2.2.5 Environmental Field Review

Following completion of the preliminary engineering feasibility evaluation, TransCanada initiated detailed field review of natural resources so as to facilitate optimization of site design in a manner that avoided, minimized or mitigated environmental impact to the extent feasible, consistent with sound engineering design and project cost constraints. Throughout the 2006 field season, TransCanada's consultants conducted field studies to identify or confirm locations of wetlands and vernal pools; characterize soils resources in potential development areas; and identify habitat areas requiring avoidance. In addition to field review, TransCanada consulted with agency and stakeholder groups to receive input on potential design and resource avoidance measures. This included several meetings as well as field visits by stakeholder personnel. Throughout the environmental field review effort, layout issues continued to be refined, often requiring additional field efforts in order to confirm that a realignment to avoid impact did not place the design feature into a different resource area.

In addition to the field review to identify and describe habitat and other resources, TransCanada's consultants conducted avian and bat surveys to evaluate and characterize passage rates and use of the area to ensure that siting a wind power project in this location would not adversely impact birds or bats.

2.2.6 Site Selection and Layout Refinement

An important element in finalizing the site layout presented in this application was on-the-ground review of each proposed roadway alignment by the environmental and engineering team. This confirmed local topography, particularly in areas where the aerial survey could not be precise due to tree cover, and identified geologic constraints such as rock outcroppings. As a part of this engineering reconnaissance, a geological evaluation was conducted across the range of development area. Visual observations and core samples were gathered to continue refining the estimation of cost and assess feasibility of utilizing excavate for road bed materials. The engineering and environmental information, considered together, were utilized to create a layout that minimized cost and impacts.

The layout as proposed is comprised of 44 turbines. A total of 46 turbine locations are shown on the drawings and assessed in the application due to the likelihood that some turbine placements will be refined as more wind resource data are collected. By presenting all 46 "potential" locations, the layout includes turbines in all possible locations where they are still being considered, but it should be noted that numerous other locations have been considered and rejected due to wetland, habitat, constructability, or wind energy constraints.

The proposed layout results in use of portions of Series A and Series B to generate 132 MW with 44 turbines. When compared to the extent (approximately 30 miles of ridgeline) and number of turbines (761 turbines; 400 in the first phase, which was comparable in energy generation to the Kibby Wind Power Project) previously proposed by Kenetech, it is evident that improvements in turbine technology and scale can significantly reduce project footprint. The careful design process, which has included consideration of a vast amount of field-collected data, has resulted in a project that can utilize the strong wind resource within this location in Maine to provide renewable energy to the regional electric grid, consistent with state and national policy and priorities.

2.3 Site Wind Resource Characteristics

Significant winds at the Kibby Wind Power Project site are generally the result of the formation of a prominent depression track across the area. It is quite common, especially in the winter, to find most of western and upper Maine, the St. Laurent Seaway, the Gaspé Peninsula, and the Maritime Provinces at the tail end of a well developed depression or storm track moving across the North American continent. The fronts of weather systems, which are sources of strong winds, have a tendency to orient themselves along the track. The formation of the track is, in turn, strongly influenced by the position and strength of the jet stream.

Given the significant elevation of the ridges when compared to Québec plains to the west, the Kibby Wind Power Project site is well exposed to the westerly winds produced by this storm track formation. The perpendicular north-south ridges also promote an acceleration of the wind speeds as the wind moves across the site.

As the first step to enable a site-specific assessment of the long-term average wind speed at each of the proposed turbine locations, TransCanada – with permission from LURC – installed three state-of-the-art 197-foot (60 m) met towers, one on Kibby Mountain and two on Kibby Range. These met towers have collected on site data over a period of approximately 8 months.

Garrad Hassan, a recognized world leader in the field of wind energy assessment, has been retained to undertake an assessment of the wind speed of the site and energy yield of the proposed wind project layout. The preliminary findings, provided in Appendix 2-A, will be updated in a final report that will be based on a full year's worth of on-site data. The revised report will be made available in the spring of 2007.

The preliminary findings indicate an average wind speed at the met tower locations (extrapolated from 60 m based on wind shear, to an 80 m hub height) of 8.7 m/s, 9.9 m/s and 8.8 m/s at each of the three met tower locations. For the proposed project layout, 37 turbine locations are estimated to have a long-term average wind speed greater than 8 m/s, with a number of turbines exceeding 9 m/s. On-site data also confirm that the predominant wind direction is from the west-northwest, making the north south alignment of the site's ridges particularly suitable to efficiently capture the energy of the winds. These preliminary findings confirm a strong wind resource at the project site.

Garrad Hassan preliminarily estimates the annual average energy production for a 144 MW turbine layout[4] based on the Vestas 3 MW V90 wind turbine at 378.2 gigawatt-hours (GWh). When adjusted to reflect the proposed 132 MW layout, this yields an average annual energy production of 357 GWh.

2.4 Description of Project Facilities

The following sections provide details regarding the location of the proposed facility, as well as details pertaining to its key features, construction details and operational information. This project description information is utilized in later sections for assessing potential project impact to environmental and community issues. This section focuses on the proposed wind energy facility to the point of the proposed Kibby Substation. Details regarding the proposed 115 kV transmission interconnection to the existing Bigelow Substation are included in Volume V.

2.4.1 Project Location

2.4.1.1 General Description of Project Area

The Kibby Wind Power Project area (Figure 1-1) is located in the Boundary Mountains of western Maine, in Franklin County. It is within the Western Mountains Biophysical Region of Maine, which borders northern New Hampshire and Quebec, Canada (Figure 2-4).

The Western Mountains Biophysical Region is best characterized by its rugged topography, cool climate, low annual precipitation, and high snowfall. The average maximum temperature in July is approximately 75 degrees Fahrenheit (ºF) (24 degrees Celsius [ºC]), which is lower than any other part of the state except the Eastern Coastal Region. The average minimum temperature in January is -1ºF (-18ºC), comparable to that of northern Maine. The average annual precipitation in this region is low, at approximately 39 inches (99 centimeters [cm]) although this varies with elevation and aspect. Due to the rain shadow effect that mountains and mountain ranges produce, windward slopes may receive up to 50 inches (127 cm) of annual precipitation while leeward slopes may receive less than 35 inches (89 cm) (McMahon 1990).

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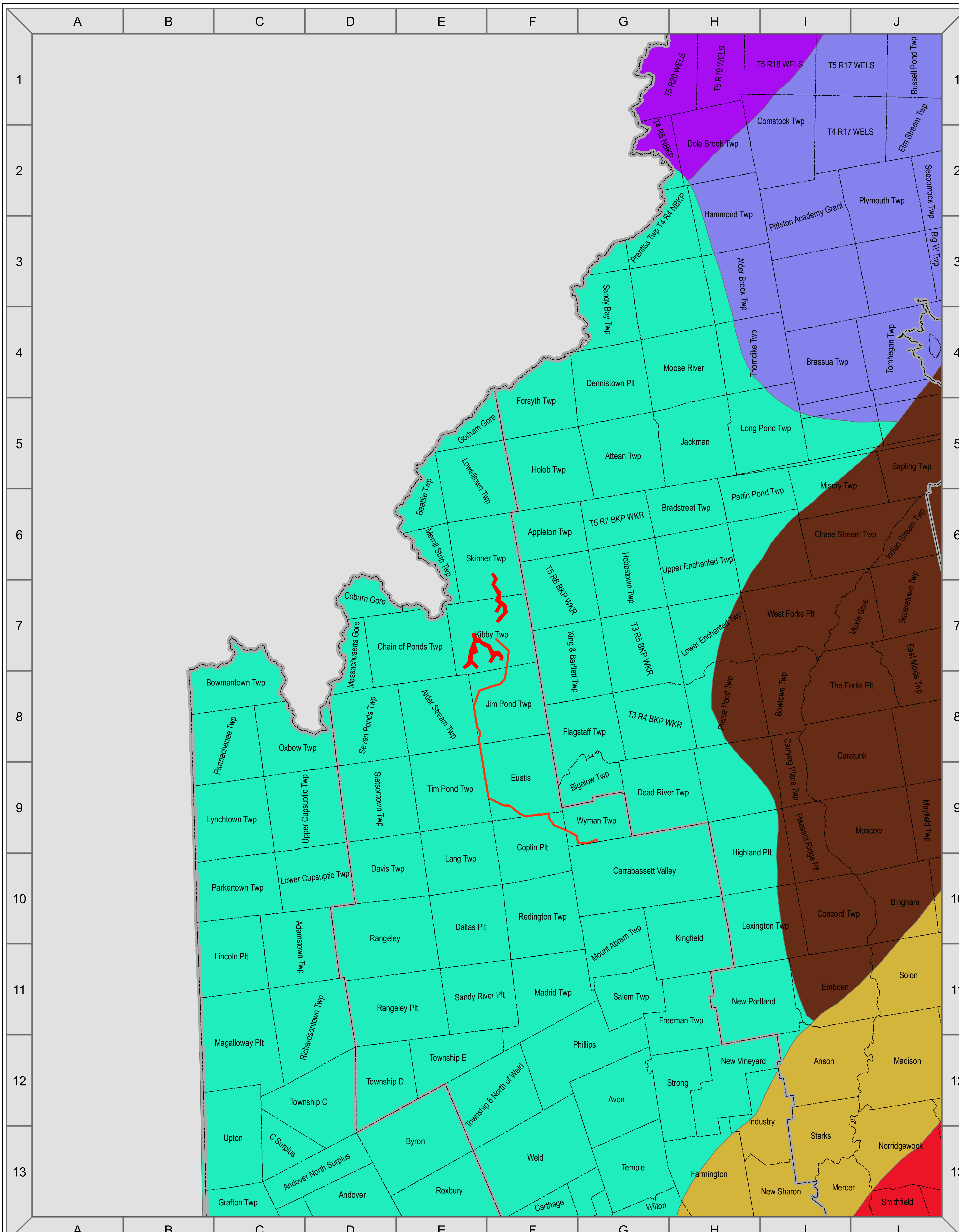
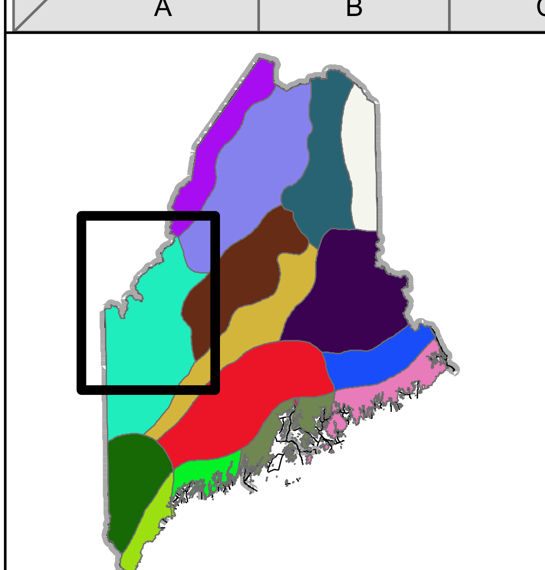
[4] Originally, TransCanada evaluated 48 potential turbine sites, of which 44 are proposed to be constructed. Within this application, 46 potential locations are evaluated, of which 44 are proposed to be constructed.





