Overhead 230 kV transmission lines will be installed to connect the Project's transformer substation to the existing 230 kV transmission line south of Seaforth Transformer Station. The transmission lines will be installed on proposed utility poles according to the requirements of the authorities having jurisdiction. It is anticipated that the utility poles will be approximately 25 m to 35 m high at a spacing of approximately 100 m, and will require proper clearance from houses, trees, and other obstructions. Conceptual details of the utility poles are provided in **Figure B5** of **Appendix B**. Utility pole layout will be modified during detailed design as required to avoid sensitive areas such as wetlands, woodlots, an airstrip, and graveyards. Avoidance can be achieved by adjusting utility pole spacing, height, relocation to the other side of the road, or installation underground as appropriate.

A variety of equipment and service trucks outlined in Section 2.5.2 will be used to dig the required holes and install the utility poles and transmission lines. In areas where the transmission line intersects a watercourse, the line will be installed according to the Operational Statements outlined in Section 2.3.5.

2.3.8 Communication Lines

Fiber optic communication lines will be installed in conjunction with the electrical collector and transmission lines described in Section 2.3.7. For the underground segments, the fiber optic cable will be installed in a common trench with the electrical lines. For the overhead segments, the fiber optic cable will be installed on the utility poles. Fiber optic and electrical cable will be installed with proper spacing according to the requirements of the authorities having jurisdiction.

2.3.9 Transformer Substation

A transformer substation will be constructed to convert the voltage from the incoming 36 kV collector lines to the outgoing 230 kV transmission lines. The transformer substation is proposed to be located near the intersection of Sararas Road and Blackbush Line in the Municipality of Bluewater, and will be approximately 73 m x 54 m (3,942 m^2). Refer to **Figure A5** of **Appendix A** for the proposed location and **Figures B6-B8** of **Appendix B** for conceptual drawings of the transformer substation.

To prepare the site, topsoil and subsoil will be stripped and stockpiled separately, followed by construction of the electrical connections and grounding, granular foundation, electrical equipment, and safety features. Access to the transformer substation will be secured by a properly grounded perimeter fence, a locked gate, and appropriate warning signage.

2.3.10 Switchyard

A Switchyard will be constructed to connect the Project's 230 kV transmission line to the provincial grid south of the Seaforth Transformer Station. Refer to **Figure A19** of **Appendix A** for the proposed location and **Figures B9-B1** of **Appendix B** for conceptual drawings of the Switchyard.

To prepare the site, topsoil and subsoil will be stripped and stockpiled separately, followed by construction of the electrical connections and grounding, granular foundation, electrical equipment, and safety features. Access to the switchyard will be secured by a properly grounded perimeter fence, a locked gate, and appropriate warning signage.

2.3.11 Parts and Storage Building

A permanent steel-framed parts and storage building with parking lot will be constructed to facilitate the long-term operations and maintenance of the wind farm. The building is proposed to be located near the intersection of Sararas Road and Blackbush Line in the Municipality of Bluewater, and will be approximately 15 m x 36 m (540 m^2). Refer to **Figure A5** in **Appendix A** for the proposed location and **Figures B11-B16** of **Appendix B** for conceptual drawings of the building.

Standard building construction techniques will be employed, including stripping and stockpiling of topsoil and subsoil separately, placement and compaction of aggregate for the parking lot and building pad, construction of a reinforced concrete foundation, and erection of framing, siding, and roofing. The building will be serviced with well water and a septic system, and an electrical service from the distribution line on Blackbush Line. As outlined in the Design and Operations Report, if the well is found to have water quality or quantity issues, a storage and/or treatment system will be constructed at the building.

2.3.12 Site Restoration

Lands to be temporarily used during construction of the Project include temporary construction access roads, and staging/work areas on private land and within the public right-of-way.

Following construction activities, all disturbed areas adjacent to project components will be restored to pre-development conditions. Restoration work will start following installation of each wind turbine and removal of all construction materials and equipment from each turbine site. In general, restoration will consist of reclaiming agricultural use on private land, and re-vegetating public land. Specific restoration measures on private land are described below. Further details on restoration measures within the public

right-of-way will be outlined in the road user agreements with each authority having jurisdiction.

Turbine Installation Sites

Turbine components will be delivered directly to the staging areas for each turbine. The components will be temporarily stored within these staging areas until assembled. Turbine staging areas will be designated during access road construction, and will form the central component of the turbine installation area. In addition, an area encircling the turbine staging area will be prepared to accommodate delivery truck turnarounds and allow for a clear area to assemble the rotor. Crane pads will also be constructed at each turbine installation site, adjacent to the proposed turbine location. The applicable portions of turbine installation area will be constructed of a suitable granular makeup to withstand the delivery truck and crane loading conditions.

After construction, a small portion of the turbine installation area will become the permanent access road for turbine maintenance. The remaining areas will be ripped to restore compacted subsoil, and surfaced with topsoil to restore the agricultural use of the land.

Construction Access Roads

Construction access roads will be required to accommodate wind turbine delivery truck turning requirements and crane crawling. These roads will require larger entrances and laneway widths than the permanent access roads for maintenance. A staging area will also be required along the edges of the access roads to temporarily store materials such as excavated soil, collector cable, and geotextile. After construction, the access roads may be reduced in size to accommodate smaller maintenance vehicle turning requirements. This would be accomplished by removing a depth of approximately 0.2 m to 0.4 m of access road aggregate from temporary construction access road areas, ripping the compacted subsoil, and replacing with topsoil to restore the agricultural use of the land.

2.4 Materials Brought On-Site

Standard building materials will be utilized for the construction of the Project. These generally include metal, aggregate, concrete, wood, geotextile, wiring, plastic, glass, and ceramic. Certain Project components will be pre-assembled prior to delivery to the site, while other components will require the raw materials to be delivered for construction on-site. The type and quantity of equipment used to deliver these materials to the site is described in Section 2.6.

2.4.1 Pre-Assembled Materials

Turbines
The turbines will be transported on-site in the following pre-assembled components: the hub, blades, nacelle, and tower sections. Each of these components have a unique material makeup, approximately 90% of which is steel by weight and approximately 6% of which is glass-fiber-reinforced plastic in the blades. The total weight of each turbine excluding the foundation is approximately 400 metric tonnes.

Electrical Equipment
With the exception of the collector and transmission lines, the majority of electrical equipment will be delivered to the site in pre-assembled components. These components generally include transformers, switches, capacitors, insulators, and meters. These pre-assembled components are predominantly comprised of composite metals and ceramics for their conductive, insulating, and structural properties.

2.4.2 Raw Materials

Raw materials will be delivered to the site's staging and construction areas according to the Contractor's detailed construction plan. Hazardous materials such as fuels, oils, and lubricants required for construction equipment will be kept in proper storage containers with associated labels and MSDS documentation, and secured in a proper location identified by the Contractor. Predominant raw material requirements for the Project are described in detail below.

Concrete
As described in Section 2.3.6, turbine foundations will require a thin layer of lean concrete under the high-strength concrete. The strength of the lean concrete will likely be 5 to 15 megapascals (MPa), and the high-strength concrete will likely be 25 to 35 MPa. It is estimated that each turbine foundation will require approximately 25 cubic metres (m^3) of lean concrete, and 450 m^3 of high-strength concrete. Concrete requirements for the entire Project will therefore be approximately 1,200 m^3 of lean concrete, and 21,600 m^3 of high-strength concrete. An additional 165 m^3 of high-strength concrete will also be required for the parts and storage building foundation. Concrete will be prepared off-site at a local commercial facility, and delivered in mixing trucks to reduce the need for water-taking activities on site during construction.

Steel
Each turbine foundation will require steel reinforcement (rebar) in the concrete to enhance tensile strength. It is estimated that each turbine foundation will require approximately 4.4 m^3, or 35 metric tonnes of rebar. Steel requirements for the turbine foundations across the entire Project will therefore be approximately 211 m^3, or 1,680 metric tonnes.

The material used for utility poles proposed along the transmission line will be determined during detailed design, but is assumed to be steel for the purposes of this report. Subject to the height and spacing requirements to be determined during detailed design, it is estimated that approximately 350 utility poles will be required.

Aggregate
Aggregate requirements for the access roads and turbine installation areas will depend on the depth of aggregate determined during detailed design. Assuming an average depth of 0.5 m, approximately 272,000 m^3 of aggregate would be required. Approximately 1,000 m^3 of additional aggregate would be required for the foundations of the transformer substation, parts and storage building and switchyard.

Geotextile
Geotextile may be required to reinforce subsurface soils. If the geotechnical investigation recommends subsurface reinforcement, up to 522,000 m^2 of geotextile could be required.

Fill
Based on the relatively flat topography of the site, it is anticipated that the excavated subsoil during access road and turbine foundation construction will be adequate for any required re-grading and backfilling. As such, no fill from an external source is anticipated to be imported to the site.

Water
Water required for concrete mixing and dust control will be acquired off-site. The water component of concrete required for each turbine foundation will be approximately 70 m^3. For dust control during the construction of access roads, approximately 0.6 L/m^2 will be used every 30 minutes, or as required to satisfy the requirements of the applicable approval agencies. Assuming there is no rain to assist with dust control, this application rate would require approximately 15,000 m^3 of water during access road construction. Dewatering requirements are discussed in Section 2.8, which indicates that less than 50,000 L/day of water will be pumped for open excavations.

Wiring
Wiring will be required to construct the underground collector and transmission lines, as well as fiber optic communications lines. It is estimated that approximately 53 km of 36 kV, 31 km of 230 kV, and 84 km of fiber optic cabling will be required.

Culverts
Culverts will be plastic, steel, or concrete depending on their required structural and geometric requirements. Approximately 22 permanent culverts will be required in

roadside ditches at site entrances, and six permanent culverts will be required to cross watercourses on private land. The Contractor may require additional culverts at site entrances during construction to facilitate drainage around wide entrance turning radii.

2.5 Construction Equipment

2.5.1 Typical Construction Equipment

The heavy construction equipment required will generally consist of earth moving and compacting equipment, cranes, and a variety of service and delivery trucks. The equipment will vary depending on the preferred techniques of the selected Contractor, but will typically include the equipment outlined in **Table 2.5.1**. Further specifications on each machine can be provided upon request, or found on the manufacturer's website.

Table 2.5.1 Typical Construction Equipment

Description	Example
Auger Drill	CME-55
Directional Drill	Vermeer D80X100
Harvester	CAT 511
Backhoe	CAT 450E
Scraper	CAT 621H
Excavator	CAT 320D L
Rotary Trencher	US Ditcher Drenag 75/100
Loader	CAT 950H
Bulldozer	CAT D6N
Vibratory Soil Compactor	CAT CP54B
Grader	CAT 12M2
Asphalt Paver	CAT AP1055E
Pneumatic Tire Compactor	CAT PS150C
Vibratory Asphalt Compactor	CAT CB54
Bundle Conductor Tensioner	Timberland PT150-4H/4
Water Truck	International 7400
Cable Reel Truck	Ground Force Cable Reel Truck
Concrete Truck (7 m^3 capacity)	Mack Granite Mixer
Tri-axle Dump Truck (15 m^3 capacity)	Mack Granite Dump
Standard Transport Truck	Volvo VN670
Wind Turbine Delivery Truck (Custom)	Temisko, Lenron, Mammoet
Lattice Boom Crawler Crane	Terex CC 2800-1
Truck Mounted Crane	Terex Roadmaster 5300

2.5.2 Construction Equipment by Activity

Each construction operation will require a variety of equipment as outlined in **Table 2.5.2**. The selected Contractor may elect to use a different combination or quantity of equipment depending on their preferred techniques.

Table 2.5.2 Construction Equipment by Activity

Activity	Equipment Required	Quantity
Geotechnical Investigation	Auger Drill	1
Site Preparation & Clearing	Harvester	1
	Bulldozer	1
	Excavator	1
	Loader	1
	Tri-axle Dump Truck	4
Culvert Crossings	Backhoe	1
	Bulldozer	1
	Excavator	1
	Vibratory Soil Compactor	1
	Grader	1
Underground Collector Line (36 kV)	Excavator or Rotary Trencher	2
	Vibratory Soil Compactor	1
	Directional Drill	1
	Cable Reel Truck	2
Agricultural Tile Drain Modifications	Rotary Trencher	1
	Backhoe	1
	Drainage Tile Reel Truck	1
Turbine Foundations	Bulldozer	1
	Excavator	1
	Loader	1
	Concrete Truck	9
	Tri-axle Dump Truck	4
	Vibratory Soil Compactor	1
	Grader	1
Local Road Improvements	Loader	1
	Tri-axle Dump Truck	4
	Vibratory Soil Compactor	1
	Grader	1

Activity	Equipment Required	Quantity
Access Roads	Scraper	4
	Bulldozer	2
	Excavator	2
	Loader	2
	Tri-axle Dump Truck	38
	Vibratory Soil Compactor	2
	Grader	2
	Water Truck	3
Transformer Substation	Bulldozer	1
	Excavator	1
	Loader	1
	Tri-axle Dump Truck	4
	Vibratory Soil Compactor	1
	Grader	1
	Standard Transport Truck	2
Transmission Line (230 kV)	Directional Drill	1
	Auger Drill	1
	Standard Transport Truck	2
	Truck Mounted Crane	1
	Cable Reel Truck	1
	Bundle Conductor Tensioner	1
Delivery of Turbine Components	Wind Turbine Delivery Truck	11
	Standard Transport Truck	4
	Truck Mounted Crane	2
Turbine Tower, Nacelle and Rotor	Lattice Boom Crawler Crane	1
	Truck Mounted Crane	2
Parts and Storage Building	Bulldozer	1
	Excavator	1
	Loader	1
	Tri-axle Dump Truck	4
	Vibratory Soil Compactor	1
	Grader	1
Electrical Interconnection	Truck Mounted Crane	1
	Bundle Conductor Tensioner	1

Activity	Equipment Required	Quantity
Site Restoration	Backhoe	4
	Tri-axle Dump Truck	6
	Loader	2
	Vibratory Soil Compactor	1
	Grader	1
	Asphalt Paver	1
	Pneumatic Tire Compactor	1
	Vibratory Asphalt Compactor	1

2.6 Transportation and Traffic

Construction of the Project will require the delivery of construction equipment, pre-assembled materials, and raw materials to the site. A Traffic Management Plan will be prepared by the Contractor during detailed design to facilitate safe delivery, and to minimize local traffic impacts due to construction operations. The Traffic Management Plan will outline access routes to be used by delivery vehicles, signage to be implemented and maintained, temporary lane modifications, and timing restrictions that may be required. The Contractor will be responsible for obtaining all required permits for the use of existing roads, and the implementation of temporary traffic measures that may be required. For overweight/oversize loads, the Contractor will be required to employ the safety measures required by each road authority, such as flags, signs, lighting, and escort vehicles as required.

Construction traffic will be dispersed across the available haul routes and construction timeframe. While the area roads have sufficient capacities to accommodate the construction traffic, additional effort will be made to schedule slow-moving traffic (e.g., delivery of turbine components via oversize vehicles) outside of the peak traffic summer period.

A summary of construction traffic generated by construction activities is provided in **Table 2.6**, and described in detail below.

Table 2.6 Construction Traffic Summary

Material Delivered	Trucks Required	Frequency of Total Trips to Site	Duration of Trips to Site
Construction Equipment – Mobilization	4 Transport Trucks	6 trips / day	1 week
Construction Equipment – During Construction	1 Transport Truck	1 trip / day	56 weeks
Wind Turbines	5 Custom Trucks	9 trips / day	10 weeks
Wind Turbine Ancillary Equipment	2 Transport Trucks	3 trips / day	10 weeks
Transformer Substation and Switchyard	1 Transport Truck	2 trips / day	1 week
Concrete – Turbine Foundations	9 Concrete Trucks	68 trips / day	10 weeks
Concrete – Parts and Storage Building Foundation	3 Concrete Trucks	24 trips / day	1 day
Steel (Rebar)	1 Transport Truck	3 trips / day	3 weeks
Aggregate	38 Dump Trucks	305 trips / day	12 weeks
Geotextile	1 Transport Truck	1 trip / day	1 week
Water	3 Water Trucks	28 trips / day	12 weeks
Utility Poles	1 Transport Truck	2 trips / day	18 weeks
Wiring – Collector Line	2 Cable Reel Trucks	2 trips / day	10 weeks
Wiring – Transmission Line	1 Cable Reel Truck	1 trip / day	24 weeks
Pipes	1 Transport Truck	2 trips / day	1 week

2.6.1 Construction Equipment Delivery

With the exception of service and delivery trucks, the construction equipment outlined in Section 2.5 will be transported to the site on transport trucks. Approximately four transport trucks will be required, making a total of six trips per day to the site over one week. During construction, track-mounted equipment will need to be transported to the turbine sites through 22 access points, which will require one transport truck to make on average one trip per day on local roads over the duration of the project.

2.6.2 Turbine Delivery

Custom wind turbine delivery trucks up to 60 m in length and weighing up to 174 metric tonnes (under load) will be required to deliver the pre-assembled components of the turbine to the site. The maximum axle load would be 11 metric tonnes. It is estimated that five custom wind turbine delivery trucks will be required for transport of the nacelles, blades, and tower sections, making a total of nine trips per day to the site

over 10 weeks. In addition, two transport trucks will be required for delivery of the base ring, hubs, and transformers, making a total of three trips per day to the site over 10 weeks.

2.6.3 Electrical Equipment Delivery

The majority of equipment for the transformer substation and switchyard will be delivered to the site with the use of transport trucks. Approximately one transport truck will be required to make two trips per day to the site area over one week.

2.6.4 Raw Material Delivery

Concrete will be prepared off-site and delivered with the use of tri-axle concrete trucks. For turbine foundations, approximately nine concrete trucks with a capacity of 7 cubic metres (7 m^3) will be required, making a total of 68 trips per day to the site over 10 weeks. For the parts and storage building foundation, approximately three concrete trucks will make 24 trips to the site area over one day.

Steel to be used as reinforcement in the concrete foundations of turbines and the parts and storage building and will be delivered to the site with the use of transport trucks. Approximately one transport truck will be required to make a total of three trips per day to the site area over three weeks.

Aggregate for the access roads and structure foundations will be delivered to the site with the use of tri-axle dump trucks. Approximately 38 trucks with a capacity of 15 m^3 will be required to make a total of 305 trips per day to the site area over 12 weeks.

If required for subsoil reinforcement, geotextile may be delivered to the site with the use of transport trucks. Approximately one transport truck will be required to make a total of one trip per day over one week.

Water for dust control during access road construction will typically be supplied with the use of a 4,000 gallon (15,150 L) water truck. Approximately three water trucks will be required to make a total of 28 trips per day to the site area over 12 weeks.

Utility poles will be delivered to the site with the use of transport trucks. Approximately one transport truck will be required to make a total of two trips per day to the 230 kV transmission line site area over 18 weeks.

Wiring for electrical lines will be delivered with the use of cable reel trucks. For the collector lines and fiber optic cable, approximately two trucks will be required to make a total of two trips per day to the site over 10 weeks. For the transmission line,

approximately one truck will be required to make one trip per day to the site area over 24 weeks.

Culverts will be delivered to the site with the use of a transport truck. Approximately one transport truck will be required to make two trips per day to the site area over one week.

2.7 Temporary Uses of Land

Temporary changes to land will be limited to the construction areas described in Section 2.3.12 of this report. The majority of these construction areas (i.e., access roads and turbine staging areas) are on private land for agricultural use. The remaining areas (i.e., site entrances and collector / transmission lines) are within the municipal right-of-way, and are used as a transportation corridor.

During construction, these areas will be used to install construction fencing, safety features, erosion and sediment control measures, and to temporarily store materials.

Any temporary structures used during construction will not be serviced with electrical or water connections, and will be placed within delineated construction work areas.

The lands proposed for temporary construction purposes are suitable for the implementation of required construction measures, and can be restored to pre-development conditions after construction, as described in Section 2.3.12.

Once construction is complete in each area, lands used for temporary construction activities will be restored. The land required for access roads and site entrances may be reduced in size to accommodate smaller maintenance vehicles. Restoration on private land will typically include the removal of aggregate and replacement of topsoil as required to restore the agricultural use of land. For areas within the municipal right-of-way, culverts installed during construction will be modified to suit permanent site entrances, and the entire corridor will be restored to the pre-development composition of topsoil, vegetation, and drainage features.

2.8 Temporary Water Takings

2.8.1 Desktop Review

A desktop review was completed to assess potential water taking activities required to facilitate construction of the Project. The review included soils, bedrock and surficial geology maps, and well records.

The following observations were made during the desktop review:

- The majority of the turbine sites are underlain by St. Joseph Till, which is a fine grained, stiff clayey silt to silty clay till, with a hydraulic conductivity of approximately 10^{-8} m/s. Approximately seven to 10 of the turbine sites are underlain by finer grained glaciolacustrine deposits, and three to five are located near sandier beach deposits, which may have a hydraulic conductivity of approximately 10^{-5} m/s.
- Overburden thickness in the area generally exceeds 25 metres and a search of well records within 150 metres of each site location indicated bedrock no shallower than 14 metres.
- Static water levels in the wells in the area are typically greater than 15 metres deep, although higher perched water tables may exist in localized areas. A review of well records within 150 metres of the sites shows only two of 84 wells with a static water level shallower than five metres (5m).
- The turbines are not located in wetlands, peat/muck, or swamps.

2.8.2 Dewatering Calculations

Using the desktop review as a basis, dewatering calculations for turbine foundation excavations were performed (refer to **Appendix C**). The typical size of excavation for the proposed wind turbine foundations was assumed to be 3 m deep x 19 m x 19 m. It was also assumed that tile drainage will be redirected around the excavated area through the use of a header around each turbine foundation.

The calculations indicate that the rate of pumping required for each proposed turbine foundation excavation is unlikely to exceed 50,000 L/day. Other subsurface excavations required for access roads and the parts and storage building are shallower, and are therefore not anticipated to exceed 50,000 L/day. Similarly to the turbine foundation excavations, other subsurface excavations will require proper tile drain modifications to be made to divert drainage around the excavated areas.

2.8.3 Dewatering Procedures

Where dewatering from Project excavations is required, water will be pumped through a filter bag to adjacent agricultural land for infiltration and settlement of suspended solids.

2.9 Materials/Waste Generated at, or Transported from, the Project Location

The general strategy for materials and waste generated at and transported from the Project during construction is as follows:

- supply construction materials without packaging;
- reuse materials and temporary structures where possible; and,
- dispose of excess materials at approved disposal facilities.

A detailed description of each waste material generated at and transported from the Project is provided below.

2.9.1 Construction Debris

The majority of materials brought on site are pre-assembled or raw materials having little or no packaging. Formwork can be reused, and a limited number of temporary structures are anticipated. It is therefore estimated that a minor amount of construction debris will be stored in bins and disposed of at an approved facility.

2.9.2 Sewage

Portable washrooms will be provided and maintained during construction by a commercial supplier. The supplier will be responsible for regular servicing of the washrooms, including removal and disposal of sewage at an approved facility. It is estimated that one sewage truck will be required to remove approximately 5,000 L of sewage from the Project location each week during construction.

2.9.3 Aggregate

As outlined in Section 2.4.2, no fill from an external source is anticipated to be imported to the site for grading works. However, temporary construction access roads will be restored to their pre-development agricultural use after construction. This will be achieved by removing a depth of approximately 0.2 m to 0.4 m of aggregate and replacing with topsoil. The amount of aggregate removed during site restoration is estimated to be approximately 50,000 m^3, and is anticipated to be either re-used on site if possible, or disposed of or recycled at an approved facility.

3.0 Potential Negative Environmental Effects, Mitigation and Monitoring

All potential negative environmental effects anticipated during construction, including associated mitigation and monitoring strategies, are detailed in **Tables 3.4 – 3.9**. The guiding principles that were used to identify and analyze each effect are summarized below.

3.1 Description of Potential Negative Environmental Effects

Any potential negative environmental effect that may result from Project construction has been identified in **Tables 3.4 – 3.9**. For a complete list of all potential negative environmental effects during construction, operation and decommissioning, refer to the Project Description Report. Effects described in **Tables 3.4 – 3.9** were identified from the construction and installation activities described in this report in conjunction with other investigations undertaken. For details relating to the natural heritage, water, archaeological, and cultural heritage features of the study area, refer to the Natural Heritage Assessment Environmental Impact Study, Water Assessment and Water Body Report, and Archaeological Stage 1-2 Assessment under separate covers as part of the REA application.

