

Bipole III

Bipole III Transmission Project: Ground Electrode Facilities

About Bipole III

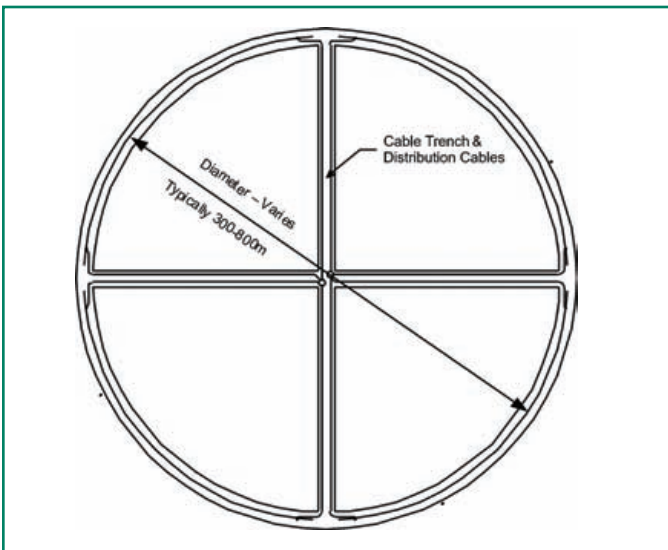


The Bipole III transmission project involves construction of a new 500 kV high-voltage direct current (HVdc) transmission line to link the northern power generating complex on the Lower Nelson River with the conversion and delivery system in southern Manitoba. The project is required to improve system reliability, decrease dependence on one

southern converter facility and provide additional transmission capacity for delivery of existing and proposed hydroelectric generation to southern markets.

The line will originate at a new northern converter station (Keewatinoow), located near the proposed Conawapa Generating Station site east of Gillam, in northern Manitoba. It will terminate at a new converter station at the Riel site east of Winnipeg. The transmission line will be built on steel towers on a 66 meter wide right-of-way, over a 1,364 km preliminary preferred route.

As part of the project, a ground electrode will also be needed for the operation of each of the new converter stations.

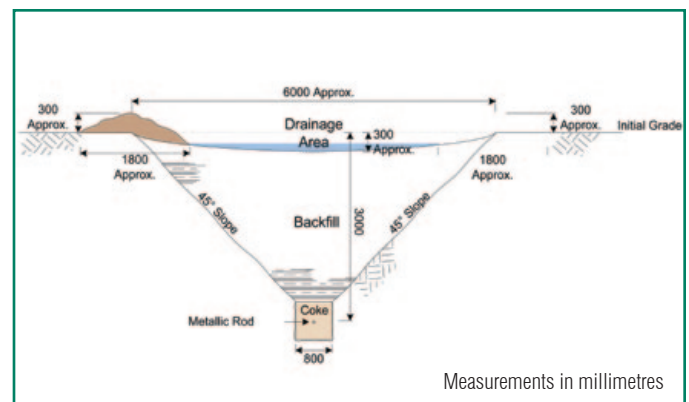


What is a Ground Electrode?

A ground electrode is typically a large metal ring about 300 - 800 metres in diameter buried approximately three metres in the ground and surrounded by a highly conductive bed of coke. The electrode provides grounding of the HVdc system to the earth when slight imbalances of current occur between the bipole lines. The electrode also acts as a ground return system that can be used during system outages.

There are currently three ground electrode sites operating in Manitoba that help ensure reliable functioning of Bipoles I and II. These are associated with the two northern facilities (Radisson and Henday Converter Stations) and one southern facility (Dorsey Converter Station) located 12 miles north of Rosser. The existing ground electrodes have been functioning successfully and without incident for up to 40 years. The Keewatinoow and Riel Converter Stations will each require ground electrodes similar to the existing facilities.

The ground electrodes must be located away from the converter station and on a site of one square mile. A low voltage feeder line is needed to connect the ground electrode to the converter station. The low voltage feeder line is similar to a standard distribution line that can be seen along many Manitoba roadways. Precise routing of the feeder line is to be determined.



*Left: Conceptual diagram of the ground electrode
Above: Ground electrode typical construction cross-section*

How was the preferred Riel Ground Electrode Site selected?

A four phased approach was undertaken by Manitoba Hydro to determine the preferred location for the ground electrode site. During Phase 1 of the selection process, 11 candidate sites were identified. Throughout Phase 2, measurements and desktop studies were undertaken. Seven of the 11 sites did not satisfy the desired technical requirements. During Phase 3 of the selection process, the four remaining sites were assessed and evaluated based on a variety of criteria listed below. Manitoba Hydro is currently engaged in Phase 4 of the selection process and will be conducting additional interference studies and more precise measurements on the preferred site.