Legend

- State Boundary
- County Boundary
- Town Boundary
- Proposed Kibby Transmission Line
- Plum Creek Optioned Area as of 11-12-06

Biophysical Region

Aroostook Hills	Eastern Lowlands
Aroostook Lowlands	Midcoast Region
Boundary Plateau	Penobscot Bay Region
Central Interior	Saint John Uplands
Central Mountains	South Coastal Region
East Coastal Region	Southwest Interior
Eastern Interior	Western Foothills
	Western Mountains

N

10

Miles

Figure: 1

Kibby Wind Power Project

Biophyisical Regions of Maine

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The predominant peaks in the project vicinity include Smart, Caribou, Kibby, Tumbledown, Spencer Bale and Sisk mountains, all of which are over 3,199 feet (975 m) high. Caribou and Kibby mountains are the tallest of these mountains, at 3,448 feet (1,051 m) and 3,658 feet (1,115 m), respectively, and were both originally considered potential wind turbine development areas for the project. Due to several reasons, including accessibility and feasibility, only the southern portion of Kibby Mountain and Kibby Range are now part of the wind turbine development area. Kibby Range is the largest of the mountain ranges in the project area, in terms of area and number of peaks included within ridgelines, and has several peaks that are approximately 3,002 feet (915 m) to 3,281 feet (1,000 m) high. The valley bottoms in the study area average between 2,133 feet (650 m) and 2,461 feet (750 m) in elevation. Gold Brook drains the southwestern portion of the project area southward, to the North Branch of the Dead River. Kibby Stream and Spencer Stream drain the central and eastern parts of the project area eastward, to the Dead River. The headwaters of the Moose River are located just north of the project area.

Soils within the project area are generally cool, shallow, and well drained at elevations above 2,500 feet (762 m). The ridge tops are made up of shallow Saddleback soils while deeper enchanted soils occur on upper slopes. Both of these soils are cryic and are characterized by a mean annual soil temperature between 32ºF (0ºC) and 47ºF (8ºC). Balsam fir (*Abies balsamea*) and red spruce (*Picea rubens*) are the dominant tree species along ridge tops above 2,500 feet (762 m). Sugar maple (*Acer saccharum*), yellow birch (*Betula alleghaniensis*), and American beech (*Fagus grandifolia*) are the dominant tree species in the valleys. Within the maple/birch/beech forests of the lower elevations within the project area, hobblebush (*Viburnum lantanoides*) is the most common woody shrub species. The project area is located within a working forest. Consequently, the dominant forest types are present in a variety of different ages and species composition. The road system in the area is well developed and forest harvesting activities within the last 12 years are fairly evenly distributed throughout the townships. Harvesting is generally limited to areas below 2,700 feet (823 m).

The Kibby Wind Power Project will be located on two mountains within the general project area. The southern portion of Kibby Mountain, known as Series A, will include up to 19 wind turbines. Kibby Mountain, which is configured in a "wishbone" shape and is known as Series B, will include up to 27 wind turbines. The focus of the project in these areas has been the result of significant engineering and environmental consideration to ensure that the project is located to utilize the strong wind resource while minimizing both impact and cost.

2.4.1.2 Description of Property to be Rezoned

The property for which D-PD rezoning is requested is shown in Exhibit B, as well as in Figure 1-2. As can be seen from that figure, portions of the project site are currently zoned by LURC as protected mountain area (P-MA), generally defined to be areas located at elevations higher than 2,700 feet (823 m). Portions of the wind turbine arrays, as well as ancillary features of the project, are located outside of the P-MA zone. Information for the entire development plan is included in this application.

2.4.1.3 Land Division History

There have been no divisions of the properties comprising the proposed D-PD subdistrict since at least 1970, other than the creation of the subject easement area on April 15, 1992. The following is a 36-year title history for the two relevant parcels (all title references are to the Franklin County Registry of Deeds):

Kibby Township Parcel (Map FR013):

- December 30, 1970: Scott Paper Company conveyed, as a single, contiguous parcel, its Kibby Township ownership to Skylark, Inc. by deed recorded in Book 434, page 566;
- November 4, 1998: Skylark, Inc. conveyed as a single, contiguous parcel, its Kibby Township ownership to S.D. Warren Company by deed recorded in Book 1798, page 107; and
- November 5, 1998: S.D. Warren Company conveyed, as a single, contiguous parcel, its Kibby Township ownership to SDW Timber II, L.L.C. (now known as Plum Creek Maine Timberlands, L.L.C.) by deed recorded in Book 1799, page 170.

Skinner Township Parcel (Map FR017):

- December 30, 1970: Scott Paper Company conveyed, as a single, contiguous parcel, its Skinner Township ownership to Skylark, Inc. by deed recorded in Book 434, page 566;
- November 4, 1998: Skylark, Inc. conveyed, as a single, contiguous parcel, its Skinner Township ownership to S.D. Warren Company by deed recorded in Book 1798, page 109; and
- November 5, 1998: S.D. Warren Company conveyed, as a single, contiguous parcel, its Skinner Township ownership to SDW Timber II, L.L.C. (now known as Plum Creek Maine Timberlands, L.L.C.) by deed recorded in Book 1799, page 179.

No other land divisions have occurred relative to the subject parcels. Therefore, the development of the subject parcels as proposed in the D-PD application does not constitute a subdivision or otherwise trigger subdivision review.

2.4.1.4 Existing Site Conditions and Uses

The project's wind turbines and ancillary facilities (with the exception of the 115 kV transmission corridor and temporary construction activities) are located on land owned by Plum Creek. TransCanada's right to develop the project within Plum Creek property is addressed in Exhibit B. Plum Creek's property in this location is approximately 70,000 acres; the project, excluding the 115 kV transmission line, will disturb less than 450 acres (approximately 358 acres of which will be temporary) within this property, 2,908 acres of which are proposed for rezoning. The

Plum Creek property is actively utilized for forest management, generally at elevations lower than 2,700 feet (823 m). Historic logging has occurred at higher elevations as well.

Access to the property is from Route 27. An extensive network of logging roads exists on the Plum Creek property. Although this is private land, these roads are in use not only by Plum Creek for logging and related activities, but also by other forest management companies and land owners (such as Domtar, the Passamaquoddy Nation, State of Maine, and others) to access properties further to the north, and by the general public as they travel through the area. The roads are heavily used for forest management purposes, and safety is a consideration for others using this access.

The primary private road used as a travel-way through Plum Creek's property is Gold Brook Road (also known as Beaudry Road). This is frequently used by travelers to access more northerly townships in the area. Relatively major side roads off of Gold Brook Road include: Wahl Road, which provides access to the Kibby Range area; Spencer Bale Road, which provides access to the Kibby Mountain area; and Hurricane Road, which will provide access to a section of a collector line. A further network of logging roads extends from these more major roadways; some are maintained and in active use, while use of others has been discontinued as work focus changed to different areas within the property. The Kibby Wind Power Project will utilize this existing road network to a great extent for the project. It should be noted that access to the project site and to areas north of the site is also available from the east via State Highway 201 and Spencer Road.

Topography in the area is variable. Because United States Geological Survey (USGS) mapping for the area was not accurate or detailed enough for project engineering purposes, TransCanada arranged for detailed topography to be developed for the site. This topography, showing 5-foot contour intervals, is shown on the maps provided in Appendix 1-A. The topographical information was developed through the use of aerial photography. In addition, to confirm the accuracy of the resulting contours, field crews walked the entire development area to "ground truth" the contour maps. In general, the Series A ridgelines are gently sloping (1 to 8 percent) with limited rock outcrop exposures and few areas of steep and very steep slopes. The steep slopes tend to be short in length and unavoidable. The proposed work areas for Series A will occur approximately between elevations 2,650 to 3,100 feet (808 to 945 m). The Series B development area on Kibby Range has distinct southwesterly and southeasterly ridgelines, and the proposed work areas for Series B will occur approximately between elevations 2,300 feet (700 m) near the southwesterly ridge area (closest to Gold Brook Road), to approximately 3,000 feet (914 m) along the southeasterly ridge area, with the highest work area at approximately 3,280 feet (1,000 m) in elevation.

Three met towers are currently located within the project area. The installation of up to eight met towers was authorized by LURC under Development Permit 4728. Of the authorized met towers, one is currently located in the southern portion of Kibby Mountain at a met tower site known as A1, and two are located on Kibby Range (met tower sites B1 and BII-1). The met towers have been collecting wind resource data since February 2006, and will continue to monitor site-specific conditions to allow for optimal project layout and design. Each met tower is a lattice style structure, approximately 197 feet (60 m) tall, and supported with anchored guy wires. Each tower is located within a clearing that is approximately 50 feet (15.2 m) in diameter, with four narrow cleared guy wire paths radiating from the central tower clearing. In addition to collecting wind resource information, these met towers have been used for environmental studies in order to monitor bat activity at heights approximating the proposed turbine hub heights. The clearings and associated access trails have also been used for other environmental survey purposes during the course of application preparation.

2.4.1.5 Proposed Uses

The uses proposed for this D-PD zone include those already allowed in the underlying respective P-MA and General Management (M-GN) subdistricts, and in addition all those uses related to the construction, operation and maintenance of the Kibby Wind Power Project.

The uses proposed in all areas of the D-PD zone in addition to those already allowed in the existing subdistricts include the following:

- Construction, maintenance and operation of 44 wind turbines including but not limited to any necessary exploratory pits and test borings to determine turbine foundation siting and construction requirements;
- Construction and maintenance of the electrical collection system and utility transmission lines associated with the wind power project;
- Construction and maintenance of a service building and substation;
- Construction and maintenance of new access roads required for the project; and
- All water crossings, wetland and other resource impacts associated with the construction, maintenance and operation of the project.

2.4.1.6 Buffers and Setbacks

The easement area within which development of major facilities is proposed is illustrated on Figure 1-2. The entire project (excluding the 115 kV transmission corridor) is located within the Plum Creek property, with the exception of a small portion of property within Chain of Ponds Township that is owned by Kennebec West Forest LLC. TransCanada is working with Kennebec West Forest LLC regarding temporary uses of its property during the construction period. No permanent project elements are proposed in Chain of Ponds Township.

Table 2-2 identifies the only proposed turbine foundation located within 400 feet (122 m) of the proposed D-PD zone. In addition, the edge of the rotor-swept zone of only three turbines would be within 400 feet (122 m) from the edge of the D-PD zone. For these three turbines, the edge of the rotor-swept zone is at least 216 feet (66 m) from the edge of the proposed D-PD zone.