A number of considerations for each potential negative environmental effect were considered to understand the extent of the effect and to develop appropriate mitigation and monitoring strategies. Key considerations included:

- the magnitude of the effect both in intensity and spatial scale;
- the proximity of the effect in relation to the Project;
- the likelihood of occurrence and reoccurrence of the effect;
- the timing and duration of the effect; and,
- the permanence or irreversibility of the effect.

3.2 Mitigation Strategies

Wherever possible, construction scheduling and procedures were developed to avoid occurrence of a potential effect. In cases where avoidance was not possible, an appropriate mitigation strategy was developed to minimize the magnitude, likelihood, duration and permanence of the potential effect. Mitigation strategies were typically developed according to the following approach:

- Design Project siting to avoid occurrence of the effect;
- Develop construction scheduling and procedures to mitigate the effect; and,
- Develop rehabilitation measures to restore affected features.

Mitigation will be implemented through a variety of mechanisms, including:

Contract Documents
Northland is committed to constructing the Project in an environmentally responsible manner and in compliance with all applicable environmental laws, regulations, and guidelines. All of Northland's contractors and subcontractors will be accountable for actions that have an adverse effect on the environment. As such, any contract documents executed by Northland will incorporate appropriate provisions from the REA documents. Additionally, all contractors, subcontractors, and other associates of the Project will follow the guiding principles of the monitoring program. These organizations will also comply with all relevant municipal, provincial, and federal legislation.

Management Structures
Northland, the turbine manufacturer, and the Contractor will take steps to ensure that they have appropriately skilled personnel to carry out the environmental responsibilities as defined in this Report. All organizations associated with Project development activities will develop responsive reporting systems that clearly assign responsibility and accountability for development actions. As appropriate, Northland will review these reporting documents.

Change Management
During Project construction, changes may be required to address unforeseen or unexpected conditions or situations. Northland, the turbine manufacturer, and the Contractor will be responsible for ensuring environmental and safety issues are addressed. Northland will put into effect any significant changes to Project programs, procedures, and plans throughout the life of the Project.

Environmental Procedures
Northland, the turbine manufacturer, and the Contractor will be responsible for implementing all approved environmental procedures during construction. Individual personnel responsibilities will be assigned as necessary to support the full and effective implementation of the environmental procedures. Environmental procedures will address the following issues to prevent environmental contamination:

- Spills and releases: to identify the specific procedures for the prevention, response, and notification of spills. In addition it should establish the general procedures for spill clean-up, personnel training, and material handling and storage to prevent spills.
- Hazardous waste management: to outline the procedures for the proper identification of hazardous waste and its proper storage, handling, transport, and disposal. In addition, the procedures should outline specific requirements for personnel training, emergency response, product review and approval, and record keeping.

- Solid waste management: to establish alternative procedures for the management and disposal of used lubricants, used drums, and general office waste.

These procedures will ensure internal and external risks are fully evaluated and the information communicated to personnel in advance of any accident or malfunction.

Training Program
As appropriate, Northland and/or the Contractor should develop a training program to ensure personnel receive appropriate training in relation to construction activities, environmental procedures, and the emergency preparedness and response plan. With respect to the environment and natural heritage, training may cover the following issues:

- Environmental Protection, including:
  - Important/sensitive environmental features and areas;
  - Incident reporting (spills, wildlife incidents); and,
  - Materials disposal.

- Facility Safety, including:
  - Accident reporting; and,
  - Chemical and hazardous materials handling.

- Emergency Preparedness, including:
  - Fire preparedness and response;
  - Natural disasters (i.e., extreme weather events); and,
  - Hazardous materials and spill response.

Training should begin as the initial staff complement is hired during the pre-construction mobilization period. There should also be on-going training for personnel as well as specific training sessions for new hires.

3.3 Environmental Monitoring

Some mitigation strategies will require environmental monitoring to ensure proper implementation and confirmation that the effect is adequately mitigated. In some cases where the likelihood of a significant negative environmental effect is low, a monitoring approach has been proposed in lieu of a mitigation strategy. To prepare for an event where environmental monitoring may reveal a negative environmental effect, contingency measures have been developed to achieve the following:

- Rehabilitate or correct a negative environmental effect;
- Notify the applicable agencies if required; and

- Develop alternative mitigation strategies that could prevent the same negative environmental effect from occurring again

3.4 Potential Negative Environmental Effects, Mitigation and Monitoring

All potential negative environmental effects during construction are detailed in **Tables 3.4 – 3.9** as follows:

- **Tables 3.4 - 3.7** includes all potential effects associated with the Natural Heritage Assessment Environmental Impact Study for the Project;
- **Table 3.8** includes all potential effects associated with the Water Assessment and Water Body Report for the Project; and,
- **Table 3.9** includes all potential effects associated with land use and socio-economic features. These effects are informed by all other investigations undertaken for the Project.

Each potential negative environmental effect is identified and assessed for performance objectives, mitigation strategies, monitoring, and contingency measures. For details relating to the natural heritage, water, archaeological, and cultural heritage features of the study area, refer to the Natural Heritage Assessment Environmental Impact Study, Water Assessment and Water Body Report, and Stage 1-2 Archaeological Assessment under separate covers as part of the Renewable Energy Approval application.

Table 3.4 Environmental Effects Monitoring Plan – Environmental Impact Study General Features

Project Activity	Potential Effects (D=Direct) (I=Indirect)	Mitigation Strategy	Residual Effect (magnitude/frequency/duration)	Performance Objective	Monitoring Plan and Contingency Measures
Site Preparation	• Limited vegetation removal (D).	• No project components will be located directly within any natural significant features boundaries • Vegetated buffers will be left in place to the extent possible. • A Tree Preservation Plan will be developed during the detailed design phase in order to identify trees which may need to be removed or trimmed during construction of the transmission line. Trees requiring removal will be replaced at a ratio determined through the Tree Preservation Plan based on the age, size, species and health of the tree. The Tree Preservation Plan will also include recommendations for minor adjustments to utility pole locations in order to minimize tree loss to the extent possible. • Time vegetation removal to avoid periods of habitat use where possible especially during breeding bird season for migratory birds (May 1 – July 30) undertaking active nest surveys if clearing of vegetation must take place during breeding bird season. • Any cleared areas will be re-vegetated using a native seed mix where appropriate.	• Duration is expected to be moderate (10-15 years until replacement trees have matured); however magnitude, frequency and geographic scope are very limited. • No residual effect anticipated	• Minimal vegetation removal for installation of utility poles only.	• Undertake monthly site inspections during the Site Preparation stage to ensure that only specified trees are removed and that remaining trees are not damaged during construction activities. • If active nests are found in an area where vegetation must be cleared, construction activities will be suspended during breeding bird period. • Replacement trees will be monitored for one year to ensure at least 80% survival. Additional trees will be planted if survival rate is lower.
All Construction Activities	• Accidental encroachment of equipment, stockpiles etc. into natural areas (I).	• All work zones should be delineated with silt fencing and be clearly marked to indicate that no work should occur outside the fenced area.	• Limited duration, frequency, geographic extent. • No residual effect anticipated.	• No disturbance to natural areas.	• An Environmental Inspector will perform regular inspection to ensure that mitigation is implemented.
All Construction Activities	• Potential soil compaction (D).	• Heavy equipment and material stockpiles will be limited to fenced construction areas. • Temporary construction staging areas and construction roads which have been compacted will be rehabilitated upon completion of construction.	• Limited duration, frequency, geographic extent. • No residual effect anticipated.	• Minimize soil compaction to the extent possible. • Rehabilitate any compacted soils within temporary construction areas.	• An Environmental Inspector will perform regular inspection to ensure that equipment and stockpiles do not extend beyond construction areas. • Northland and the contractor will work with participating landowners to ensure that soils in construction areas are rehabilitated to pre-construction conditions.

Project Activity	Potential Effects (D=Direct) (I=Indirect)	Mitigation Strategy	Residual Effect (magnitude/frequency/duration)	Performance Objective	Monitoring Plan and Contingency Measures
All Construction Activities	• Mortality of wildlife inadvertently moving through construction zones (I).	• Silt fencing will be properly installed and maintained around work zones will also act to kept wildlife out of work areas. • Construction traffic will be restricted to day time hours. • Speed limit signage will be posted along construction travel routes to ensure that construction vehicles respect appropriate speeds.	• Limited duration, frequency, geographic extent. • No residual effect anticipated.	• No wildlife mortality.	• An environmental inspector will regularly monitor fenced areas to ensure that fencing is properly keyed/toed in to the ground to ensure that wildlife cannot gain access under fenced area. • If wildlife inadvertently moves into a construction area, the Environmental Inspector will move the species outside of the work area, if possible, using gloves and a bucket or plastic tub, as appropriate. • If any species at risk are encountered that are not identified on relevant permits, all work will cease within the immediate work area and the Ministry of Natural Resources will be contacted.
Installation of 36kV collector lines, 230kV transmission line, communication lines	• Sediment and erosion impacts associated with open cuts/trenching and directional drilling/punch and bore activities (I).	• Implementation of the erosion and sediment control measures will conform to industry best management practices and recognized standard specifications such as Ontario Provincial Standards Specifications (OPSS). • Sediment and erosion control measures will be implemented prior to construction and maintained during the construction phase to prevent the escape of sediment from work zones: • All sediment and erosion control measures will be inspected prior to construction and maintained during the construction phase to prevent entry of sediment into natural features; • If the sediment and erosion control measures are not functioning properly, no further work will occur until the sediment and/or erosion problem is addresses; • All disturbed areas of the construction site will be stabilized immediately and re-vegetated as soon as conditions allow; and, • Sediment and erosion control measures will be left in place until all areas of the construction site have been stabilized. • Directional drilling will be undertaken in accordance with the Department of Fisheries and Oceans' Operational Statement. • Directional drilling and/or punch and bore operations will be designed with launching and receiving pits that will minimize tree loss and disturbance of natural vegetation wherever possible.	• Limited duration, frequency, geographic extent. • No residual effect anticipated.	• No erosion and sediment impacts on wildlife habitats.	• A plan for addressing impacts associated with "frac-out" during directional drilling will be prepared in accordance with the Operational Statement. • Erosion and sediment control measures will be regularly inspected to ensure they are functioning and are maintained as required. • If erosion and sediment control measures are not functioning properly, alternative measures will be implemented and prioritized above other construction activities.

Project Activity	Potential Effects (D=Direct) (I=Indirect)	Mitigation Strategy	Residual Effect (magnitude/frequency/duration)	Performance Objective	Monitoring Plan and Contingency Measures
Site Restoration	• Introduction of invasive species into natural areas (I).	• All disturbed areas of the construction site will be re-vegetated as soon as conditions allow. Where re-vegetation is required in the municipal road allowance, as a result of transmission line installation, standard roadside seed mixes, which do not contain invasive species, will be used.	• Limited duration, frequency, geographic extent. • No residual effect anticipated.	• No introduction of invasive species.	• An Environmental Inspector will perform regular inspection to ensure that mitigation is implemented. • If extensive invasion of non-native species is identified as a result of the Project, contingency measures may include an applicable herbicide application. An herbicide application plan will be developed as required.
Turbine assembly	• Effects on groundwater levels/seepage areas and wetlands due to dewatering for construction of turbine foundations (I).	• Any discharge from dewatering will be outlet to a vegetated area at least 30m from a habitat area utilizing a sediment filter bag.	• Limited duration, frequency, geographic extent. • No residual effect anticipated.	• No effect on groundwater levels.	• An Environmental Monitor should be on-site during any dewatering within 120m of natural features. The Monitor should ensure that the filter bag is working appropriately and ensure that no sediment is entering habitat areas. • In the event of sediment discharge, all operations should stop immediately until the problem can be resolved. • If significant changes in water levels/seepage areas are noted, operations should cease until water levels recover.
All Construction Activities	• Spills from equipment fueling, oiling, greasing of project components (I).	• All materials and equipment used for the purpose of site preparation and project construction shall be operated and stored in a manner that prevents any deleterious substances (petroleum produces, silt, etc.) from entering natural features: • Any stockpiled materials will be stored and stabilized away from the feature; • Refueling and maintenance of construction equipment should occur a minimum of 30 m from a natural feature; and, • Hazardous material transportation and application will occur in designated areas according to operational procedures. Proper spill containment equipment will be used and maintained on site.	• Limited duration, frequency, geographic extent. • No residual effect anticipated.	• Minimize potential for indirect effects from accidental spills.	• As appropriate, spills will be reported to the MOE Spills Action Centre.

Project Activity	Potential Effects (D=Direct) (I=Indirect)	Mitigation Strategy	Residual Effect (magnitude/frequency/duration)	Performance Objective	Monitoring Plan and Contingency Measures
All Construction Activities	• Impacts of construction noise on wildlife (I).	• Environmental noise will be reduced through the standard operating practices. A traffic plan will be developed and implemented by the Construction Contractor. • Work within 120 m of Amphibian Breeding Habitats (GCSWH-ABH) will not occur after dusk during the breeding season (April, May and June). • Work within 120m of bird habitats (GCSWH-WRN, GCSWH-WASBB, GCSWH-WNA, GCSWH-WSSA) will not occur in the early morning hours (between dawn and 1.5 hours after dawn) during the breeding season (May 15-July 30).	• Limited duration, frequency, geographic extent. • No residual effect anticipated.	• Minimize effects of noise.	• The Environmental Inspector will ensure that all operational plans and construction timing associated with noise reduction are being followed.
All Construction Activities	• Dust effects on wildlife habitat (I).	• As appropriate, dust from the work areas will be controlled through suppressants (e.g. water).	• Limited duration, frequency, geographic extent. • No residual effect anticipated.	• Minimize effects from dust on wildlife habitats.	• Dust emissions will be monitored daily during construction to ensure dust control watering frequency and rates are adequate.

Table 3.5 Environmental Effects Monitoring Plan – Environmental Impact Study Significant Features

Affected Environmental Feature(s)	Project Activity	Potential Effects (D=Direct) (I=Indirect) Potential effect on the size, diversity, health, connectivity, functionality and resilience of the natural feature.	Mitigation Strategy	Residual Effect (magnitude/frequency/ duration)	Performance Objective	Monitoring Plan and Contingency Measures
All Significant Features Significant Valleylands V-001 Significant Wetlands WE-027, WE-029 Significant Woodlands W-004, W-012, W-013, W-014, W-020, W-021, W-023, W-026, W-029, W-030, W-031, W-034, W-036, W-037, W-039, W-041, W-042, W-053, W-067, W-079, W-081, W-086, W-088, W-093, W-094, W-099, W-102, W-104, W-118, W-123, W-127, W-128 Turtle Nesting Areas TNA-003 Deer Yarding Areas DYA-001 DYA-002 Amphibian Breeding Habitat ABH-007	• All Construction Activities	• General construction and decommissioning effects. • Refer to effects listed under Generalized Significant Wildlife Habitat.	• Refer to mitigation listed under Generalized Significant Wildlife Habitat.	• Refer to Residual Effects listed under Generalized Significant Wildlife Habitat.	• Refer to Performance Objectives listed under Generalized Significant Wildlife Habitat.	• Refer to monitoring and contingency measures listed under Generalized Significant Wildlife Habitat.
Significant Valleylands V-001	Installation of 230kV transmission line and communication lines	• Slope failure, erosion or slumping during work in and around slope areas (I). • The effects identified above could have an effect on the health (water quality) of the watercourse within the valley as well as on the health of the forested areas within the valley.	• The detailed design and construction plan for this area will include a geotechnical assessment that will outline specific mitigation for work on sloped areas. • A permit from the Ausable Bayfield Conservation Authority will be required for work in this area. All conditions of the permit will be met.	• Limited duration, frequency, geographic extent. • No residual effect anticipated.	• No slope failure, erosion or slumping. • No decrease in health, functionality and stability of the valleyland.	• Erosion and slope stability measures will be regularly inspected to ensure they are functioning and are maintained as required.

Affected Environmental Feature(s)	Project Activity	Potential Effects (D=Direct) (I=Indirect) Potential effect on the size, diversity, health, connectivity, functionality and resilience of the natural feature.	Mitigation Strategy	Residual Effect (magnitude/frequency/ duration)	Performance Objective	Monitoring Plan and Contingency Measures
Significant Woodlands W-04, W-020, W-21, W-23, W-026, W-29, W-30, W-31, W-34, W-036, W-37, W-042, W-053,	• Construction of access roads adjacent to the following woodlands: • W-053 (access road to T-16); • W-042 (access road to T-18); • W-036 (access road to T-25 and T-28); • W-026 (access road to T-31); and, • W-020 (access road to T-40). • Installation of 36kV collector lines adjacent to the following woodlands: • W-04 and W-037 (collector line along Sararas Road); • W-029, W-030, W-034, W-031 (collector line along Shipka Road); • W-023 and W-026 along Schadeview Road; • W-020 along Turnbull's Road; and, • W-021 along the field edge between T-37 and T-39.	• Inadvertent loss of, or disturbance to, vegetation along the edge of woodlands during construction of adjacent access roads and below ground collector lines (I). • The effects identified above could have minor effect on the size of woodlands and their function in providing edge habitat for a variety of species including Red-headed woodpecker (Special Concern species).	• Access road and collector lines will be no closer than the dripline of each woodland edge. • Below ground collector lines will be located within the gravel road shoulder and will not extend into wooded areas. • Additional, taller tree protection fencing (tree hoarding) should be installed in these areas to protect tree limbs from equipment in adjacent areas. • Any tree roots which extend into the construction area should be cut and re-packed into soil to avoid desiccation. • Vegetation along the woodland edges should be surveyed for rare species by biologist prior to removal (see mitigation for Species of Conservation Concern).	• Limited duration, frequency, geographic extent. • No residual effect anticipated.	• No disturbance to woodlots.	• Silt fencing and tree hoarding will be installed along the dripline and monitored by an Environmental Inspector.
Significant Wetlands WE-027, WE-029	• Installation of 230kV transmission line and communication lines	• Inadvertent loss of, or disturbance to, vegetation within the wetlands (I). • Movement of exposed sediment into the wetlands (I). • The effects identified above could have minor effect on the size of wetlands and on the function of the wetland as surface water storage.	• Two options for mitigation may be used: • The transmission line may be located on the opposite side of the road from these wetlands. In this case, mitigation will include: • Clearly demarcating wetlands and ensuring the equipment and material stockpiles do not encroach into the wetland in the opposite ROW. • The transmission line may be directionally drilled below ground under the wetlands. In this case, mitigation measures will include: • Entrance and exit pits will be at least 30m from the edge of the wetland; and,	• May be residual effect associated with frac-out during directional drilling. • Likelihood is low, limited duration, frequency and geographic extent.	• No vegetation loss or disturbance associated with sediment and erosion on Provincially Significant Wetlands.	• An Environmental Inspector will regularly monitor operations to ensure that activities do not encroach into wetland areas. • If directional drilling is used, an Environmental Inspector will be on-site during drilling activities. • A plan to address potential frac-out will be developed and activated by the Environmental Inspector if required.

Affected Environmental Feature(s)	Project Activity	Potential Effects (D=Direct) (I=Indirect) Potential effect on the size, diversity, health, connectivity, functionality and resilience of the natural feature.	Mitigation Strategy	Residual Effect (magnitude/frequency/ duration)	Performance Objective	Monitoring Plan and Contingency Measures
			• Sediment and erosion controls will be used around the entrance and exit pits.			
Significant Turtle Nesting and Amphibian Breeding Habitat ABH-007 TNA-002	All Construction Activities	• Accidental mortality due to wildlife moving through the construction zone (I). • The effect identified above may affect individual animals but unlikely to affect population health or resiliency. No effect on habitat functionality.	• During construction wildlife fencing (sediment fencing) will be installed around all work areas within 120m of these habitats prior to any earth movement, stockpiling or other activities on the site. Fencing must be keyed in correctly and monitored for proper installation and maintenance by the Environmental Inspector.	• Limited duration, frequency, geographic extent. • No residual effect anticipated.	• No accidental mortality. • No reduced amphibian breeding due to noise impacts.	• The Environmental Inspector should be on-site for daily inspections of wildlife fencing for signs of turtles accessing the construction zone. This should occur in the work zone associated with T-40, its access road and all associated components during the period between March and October when turtles are active. • If any turtles are found within the work zone, the Environmental Inspector should relocate them to the nearest habitat area outside of the work zone. When relocating snapping turtles, care should be taken to avoid injury by wearing gloves and placing turtles into a bucket or large plastic tub for relocation. • Sediment/wildlife fencing within 120m of Amphibian Breeding Habitat (ABH-007) should also be inspected by the Environmental Inspector at least once a week during the breeding season.
Amphibian Breeding Habitat ABH-007	Construction of turbines T-21, T-22, T-23, T-24 and T-25, their access roads and all associated components	• Inhibition of amphibian breeding patterns and reproductive success due to disruptions of breeding calling patterns from turbine noise (I). • The effect identified above could affect the size and diversity of the amphibian population in this pond.	• Construction of turbines T-21, T-22, T-23, T-24 and T-25, their access roads and all associated components should not occur after dusk during the breeding season (April, May and June).	• Limited duration, frequency, geographic extent. • No residual effect anticipated.	• No significant decrease in amphibian populations.	• Contractor and Environmental Inspector to monitor work schedules to ensure that no work occurs within the restricted timing window.

Table 3.6 Environmental Effects Monitoring Plan – Environmental Impact Study Wetlands Treated as Significant

Affected Environmental Feature(s)	Project Activity	Potential Effects (D=Direct) (I=Indirect) Potential effect on the size, diversity, health, connectivity, functionality and resilience of the natural feature.	Mitigation Strategy	Residual Effect (magnitude/frequency/duration)	Performance Objective	Monitoring Plan and Contingency Measures
Wetlands Treated as Significant WE-001, WE-002, WE-008, WE-010, WE-011, WE-012, WE-013, WE-014, WE-015, WE-016, WE-017, WE-020, WE-022, WE-026, WE-030, WE-031, WE-032, WE-033, WE-034, WE-035, WE-037, WE-038,	All Construction Activities	• General construction and decommissioning effects. • Refer to effects listed under Generalized Significant Wildlife Habitat.	• Refer to mitigation listed under Generalized Significant Wildlife Habitat.	• Refer to Residual Effects listed under Generalized Significant Wildlife Habitat. • No residual effect anticipated.	• Refer to Performance Objectives listed under Generalized Significant Wildlife Habitat.	• Refer to monitoring and contingency measures listed under Generalized Significant Wildlife Habitat.
Wetlands Treated as Significant WE-013, WE-014, WE-015, WE-017, WE-020, WE-022, WE-026, WE-031, WE-038	Installation of 230kV transmission line and communication lines	• Minor loss of vegetation within the wetlands (D). • Movement of exposed sediment into the wetlands (I). • The effects identified above could have minor effect on the size of wetlands and on the function of the wetland as surface water storage and flood control.	• Two options for mitigation may be used: • The transmission line may be located on the opposite side of the road from these wetlands. In this case, mitigation will include: • Clearly demarcating wetlands and ensuring the equipment and material stockpiles do not encroach into the wetland in the opposite ROW. • The transmission line may be directionally drilled below ground under the wetlands. In this case, mitigation measures will include: • Entrance and exit pits will be at least 30m from the edge of the wetland; and, • Sediment and erosion controls will be used around the entrance and exit pits.	• May be residual effect associated with frac-out during directional drilling. Likelihood is low, limited duration, frequency and geographic extent. • No residual effect anticipated.	• No vegetation loss or disturbance associated with sediment and erosion on Provincially Significant Wetlands.	• An Environmental Inspector will regularly monitor operations to ensure that activities do not encroach into wetland areas. • If directional drilling is used, an Environmental Inspector will be on-site during drilling activities. • A plan to address potential frac-out will be developed and activated by the Environmental Inspector if required.