Site Selection Criteria

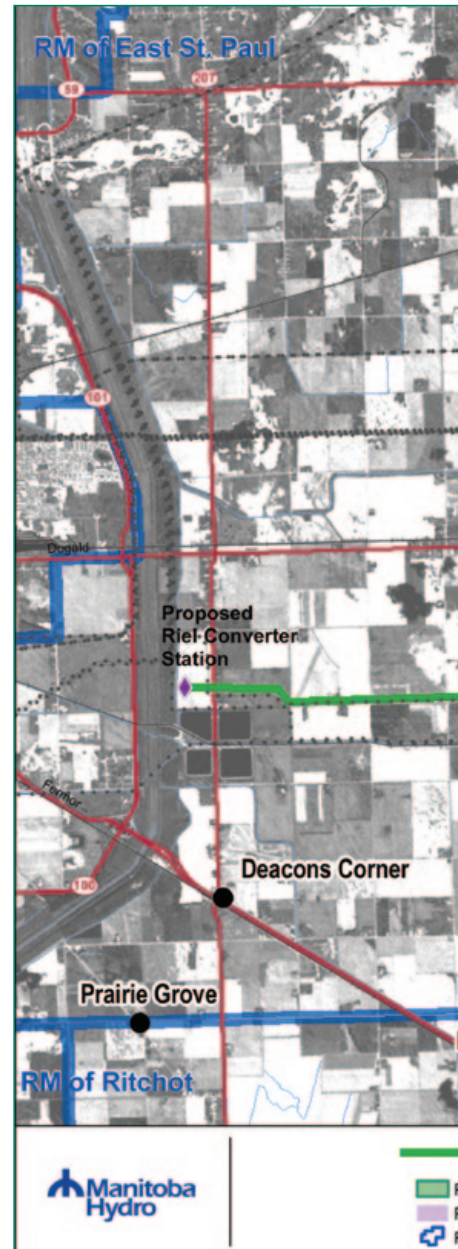
- ✓ Topography
- ✓ Ground resistivity
- ✓ Water supply
- ✓ Ground potential rise
- ✓ Soil moisture
- ✓ Thermal conductivity of the soil
- ✓ Heat capacity of the soil
- ✓ Land use
- ✓ Step potential (safety)
- ✓ Existing infrastructure (pipelines, rail lines, transformers, transmission lines, etc.)
- ✓ Distance from the Riel Converter Station
- ✓ Construction costs

Preferred Site Location

Site SES1c (21-11-6E1) was determined as the preferred location of the Riel ground electrode based on the following findings:

- Relatively flat site
- Lowest ground resistivity (13 Ω -m) of all sites evaluated
- Wet ground condition
- Groundwater availability
- Good thermal conductivity and heat capacity of soil
- Low step potential to protect humans and animals
- Farm land with limited development
- Shortest electrode line of all sites evaluated
- Lowest anticipated construction costs