Table 2-2: Turbines Within 400 Feet of the Proposed D-PD Zone Boundary (feet)

Turbine Number	Distance from Turbine Foundation (feet/m)	Distance from Turbine Blade (feet/m)
A-13	517/158	378/115
A-20	525/160	386/118
B-15	355/108	216/66

There are no ponds or public roads included in the project site that would require buffers. There are, however, several streams that are in relatively close proximity to, or are crossed by project features that will have buffer maintenance plans incorporated into the project design, and these areas are detailed in Section 8.5. Buffering is also included in the project design to avoid a potential habitat area located along the ridgeline on Kibby Range. This issue is addressed in detail in Section 7.4.1.3.

2.4.2 General Project Description

A wind project is intended to create electricity using wind power, and must be sited in locations where a strong source of this renewable resource is available. Wind projects are comprised of a number of general components in order to deliver this renewable energy to the existing electrical system for public use. Components typically include the wind turbines; access roads to the turbines; electrical connector lines; a transformer substation; electrical transmission lines to the existing system; and a service building. Additional elements are required during construction. These elements, as they have been designed for the Kibby Wind Power Project, are described in the following sections.

The proposed Kibby Wind Power Project will consist of 44 turbines rated at 3 MW each that will generate up to 132 MW of electrical capacity, producing approximately 357,000 MWh per year of energy. Note that 46 turbines are shown on site plans and assessed in this application. Through further site optimization, two turbines will be eliminated to achieve the 44 proposed. This application shows the range of potential locations where those turbines could occur in order to assess impacts of individual areas as precisely as possible. The design of the project has been developed through extensive consideration of engineering and environmental issues, and minimizes impact on the range of environmental and community concerns, as addressed in the balance of this application.

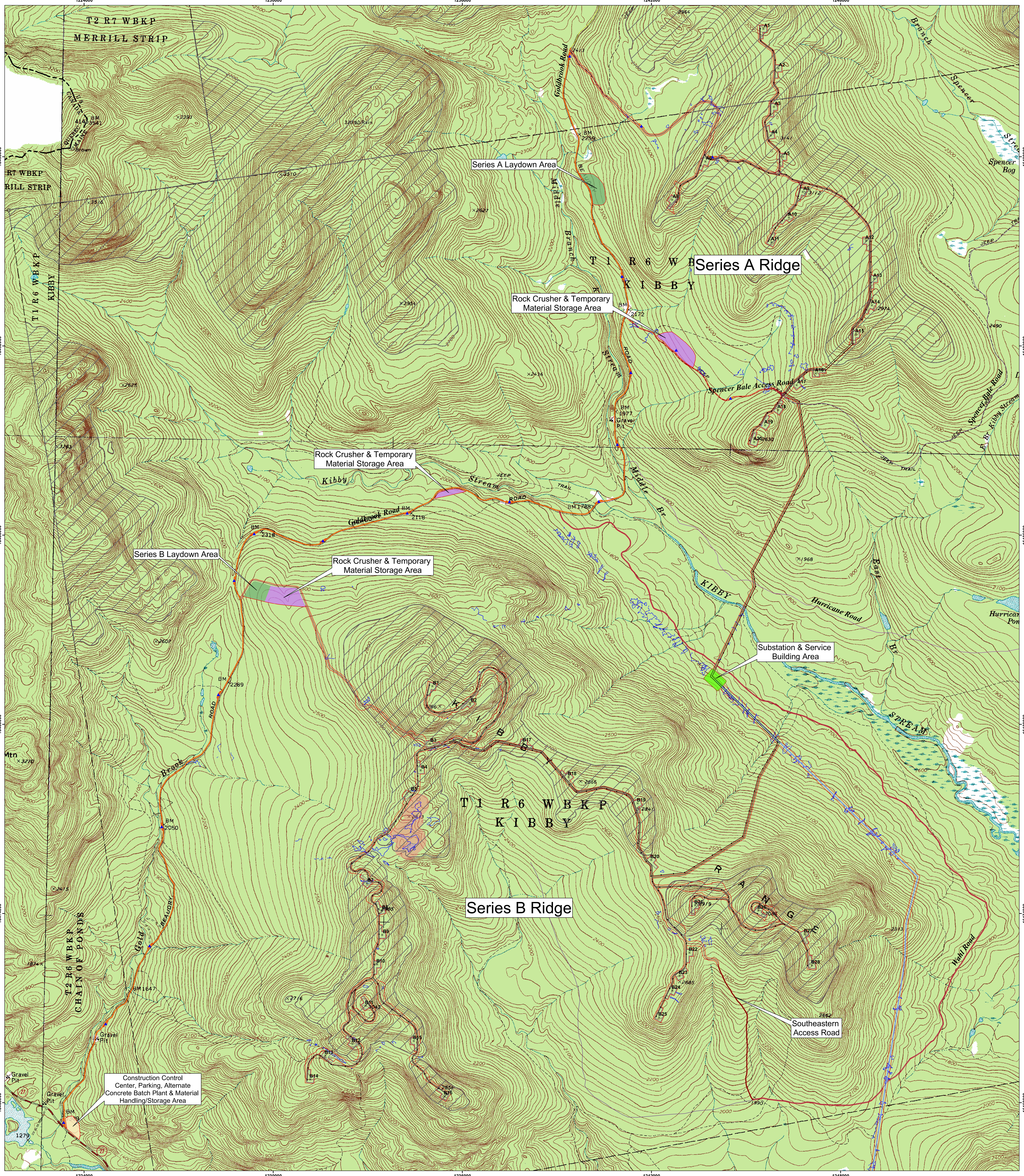
2.4.3 Design of Major Project Elements

Details regarding various project elements are provided in Table 2-3 and illustrated in Figure 2-5.

Table 2-3. Summary of Construction/Operational Areas

Project Element	Comments	Estimated Disturbance (Acres)		
		Total	Temporary	Permanent
Series A and B turbines and roads	Turbines and associated collector system corridors and access roads on Series A and Series B. Roads between turbines will be 34 feet wide; access roads to ridge will be 20 feet wide. Two pull-off areas will be located along access road A-1 road.	A – 100 B – 228	82 192	18 36
Series B ridge construction egress road B-2 (for one-way construction traffic)	A road 20 feet wide will need to be constructed for a distance of 0.9 mile in length; no pull-offs included. Selected culverts and bridges will need to be upgraded.	1	0	1
Gold Brook Road improvement activities	Gold Brook Road is wide enough to provide access for construction; some straightening and improvement of slopes and curves; selected culverts and bridges may need to be upgraded and widened.	15	0	15
Gold Brook Road pull-off areas	An estimated 15 pull-offs are required. Each pull-off will be 250 feet long and 20 feet wide. Pull-offs will generally alternate on opposite sides of the road and be about a half a mile apart, with allowance for avoiding natural resources.	2	2	0
Wahl Road improvement activities	Wahl Road will be widened from about 13 feet to 15 to 25 feet in width for a distance of about 6 miles (31,680 feet). No pull-offs are included for Wahl Road. Selected culverts and bridges may need to be upgraded and widened.	10	0	10
Spencer Bale Road improvement activities	Spencer Bale Road will be widened from approximately 13 feet to 25 feet in width for a distance of about 1.2 miles (6,336 feet). Two pull-off areas (250 feet long by 20 feet wide) will be located along Spencer Bale Road. Selected culverts and bridges may need to be upgraded and widened.	3	0	3
Rock crusher and temporary material storage areas	Three rock crusher/material storage areas are required, one each near Series A and B and one between the ridges. About 3 acres will be required for each rock crusher. About 20 acres of long-term temporary material storage is also assumed at these locations to accommodate about 159,500 cubic yards of excess rock not used for fill.	29	29	0
Series A and B temporary laydown areas	The laydown areas are 8 acres for Series A and 10 acres for Series B.	18	18	0
Potential concrete batch plant and material handling storage area	The batch plant will require about 1.5 acres, and presumed to require a water well with a yield of about 60 gallons per minute (gpm) required. Water tank may be necessary for water storage.	3	3	0
Construction control center and parking	This area includes 150 parking spaces for construction personnel. A potable water well; Port-a-johns or septic system; and a temporary construction	1	1	0

Project Element	Comments	Estimated Disturbance (Acres)		
		Total	Temporary	Permanent
	communication system is required.			
115 kV transmission line corridor	Addressed in Volume V.	--	--	--
Collector system corridor	The collector system corridor (approximately 3.9 miles) will be 60 feet wide. Disturbance associated with collector system cables located *within* turbine pad area and road right of way are included in those estimates.	29	19	10
Kibby Substation	The fenced substation area will be 215 feet by 415 feet. Stormwater management features and the access road will extend beyond the fence line.	3	0	3
Service building area	The 3,600 square foot building (60 feet by 50 feet) will be co-located with the substation, outside the fenced area. A 7,500 square foot personnel parking area will be provided. A potable water well and septic system will be required, sized for up to 15 persons. A communications system will also be included.	1	0	1
Met towers	Permanent met towers, if needed, will be located within areas already disturbed for turbines/roads.	0	0	0
Estimated Total Acres of Disturbance		**443**	**346**	**97**



LEGEND

- Turbines
- Pull-off Areas
- 34.5 kV Collector System
- Transmission Line
- Turbine Road
- Goldbrook Road
- Delineated Streams
- Delineated Wetlands
- Series A & B Laydown Area
- Bigelow Substation
- Proposed Kibby Substation & Service Building
- 250' Buffer of Critical Habitat
- LURC PMA Zone
- Construction Area
- Pull-Off Areas
- Construction Control Center, Parking, & Alternate Concrete Batch Plant & MaterialHandling/ Storage Area
- Rock Crusher & Temporary Material Storage Area

FIGURE #

Construction Work Area
Kibby Wind Project
Franklin County, ME

TransCanada
In business to deliver

amec
AMEC EARTH & ENVIRONMENTAL, INC.
11676 Perry Highway, Suite 3101
Wexford, Pennsylvania 15090

1 inch equals 1,000 feet

0 500 1,000 2,000 3,000 4,000
Feet

NOTES

1. This map supercedes all previous maps. Site boundaries and surface features are approximate only and are subject to location by an actual field survey.

2. Coordinate system:UTM NAD83 Zone 19 Feet

Date Revised: 04 Jan 07	Drawn By: Jason Boni
Reviewed By: Peter Barth	
Preliminary	Map Size: ANSI E (34" x 44")
	Project File: KibbyConstructionArea.mxd

2.4.3.1 Wind Turbines

The wind turbine proposed for installation at the Kibby Wind Power Project is the Vestas V90, which has a 3.0 MW nominal capacity. The Vestas specification related to this turbine is presented as Appendix 2-I. Vestas has been a leader in the development and manufacture of commercial wind turbines for over 20 years and is the largest manufacturer of wind turbines in the world. Their recently introduced V90 design is based on new, thoroughly tested improvements in the blade and nacelle design, within the context of Vestas' known and proven turbine technology. The Vestas V90 is one of the newest of the high-output wind turbines currently available. The V90 is specifically designed to be situated in high wind areas. Because the project site has a very strong wind resource, the V90 is well suited for this project. The V90 is a pitch-regulated upwind wind turbine, with active yaw control and a three-blade rotor. The turbine has a rotor diameter of about 300 feet (90 m), with a generator rated at 3.0 MW.