Affected Environmental Feature(s)	Project Activity	Potential Effects (D=Direct) (I=Indirect) Potential effect on the size, diversity, health, connectivity, functionality and resilience of the natural feature.	Mitigation Strategy	Residual Effect (magnitude/frequency/duration)	Performance Objective	Monitoring Plan and Contingency Measures
Wetlands Treated as Significant WE-001, WE-002, WE-008, WE-010, WE-011,	Turbine Assembly	• Localized effects on wetland water levels due to dewatering for construction of turbine foundations (I). • Water from the dewatering process could be outlet into a wetland causing scour within the wetland and deposition of sediment from the pumped water (I). • The effects identified above could affect habitat for aquatic species if standing water is drawn down. • Sedimentation could affect wetland functions associated with surface water storage and flood control.	• Dewatering will be minimized to the extent possible. • Any discharge from dewatering will be outlet to a vegetated area at least 30 m from a wetland utilizing a sediment filter bag.	• Limited duration, frequency, geographic extent. • No residual effect anticipated.	• No effect on wetland water levels. • No sediment discharge into wetlands.	• An Environmental Monitor should be on-site during any dewatering within 120m of wetlands. The Monitor should ensure that the filter bag is working appropriately and ensure that no sediment is entering wetland areas. • In the event of sediment discharge, all operations should stop immediately until the problem can be resolved. • Although no effects on water levels is anticipated, the Environmental Monitor should also monitor water levels in the vicinity of dewatering activities during the dewatering process. If significant changes in water levels are noted, operations should cease until water levels recover.

Table 3.7 Environmental Effects Monitoring Plan – Environmental Impact Study Features Treated as Significant

Affected Environmental Feature(s)	Project Activity	Potential Effects (D=Direct) (I=Indirect) Potential effect on the size, diversity, health, connectivity, functionality and resilience of the natural feature.	Mitigation Strategy	Residual Effect (magnitude/frequency/duration)	Performance Objective	Monitoring Plan and Contingency Measures
Wildlife Habitat Treated as Significant Bat Maternal Colonies BMC-001, BMC-002, BMC-003, BMC-004, BMC-005, BMC-006, BMC-007, BMC-008, BMC-009, BMC-010 Turtle Wintering Area TWA-003 Habitat of Species of Conservation Concern SCC-001, SCC-002, SCC-003, SCC-004, SCC-005, SCC-006, SCC-007, SCC-008, SCC-009, SCC-010, SCC-011, SCC-012, SCC-013	All Construction Activities	• General construction effects. • Refer to effects listed under Generalized Significant Wildlife Habitat.	• Undertake Habitat Use Study prior to construction to confirm significance. • Apply mitigation measures listed under Generalized Candidate Significant Wildlife Habitat in the case that habitats are significant.	• Limited duration, frequency, geographic extent. • No residual effect anticipated.	• Minimize impacts.	• In the case that habitats are significant, refer to monitoring and contingency measures listed under Generalized Candidate Significant Wildlife Habitat.
Species of Conservation Concern SCC-001, SCC-002, SCC-003, SCC-004, SCC-005, SCC-006, SCC-007, SCC-008, SCC-009, SCC-010, SCC-011, SCC-012, SCC-013	Site Preparation	• No SCC anticipated within work zones; however, small number of unanticipated individuals may be present outside of identified habitat areas and may require removal (I). • The effect identified above may affect individuals but no effect anticipated at the population scale.	• If a species is identified within a work zone during Habitat Use Studies, the qualified biologist undertaking surveys, in conjunction with the Environmental Inspector, will determine whether the species can be protected in situ or whether it can be re-located/transplanted to an alternative location away from construction activities.	• Likelihood of encountering individuals is minimal. • Magnitude of effect on population size and health is minimal. • Limited frequency. • No residual effect anticipated.	• No net loss of species of conservation concern.	• If a species cannot be successfully transplanted (e.g. a mature tree), replacement trees will be planted of the same species at a 2:1 ratio. • Transplants and replacement trees will be monitored for one year to ensure 80% survival rate. To the extent that this 80% survival rate isn't met additional specimens will be replanted.

Table 3.8 Environmental Effects Monitoring Plan – Water Assessment and Water Body Features

Affected Environmental Feature(s)	Project Activity	Potential Effects	Performance Objective	Mitigation Strategy	Monitoring Plan and Contingency Measures
Aquatic Species and Aquatic Habitat Watercourse Crossings: CR-013, CR-018, CR-023, CR-031, CR-032, CR-041	All Construction Activities	• Potential direct effects to aquatic habitat quality from sedimentation during construction activities (i.e. culverts for access roads). • Effects to riparian vegetation during construction • Effects to fish during in-water works • Potential failure of slopes – impacts to bed/banks of stream during culvert construction.	• Minimize indirect effects from dust, sedimentation and erosion. • Minimize direct effects to fish and fish habitat during construction	• Erosion and sediment control measures (i.e., silt fence, straw bales, wooden stakes, sand bags, filters, pumps, snow fencing) will be installed and will be maintained during the construction work phase and until the site has been stabilized. Implementation of the erosion and sediment control measures will conform to industry best management practices and recognized standard specifications such as Ontario Provincial Standards Specifications (OPSS). • Minimize footprint for culvert crossings at access roads. • Culvert construction will take place outside fish and fish habitat timing windows, and will be designed and installed according to the requirements of the Ausable Bayfield Conservation Authority. • Directional drilling and/or punch and bore operations will be designed with launching and receiving pits with appropriate setbacks from watercourses wherever possible. • Dewatering from open excavations will take place on tile-drained agricultural land to promote infiltration and settling of suspended solids prior to entering a watercourse. • Fish salvage will be conducted by a qualified biologist under a Scientific Collection Permit from MNR and all fish captured within the work area will be released downstream unharmed. • Operational Statements (OS) provided by DFO will be used where appropriate to ensure that no impact to fish and fish habitat will occur during construction (i.e., punch and bore, directional drilling, open-cut watercourse crossings and isolated dam and pump).	• Regular weekly site inspection will occur by designated Environmental Monitor for sediment and erosion control measures. Severe weather conditions may require additional site visits depending on the proximity of the watercourse. • The level of monitoring and reporting would be based on the severity of the spill and may be discussed with the MOE Spills Action Center and MNR. **Contingency Measures** • Environmental Monitor will be responsible for "stop works" if mitigation measures are not incorporated into the construction activities or performance objectives are not achieved • Changes to the mitigation measures to best suit the current conditions will be adopted to achieve overall performance objective.
Aquatic Species and Aquatic Habitat	All Construction Activities	• Potential contamination from accidental spills.	• Minimize potential for indirect effects from accidental spills.	• Hazardous material transportation and application will occur in designated areas according to operational procedures. Proper spill containment equipment will be used and maintained on site. • No fuelling within 30 m of any watercourse. • No fuel storage within 30 m of any watercourse. • A spill containment kit will be available during construction for every location that heavy equipment is operated.	• Regular site inspections will occur by designated Environmental Monitors for in-water works and work adjacent to sensitive areas. • The level of monitoring and reporting would be based on the severity of the spill and may be discussed with the MOE Spills Action Center and MNR. **Contingency Measures** • Additional sediment and erosion control measure (silt fence, erosion control blankets , etc) will be on site a ready for use if original measures are not suitable • Refer to Spill Contingency Plan. • Contaminated soil will be removed and disposed of at an approved facility.
Surface Water/Soils	All Construction Activities	• Short-term degradation of soil/water quality and fisheries habitat due to accidental spills or releases.	• Minimize indirect effects from dust, sedimentation and erosion. • Minimize potential for indirect effects from accidental spills.	• Erosion and sediment control measures (i.e., silt fence, straw bales, wooden stakes, sand bags, filters, pumps, snow fencing) will be installed and will be maintained during the construction work phase and until the site has been stabilized. Implementation of the erosion and sediment control measures will conform to industry best management practices and recognized standard specifications such as Ontario Provincial Standards Specifications (OPSS). • Culvert construction will take place outside fish and fish habitat timing windows, and will be designed and installed according to the requirements of the Ausable	• Regular site inspection will occur by designated Environmental Monitors. The level of monitoring and reporting would be based on the severity of the occurrence and may be discussed with the MOE Spills Action Center and MNR. **Contingency Measures**

Affected Environmental Feature(s)	Project Activity	Potential Effects	Performance Objective	Mitigation Strategy	Monitoring Plan and Contingency Measures
				Bayfield Conservation Authority. • Directional drilling and/or punch and bore operations will be designed with launching and receiving pits with appropriate setbacks from watercourses wherever possible. • Dewatering from open excavations will take place on tile-drained agricultural land to promote infiltration and settling of suspended solids prior to entering a watercourse. • Hazardous material transportation and application will occur in designated areas according to operational procedures. Proper spill containment equipment will be used and maintained on site.	• Contaminated soil will be removed and disposed of at an approved facility.
Groundwater	All Construction Activities	• Potential direct impacts to groundwater quality and quantity due to water taking at Parts and Storage Building. • Water quality impacts due to potential fuel and oil spills. • Dewatering operations during construction are not expected to impact groundwater quantity or quality. Refer to the Construction Plan Report for further details.	• Minimize impacts to groundwater quality and quantity. • No spills.	• Confirmation of water supply needs and capacity for the Part and Storage Building will be verified at the detailed design phase. If required, detailed design and implementation plans will include measures for water storage and/or water treatment. • An Emergency Response and Communications Plan will be developed during detailed design to ensure proper mitigation and notification procedures are in place regarding groundwater quality during Project operation.	• Regular site inspection will occur by designated Environmental Monitors. The level of monitoring and reporting would be based on the severity of the occurrence and may be discussed with the MOE Spills Action Center and MNR. **Contingency Measures** • All spills that could potentially have an adverse environmental effect, are outside the normal course of events, or are in excess of the prescribed regulatory levels would be reported to the MOE's Spills Action Centre.

Table 3.9 Environmental Effects Monitoring Plan – Land Use and Socio-Economic Features

Affected Environmental Feature(s)	Project Phase	Potential Effects	Performance Objective	Mitigation Strategy	Monitoring Plan and Contingency Measures
Petroleum, Oil and Gas Resources	All Construction Activities	• Fires and explosions from disturbance of existing oil and gas resources. • Methane and sour gas releases from disturbance of existing oil and gas resources.	• No fires or explosions from existing oil and gas resources as a result of Project activities. • No methane and sour gas releases from existing oil and gas resources as a result of Project activities.	• Project infrastructure has been sited with a clearance of over 75 metres from existing active wells. • For Project infrastructure located within 75 metres of abandoned wells, a visual search will be conducted to confirm the condition of the abandoned well. If required, the abandoned well will be properly decommissioned prior to construction within 75 metres of the abandoned well. • An engineer's report will be prepared outlining risks, mitigation, and emergency response procedures for wells within 75 metres of Project activities.	• Contingency Measures • Existing well records indicate 2 abandoned wells are located within 75 metres of an access road and the transmission line. The wells have been decommissioned and are not likely to be affected by Project activities. If a fire, explosion, or release of sour gas occurs during Project activities, the Emergency Response Plan will be implemented.
Existing Land Uses - Agriculture and Rural Resources	All Construction Activities	• Loss of lands required for the lease period and farming practices • Potential impacts to drainage systems • Potential impact from soil compaction • Potential impact to crop production and yields	• Minimize disturbance to agricultural lands, drainage systems, soil compaction and crop production	• Siting of Project components in discussion with landowners. • Compensation provided to the landowners who have Land Lease Agreements. • Construction methods have been included that will avoid impacts to drainage systems and soil compaction thereby minimizing impacts to normal crop production and yields.	• During construction the environmental inspector will monitor the drainage and soil remediation measures to be implemented. • A landowner complaint procedure will be established. • Following construction all site areas will be monitored by qualified professionals for a two year period to ensure that drainage systems are functioning properly and normal crop production is not reduced. **Contingency Measures** • Additional drainage system repairs as required • Additional soil compaction relief measures as required. • Crop compensation, if necessary, to landowners.
Game and Fisheries Resources	All Construction Activities	• Disturbance to game species from noise	• Minimize disturbance	• Keep equipment in good working condition and regularly maintained to minimize noise • Minimize impacts to aquatic resources see protection and mitigation measures under water bodies and natural heritage. • Schedule construction periods to avoid impacts	• Complaint response protocol will be followed
Provincial and Local Infrastructure and Local Traffic	All Construction Activities	• Traffic impacts during construction phases • Impacts to structures (ie. culverts, bridges, watermain, gas, sewers) due to construction traffic loading	• Minimize traffic disturbance • Prevent damage to structures	• The Contractor will implement a traffic management plan • Road user agreement anticipated with local municipalities • Permits will be obtained for applicable oversize / overweight loads • Public notification of non-conventional load movements (if required). Escort vehicles will be used as appropriate • Roads will be maintained and any additional repairs necessary will be completed immediately following construction to pre-development conditions or better.	• Complaint response protocol will be followed • Monitor road conditions weekly during construction and decommissioning **Contingency Measures** • Road maintenance, repair crews and materials to be on standby for repairs as required.
Air, Odour, Dust	All Construction Activities	• Air and dust emissions from construction vehicles. No odour effects anticipated.	• Minimize emissions	• The Contractor would implement good site practices with regard to air which may include: – Multi-passenger vehicles would be utilized to the extent practical; – Company and contractor personnel would avoid idling of vehicles when not necessary; – Equipment and vehicles would be turned off when not in use unless required for activities and/or effective operation of the equipment or vehicle; – Equipment and vehicles would be maintained in good working order with functioning mufflers and emission control systems as available;	• Complaint Response Protocol will be followed

Affected Environmental Feature(s)	Project Phase	Potential Effects	Performance Objective	Mitigation Strategy	Monitoring Plan and Contingency Measures
				– All vehicles would be fitted with catalytic converters as required; • The Contractor would implement good site practices with regard to dust which may include: – Protecting stockpiles of friable material with a barrier; – Dust suppression (e.g. water) of source areas; – Covering loads of friable materials during transport.	
Environmental Noise	All Construction Activities	• Noise emitted from construction vehicles	• Minimize noise impacts to meet MOE standards	• Construction equipment to be maintained with normal noise attenuation. • Schedule construction work to minimize noise impacts.	• Noise levels will be monitored in the field as required • Complaints protocol will be established with follow-up investigations and action, as required.
Contaminated Lands – Disposal of wastes	All Construction Activities	• Nuisance refuse dispersed to adjacent properties • Potential contamination to soil, groundwater and/ or surface water resources on or off the Project site	• Proper disposal of waste materials	The Contractor would implement a site-specific waste collection and disposal management plan which may include site practices such as: • Systematic collection of waste and on-site storage in weather protected areas; • All waste materials and recycling will be transported off site by private waste material collection contractors licensed with a Certificate of Approval – Waste Management System; • Contractors will be required to remove excess materials from the site (such as extra cable, scrap metals, pallets, etc.); • Appropriate handling and disposal of all wastes classes according to current provincial standards and guidelines; • Disposal of contaminated material (if encountered) to a registered waste facility according to current regulatory standards; • Labelling and proper storage of liquid wastes (e.g., used oil, drained hydraulic fluid, and used solvents) in a secure area that will ensure containment of the material in the event of a spill; • Any spill that does occur, which could potentially cause an adverse environmental effect, should be reported to the MOE's Spills Action Centre (SAC); • Prohibition of dumping or burying wastes within the Project areas; • Should contaminated soil be encountered during the course of excavations the contaminated material will be disposed of in accordance with the current appropriate provincial legislation, specifically Ontario Regulation 153/04; • Disposal of non-hazardous waste at a registered facility; • Disposal of sanitary wastes will be the responsibility of the contracted third party and they will ensure disposal in accordance with appropriate legislation, standards and policies; and, • Implementation of an on-going waste management program consisting of reduction, reuse and recycling of material.	• Monitoring by the Environmental Inspector to ensure compliance during construction and decommissioning phases. • Routine staff waste management procedures and inspection during operational phases.

4.0 Conclusion

The Grand Bend Wind Farm can be constructed without causing significant adverse environmental effects. This will be achieved through proper implementation of the mitigation, monitoring, and contingency measures outlined in this report.

Burnside has prepared the Grand Bend Wind Farm Construction Plan Report for Northland in accordance with O.Reg. 359/09. This report has been prepared by Burnside for the sole benefit of Northland, and may not be re-produced by any third party without the express written consent of Northland.

Respectfully submitted,

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Appendix A
Site Plan

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Appendix A
Figure 1 Key Map

Grand Bend Wind Farm

Construction Plan Report

Turbine Location: Northland Power Grand Bend Project

Turbine Location: NextEra Bluewater Project

Turbine Location: Magnum Wind Energy

Transformer Sub-Station | Switch Yard

Project Area

Lake Huron

Central Huron

Huron East

Mitchell

West Perth

Hensall

Zurich

Bluewater

Hay

Exeter

South Huron

Grand Bend

A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13 A14 A15 A16 A17 A18 A19

Switch Yard

Transformer Sub-Station

500kv

230kv / 115kv

230kv

115kv

21 4 8 84 83 23 81

NOTES:

1. Reference Figures 01 - 11 for site detail and 12 - 19 for transmission network.

DATA SOURCES:

1. Ministry of Natural Resources, © Queen's Printer for Ontario
2. Natural Resources Canada © Her Majesty the Queen in Right of Canada

Scale: 1:150,000
Date: 10 August 2012
Project Number: PIA019991

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Prepared: P. Stubbert

Checked By: C. Shilton

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Appendix A
Figure A1

Grand Bend Wind Farm

Construction Plan Report

- Project Wind Turbine (Northland Energy)
- Wind Turbine (NextEra)
- Permanent Access Road & Collector Line
- Permanent Access Road (No Collector Line)
- Temporary Access Road (Removed After Construction)
- Collector Line: Underground / Transmission Line: Underground Section
- Transmission Line: Overhead
- Existing Transmission Line: Overhead
- Area of Construction
- Building / Transformer Sub-Station / Switching Yard
- Participating Property
- Contour (5m Interval)

Siemens SWT-2.3-113 Turbine:

Base Diameter 4.2m | Hub Height 99.5m | Blade Length 55m

NOTES:

1. Reference the Figure 1 Key Map for location in the overall project area.
2. NextEra Turbine Locations taken from the document DRAFT Site Plan - Bluewater Wind Engery Centre, December 2011.

DATA SOURCES:

1. County of Huron (including Imagery: 2010)
2. Ministry of Natural Resources, © Queen's Printer for Ontario
3. Natural Resources Canada © Her Majesty the Queen in Right of Canada

Scale: 1:10,000
Date: 10 August 2012
Project Number: PIA019991

Prepared: P. Stubbert

Checked By: C. Shilton

0 100 200 300 400 500 600 700 800

Meters

NEEGAN BURNSIDE

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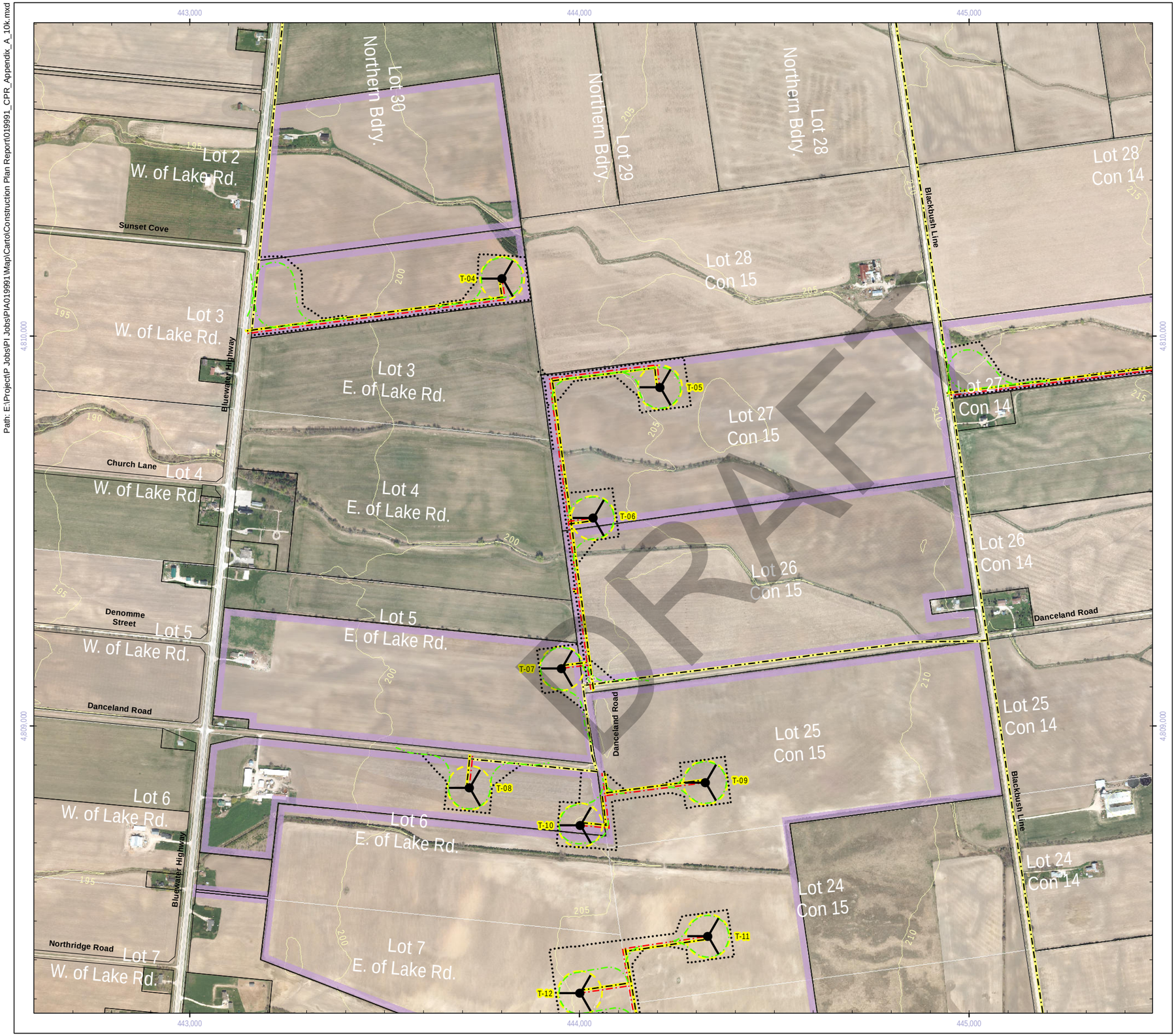

Appendix A
Figure A2

Grand Bend Wind Farm

Construction Plan Report

- Project Wind Turbine (Northland Energy)
- Wind Turbine (NextEra)
- Permanent Access Road & Collector Line
- Permanent Access Road (No Collector Line)
- Temporary Access Road (Removed After Construction)
- Collector Line: Underground / Transmission Line: Underground Section
- Transmission Line: Overhead
- Existing Transmission Line: Overhead
- Area of Construction
- Building / Transformer Sub-Station / Switching Yard
- Participating Property
- Contour (5m Interval)

Siemens SWT-2.3-113 Turbine:

Base Diameter 4.2m | Hub Height 99.5m | Blade Length 55m

NOTES:

1. Reference the Figure 1 Key Map for location in the overall project area.
2. NextEra Turbine Locations taken from the document DRAFT Site Plan - Bluewater Wind Engery Centre, December 2011.