Table 2-4 summarizes the individual characteristics of the Vestas V90 turbines. It should be noted that a number of other major turbine manufacturers also produce turbines that are 2 MW and greater that would also be suitable for use at this site.

Table 2-4: Wind Turbine Specifications

Number of blades	3
Blade length	144 feet (44 m)
Rotor Diameter	295 feet (90 m)
Rotor swept area	68,482 square feet (6,362 m^2)
Nominal revolutions Variable range	16.1 rpm 8.6-18.4 rpm
Operation	
Nominal capacity	3.0 MW
Voltage	34.5 kV (the generator produces 1,000 volts and the transformer in the nacelle steps up to 34.5 kV)
Frequency	60 Hz
Minimum wind speed (turbine cuts in)	9 mph (4 m/s)
Maximum wind speed (turbine cuts out)	56 mph (25 m/s)
Other features	Nacelle rotates to face the wind
Tower	
Hub Height	263 feet (80 m)
Number of Sections	4
Base Diameter	13.5 feet (4 m)
Foundation (cylindrical, dimensions vary by installation site characteristics)	
Approximate Diameter	18 – 65 feet (5.5 to 20 m)
Approximate Height	8 – 25 feet (2 to 8 m)

The turbines will be located along ridgelines on the southern portion of Kibby Mountain and along Kibby Range, as shown in Figure 1-2. Turbine spacing varies from 2 to 4 rotor diameters. There are no guy wires or external ladders associated with the wind turbines.

A wind turbine generator package is made up of: a reinforced concrete foundation; a tower to support the wind turbine elements; and the wind turbine elements themselves (the nacelle, rotor and blades). Each is described below.

Turbine Foundations

There are three general types of foundations proposed to securely anchor wind turbines to the earth, described as the socket (or plug) type, gravity type, and rock-anchored. Civil engineers choose foundation designs that hold fast in strong winds, are low cost to build and have low construction risks. Based on the preliminary geotechnical site work, it is expected that most of the foundations will be placed in rock and will, therefore, be of the socket type, but additional boreholes or core samples will be required before final design and installation. Socket-type foundations require less excavation and use less reinforced concrete than gravity-based foundations.

Socket-Type Foundation

To build a socket-type foundation (Figure 2-6) a hole roughly the shape of a flower pot is prepared either by mechanical excavation or by blasting. The rock edges of the hole serve as formwork for the placement of reinforced concrete which serves as a base for the wind turbine.

Gravity-Type Foundation

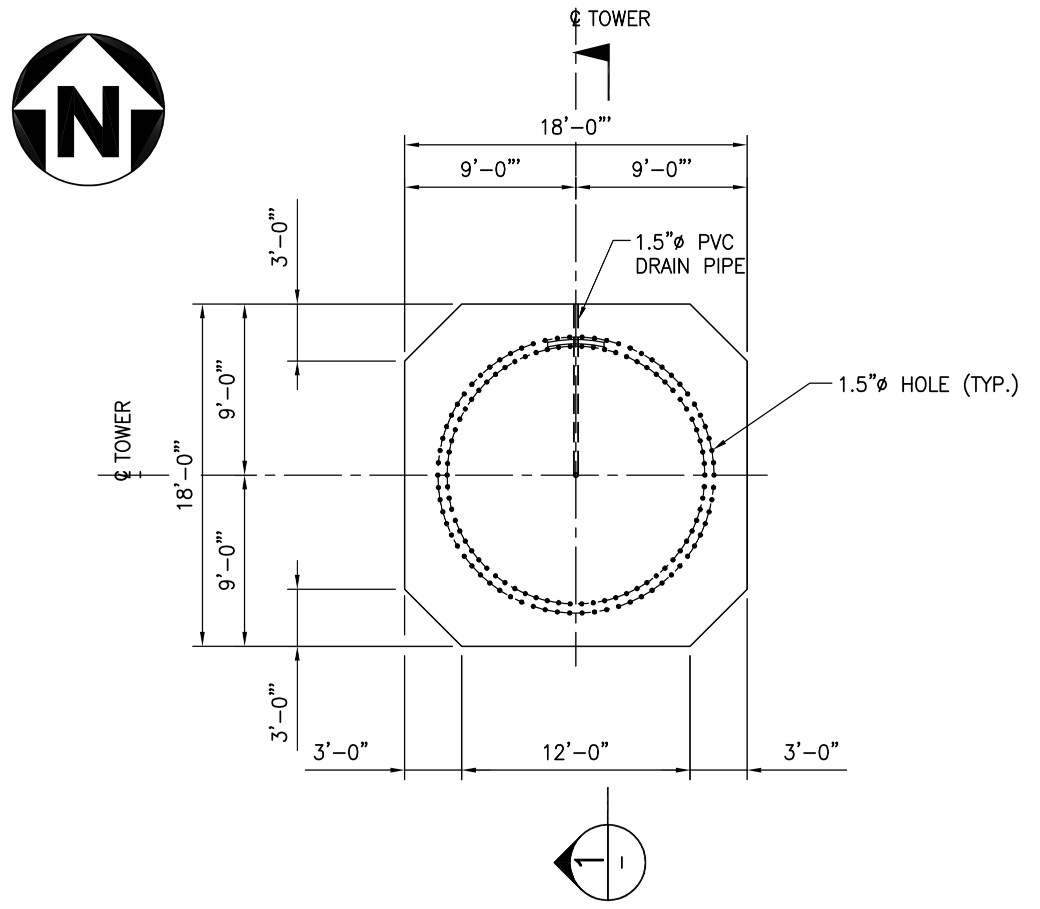
The gravity-type foundation, shaped like an inverted mushroom, is designed to be installed in existing soils, and to hold the wind turbine upright through sheer weight and leverage. The design (Figure 2-7) is used widely, but requires the most excavation and the most concrete to build (and, thus, is most costly).

Rock-Anchored Foundation

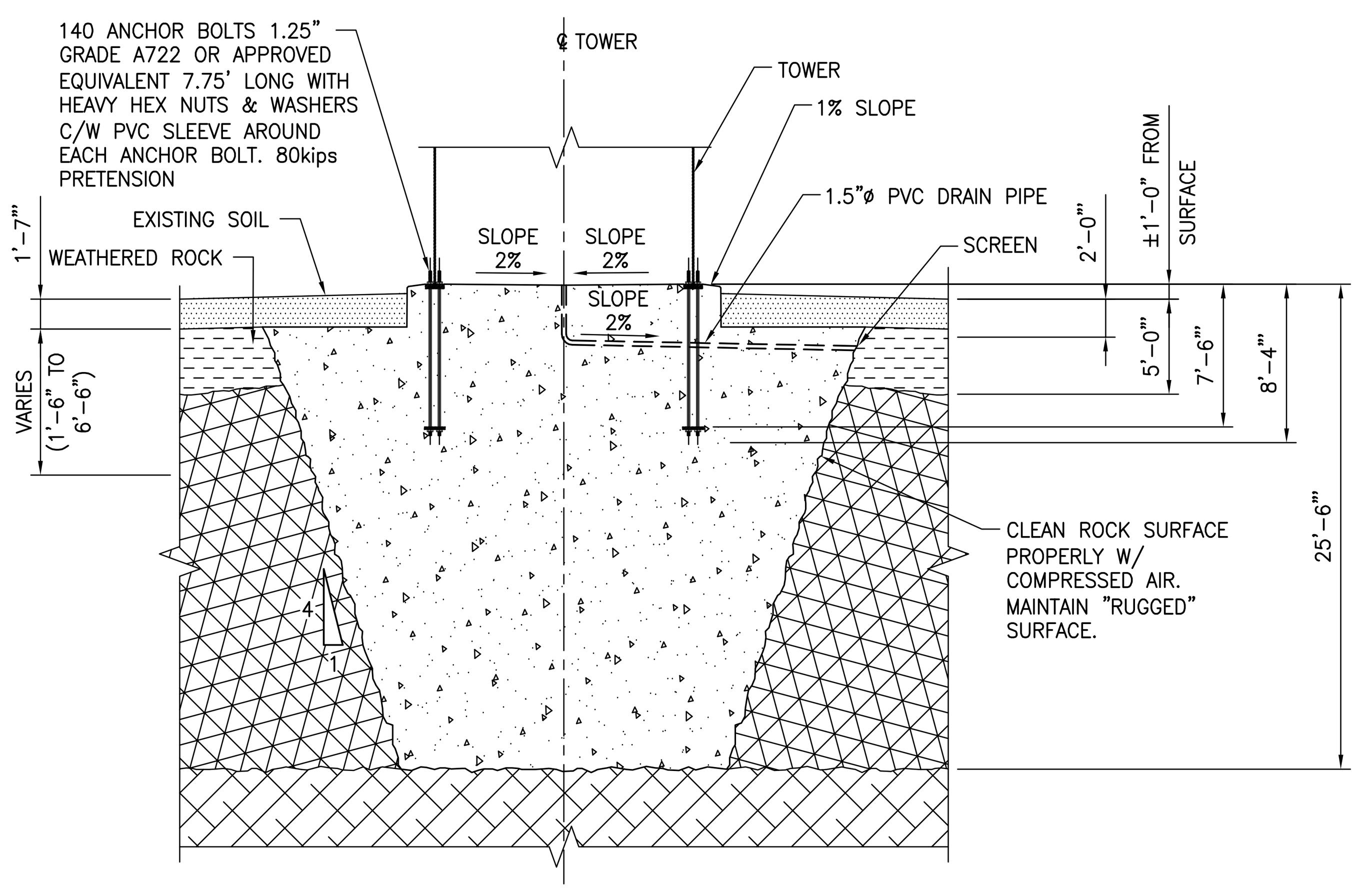
If a wind turbine is sited on solid, non-fracturing rock, a series of anchors can be drilled into the base stone and then tied to a foundation cap on the surface. This rock-anchored type of foundation (Figure 2-8) is less expensive to build than a gravity foundation, but can only be used where the rock formations are close to the surface, with a geologic structure that will hold anchors securely over time.

Wind Turbine Tower

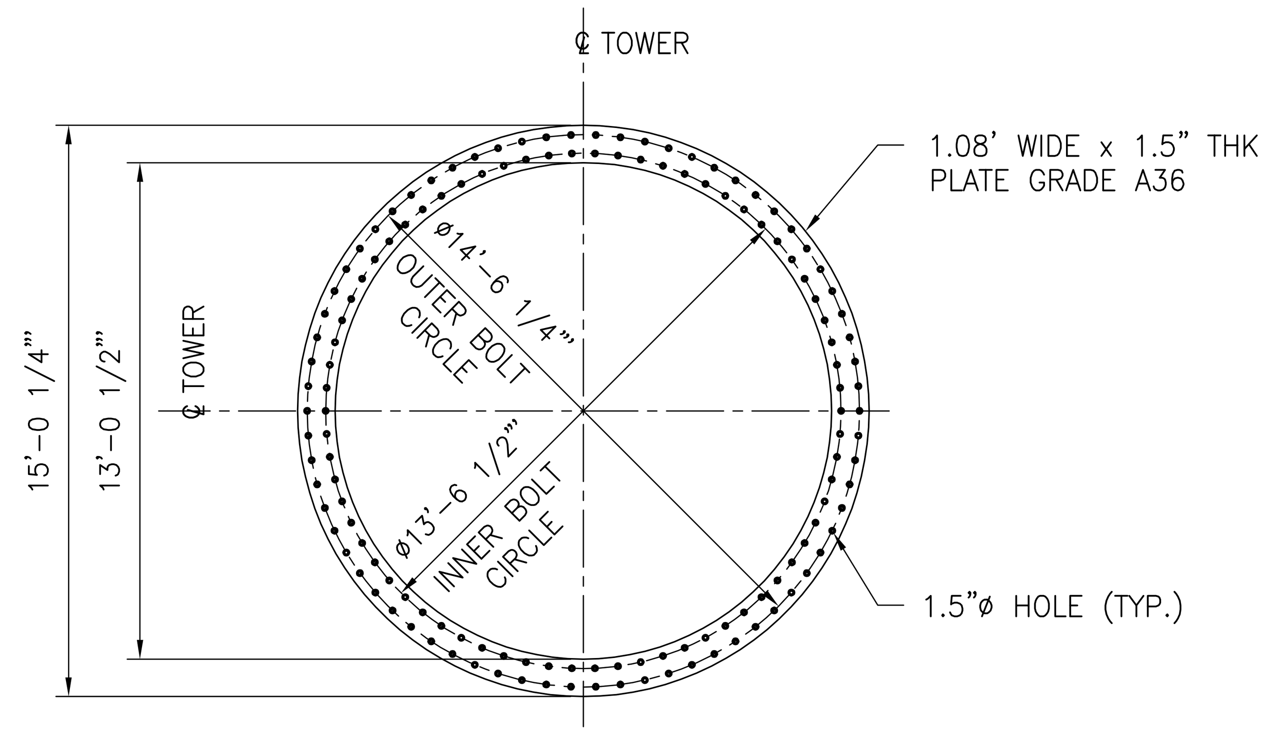
The wind turbine tower is manufactured out of steel, of tubular form, and is generally painted white. The wind turbine towers are fabricated from four pieces of conical tubular steel, 13 feet



PLAN
SCALE: 1/8"=1'-0"



SECTION 1/–
SCALE: 1/8"=1'-0"



ANCHOR RING 2/–
SCALE:1/4"=1'-0"

GENERAL NOTES:

SOIL NOTES:

S1. FOUNDATION SHOULD PENETRATE AT LEAST 17'-0" INSIDE SOUND ROCK WITH MINIMUM RQD OF 75%.

S2. THE SLOPE OF EXCAVATION SHOULD BE AT A MINIMUM OF 1:1 (HORIZONTAL:VERTICAL) OR FLATTER, IN ACCORDANCE WITH THE OCCUPATIONAL HEALTH AND SAFETY ACT (OHSA). FLATTER SLOPE MAY BE REQUIRED IF GROUNDWATER IS ENCOUNTERED.

S3. THE TOP 1' THICK OF THE SOIL LAYER OF THE FINAL GROUND SURFACE SHOULD CONSIST OF COMPACTED CLAYEY/TOP SOIL, OR EQUIVALENT IN ORDER TO REDUCE RAINFALL INFILTRATION. CLAYEY SOIL SHOULD BE USED FOR BACKFILLING THE EXCAVATION. THE FINAL GROUND SURFACE SHOULD BE PROTECTED AGAINST EROSION BY PROVIDING VEGETATIVE COVER OR EQUIVALENT.

CONCRETE NOTES:

C1. ALL CONCRETE WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH ACI 318.

C2. CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4000 psi AT 28 DAYS IN ACCORDANCE WITH ACI 318 SPECIFICATION, UNLESS NOTED OTHERWISE. SUBMIT CONCRETE MIX DESIGN FOR APPROVAL.

C3. GROUT SHALL BE NON SHRINK CEMENTITOUS AND HAVE MINIMUM COMPRESSIVE STRENGTH:
6000psi @ 3 DAYS
8000psi @ 28 DAYS

C4. REINFORCEMENT SHALL BE NEW DEFORMED STEEL BARS, WITH A YIELD STRESS OF 60 ksi.

C5. CONTRACTOR TO PROVIDE ALL ANCHOR BOLTS, NUTS AND WASHERS, UNLESS NOTED OTHERWISE.

C6. HEAT EXCAVATION A MINIMUM OF 24 HOURS BEFORE POURING CONCRETE. TEMPERATURE TO BE ABOVE 5°C.

NOTES

LEGEND

KEYPLAN

REV	D/M/Y	REVISION	DRN	CHK	APP	APP	APP	APP
B	30/03/06	ISSUED FOR PRELIMINARY	MBH	DA				
A	24/02/06	ISSUED FOR CLIENT REVIEW	MBH	DA				

ISS	D/M/Y	APP	ISSUED FOR
B	30/03/06	DA	PRELIMINARY
A	24/02/06	DA	CLIENT REVIEW

REFERENCES

REF	NUMBER	TITLE

STAMP/SEAL

APPROVED FOR CONSTRUCTION

CLIENT PROJECT MGR. DEPARTMENT MGR. PROJECT MGR.

PROJECT PHASE

AREA 00

PROJECT NO. 150422 | ACTIVITY NO. | PACKAGE CODE

SCALE NTS

	BY	D/M/Y
DSN.	D.A.	
DRN.	M.HALL	01/27/06

TransCanada
In business to deliver

SUBJECT
KIBBY WIND POWER PROJECT
FOUNDATION FOR WIND TURBINE GENERATOR – PLAN & SECTION

amec

CLIENT DWG. NO.