DATA SOURCES:

1. County of Huron (including Imagery: 2010)
2. Ministry of Natural Resources, © Queen's Printer for Ontario
3. Natural Resources Canada © Her Majesty the Queen in Right of Canada

Scale: 1:10,000
Date: 10 August 2012
Project Number: PIA019991

N

Prepared: P. Stubbert

Checked By: C. Shilton

0 100 200 300 400 500 600 700 800

Meters

NEEGAN BURNSIDE

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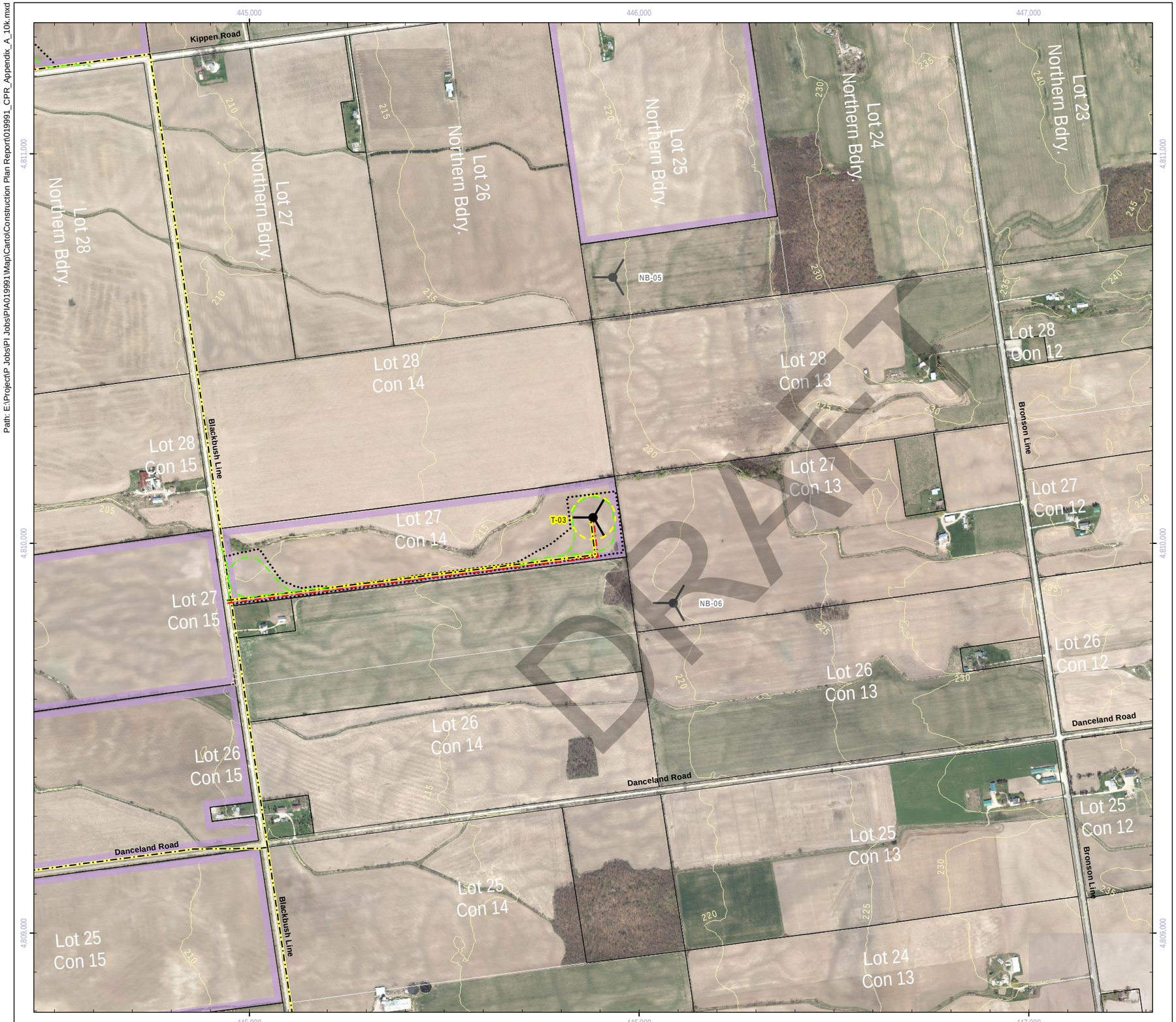

Appendix A
Figure A3

Grand Bend Wind Farm

Construction Plan Report

- Project Wind Turbine (Northland Energy)
- Wind Turbine (NextEra)
- Permanent Access Road & Collector Line
- Permanent Access Road (No Collector Line)
- Temporary Access Road (Removed After Construction)
- Collector Line: Underground / Transmission Line: Underground Section
- Transmission Line: Overhead
- Existing Transmission Line: Overhead
- Area of Construction
- Building / Transformer Sub-Station / Switching Yard
- Participating Property
- Contour (5m Interval)

Siemens SWT-2.3-113 Turbine:

Base Diameter 4.2m | Hub Height 99.5m | Blade Length 55m

NOTES:

1. Reference the Figure 1 Key Map for location in the overall project area.
2. NextEra Turbine Locations taken from the document DRAFT Site Plan - Bluewater Wind Engery Centre, December 2011.

DATA SOURCES:

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Scale: 1:10,000
Date: 10 August 2012
Project Number: PIA019991

N

Prepared: P. Stubbert

Checked By: C. Shilton

0 100 200 300 400 500 600 700 800

Meters

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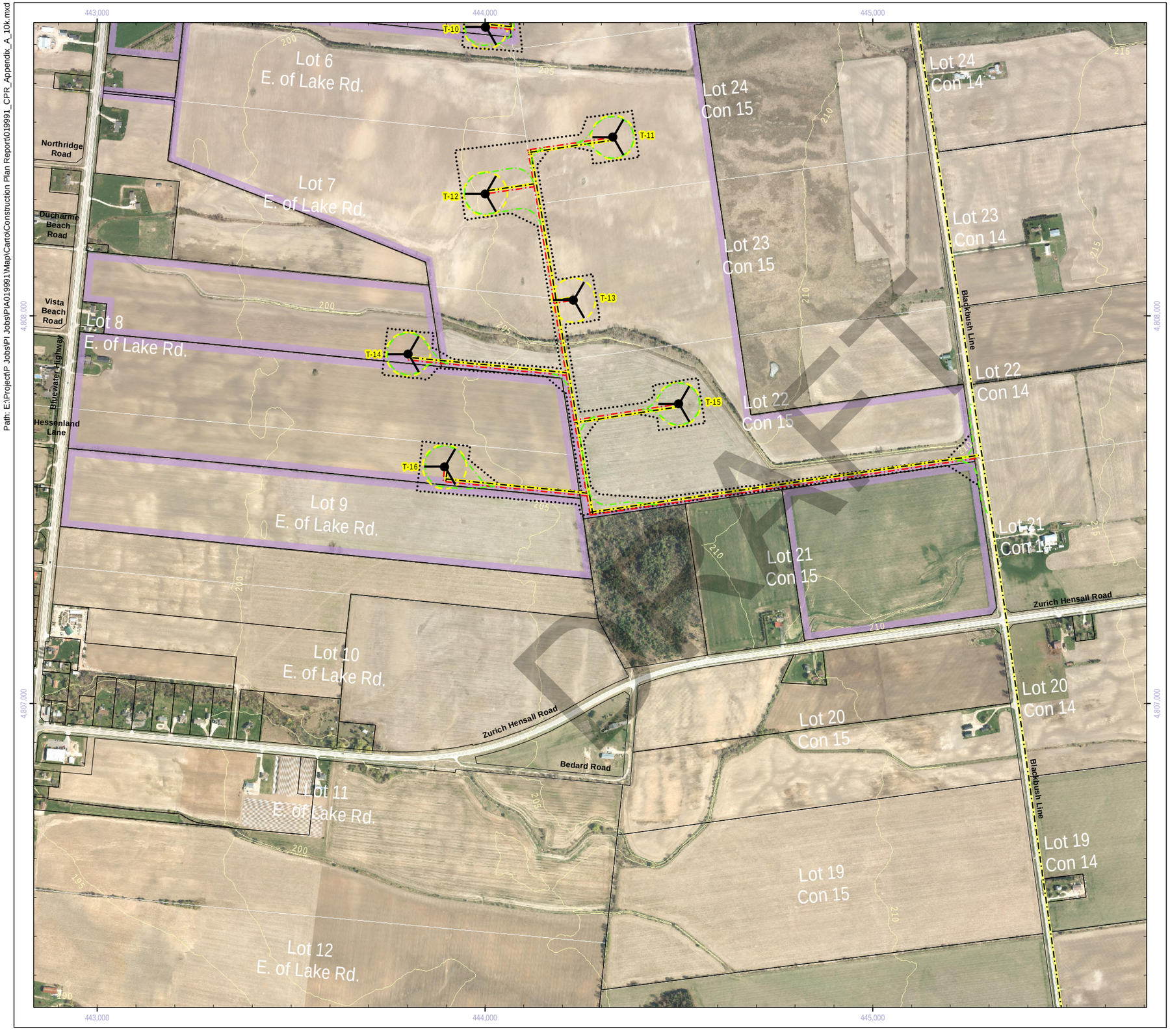

Appendix A
Figure A4

Grand Bend Wind Farm

Construction Plan Report

- T-02 — Project Wind Turbine (Northland Energy)
- Wind Turbine (NextEra)
- Permanent Access Road & Collector Line
- Permanent Access Road (No Collector Line)
- Temporary Access Road (Removed After Construction)
- Collector Line: Underground / Transmission Line: Underground Section
- Transmission Line: Overhead
- Existing Transmission Line: Overhead
- Area of Construction
- Building / Transformer Sub-Station / Switching Yard
- Participating Property
- 200 — Contour (5m Interval)

Siemens SWT-2.3-113 Turbine:

Base Diameter 4.2m | Hub Height 99.5m | Blade Length 55m

NOTES:

1. Reference the Figure 1 Key Map for location in the overall project area.
2. NextEra Turbine Locations taken from the document DRAFT Site Plan - Bluewater Wind Engery Centre, December 2011.

DATA SOURCES:

1. County of Huron (including Imagery: 2010)
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Scale: 1:10,000
Date: 10 August 2012
Project Number: PIA019991

N

Prepared: P. Stubbert

Checked By: C. Shilton

0 100 200 300 400 500 600 700 800

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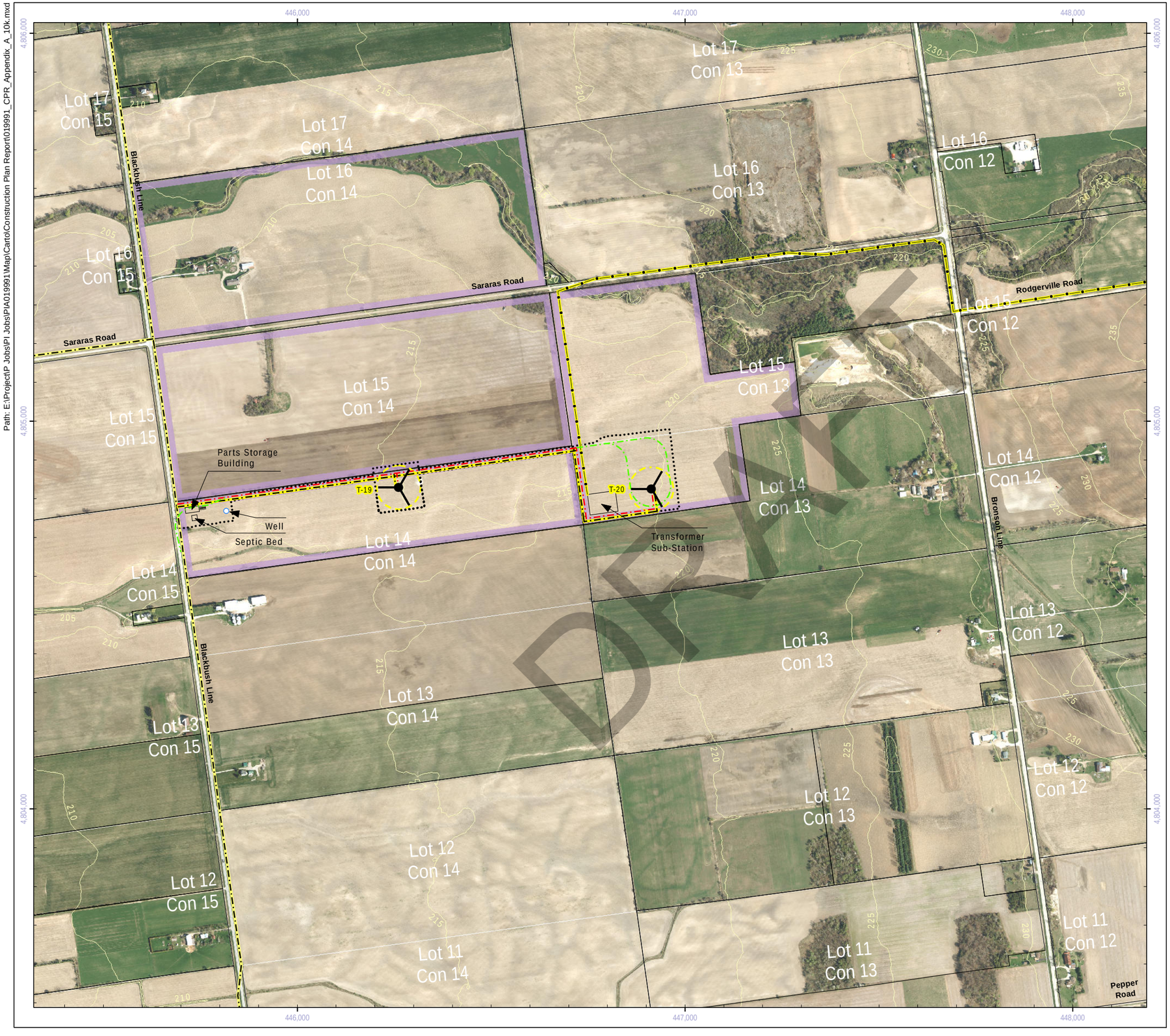

Appendix A
Figure A5

Grand Bend Wind Farm

Construction Plan Report

- Project Wind Turbine (Northland Energy)
- Wind Turbine (NextEra)
- Permanent Access Road & Collector Line
- Permanent Access Road (No Collector Line)
- Temporary Access Road (Removed After Construction)
- Collector Line: Underground / Transmission Line: Underground Section
- Transmission Line: Overhead
- Existing Transmission Line: Overhead
- Area of Construction
- Building / Transformer Sub-Station / Switching Yard
- Participating Property
- Contour (5m Interval)

Siemens SWT-2.3-113 Turbine:

Base Diameter 4.2m | Hub Height 99.5m | Blade Length 55m

NOTES:

1. Reference the Figure 1 Key Map for location in the overall project area.
2. NextEra Turbine Locations taken from the document DRAFT Site Plan - Bluewater Wind Engery Centre, December 2011.

DATA SOURCES:

1. County of Huron (including Imagery: 2010)
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Scale: 1:10,000
Date: 10 August 2012
Project Number: PIA019991

N

Prepared: P. Stubbert

Checked By: C. Shilton

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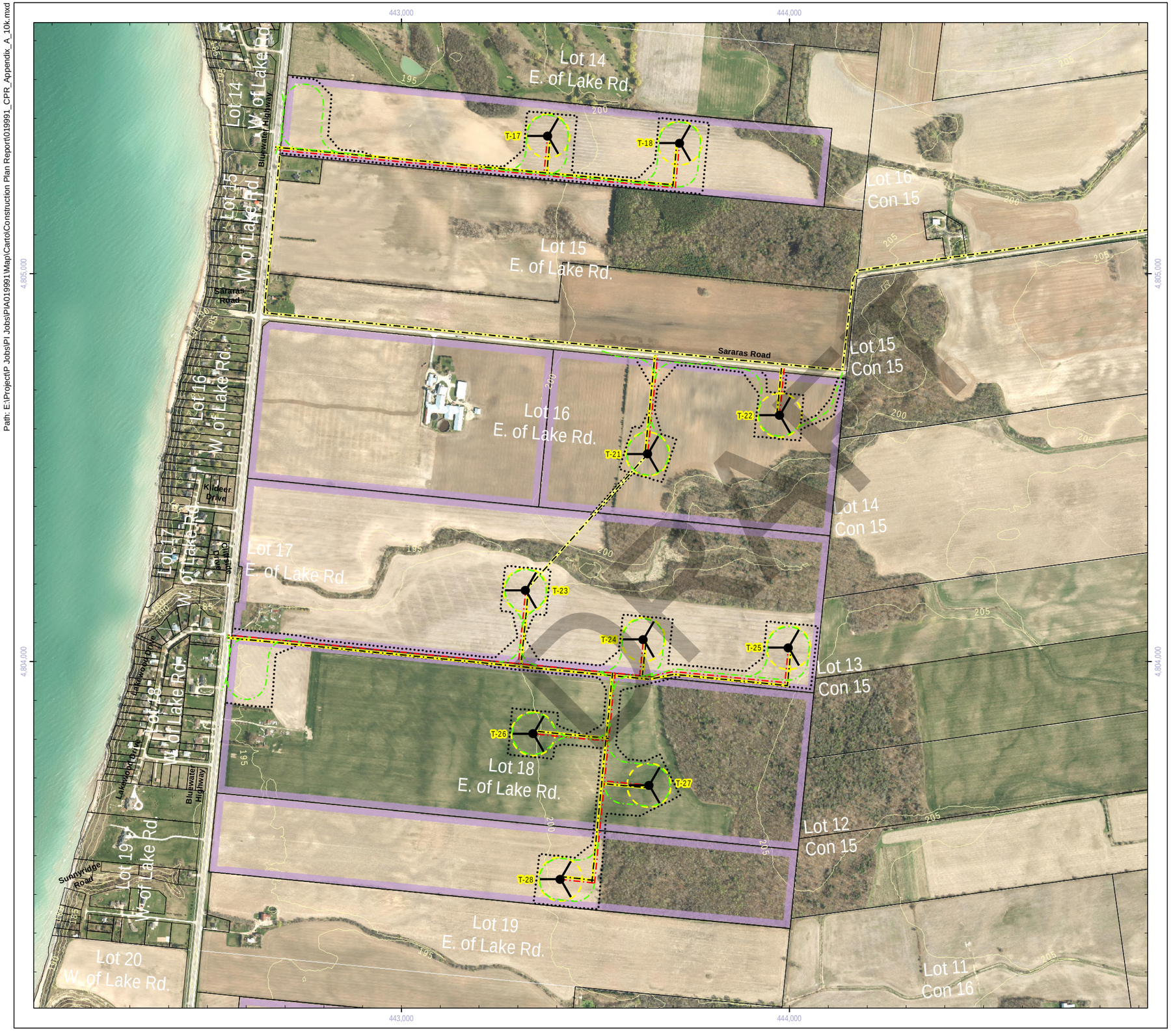

Appendix A
Figure A6

Grand Bend Wind Farm

Construction Plan Report

- T-02 — Project Wind Turbine (Northland Energy)
- Wind Turbine (NextEra)
- Permanent Access Road & Collector Line
- Permanent Access Road (No Collector Line)
- Temporary Access Road (Removed After Construction)
- Collector Line: Underground / Transmission Line: Underground Section
- Transmission Line: Overhead
- Existing Transmission Line: Overhead
- Area of Construction
- Building / Transformer Sub-Station / Switching Yard
- Participating Property
- 200 — Contour (5m Interval)

Siemens SWT-2.3-113 Turbine:

Base Diameter 4.2m | Hub Height 99.5m | Blade Length 55m

NOTES:

1. Reference the Figure 1 Key Map for location in the overall project area.
2. NextEra Turbine Locations taken from the document DRAFT Site Plan - Bluewater Wind Engery Centre, December 2011.

DATA SOURCES:

1. County of Huron (including Imagery: 2010)
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Scale: 1:10,000
Date: 10 August 2012
Project Number: PIA019991

N

Prepared: P. Stubbert

Checked By: C. Shilton

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Meters

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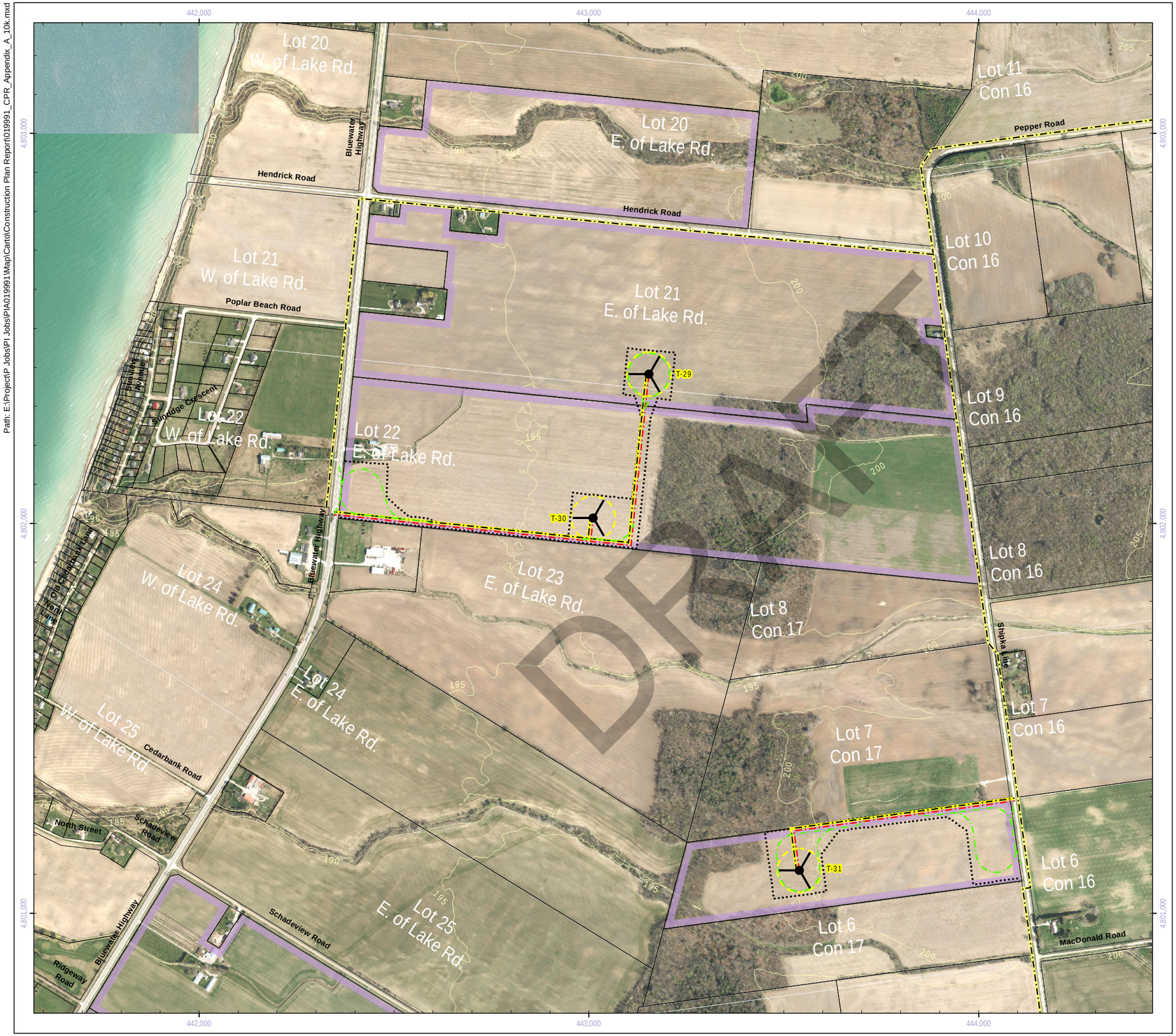

Appendix A
Figure A7

Grand Bend Wind Farm

Construction Plan Report

- Project Wind Turbine (Northland Energy)
- Wind Turbine (NextEra)
- Permanent Access Road & Collector Line
- Permanent Access Road (No Collector Line)
- Temporary Access Road (Removed After Construction)
- Collector Line: Underground / Transmission Line: Underground Section
- Transmission Line: Overhead
- Existing Transmission Line: Overhead
- Area of Construction
- Building / Transformer Sub-Station / Switching Yard
- Participating Property
- Contour (5m Interval)

Siemens SWT-2.3-113 Turbine:

Base Diameter 4.2m | Hub Height 99.5m | Blade Length 55m

NOTES:

1. Reference the Figure 1 Key Map for location in the overall project area.
2. NextEra Turbine Locations taken from the document DRAFT Site Plan - Bluewater Wind Engery Centre, December 2011.