DRAWING NO. D-150422-00-121-0902
REV. B

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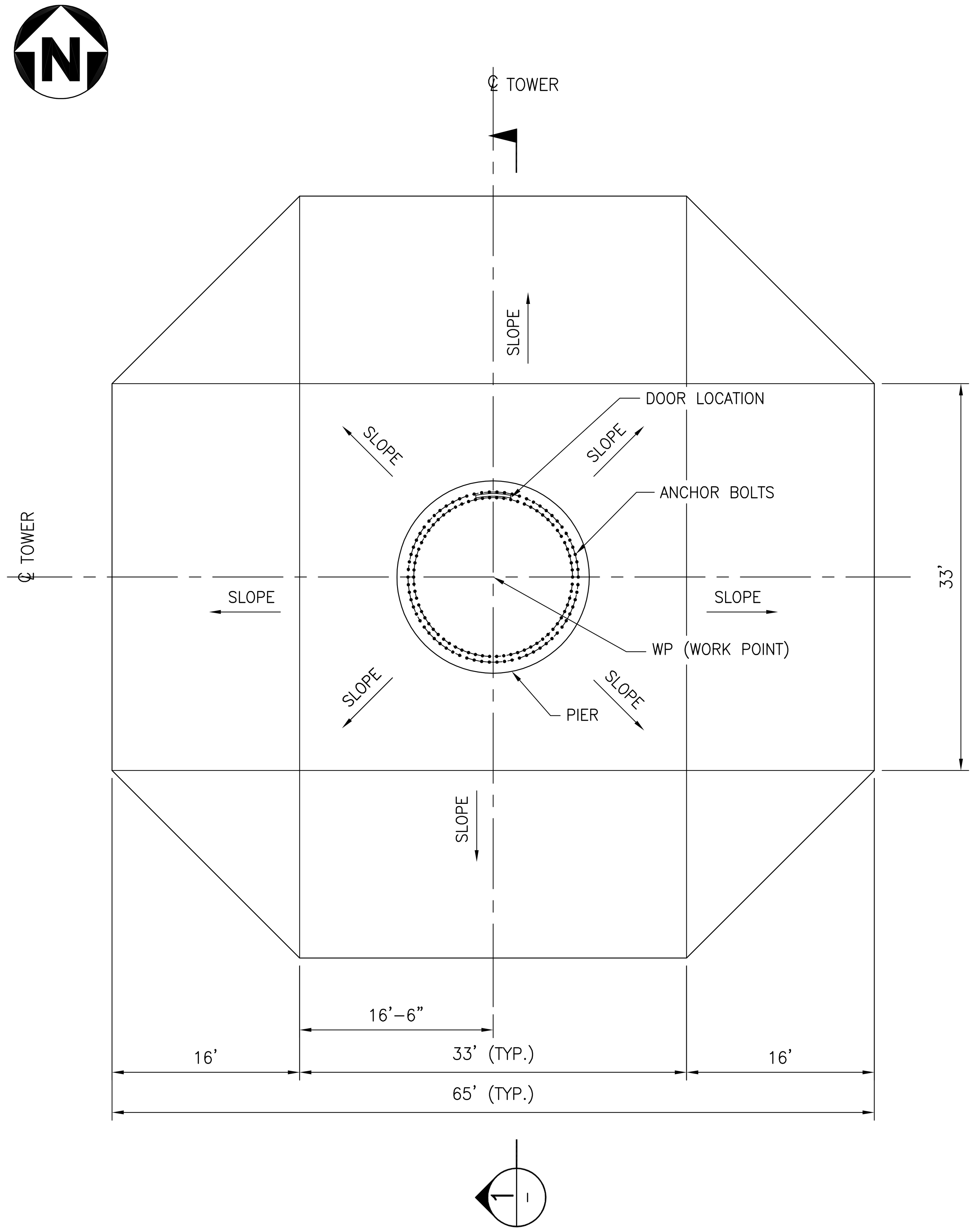
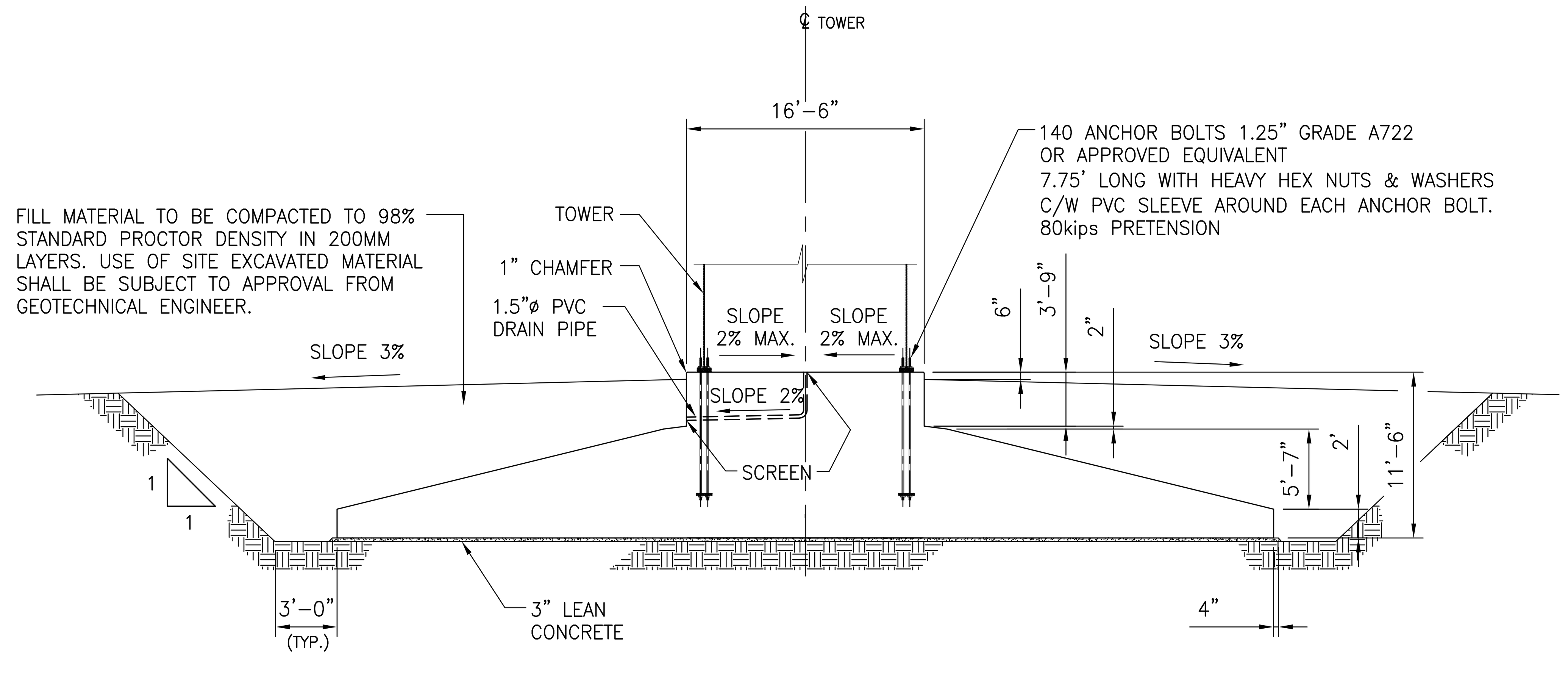
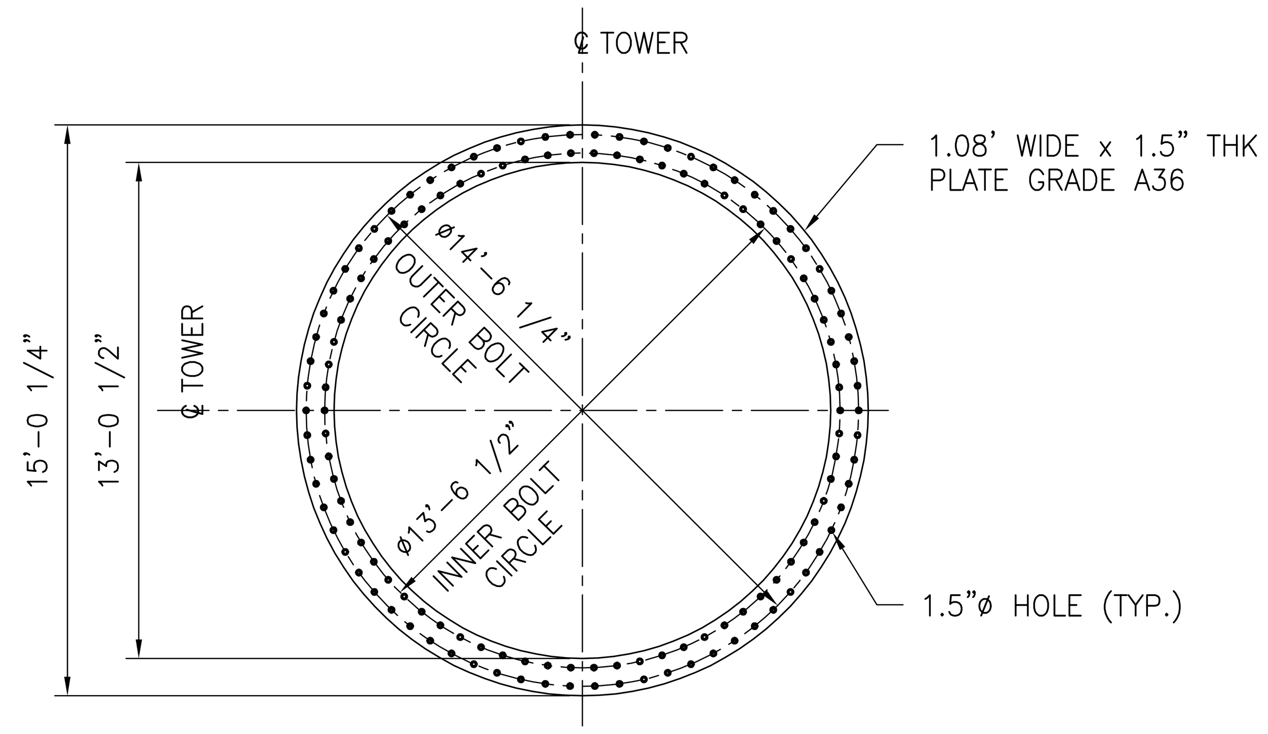


PLAN
SCALE: 1/8"=1'-0"



SECTION 1
SCALE: 1/8"=1'-0"



ANCHOR RING 2
SCALE: 1/4"=1'-0"

GENERAL NOTES:

SOIL NOTES:

S1. FOUNDING LEVEL OF ALL SPREAD FOOTINGS MUST BE INSPECTED AND APPROVED BY A GEOTECHNICAL ENGINEER PRIOR TO PLACING LEAN CONCRETE. FOUNDING LEVEL MUST BE CAPABLE OF SUPPORTING A GROSS BEARING PRESSURE OF AT LEAST 25 psi.

S2. THE SLOPE OF EXCAVATION SHOULD BE AT A MINIMUM OF 1:1 (HORIZONTAL:VERTICAL) OR FLATTER, IN ACCORDANCE WITH THE OCCUPATIONAL HEALTH AND SAFETY ACT (OHSA). FLATTER SLOPE MAY BE REQUIRED IF GROUNDWATER IS ENCOUNTERED.

S3. THE TOP 1' THICK OF THE SOIL LAYER OF THE FINAL GROUND SURFACE SHOULD CONSIST OF COMPACTED CLAYEY/TOP SOIL, OR EQUIVALENT IN ORDER TO REDUCE RAINFALL INFILTRATION. CLAYEY SOIL SHOULD BE USED FOR BACKFILLING THE EXCAVATION. THE FINAL GROUND SURFACE SHOULD BE PROTECTED AGAINST EROSION BY PROVIDING VEGETATIVE COVER OR EQUIVALENT.

CONCRETE NOTES:

C1. ALL CONCRETE WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH ACI 318.

C2. CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4400 psi AT 28 DAYS IN ACCORDANCE WITH ACI 318 SPECIFICATION, UNLESS NOTED OTHERWISE. SUBMIT CONCRETE MIX DESIGN FOR APPROVAL.

C3. GROUT SHALL BE NON SHRINK CEMENTITOUS AND HAVE MINIMUM COMPRESSIVE STRENGTH:
6000psi @ 3 DAYS
8000psi @ 28 DAYS

C4. REINFORCEMENT SHALL BE NEW DEFORMED STEEL BARS, WITH A YIELD STRESS OF 60 ksi.

C5. CONTRACTOR TO PROVIDE ALL ANCHOR BOLTS, NUTS AND WASHERS, UNLESS NOTED OTHERWISE.

C6. HEAT EXCAVATION A MINIMUM OF 24 HOURS BEFORE POURING CONCRETE. TEMPERATURE TO BE ABOVE 5°C.

NOTES

LEGEND

KEYPLAN

REV	D/M/Y	REVISION	DRN	CHK	APP	APP	APP	APP
B	30/03/06	ISSUED FOR PRELIMINARY	MBH	DA				
A	24/02/06	ISSUED FOR CLIENT REVIEW	MBH	DA				

ISS	D/M/Y	APP	ISSUED FOR
B	30/03/06	DA	PRELIMINARY
A	24/02/06	DA	CLIENT REVIEW

REF	NUMBER	TITLE

REFERENCES

STAMP/SEAL

APPROVED FOR CONSTRUCTION

CLIENT PROJECT MGR. DEPARTMENT MGR. PROJECT MGR.

PROJECT PHASE

AREA 00

PROJECT NO.	ACTIVITY NO.	PACKAGE CODE
150422		

SCALE		BY	D/M/Y
AS SHOWN	DSN.	D.A.	
	DRN.	M.HALL	01/27/06

TransCanada
In business to deliver

SUBJECT
KIBBY WIND POWER PROJECT
SPREAD FOOTING FOR WIND TURBINE
GENERATOR – PLAN, SECT. & DETAIL

amec

CLIENT DWG. NO.

DRAWING NO. D-150422-00-121-0901 REV. B

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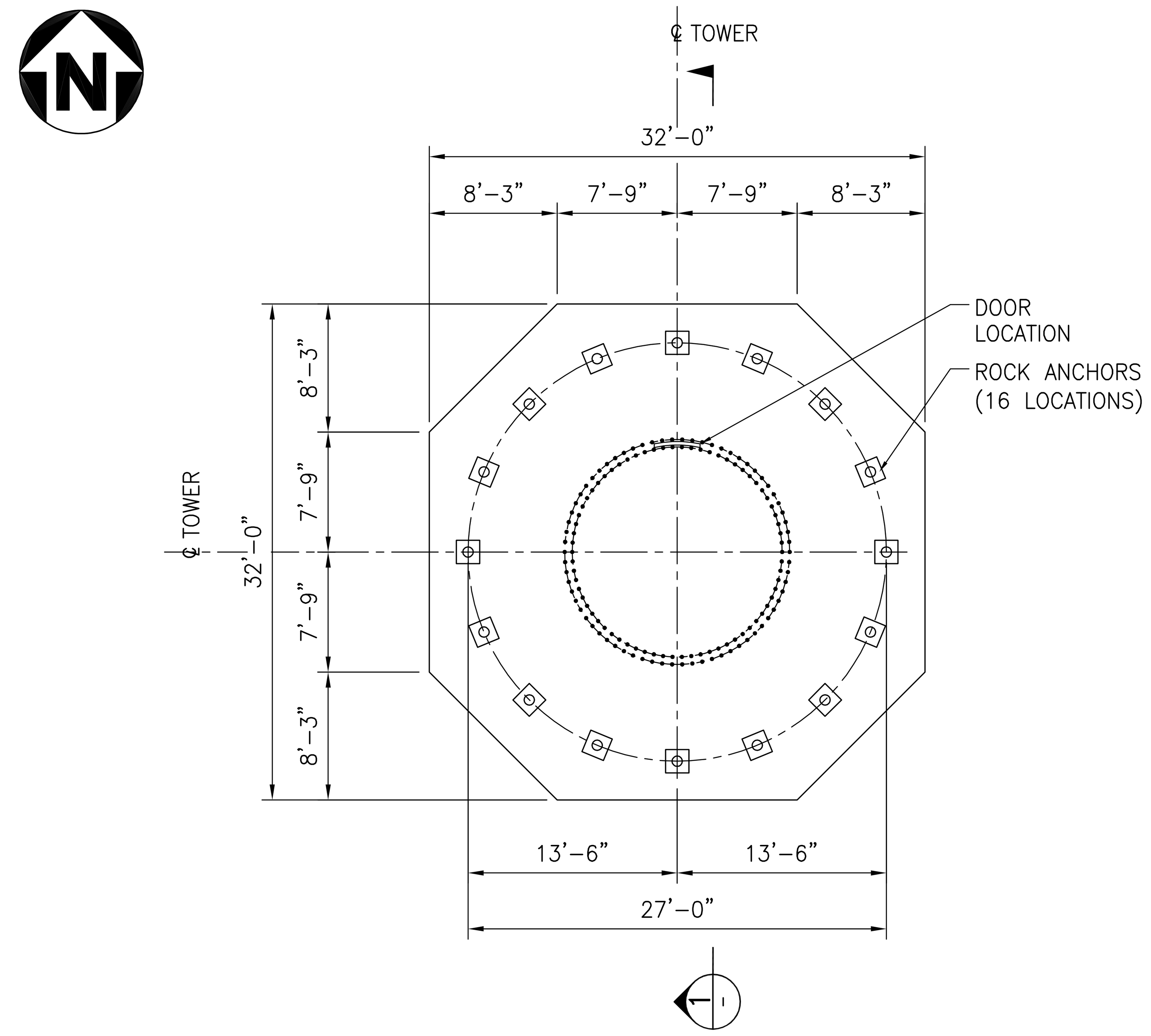
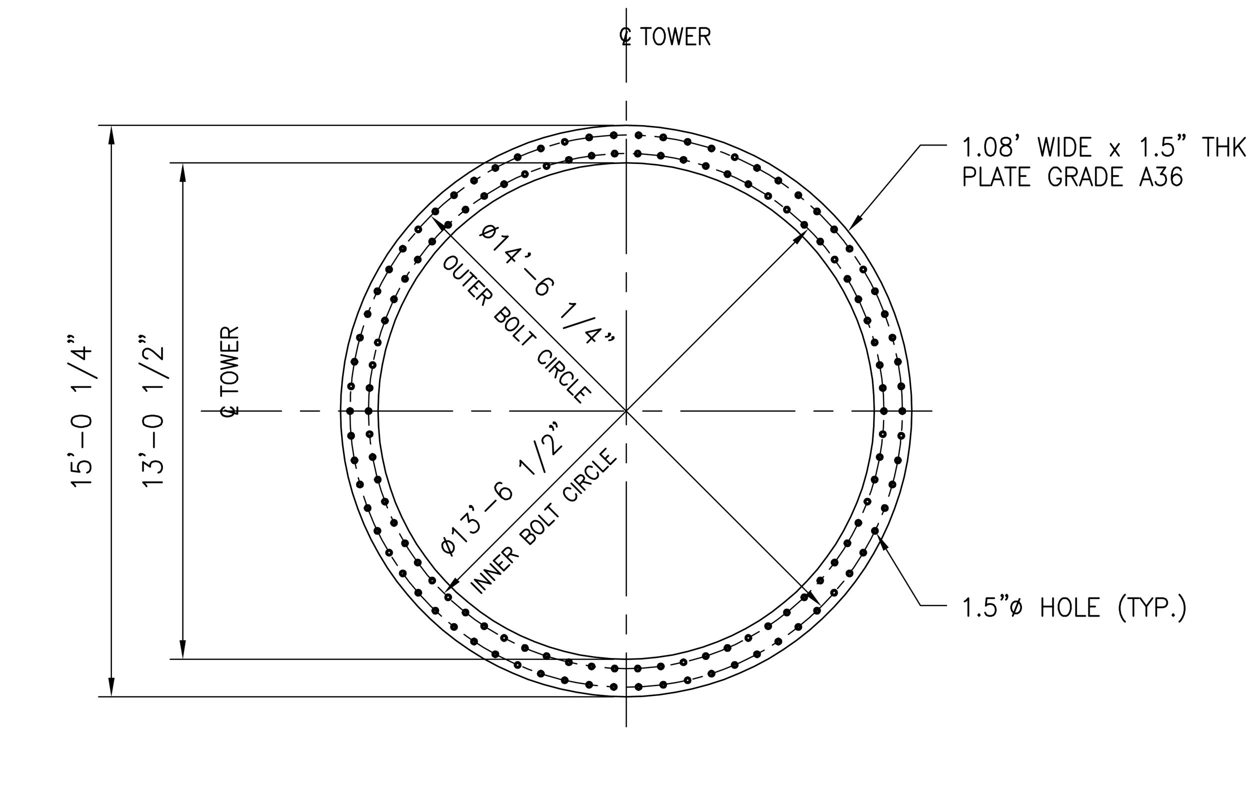
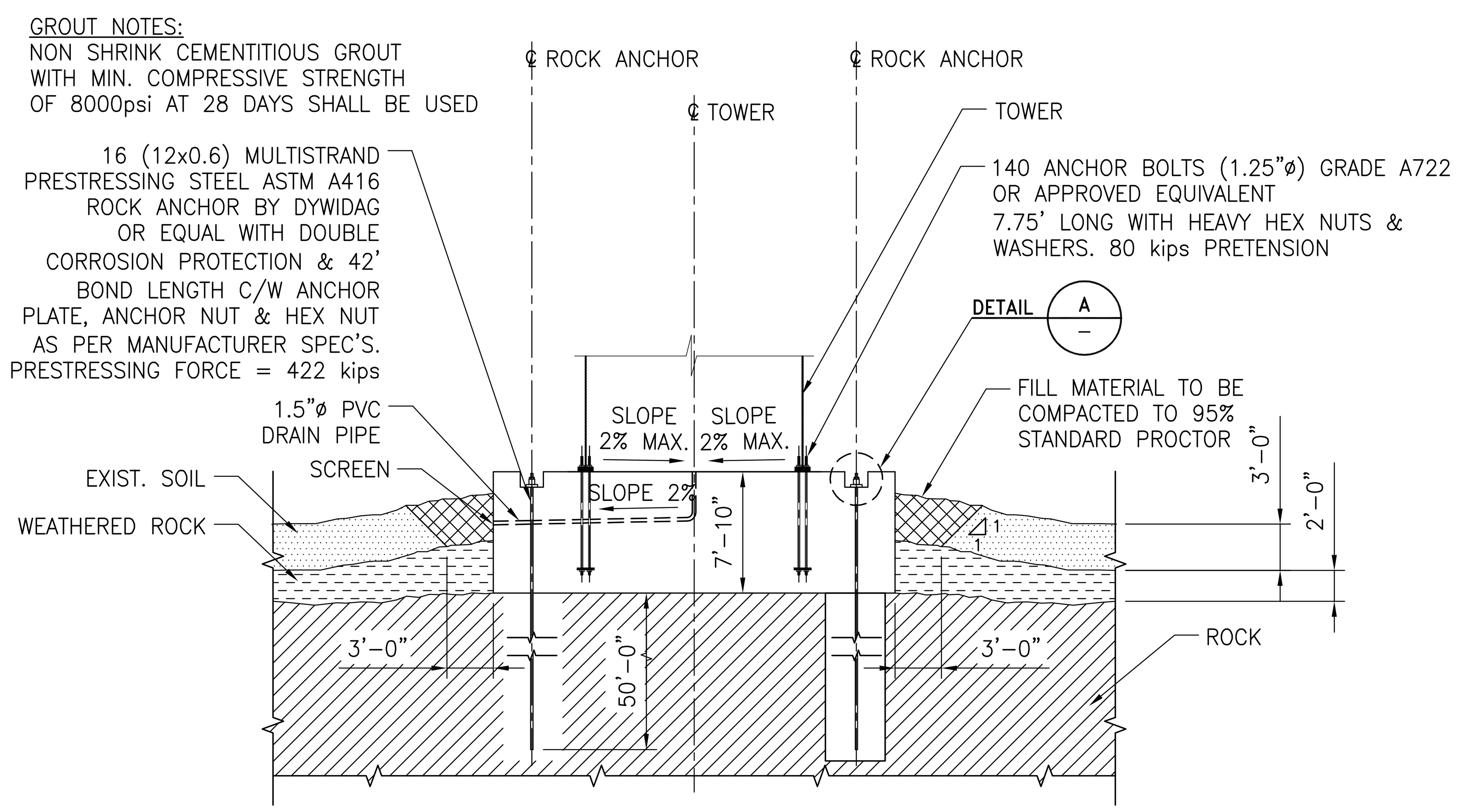


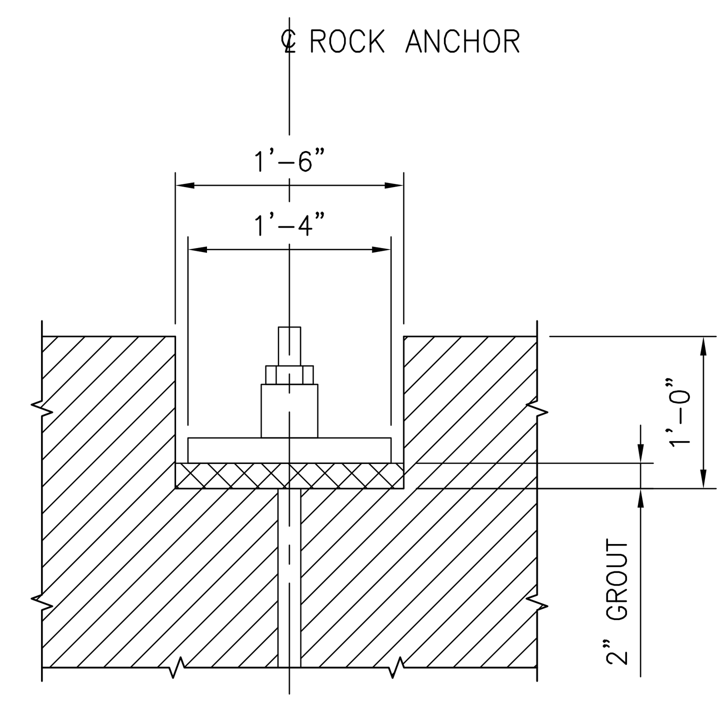
PLAN
SCALE: 1/8"=1'-0"



ANCHOR RING (2)
SCALE:1"=4'



SECTION (1)
SCALE: 1/8"=1'-0"



DETAIL (A)
SCALE:1"=2'

GENERAL NOTES:

SOIL NOTES:

S1. FOUNDATION SHOULD BE CONSTRUCTED OVER SOUND ROCK WITH MINIMUM RQD OF 75%.