DATA SOURCES:

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Scale: 1:10,000
Date: 10 August 2012
Project Number: PIA019991

N

Prepared: P. Stubbert

Checked By: C. Shilton

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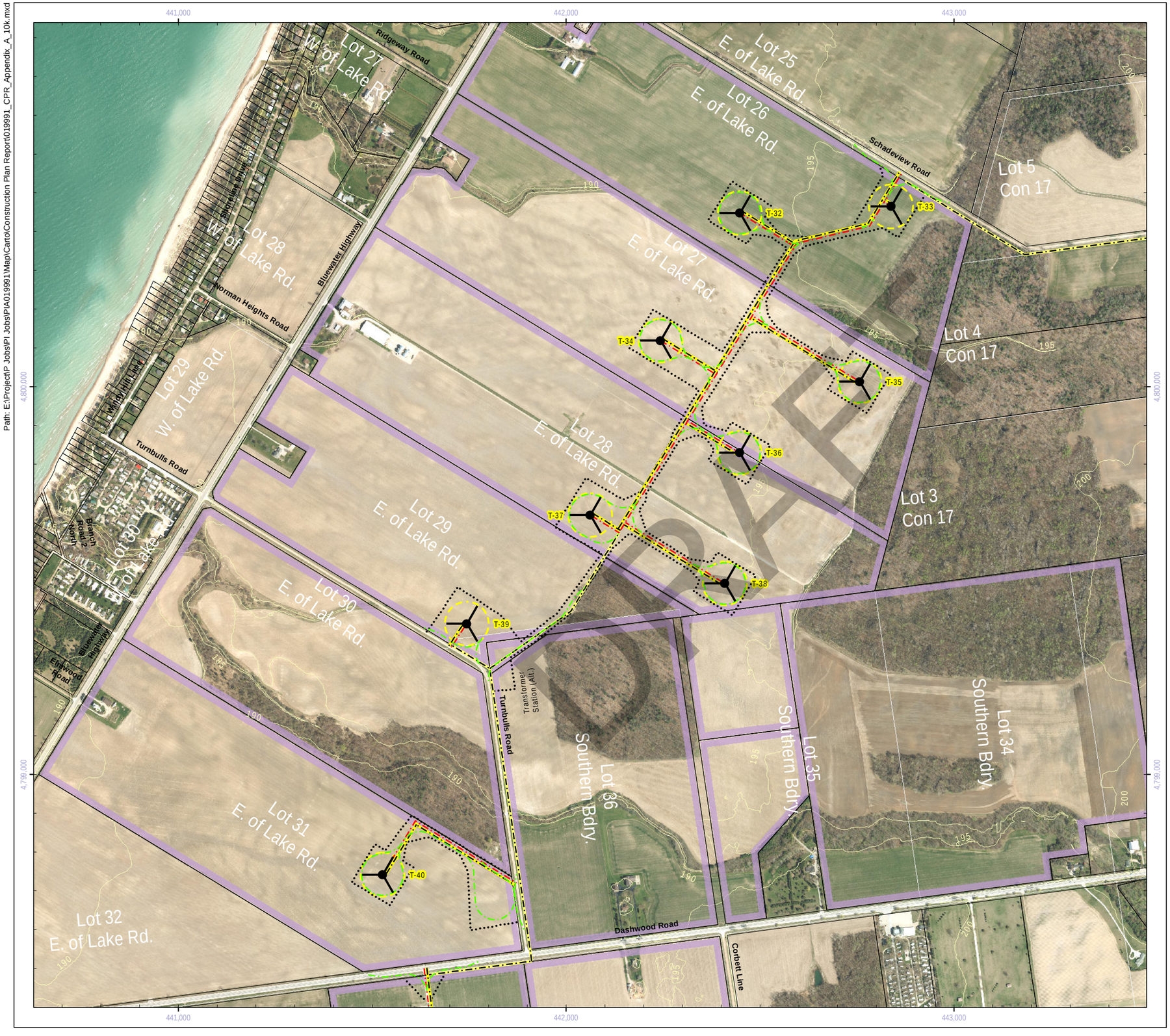

Appendix A
Figure A8

Grand Bend Wind Farm

Construction Plan Report

- Project Wind Turbine (Northland Energy)
- Wind Turbine (NextEra)
- Permanent Access Road & Collector Line
- Permanent Access Road (No Collector Line)
- Temporary Access Road (Removed After Construction)
- Collector Line: Underground / Transmission Line: Underground Section
- Transmission Line: Overhead
- Existing Transmission Line: Overhead
- Area of Construction
- Building / Transformer Sub-Station / Switching Yard
- Participating Property
- Contour (5m Interval)

Siemens SWT-2.3-113 Turbine:

Base Diameter 4.2m | Hub Height 99.5m | Blade Length 55m

NOTES:

1. Reference the Figure 1 Key Map for location in the overall project area.
2. NextEra Turbine Locations taken from the document DRAFT Site Plan - Bluewater Wind Engery Centre, December 2011.

DATA SOURCES:

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3. Natural Resources Canada © Her Majesty the Queen in Right of Canada

Scale: 1:10,000
Date: 10 August 2012
Project Number: PIA019991

N

Prepared: P. Stubbert

Checked By: C. Shilton

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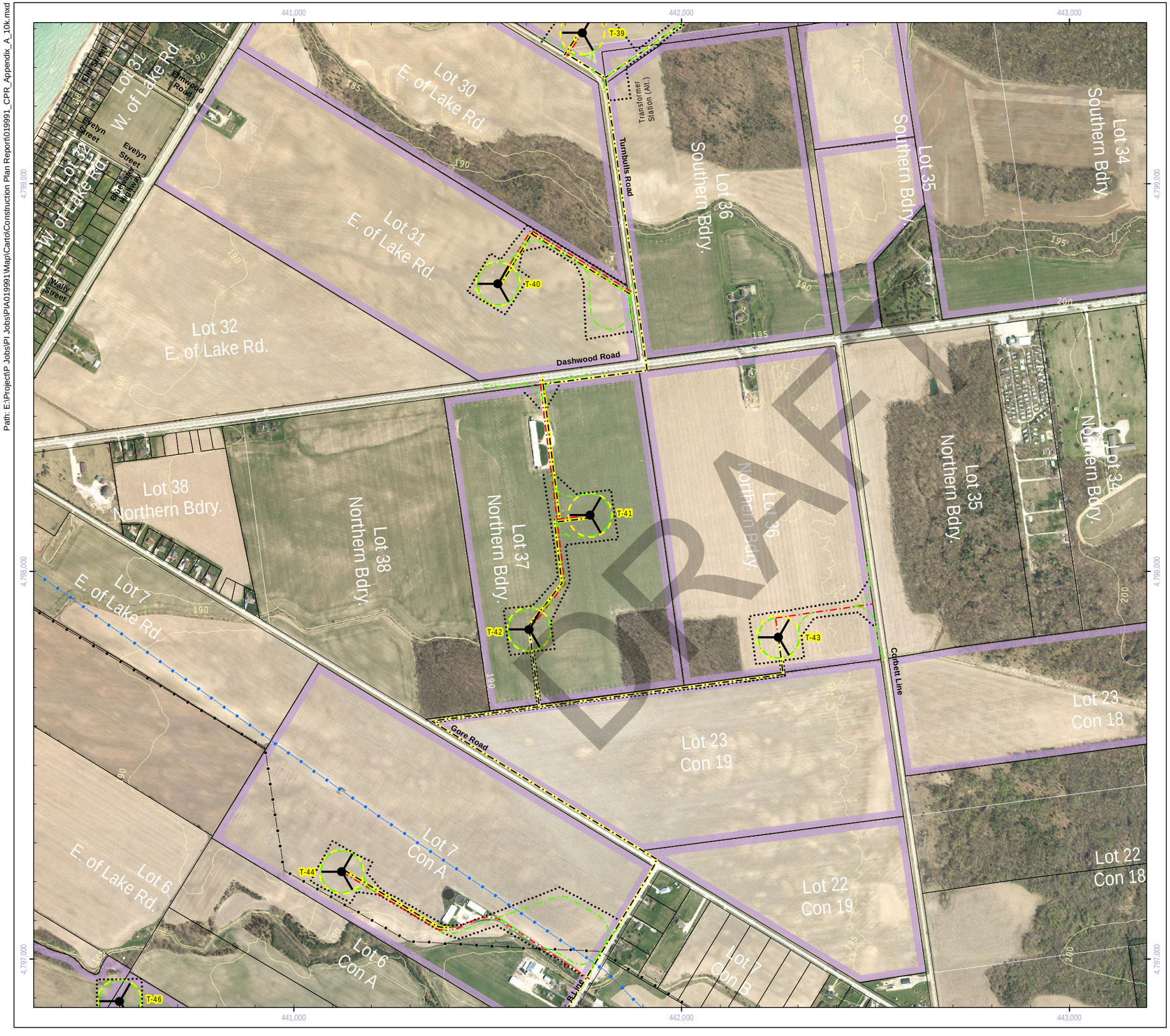

Appendix A
Figure A9

Grand Bend Wind Farm

Construction Plan Report

- Project Wind Turbine (Northland Energy)
- Wind Turbine (NextEra)
- Permanent Access Road & Collector Line
- Permanent Access Road (No Collector Line)
- Temporary Access Road (Removed After Construction)
- Collector Line: Underground / Transmission Line: Underground Section
- Transmission Line: Overhead
- Existing Transmission Line: Overhead
- Area of Construction
- Building / Transformer Sub-Station / Switching Yard
- Participating Property
- Contour (5m Interval)

Siemens SWT-2.3-113 Turbine:

Base Diameter 4.2m | Hub Height 99.5m | Blade Length 55m

NOTES:

1. Reference the Figure 1 Key Map for location in the overall project area.
2. NextEra Turbine Locations taken from the document DRAFT Site Plan - Bluewater Wind Engery Centre, December 2011.

DATA SOURCES:

1. County of Huron (including Imagery: 2010)
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3. Natural Resources Canada © Her Majesty the Queen in Right of Canada

Scale: 1:10,000
Date: 10 August 2012
Project Number: PIA019991

N

Prepared: P. Stubbert

Checked By: C. Shilton

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Meters

NEEGAN BURNSIDE

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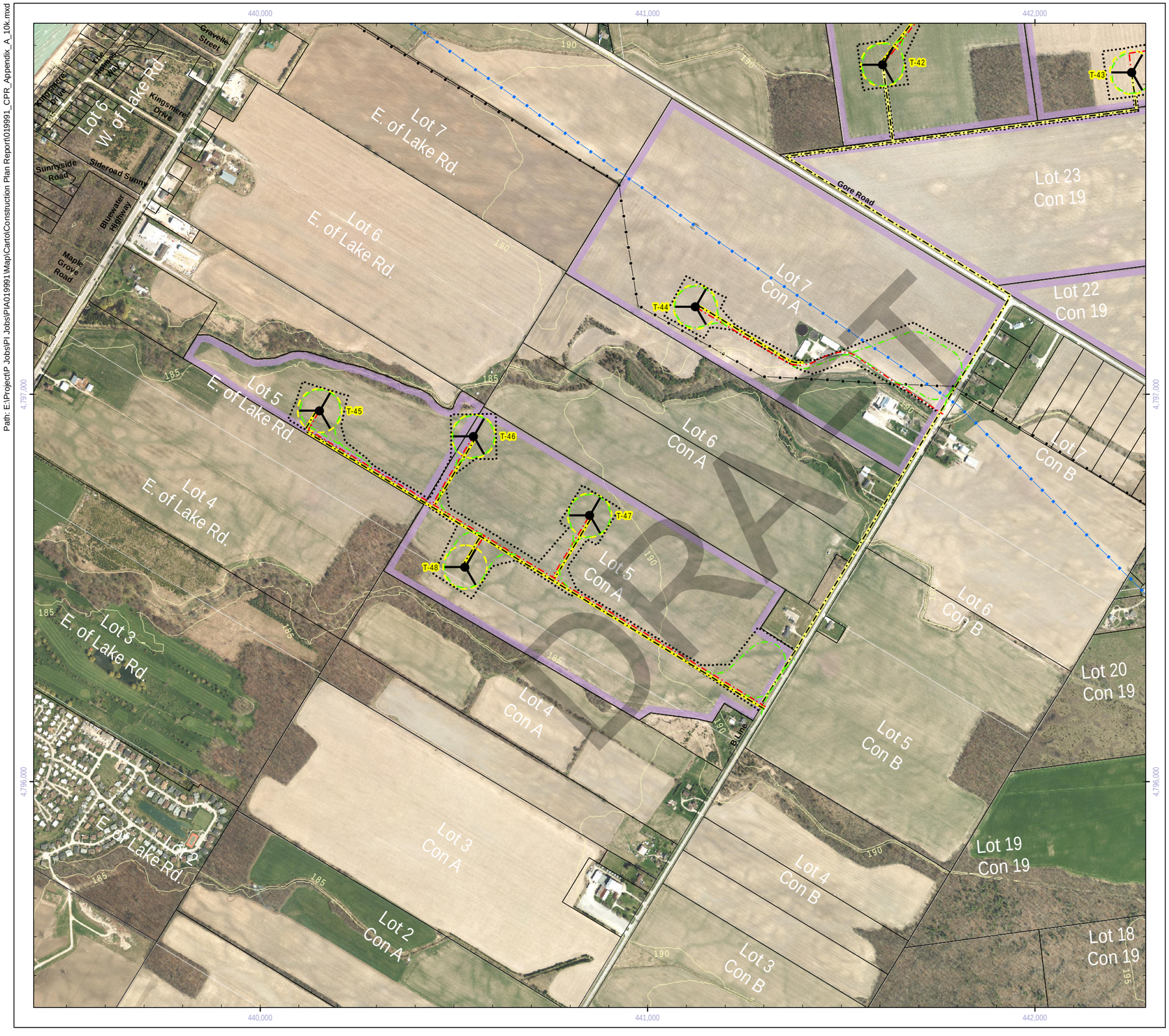

Appendix A
Figure A10

Grand Bend Wind Farm

Construction Plan Report

- Project Wind Turbine (Northland Energy)
- Wind Turbine (NextEra)
- Permanent Access Road & Collector Line
- Permanent Access Road (No Collector Line)
- Temporary Access Road (Removed After Construction)
- Collector Line: Underground / Transmission Line: Underground Section
- Transmission Line: Overhead
- Existing Transmission Line: Overhead
- Area of Construction
- Building / Transformer Sub-Station / Switching Yard
- Participating Property
- Contour (5m Interval)

Siemens SWT-2.3-113 Turbine:

Base Diameter 4.2m | Hub Height 99.5m | Blade Length 55m

NOTES:

1. Reference the Figure 1 Key Map for location in the overall project area.
2. NextEra Turbine Locations taken from the document DRAFT Site Plan - Bluewater Wind Engery Centre, December 2011.

DATA SOURCES:

1. County of Huron (including Imagery: 2010)
2. Ministry of Natural Resources, © Queen's Printer for Ontario
3. Natural Resources Canada © Her Majesty the Queen in Right of Canada

Scale: 1:10,000
Date: 10 August 2012
Project Number: PIA019991

N

Prepared: P. Stubbert

Checked By: C. Shilton

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Meters

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Appendix A
Figure A11

Grand Bend Wind Farm

Construction Plan Report

- Project Wind Turbine (Northland Energy)
- Wind Turbine (NextEra)
- Permanent Access Road & Collector Line
- Permanent Access Road (No Collector Line)
- Temporary Access Road (Removed After Construction)
- Collector Line: Underground / Transmission Line: Underground Section
- Transmission Line: Overhead
- Existing Transmission Line: Overhead
- Area of Construction
- Building / Transformer Sub-Station / Switching Yard
- Participating Property
- Contour (5m Interval)

Siemens SWT-2.3-113 Turbine:

Base Diameter 4.2m | Hub Height 99.5m | Blade Length 55m

NOTES:

1. Reference the Figure 1 Key Map for location in the overall project area.
2. NextEra Turbine Locations taken from the document DRAFT Site Plan - Bluewater Wind Engery Centre, December 2011.

DATA SOURCES:

1. County of Huron (including Imagery: 2010)
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3. Natural Resources Canada © Her Majesty the Queen in Right of Canada

Scale: 1:10,000
Date: 10 August 2012
Project Number: PIA019991

N

Prepared: P. Stubbert

Checked By: C. Shilton

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Meters

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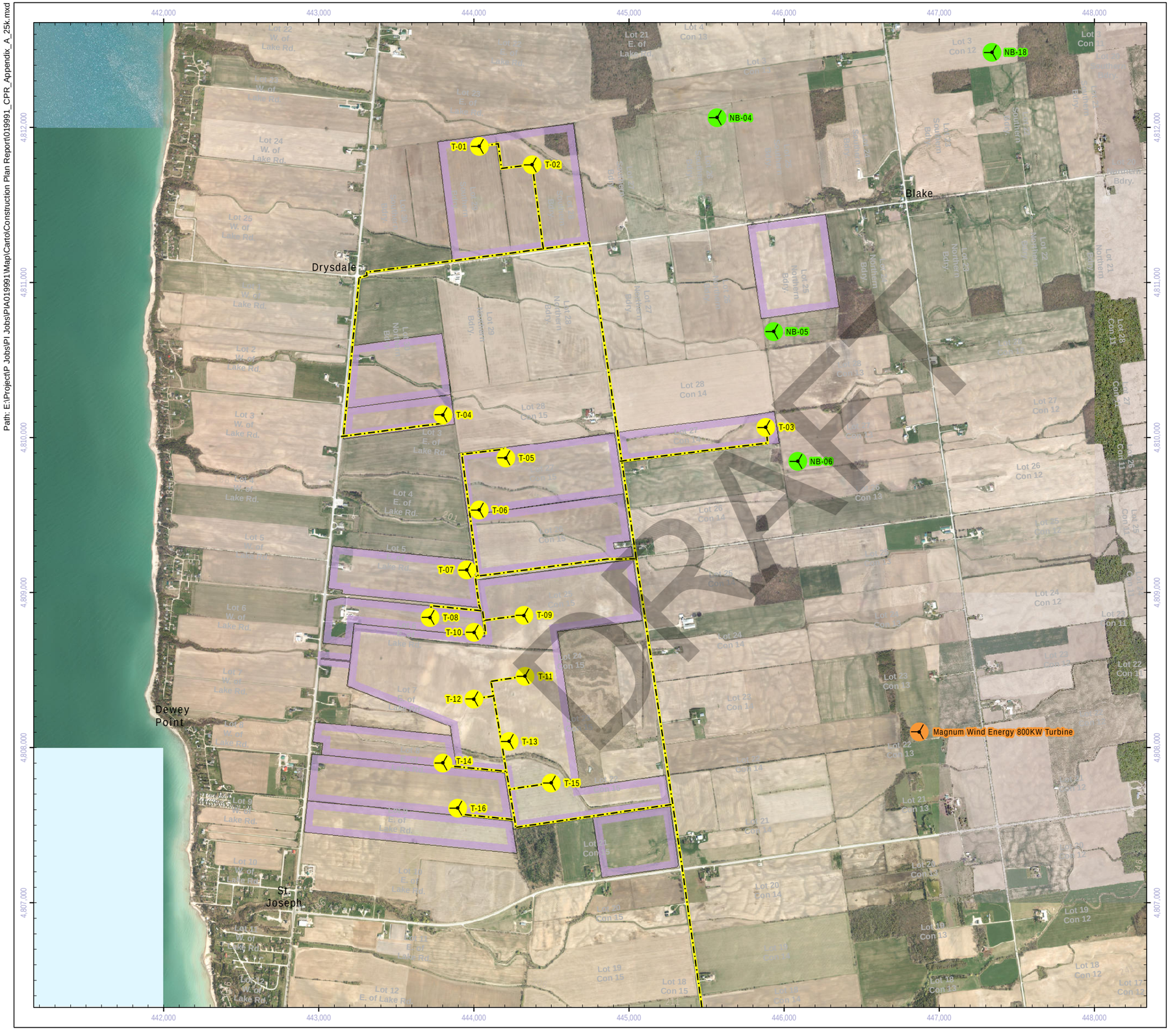

Appendix A
Figure A12

Grand Bend Wind Farm

Construction Plan Report

- Project Wind Turbine (Northland Power)
- Wind Turbine (NextEra)
- Wind Turbine (Magnum)
- Collector Line: Underground / Transmission Line: Underground Section
- Transmission Line: Overhead
- Existing Transmission Line: Overhead
- Transformer Sub-Station or Switch Yard

NOTES:

1. Reference the Figure 1 Key Map for location in the overall project area.
2. NextEra Turbine Locations taken from the document DRAFT Site Plan - Bluewater Wind Engery Centre, December 2011.

DATA SOURCES:

1. County of Huron (including Imagery: 2010)
2. Ministry of Natural Resources, © Queen's Printer for Ontario
3. Natural Resources Canada © Her Majesty the Queen in Right of Canada

Scale: 1:25,000
Date: 10 August 2012
Project Number: PIA019991

N

Prepared: P. Stubbert

Checked By: C. Shilton

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Meters

NEEGAN BURNSIDE

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Appendix A
Figure A13

Grand Bend Wind Farm

Construction Plan Report

- Project Wind Turbine (Northland Power)
- Wind Turbine (NextEra)
- Wind Turbine (Magnum)
- Collector Line: Underground / Transmission Line: Underground Section
- Transmission Line: Overhead
- Existing Transmission Line: Overhead
- Transformer Sub-Station or Switch Yard

NOTES:

1. Reference the Figure 1 Key Map for location in the overall project area.
2. NextEra Turbine Locations taken from the document DRAFT Site Plan - Bluewater Wind Engery Centre, December 2011.

DATA SOURCES:

1. County of Huron (including Imagery: 2010)
2. Ministry of Natural Resources, © Queen's Printer for Ontario
3. Natural Resources Canada © Her Majesty the Queen in Right of Canada

Scale: 1:25,000
Date: 10 August 2012
Project Number: PIA019991

N

Prepared: P. Stubbert

Checked By: C. Shilton

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Meters

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Appendix A
Figure A14

Grand Bend Wind Farm

Construction Plan Report

Project Wind Turbine (Northland Power)	Wind Turbine (NextEra)
Wind Turbine (Magnum)	Collector Line: Underground / Transmission Line: Underground Section
Transmission Line: Overhead	Existing Transmission Line: Overhead
Transformer Sub-Station or Switch Yard	

NOTES:

1. Reference the Figure 1 Key Map for location in the overall project area.
2. NextEra Turbine Locations taken from the document DRAFT Site Plan - Bluewater Wind Engery Centre, December 2011.

DATA SOURCES:

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Scale: 1:25,000
Date: 10 August 2012
Project Number: PIA019991

N

Prepared: P. Stubbert

Checked By: C. Shilton

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Meters

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Appendix A
Figure A15

Grand Bend Wind Farm

Construction Plan Report

- Project Wind Turbine (Northland Power)
- Wind Turbine (NextEra)
- Wind Turbine (Magnum)
- Collector Line: Underground / Transmission Line: Underground Section
- Transmission Line: Overhead
- Existing Transmission Line: Overhead
- Transformer Sub-Station or Switch Yard

NOTES:

1. Reference the Figure 1 Key Map for location in the overall project area.
2. NextEra Turbine Locations taken from the document DRAFT Site Plan - Bluewater Wind Engery Centre, December 2011.

DATA SOURCES:

1. County of Huron (including Imagery: 2010)
2. Ministry of Natural Resources, © Queen's Printer for Ontario
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Scale: 1:25,000
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Project Number: PIA019991

N

Prepared: P. Stubbert

Checked By: C. Shilton

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Meters

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Appendix A
Figure A16

Grand Bend Wind Farm

Construction Plan Report

- Project Wind Turbine (Northland Power)
- Wind Turbine (NextEra)
- Wind Turbine (Magnum)
- Collector Line: Underground / Transmission Line: Underground Section
- Transmission Line: Overhead
- Existing Transmission Line: Overhead
- Transformer Sub-Station or Switch Yard

NOTES:

1. Reference the Figure 1 Key Map for location in the overall project area.
2. NextEra Turbine Locations taken from the document DRAFT Site Plan - Bluewater Wind Engery Centre, December 2011.

DATA SOURCES:

1. County of Huron (including Imagery: 2010)
2. Ministry of Natural Resources, © Queen's Printer for Ontario
3. Natural Resources Canada © Her Majesty the Queen in Right of Canada

Scale: 1:25,000
Date: 10 August 2012
Project Number: PIA019991

N

Prepared: P. Stubbert

Checked By: C. Shilton

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Meters

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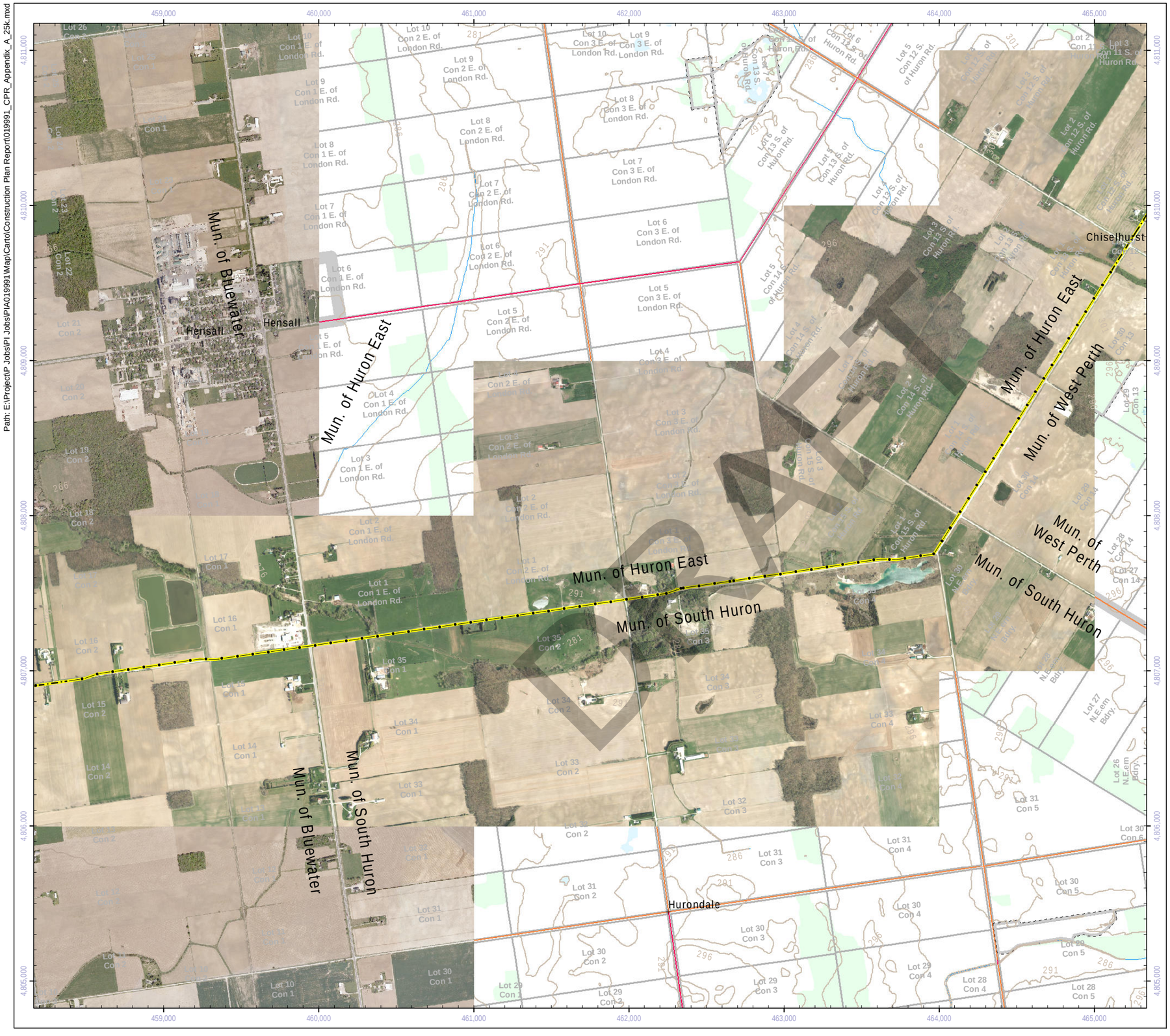

Appendix A
Figure A17

Grand Bend Wind Farm

Construction Plan Report

- Project Wind Turbine (Northland Power)
- Wind Turbine (NextEra)
- Wind Turbine (Magnum)
- Collector Line: Underground / Transmission Line: Underground Section
- Transmission Line: Overhead
- Existing Transmission Line: Overhead
- Transformer Sub-Station or Switch Yard

NOTES:

1. Reference the Figure 1 Key Map for location in the overall project area.
2. NextEra Turbine Locations taken from the document DRAFT Site Plan - Bluewater Wind Engery Centre, December 2011.

DATA SOURCES:

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Scale: 1:25,000
Date: 10 August 2012
Project Number: PIA019991

N

Prepared: P. Stubbert

Checked By: C. Shilton

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Meters

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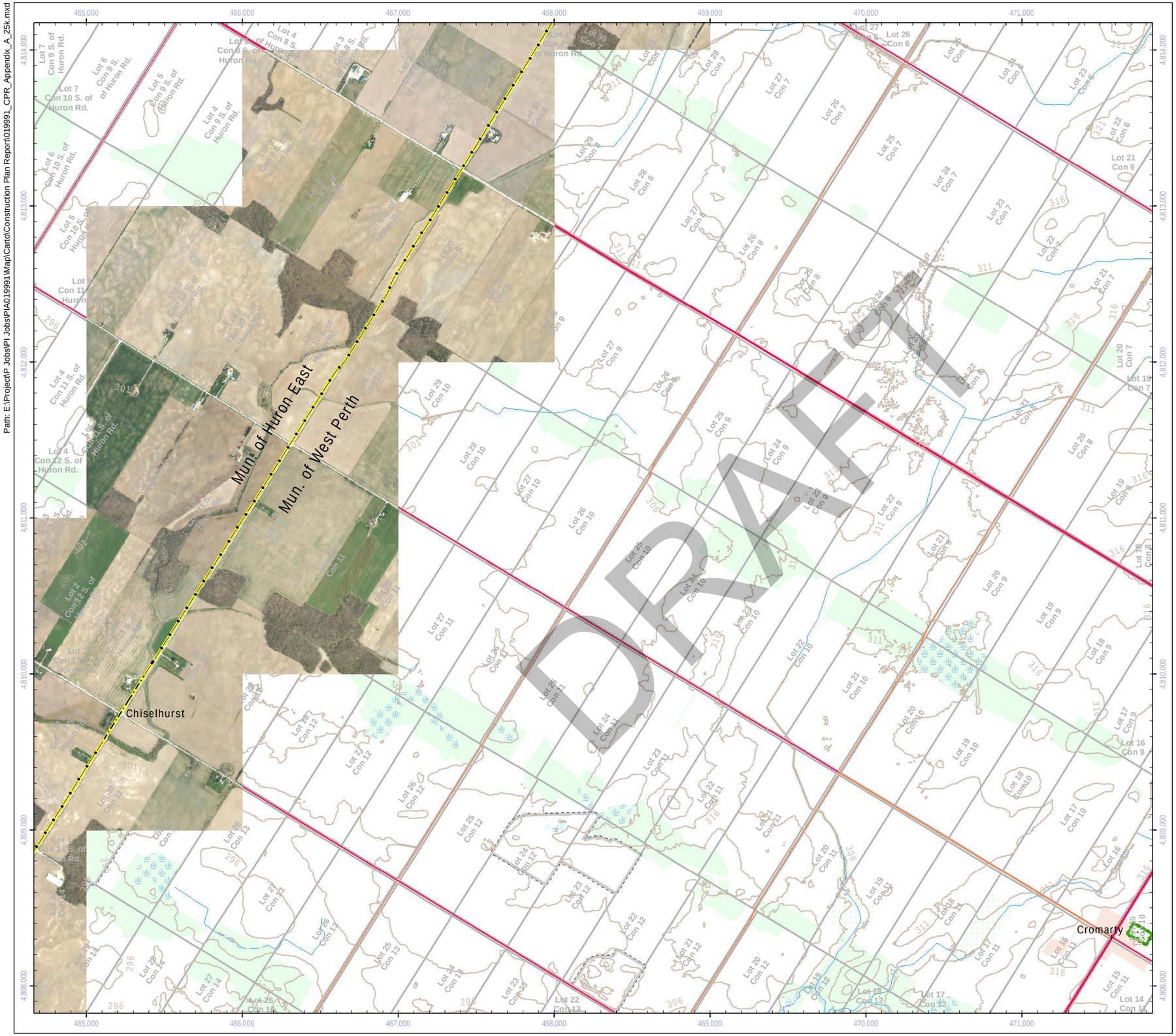

Appendix A
Figure A18

Grand Bend Wind Farm

Construction Plan Report

- Project Wind Turbine (Northland Power)
- Wind Turbine (NextEra)
- Wind Turbine (Magnum)
- Collector Line: Underground / Transmission Line: Underground Section
- Transmission Line: Overhead
- Existing Transmission Line: Overhead
- Transformer Sub-Station or Switch Yard

NOTES:

1. Reference the Figure 1 Key Map for location in the overall project area.
2. NextEra Turbine Locations taken from the document DRAFT Site Plan - Bluewater Wind Engery Centre, December 2011.

DATA SOURCES:

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Scale: 1:25,000
Date: 10 August 2012
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Prepared: P. Stubbert

Checked By: C. Shilton

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Appendix A
Figure A19

Grand Bend Wind Farm

Construction Plan Report

- Project Wind Turbine (Northland Power)
- Wind Turbine (NextEra)
- Wind Turbine (Magnum)
- Collector Line: Underground / Transmission Line: Underground Section
- Transmission Line: Overhead
- Existing Transmission Line: Overhead
- Transformer Sub-Station or Switch Yard

NOTES:

1. Reference the Figure 1 Key Map for location in the overall project area.
2. NextEra Turbine Locations taken from the document DRAFT Site Plan - Bluewater Wind Engery Centre, December 2011.

DATA SOURCES:

1. County of Huron (including Imagery: 2010)
2. Ministry of Natural Resources, © Queen's Printer for Ontario
3. Natural Resources Canada © Her Majesty the Queen in Right of Canada

Scale: 1:25,000
Date: 10 August 2012
Project Number: PIA019991

N

Prepared: P. Stubbert

Checked By: C. Shilton

0 1,000 2,000

Meters

NEEGAN BURNSIDE

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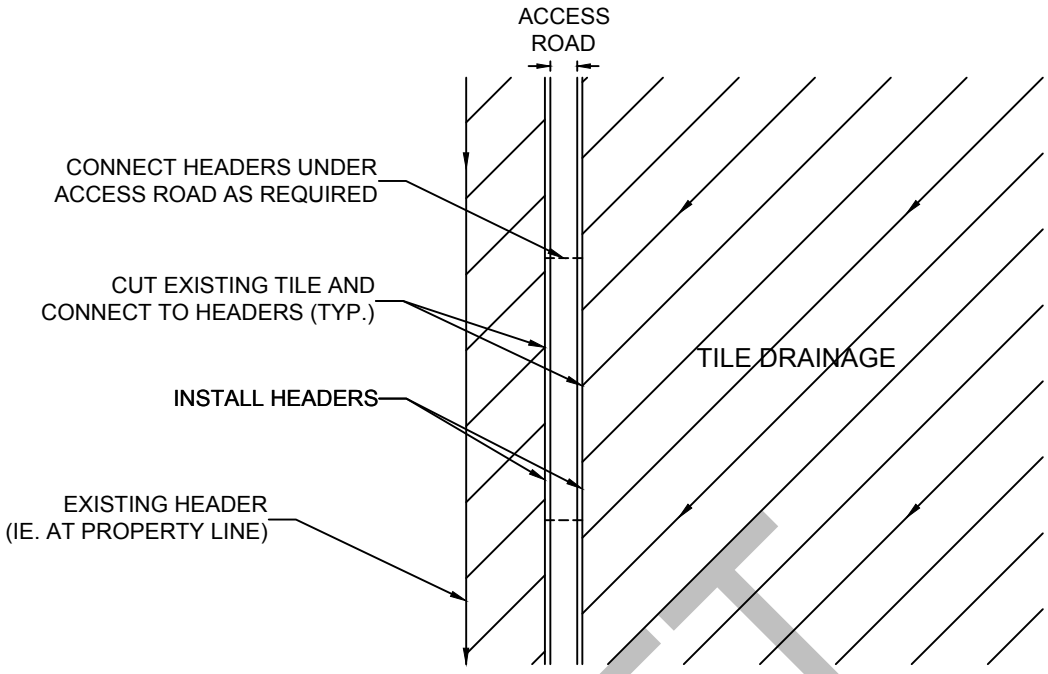
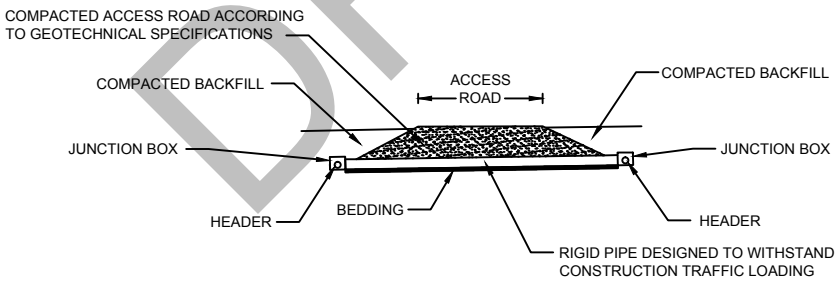
Appendix B
Conceptual Plans / Specifications



REPRESENTATIVE ACCESS ROAD
TILE DRAIN MODIFICATIONS



REPRESENTATIVE HEADER
CONNECTION UNDER ACCESS ROAD

Client

NORTHLAND POWER INC.
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M4A 3A1

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telephone (905) 821-1800 **fax** (905) 821-1809
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Drawing Title

TILE DRAIN MODIFICATIONS
FOR ACCESS ROADS

Drawn By	Checked By	Drawing No.
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Scale	Project No.	
N.T.S.	PIA019991	

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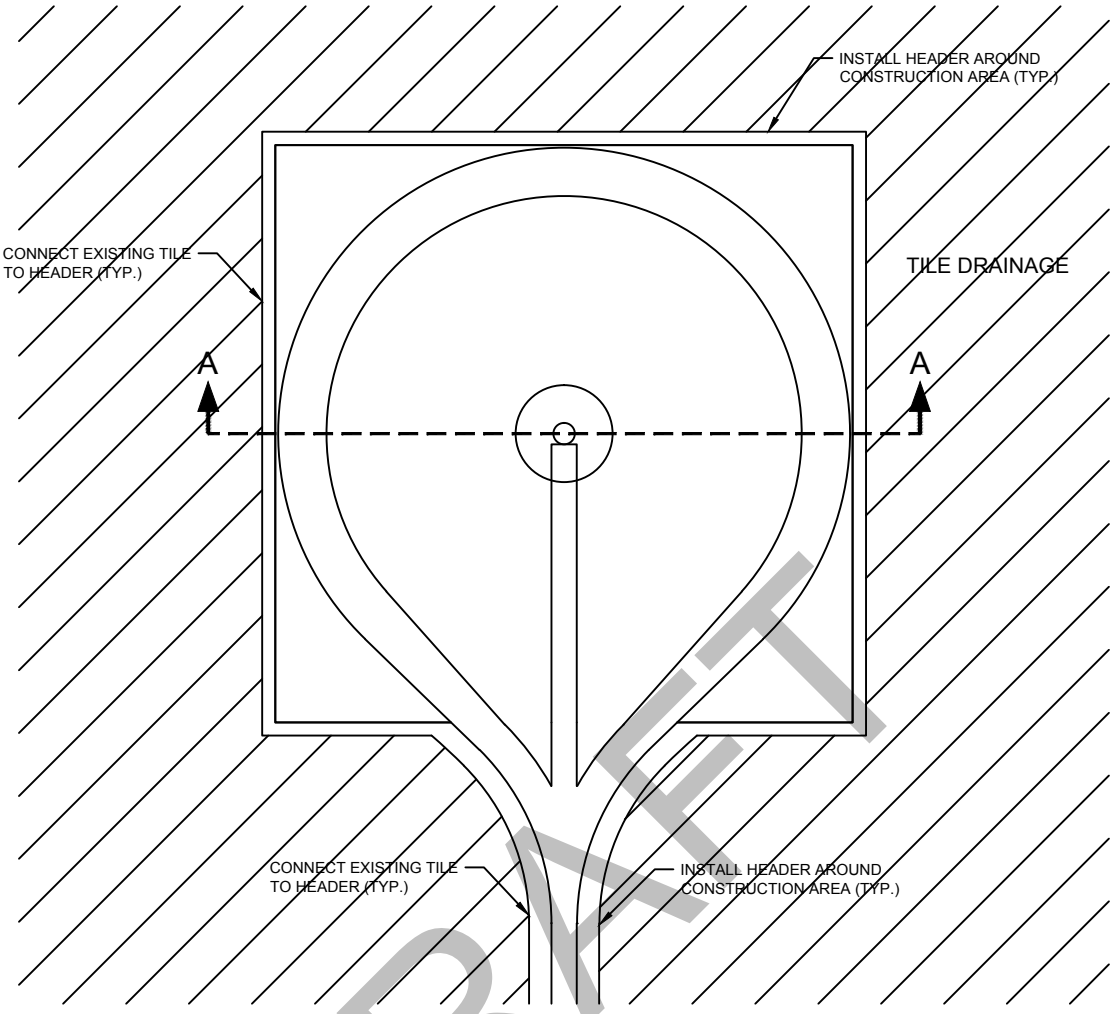
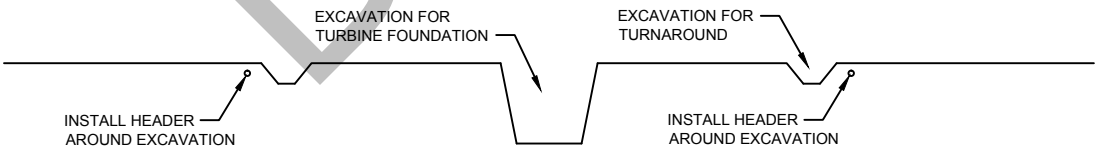
Plotted By: cshilton



PLAN



SECTION A-A

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Drawing Title

TILE DRAIN MODIFICATIONS FOR TURBINE INSTALLATION AREAS

Drawn By	Checked By	Drawing No.
CS	LP	B2
Scale	Project No.	
N.T.S.	PIA019991	

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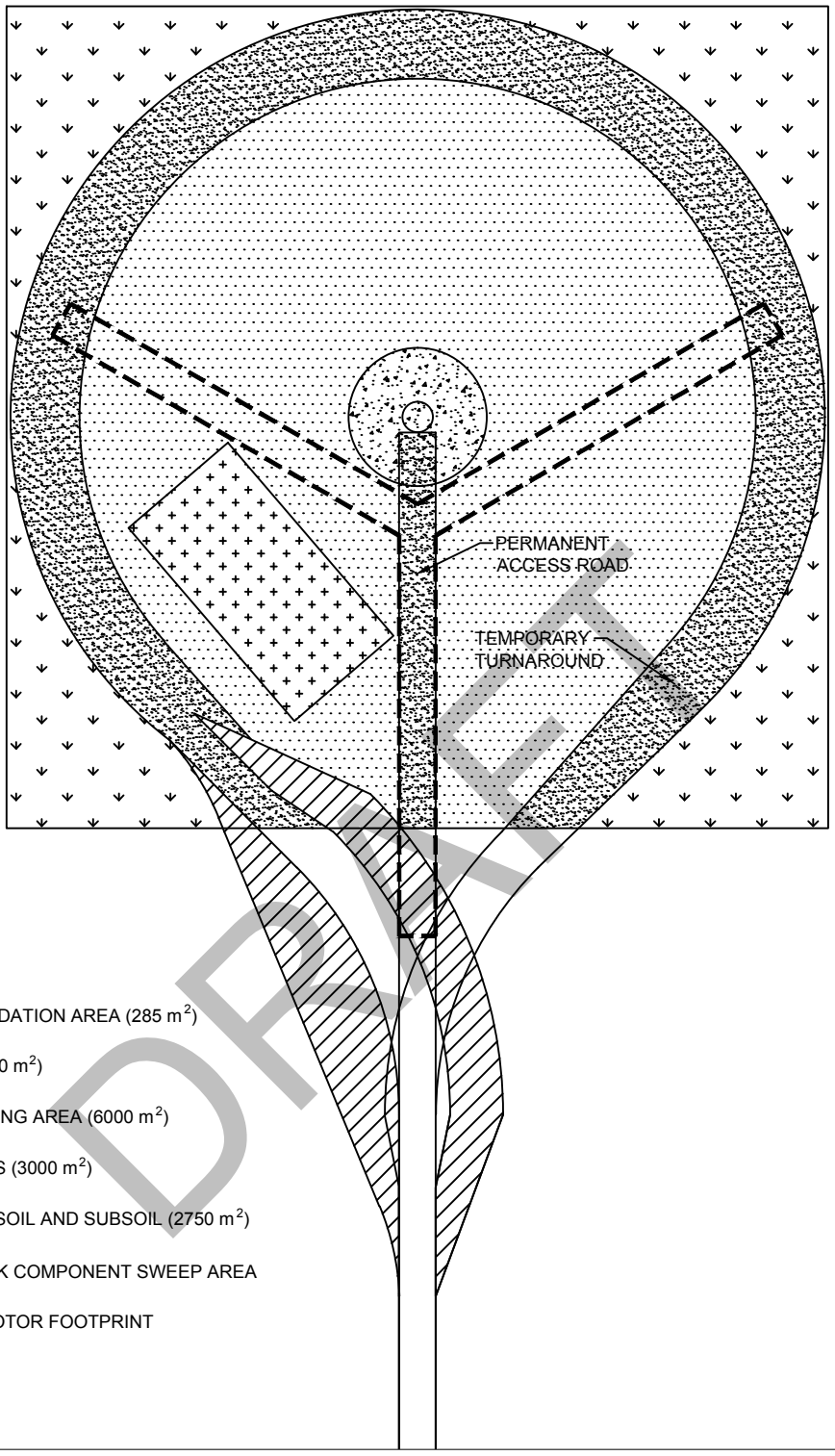
Plotted By: cshilton



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Drawing Title

CONCEPTUAL TURBINE INSTALLATION AREA

Drawn By	Checked By	Drawing No.
CS	LP	B3
Scale	Project No.	
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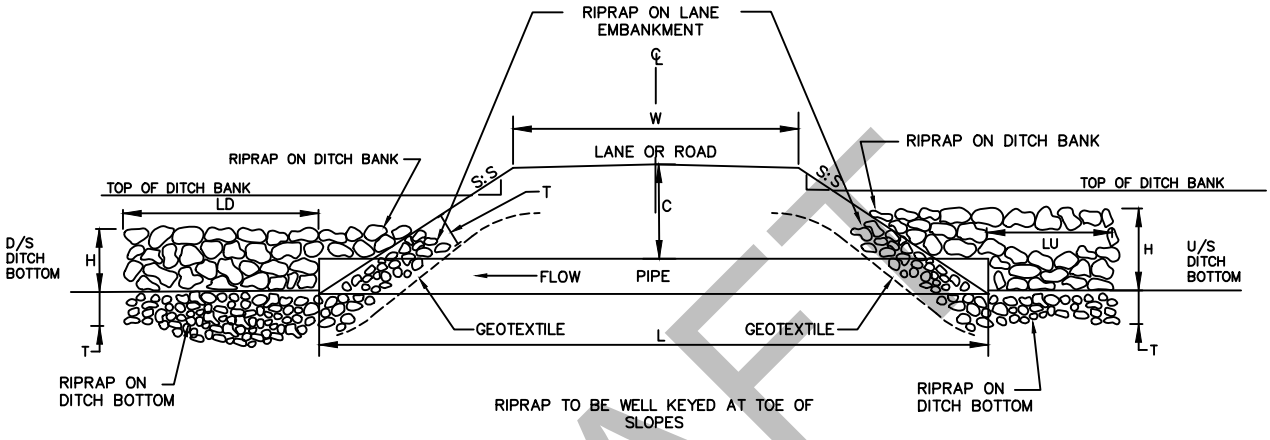