S2. THE SLOPE OF EXCAVATION SHOULD BE AT A MINIMUM OF 1:1 (HORIZONTAL:VERTICAL) OR FLATTER, IN ACCORDANCE WITH THE OCCUPATIONAL HEALTH AND SAFETY ACT (OHSA). FLATTER SLOPE MAY BE REQUIRED IF GROUNDWATER IS ENCOUNTERED.

S3. THE TOP 1' THICK OF THE SOIL LAYER OF THE FINAL GROUND SURFACE SHOULD CONSIST OF COMPACTED CLAYEY/TOP SOIL, OR EQUIVALENT IN ORDER TO REDUCE RAINFALL INFILTRATION. CLAYEY SOIL SHOULD BE USED FOR BACKFILLING THE EXCAVATION. THE FINAL GROUND SURFACE SHOULD BE PROTECTED AGAINST EROSION BY PROVIDING VEGETATIVE COVER OR EQUIVALENT.

CONCRETE NOTES:

C1. ALL CONCRETE WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH ACI 318.

C2. CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4000 psi AT 28 DAYS IN ACCORDANCE WITH ACI 318 SPECIFICATION, UNLESS NOTED OTHERWISE. SUBMIT CONCRETE MIX DESIGN FOR APPROVAL.

C3. GROUT SHALL BE NON SHRINK CEMENTITOUS AND HAVE MINIMUM COMPRESSIVE STRENGTH:
6000psi @ 3 DAYS
8000psi @ 28 DAYS

C4. REINFORCEMENT SHALL BE NEW DEFORMED STEEL BARS, WITH A YIELD STRESS OF 60 ksi.

C5. CONTRACTOR TO PROVIDE ALL ANCHOR BOLTS, NUTS AND WASHERS, UNLESS NOTED OTHERWISE.

C6. HEAT EXCAVATION A MINIMUM OF 24 HOURS BEFORE POURING CONCRETE. TEMPERATURE TO BE ABOVE 5°C.

ROCK ANCHOR NOTES:

R1. FOR ROCK QUALITY DESIGNATION (RQD) LESS THAN 75%, ROCK SHOULD BE GROUTED PRIOR TO STRESSING ANCHORS.

S2. ROCK ANCHORS SHOULD BE ASTM GRADE A416.

S3. DIAMETER OF THE HOLE IN THE ROCK MAY VARY FROM 6" TO 7" BASED ON ROCK CONDITION AND MANUFACTURER REQUIREMENTS.

NOTES

LEGEND

KEYPLAN

REV	D/M/Y	REVISION	DRN	CHK	APP	APP	APP	APP
B	30/03/06	ISSUED FOR PRELIMINARY	MBH	DA				
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ISS	D/M/Y	APP	ISSUED FOR
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REFERENCES

REF	NUMBER	TITLE

STAMP/SEAL

APPROVED FOR CONSTRUCTION

CLIENT PROJECT MGR. DEPARTMENT MGR. PROJECT MGR.

PROJECT PHASE

AREA 00

PROJECT NO. 150422 | ACTIVITY NO. | PACKAGE CODE

SCALE NTS

	BY	D/M/Y
DSN.	D.A.	
DRN.	M.HALL	01/27/06

TransCanada
In business to deliver

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SUBJECT
KIBBY WIND POWER PROJECT
ROCK ANCHOR OPTION FOR WIND TURBINE GEN. – PLAN & SECTION

CLIENT DWG. NO.

DRAWING NO. D-150422-00-121-0905

REV. B

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(4 m) in diameter at the base, tapering to 7.5 feet (2.3 m) at the top. The height of the tower will be 263 feet (80 m). TransCanada will utilize the appropriate class of tower to accommodate the strong wind resource and the winter conditions expected at the site. A sketch and description of the Vestas wind turbine generator is shown in Appendix 2-I.

Turbine Nacelle

The nacelle, situated at the top of the tower, is the "electrical box" of the wind turbine: it contains the principal components which produce electricity. It is a heated, weather-protected steel frame and fiberglass assembly. The nacelle houses the turbine's 360 degree yaw control, main rotor bearing and blade pitch mechanism, transmission, gearbox coupled with the rotor, the electrical generator, transformer and control system. The electricity generator transforms the mechanical energy of the wind into electrical power. An opening in the floor provides access into the nacelle from the tower. The roof section is equipped with a skylight, which can be opened to access the wind sensors (anemometer and wind vane), which are mounted on the nacelle roof along with FAA lighting, where required.

A cold-weather package for the V90 will be used, consisting of extra sealing and heating in the nacelle, special cold-weather lubricants, and adjustments to the turbine control system to allow operation in colder temperatures.

In order to optimize the transformation of the wind energy into electricity, the wind turbine is equipped with an orientation system. This system makes it possible to swivel the nacelle so that the rotor is always oriented with the wind. The nacelle can turn 360 degrees, clockwise and counter-clockwise, so as to maximize energy production. This orientation system is connected to the control system, which is connected to the wind vane sensors. Thus, if a change of direction in wind is indicated to the control system, the orientation system modifies the position of the rotor.

The control system also functions to stop the wind turbine if a technical problem occurs (for example if the blades turn too quickly, if there is rotor imbalance or if the gearbox associated with the generator overheats, or if the wind speeds are too high).

The energy produced by the generator is sent to the transformer which increases the low-voltage electricity generated by the generator to an ideal level for electrical transmission through the electrical collector system to the transformer substation.

Turbine Rotor and Blades

The rotor is attached to the nacelle, and is comprised of a hub and three turbine blades, shaped similar to the wings of an airplane. The blades collect the wind and transfer its power to the generator inside the nacelle.

The blade design uses a new airfoil shape, developed in conjunction with the Riso National Laboratory in Denmark. It is also extremely light, using carbon fibers in place of fiberglass for the load-carrying structure of the blade, reducing the fiberglass content overall and cutting weight even further. The 144 foot (44 m) long V90 blades are actually lighter than the 130 foot (40 m) blades used on the earlier model V80.

Safety Lighting

The V90 wind turbines, as with all structures over 200 feet (61 m) high, must have aircraft warning lights installed in accordance with FAA guidelines. Wind farms around the country share the same challenge: to meet the need for aviation safety while minimizing annoyance to the project's neighbors and avoiding undue attraction and collision risk to migrating birds and bats.

The wind industry, FAA representatives, and the U.S. DOE NREL collaborated on a study of different wind project lighting designs in 2002. Initial findings show that lighting the perimeter of wind projects with simultaneously flashing lights is sufficient to indicate one large obstacle to pilots. Other studies of residents near communication towers have found that red lights are less intrusive to humans than white lights, and strobes are considered annoying. Finally, recent avian research indicates that night-migrating birds may be attracted to steady-burning red lights, placing them in danger. The proposed lighting plan for the project is intended to address these three important but conflicting concerns.

The lighting plan will follow FAA requirements (Appendix 1-B). FAA determinations for the project indicate that synchronized red lights are required at night, flashing with a slow-on, slow-off profile, similar to a lighthouse. Lights will be mounted on the nacelles, located approximately one half mile apart around the perimeter of the site. As layout is refined, TransCanada will continue to work with the FAA to appropriately balance the safety and impact potential of this lighting requirement.

2.4.3.2 Roads, Accessways, and Turbine Pads

Primary access for the project will be from Route 27 via Gold Brook Road, located on Plum Creek and Kennebec Forest LLC property. Access to the B series will require construction of a new access roadway to the ridge top from an unnamed road off Gold Brook Road, with a secondary new access from another unnamed road off Wahl Road. The A series will also have two access points: one from an unnamed road off Gold Brook Road, and the other off of Plum Creek's existing Spencer Bale Road. Access to the turbine sites has been carefully planned to utilize existing forestry roads to the extent possible. Existing roads will require minor upgrades to accommodate the foundation construction and delivery of turbine components.

The engineering design for the roads has been accomplished with the following goals in mind:

- To use existing logging roads as much as possible, and build new roads only where necessary;

- To locate the roads to minimize cut and fill, and maintain grades of approximately 10 percent or less;
- To make the ridgeline access roads as narrow as possible, and minimize turning radii; and
- To achieve load-carrying functionality, drainage and erosion control while minimizing width, wetland impacts and visual impacts.

The design for the project roads has included careful, site-specific field investigation and design. However, all construction conditions cannot be fully characterized and quantified until work is underway. Therefore, a series of design measures have been specified for certain conditions expected to be encountered in the construction process. This approach allows for a level of certainty in the construction process, but also allows for the use of engineering judgment in the construction process to best respond to actual field conditions.

Drainage and erosion control are important parts of the road design, given the mountain terrain and typical winter snow and spring melt conditions. The project team has worked extensively with state agency representatives including the Maine State Soil Scientist to review potential design measures appropriate for maintaining stability and hydrologic flow. The resulting design measures proposed for the Kibby Wind Power Project are outlined in this section and in Appendix 2-K.

The appendix includes maps that indicate, with color-coding to better interpret grading, locations where cut and fill are required for the current layout. Although the roadway design is not finalized, the layout presented provides a substantial level of detail, as TransCanada's feasibility assessment for the project included developing detailed cost estimates based on a realistic design scenario. The design will be further refined following detailed geotechnical investigations (which would occur prior to the next phase of LURC review), and could result in reducing areas where cuts are currently proposed on both sides of a road. This will be a priority, where possible, in the final design; possible approaches will include adjusting the road centerline to require cut on one side only or reducing road widths further (which will require detailed consideration of construction logistics, as crane dismantling would be required in those selected locations, a time- and cost-intensive measure). Where such areas remain in the final design, drainage measures will include sub-level spreaders to ensure that water flow is properly handled.

The measures identified in this application, through consultation with the Maine State Soil Scientist, will be targeted for use in particular areas during the final design. In addition, an on-site engineer will make field observations throughout the construction effort and adjust specific techniques, as appropriate, to respond to observed field conditions. In addition, a detailed erosion and sedimentation control plan will be prepared with the final design. An example, utilized for met tower installation, is provided in Appendix 2-J.