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Drawing Title

TYPICAL CULVERT INSTALLATION WITH RIPRAP

Drawn By	Checked By	Drawing No.
CS	JD	B4
Scale	Project No.	
N.T.S.	PIA019991	

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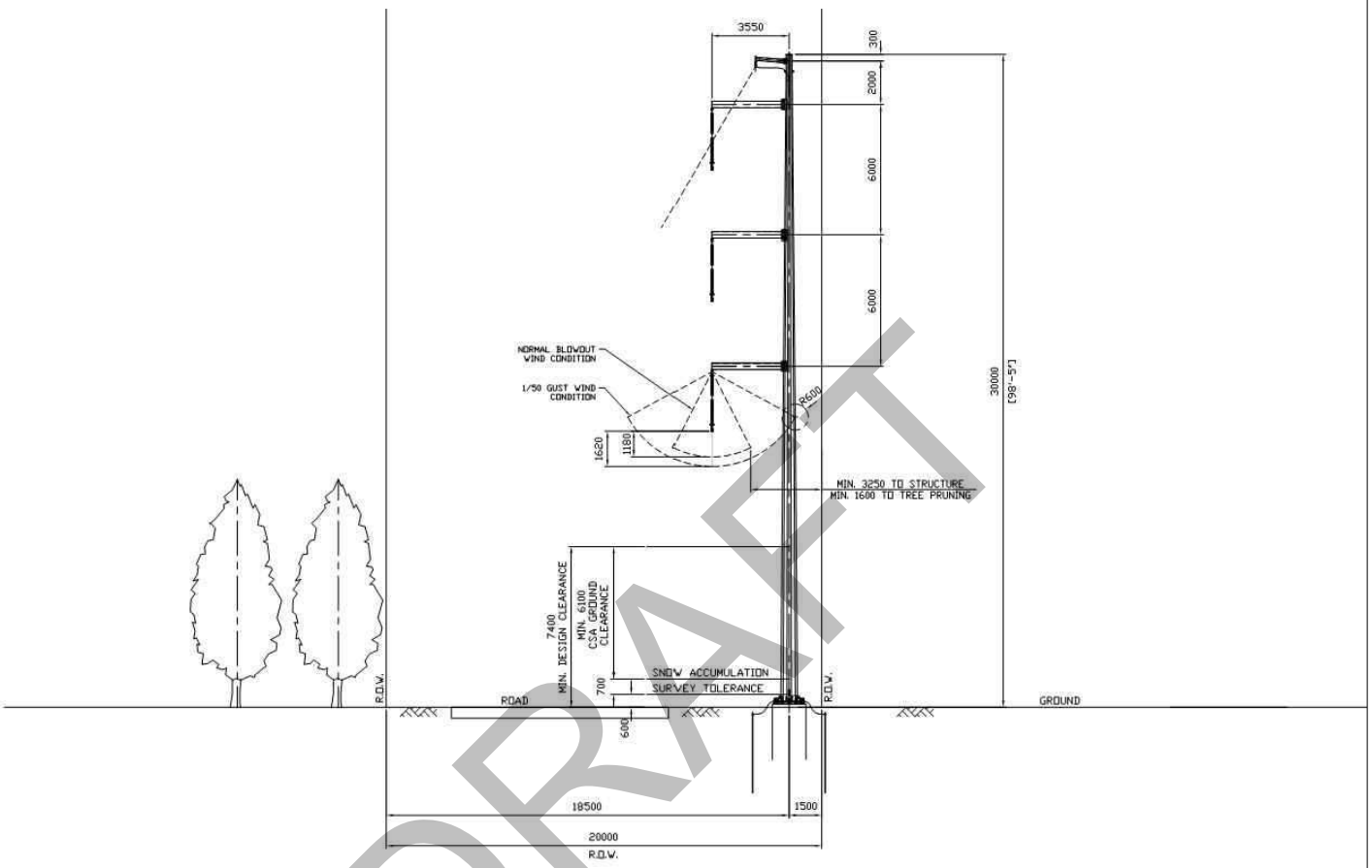

230kV TRANSMISSION LINE
TANGENT STRUCTURES
CONCEPTUAL RIGHT OF WAY DESIGN

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Drawing Title

CONCEPTUAL TRANSMISSION LINE
UTILITY POLE

Drawn By	Checked By	Drawing No.
OTHERS	NORTHLAND	B5
Scale: N.T.S.	Project No.: PIA019991	

W:\Northland Grand Bend Wind Farm\Reports\Design and Operations\Report Figures\Individuc
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Plotted By: cshilton

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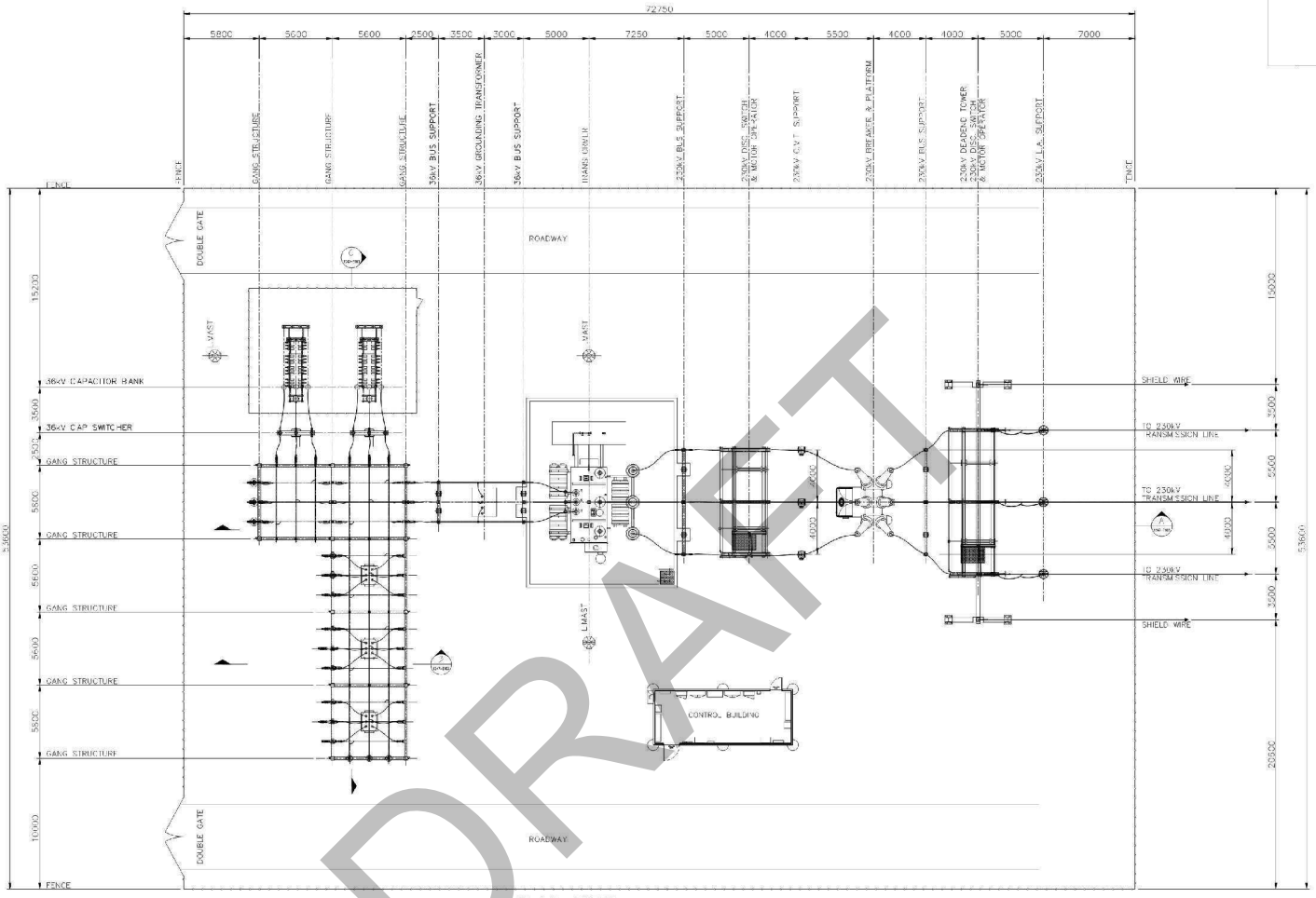

PLAN VIEW

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Drawing Title

CONCEPTUAL TRANSFORMER SUBSTATION - LAYOUT

Drawn By	Checked By	Drawing No.
OTHERS	NORTHLAND	B6
Scale: N.T.S.	Project No.: PIA019991	

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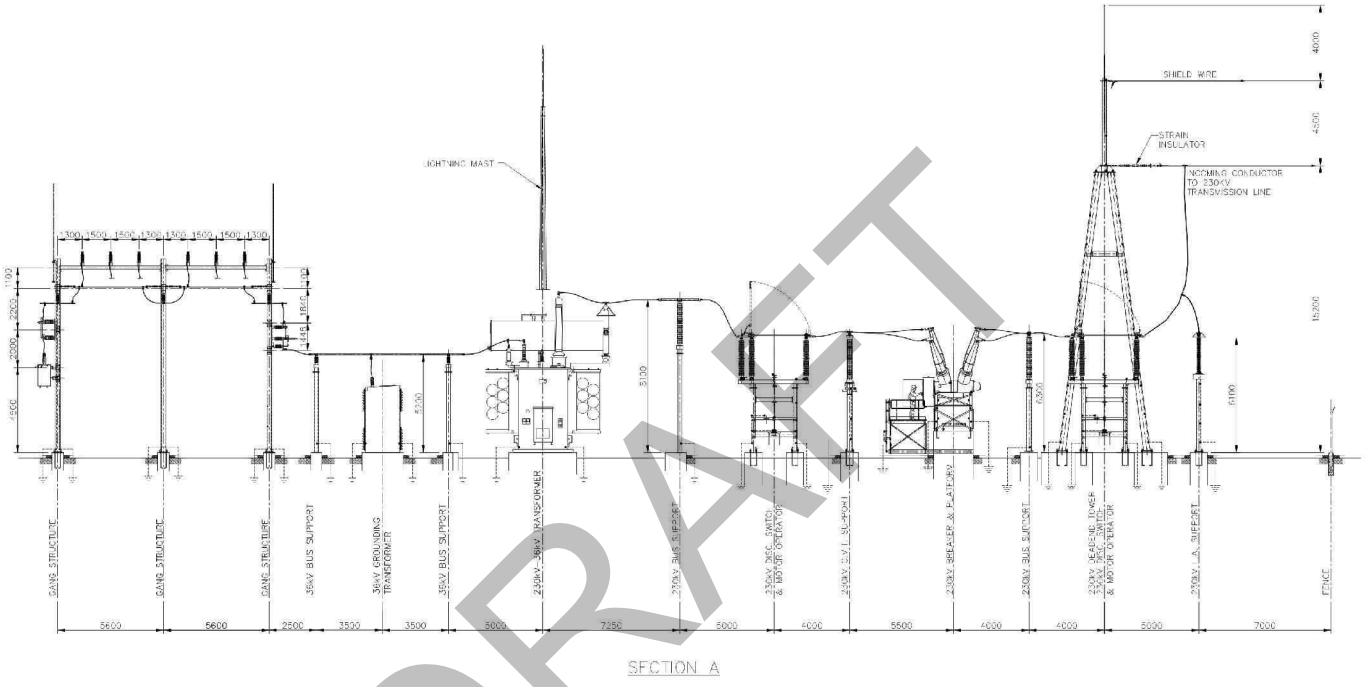

SECTION A

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Drawing Title

CONCEPTUAL TRANSFORMER SUBSTATION - SECTION A

Drawn By	Checked By	Drawing No.
OTHERS	NORTHLAND	B7
Scale: N.T.S.	Project No.: PIA019991	

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Date Plotted: Aug 10, 2012 – 12:35pm
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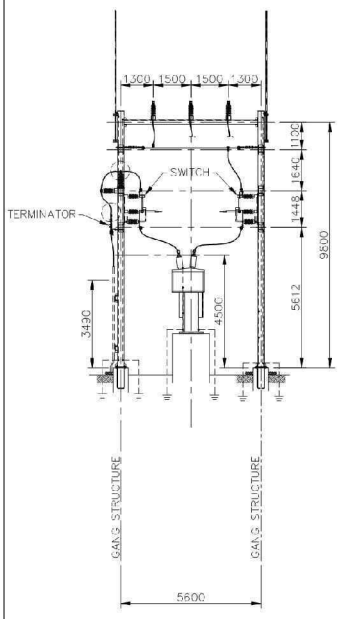
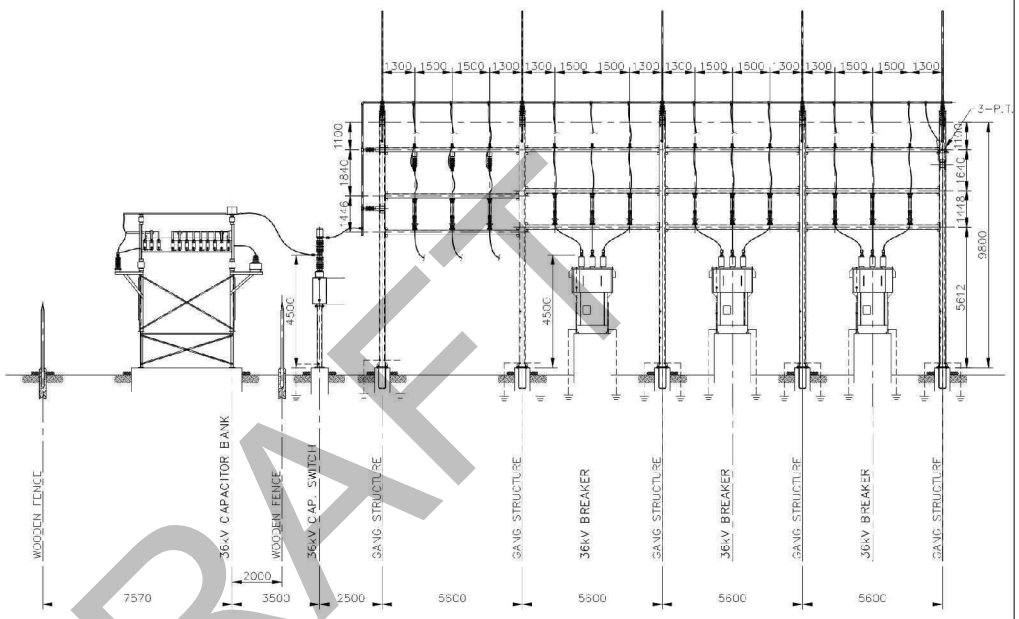


SECTION B



SECTION C

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Drawing Title

CONCEPTUAL TRANSFORMER SUBSTATION - SECTIONS B AND C

Drawn By	Checked By	Drawing No.
OTHERS	NORTHLAND	B8
Scale	Project No.	
N.T.S.	PIA019991	

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Date Plotted: Aug 10, 2012 - 12:35pm
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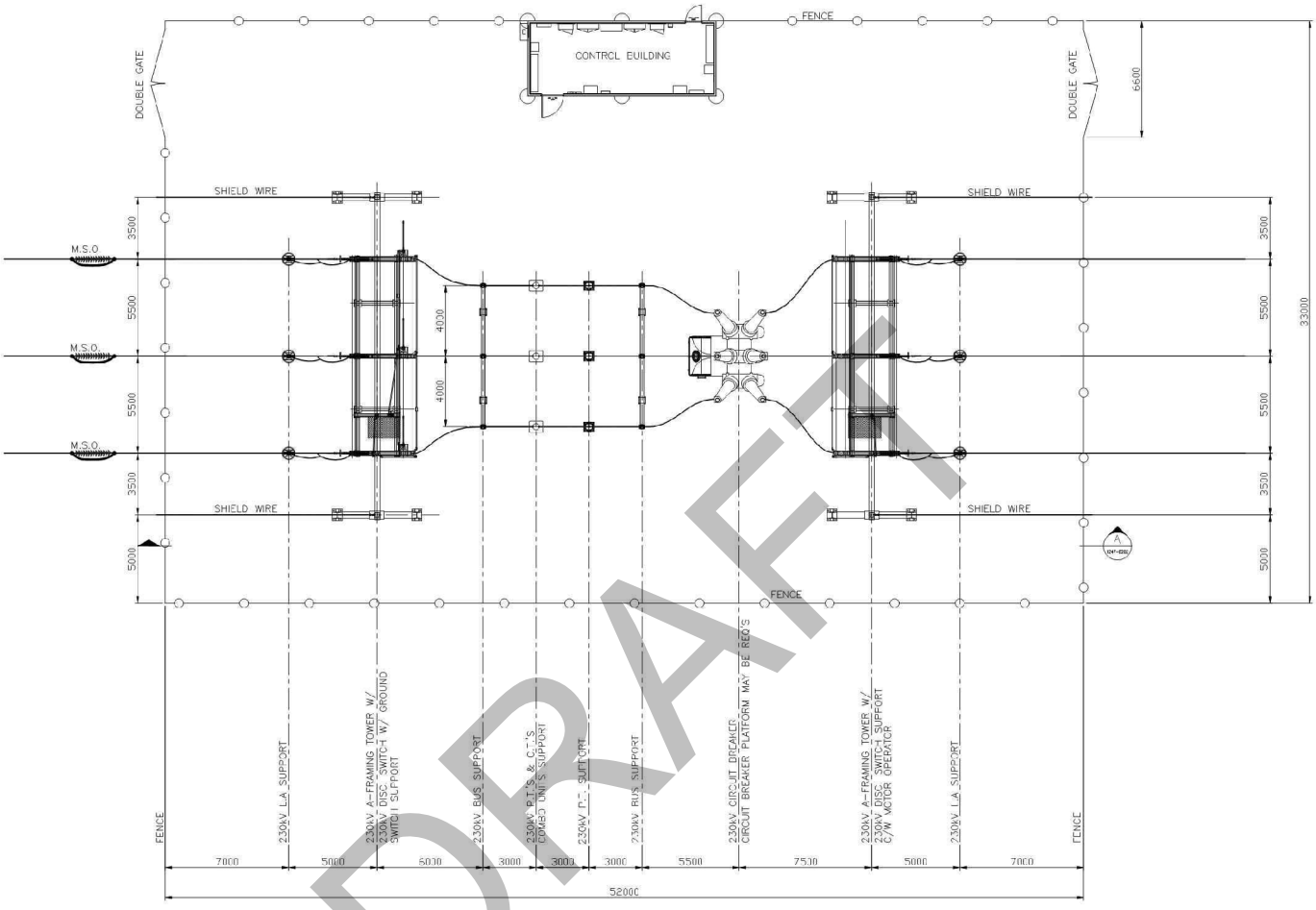

PLAN VIEW

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Drawing Title

CONCEPTUAL SWITCHYARD - LAYOUT

Drawn By	Checked By	Drawing No.
OTHERS	NORTHLAND	B9
Scale: N.T.S.	Project No.: PIA019991	

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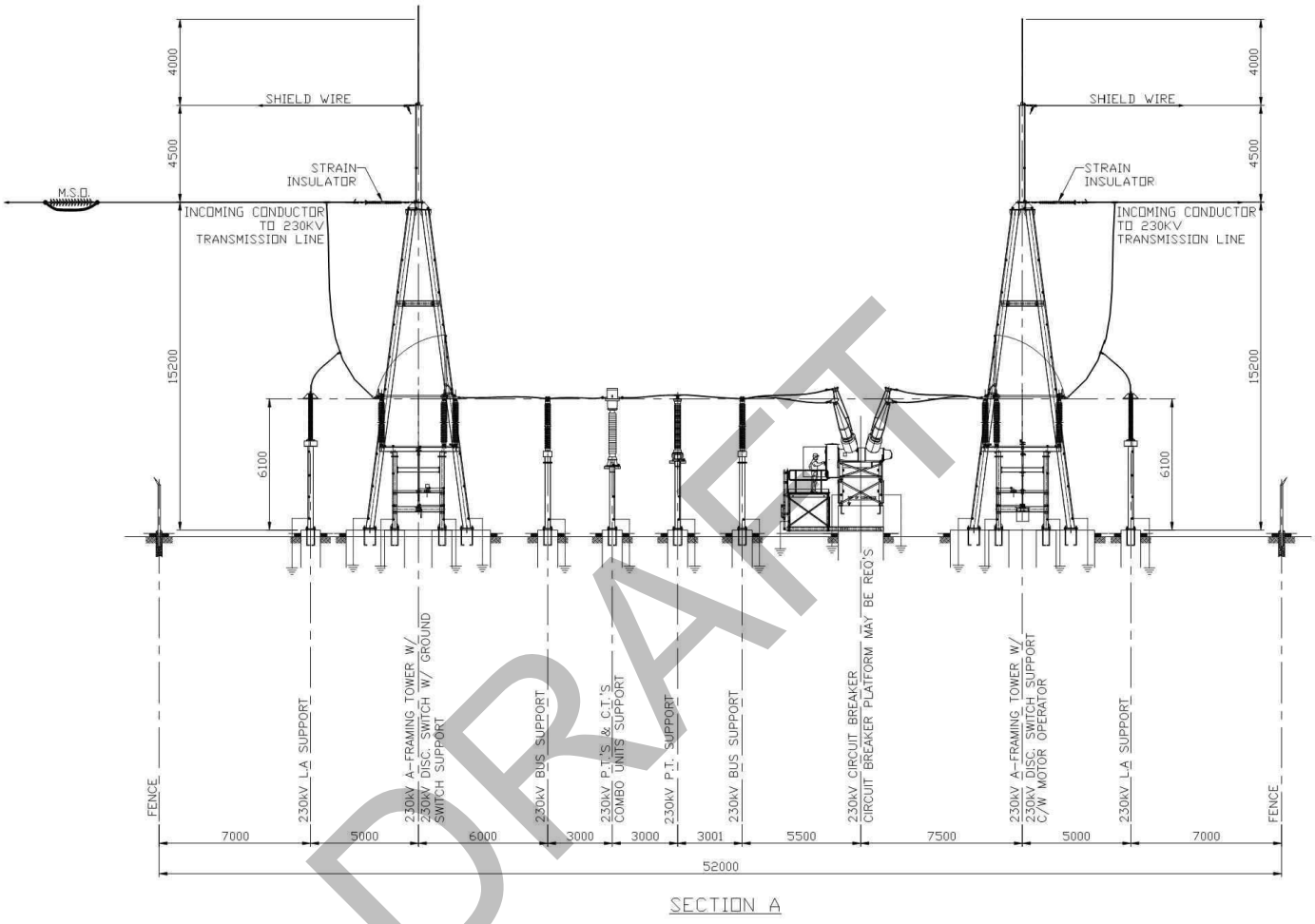

SECTION A

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Drawing Title	Drawn By	Checked By	Drawing No.
CONCEPTUAL SWITCHYARD - SECTION A	OTHERS	NORTHLAND	B10
	Scale: N.T.S.	Project No.: PIA019991	

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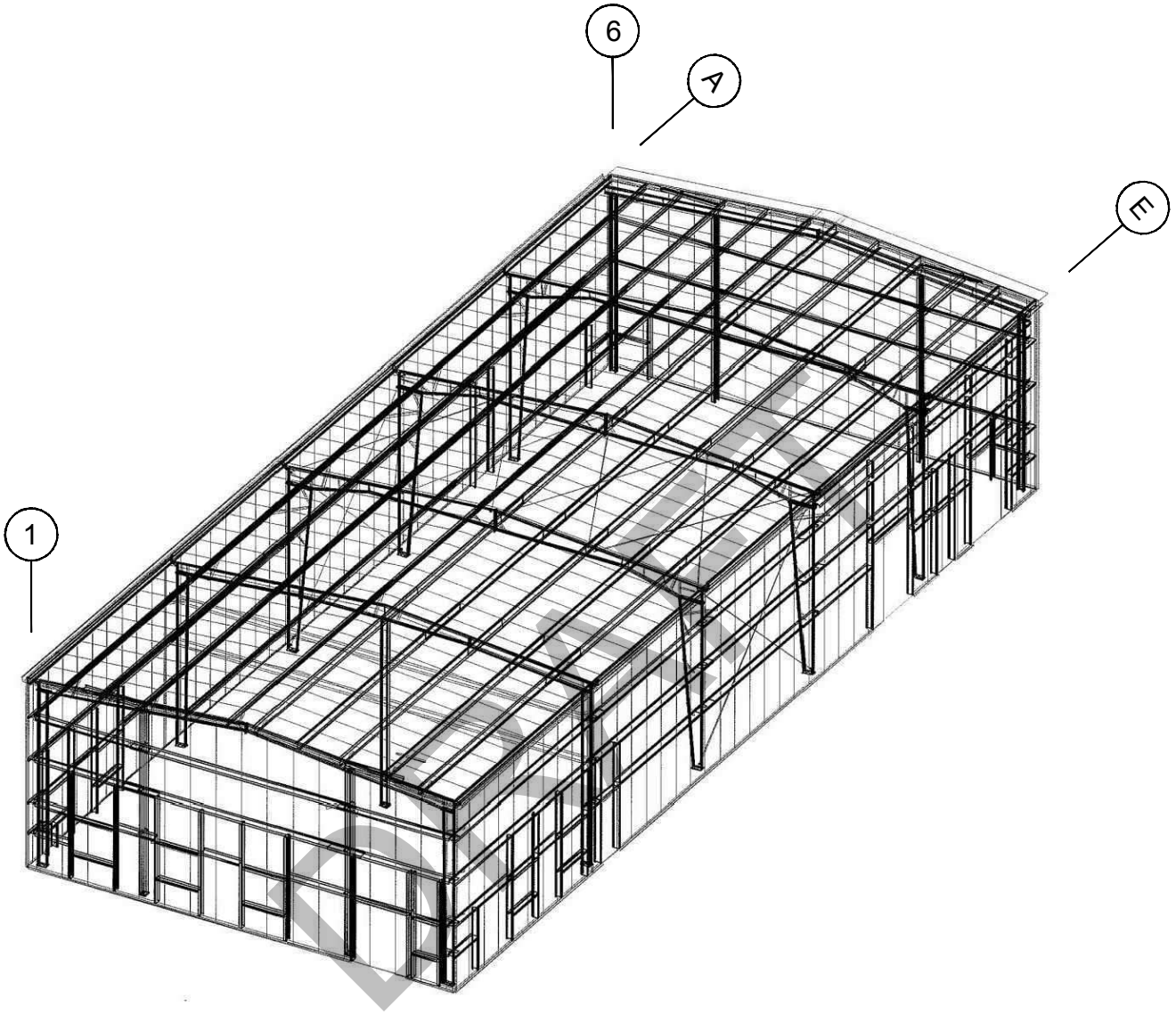

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Drawing Title	Drawn By	Checked By	Drawing No.
CONCEPTUAL PARTS AND STORAGE BUILDING - ISOMETRIC			B11
	Scale: NTS	Project No.: PIA019991	

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Date Plotted: Aug 10, 2012 - 12:40pm
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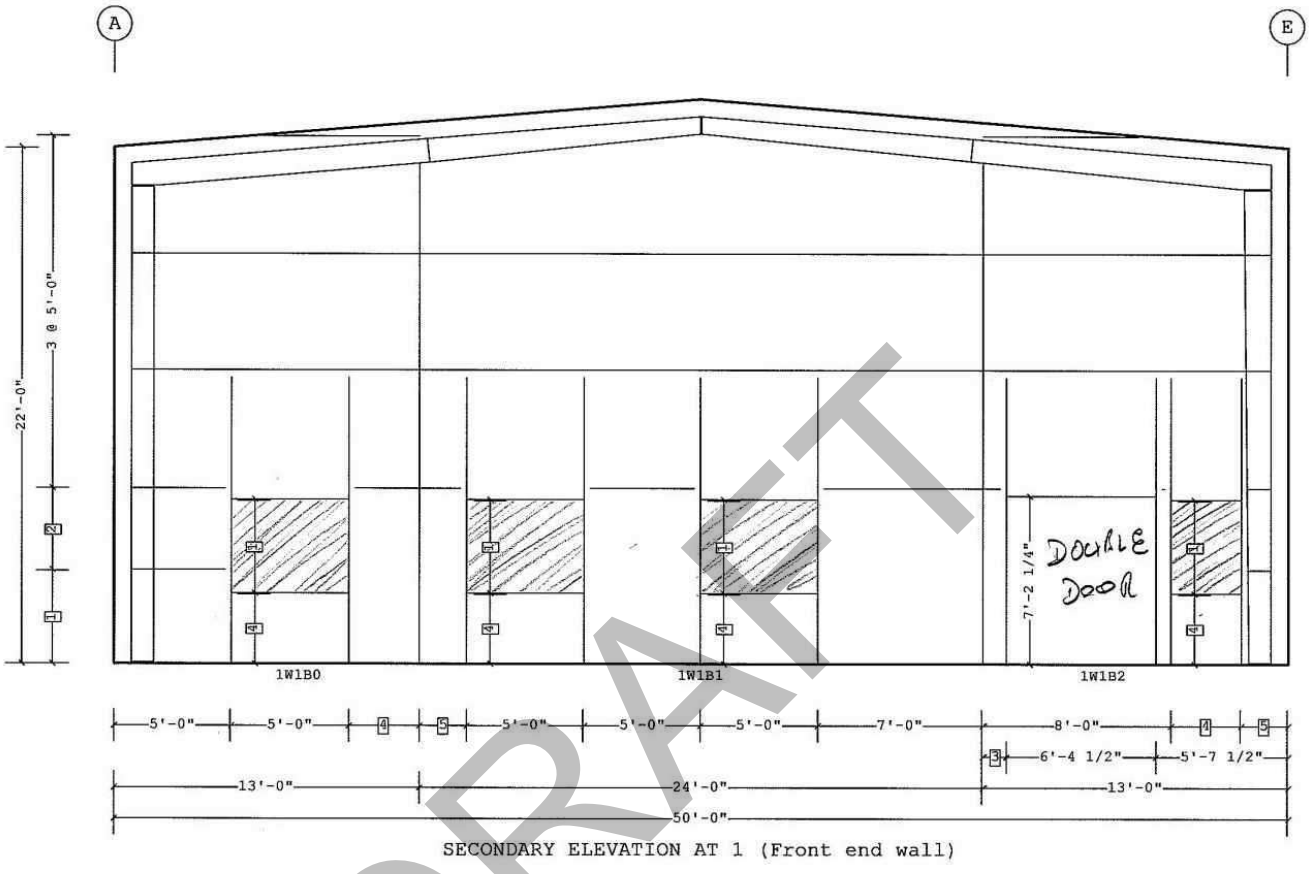

SECONDARY ELEVATION AT 1 (Front end wall)

5 2'-0"
4 3'-0"
3 1'-0"
2 3'-6"
1 4'-0"
Dimension Key

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Drawing Title

CONCEPTUAL PARTS AND STORAGE BUILDING - ELEVATION AT 1

Drawn By	Checked By	Drawing No.
		B12
Scale: NTS	Project No.: PIA019991	

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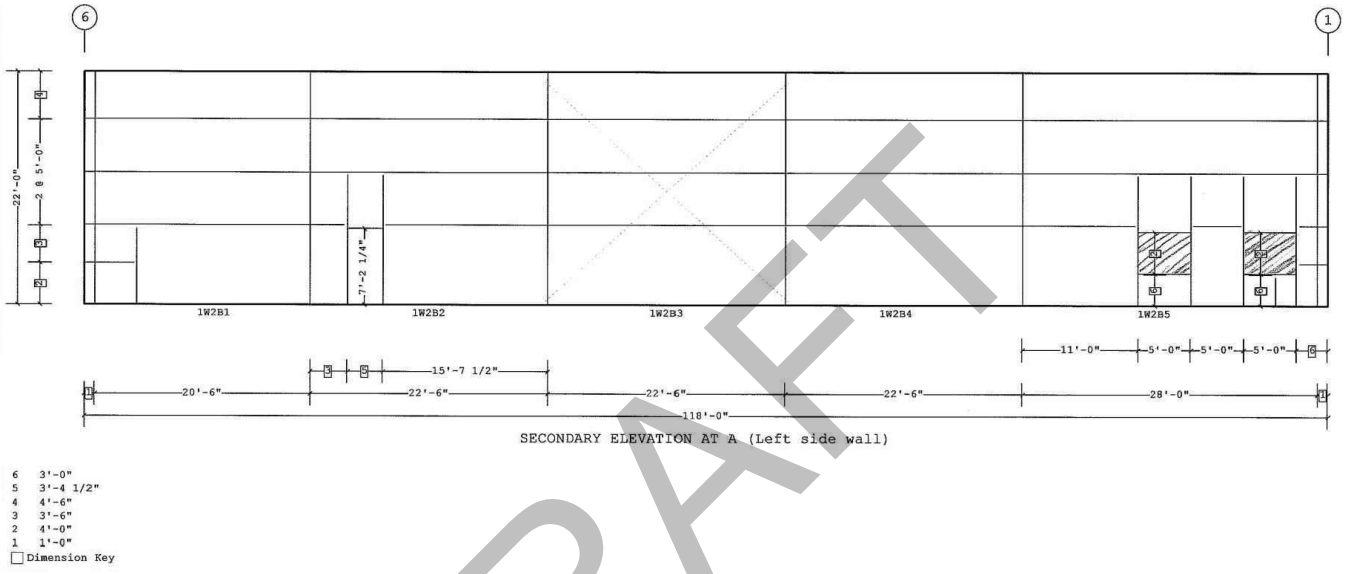

SECONDARY ELEVATION AT A (Left side wall)

6	3'-0"
5	3'-4 1/2"
4	4'-6"
3	3'-6"
2	4'-0"
1	1'-0"

☐ Dimension Key

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Drawing Title

CONCEPTUAL PARTS AND STORAGE BUILDING - ELEVATION AT A

Drawn By	Checked By	Drawing No.
		B13
Scale: NTS	Project No.: PIA019991	

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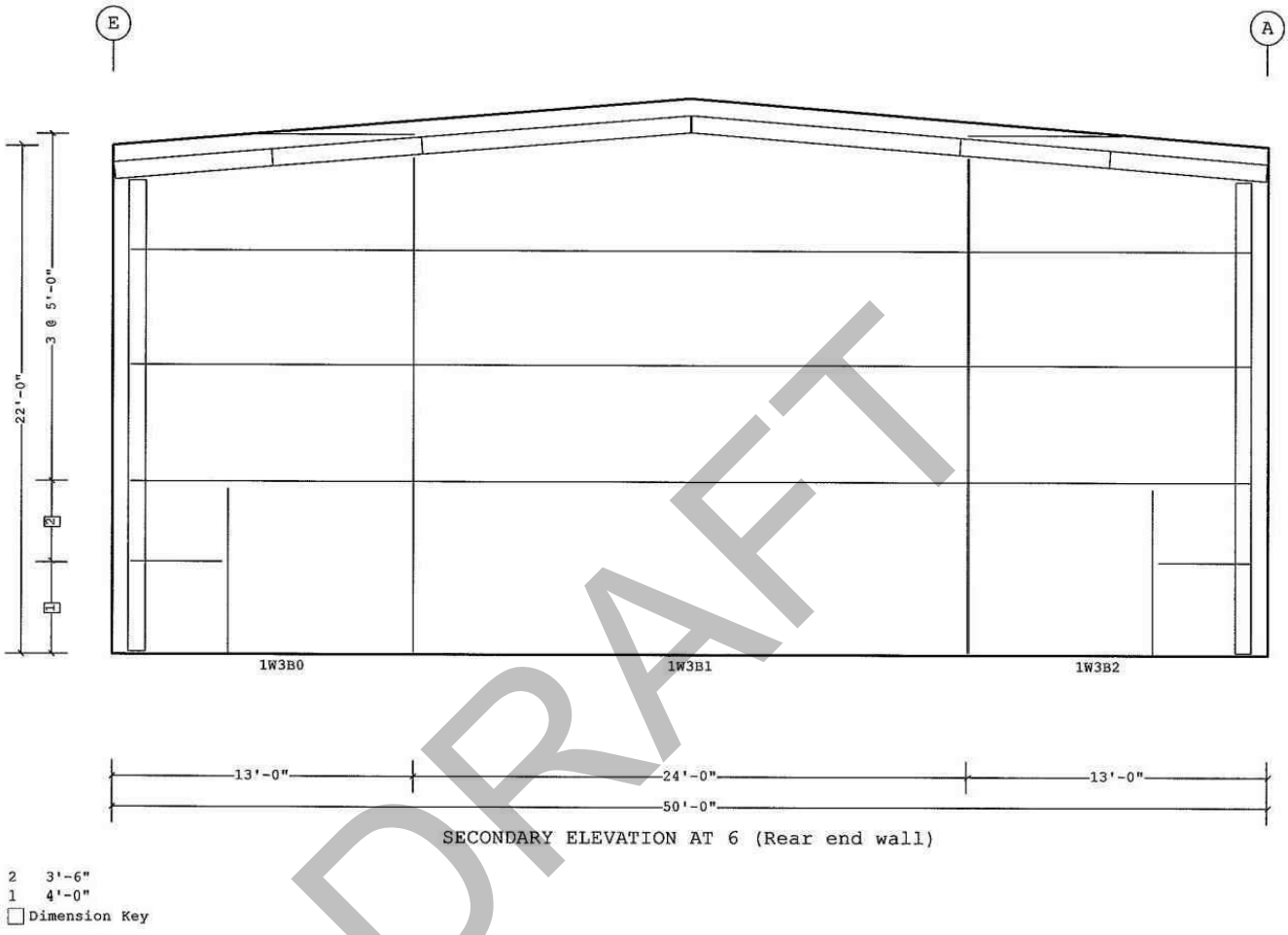

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Drawing Title

CONCEPTUAL PARTS AND STORAGE BUILDING - ELEVATION AT 6

Drawn By	Checked By	Drawing No.
		B14
Scale: NTS	Project No.: PIA019991	

C:\Users\cshilton\appdata\local\temp\AcPublish_7688\019991_FIG_B11-B16.dwg

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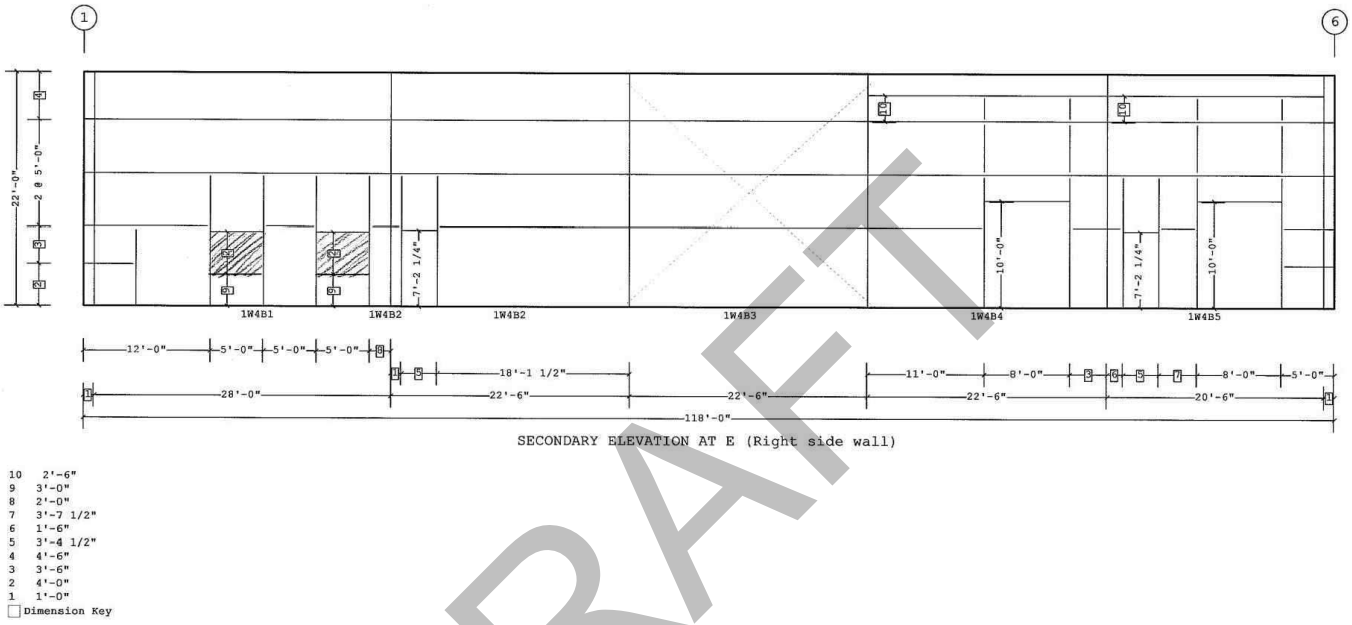

SECONDARY ELEVATION AT E (Right side wall)

10 2'-6"
9 3'-0"
8 2'-0"
7 3'-7 1/2"
6 1'-6"
5 3'-4 1/2"
4 4'-6"
3 3'-6"
2 4'-0"
1 1'-0"
Dimension Key

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Drawing Title

CONCEPTUAL PARTS AND STORAGE BUILDING - ELEVATION AT E

Drawn By	Checked By	Drawing No.
		B15
Scale: NTS	Project No.: PIA019991	

C:\Users\cshilton\appdata\local\temp\AcPublish_7688\019991_FIG_B11-B16.dwg

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Plotted By: cshilton

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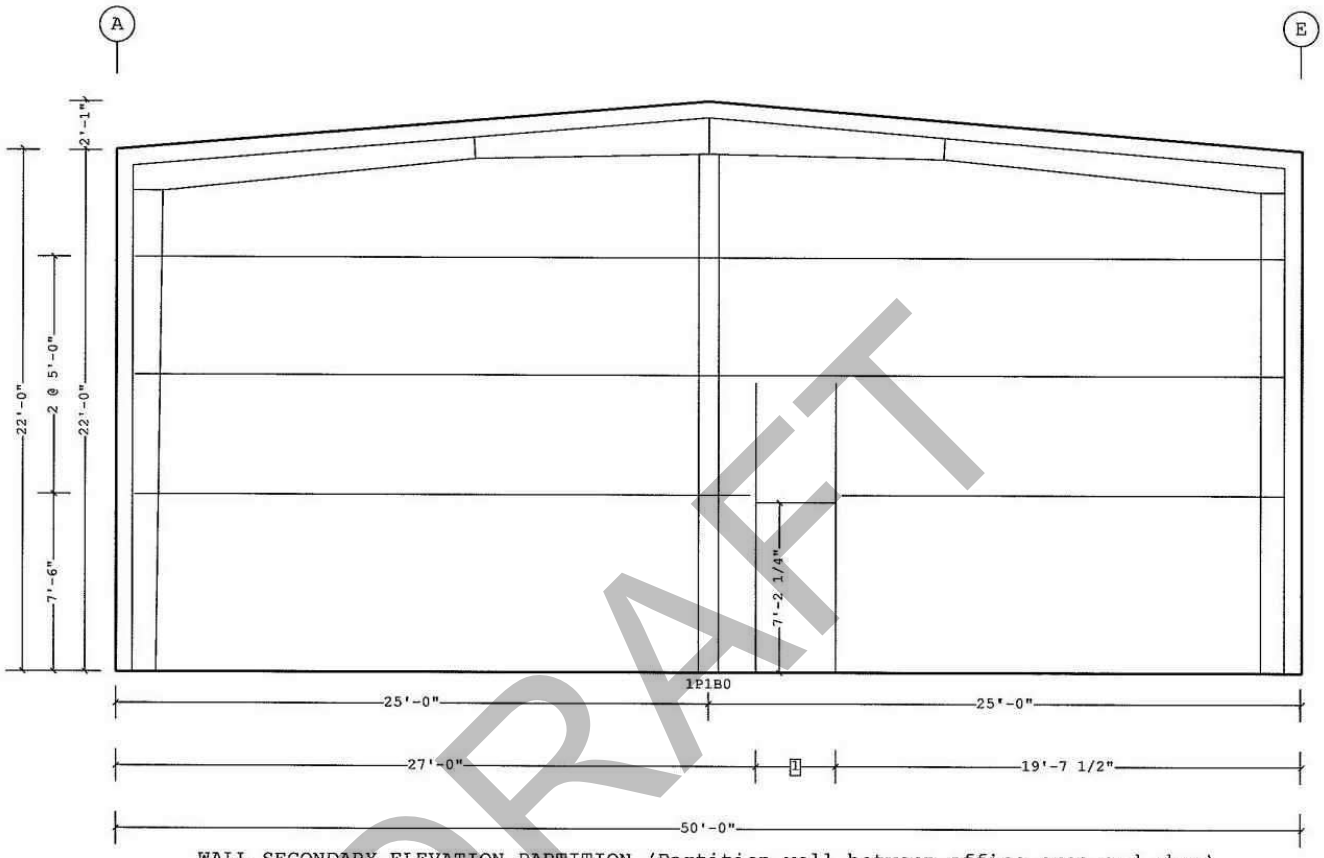

WALL SECONDARY ELEVATION PARTITION (Partition wall between office area and shop)

1 3'-4 1/2"
Dimension Key

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Drawing Title

CONCEPTUAL PARTS AND STORAGE BUILDING - PARTITION ELEVATION

Drawn By	Checked By	Drawing No.
		B16
Scale: NTS	Project No.: PIA019991	

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Date Plotted: Aug 10, 2012 – 12:42pm
Plotted By: cshilton

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Appendix C
Water Taking Calculations

Dewatering Calculations
Grand Bend Wind Farm

Groundwater Inflow Rate Calculations - see notes section below for explanation of scenarios

*Using Q = (((Kx(H^2 - h^2))/2L)*n

where
Q = inflow rate m3/s
K = hydraulic conductivity m/s
x = length of trench (m)
H = saturated thickness before dewatering (m)
h = saturated thickness after dewatering (m)
L = distance to line source (m)
n = number of sides of excavation

Scenarios for TILL

Input	1	2	3	4	5	6	7
K	1.00E-08	1.00E-08	1.00E-08	1.00E-08	1.00E-08	1.00E-08	1.00E-08
H	3	3	3	25	25	50	50
h	0	0	0	22	22	47	47
x	19	19	19	19	19	19	19
n	4	4	4	4	4	4	4
L	200	50	10	10	50	10	50
Output							
Q m3/s	1.71E-08	6.84E-08	3.42E-07	5.36E-06	1.07E-06	1.11E-05	2.21E-06
Q l/day	1	6	30	463	93	955	191

Scenarios for SAND/ALLUVIAL

Input	1	2	3	4	5	6	7
K	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05
H	3	3	3	3	10	10	13
h	0	0	0	0	7	7	10
x	19	19	19	19	19	19	19
n	4	4	4	4	4	4	4
L	200	100	50	30	100	50	50
Output							
Q m3/s	1.71E-05	3.42E-05	6.84E-05	1.14E-04	1.94E-04	3.88E-04	5.24E-04
Q l/day	1,477	2,955	5,910	9,850	16,744	33,489	45,308

note: assumes steady state conditions, initial pumping rate will be higher

*"Construction Dewatering and Groundwater Control", Third Edition, 2007, Powers et al.

NOTES

Assumptions
The L value in the calculations represents distance to line source from the excavation. The line source in this scenario is most likely a stream. It is assumed that the L value realistically will not be less than 50 m, but other values are shown for comparison purposes. In all calculations the excavation is assumed to be a square with sides of 19m excavated to a depth of 3m.

Scenarios for TILL
Scenarios 1 - 3 for TILL show pumping rate calculations using L values of 200, 50 and 10m and a saturated layer extending from surface to a depth of 3m. Scenarios 4 through 7 show calculations assuming saturated layers to depths of 25m and 50m using L values of 10m and 50m. In all till scenarios the pumping requirements are well below PTTW.

Scenarios for SAND/ALLUVIAL
Higher pumping rates will be required in those areas where coarser grained material such as sand is excavated (due to higher hydraulic conductivity value). Scenarios 1 through 4 show pumping rate calculations for a saturated layer to 3m depth and L values of 200, 100, 50 and 30m. Scenarios 5 to 7 show calculations assuming a saturated layer to depths of 10 and 13m with L values of 100 and 50m.

The pumping rate shown in Scenario 7 is near the 50,000 l/day which is the PTTW threshold. In this case we have assumed a saturated sand layer to 13 m depth with a line source 50m away. Although sand is likely to be found at some of the WTG sites, our desktop study indicates that it is typically < 3 m thick and is unlikely to be saturated to surface. Therefore there is a low probability that these conditions will be encountered during excavation work.