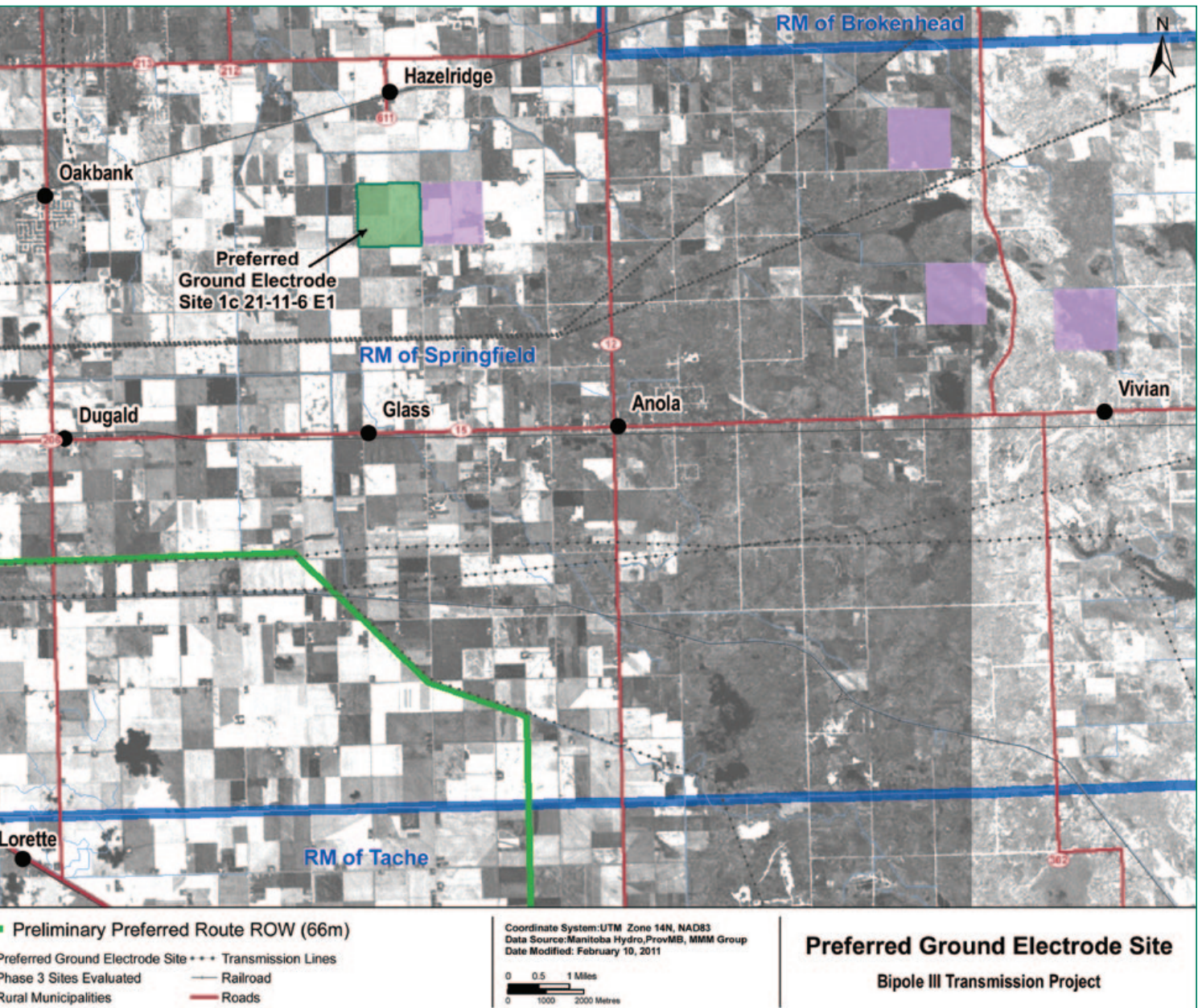
Preferred Riel Ground Electrode Site



DC Electric and Magnetic Fields

Like any electric apparatus (e.g. televisions) the ground electrode facilities will have electric and magnetic fields associated with them. Like the Bipole III line DC electric and magnetic fields will surround the electrode line, while only DC magnetic fields would occur above the electrode (the earth shields the DC electric field). National and international

Electrode Site Location



scientific agencies responsible for public health have gathered multidisciplinary groups of scientists to evaluate DC field health and safety research. Organizations such as the World Health Organization, National Radiological Protection Board of Great Britain and the International Agency for Research on Cancer have come to the conclusion that there are no known adverse health effects associated with low levels of static electric or magnetic fields such as those associated with DC transmission lines. The

field levels associated with the operation of the electrode and connecting line will be well below levels recommended by the International Commission on Non-Ionizing Radiation Protection (ICNIRP).

For further information on DC transmission and Electric and Magnetic fields, please access the Manitoba Hydro Website for the *Direct Current Electric and Magnetic Fields* brochure.



Above: Buried metal rod in coke bed from actual ground electrode

Construction

Construction of the ground electrode facility is scheduled to commence with the construction of the Riel Converter Station; beginning in 2012, with an anticipated completion date of 2017.

Ground electrode construction will consist of land clearing, trench excavation, assembly of the metal rods and coke matrix, irrigation pipe installation to ensure adequate moisture is achieved, backfilling and compaction of the electrode trench and burying the feeder cable from the feeder line.

Manitoba Hydro is meeting with stakeholders to discuss potential effects and mitigation with regards to pipelines, railways and existing Manitoba Hydro infrastructure. The current from the ground electrode may cause electrical potential shift along certain infrastructure or exceed allowable current flows. To mitigate these effects, upgrades may be required on some pipeline cathodic protection systems, transformer grounding systems, older railway signaling relays, and the installation of additional insulators on transmission lines. Mitigation measures to upgrade the infrastructure will be considered for affected stakeholders.

During the site selection process, proximity to nearby infrastructure was considered by the project team. The preferred site is located in a rural area with separation from pipelines, transformers, transmission lines and rail lines.

Operation and Maintenance

The ground electrode will be in constant operation to ground imbalance currents that occur between the two bipole lines. Normal operation will account for a maximum of 5% of the total design current on Bipole III for 91.7% of the time it is in operation. During emergency or maintenance operation (the remaining 8.3% of the operational time) the electrode is designed to operate at full current for a maximum of 60 days, providing ample time to rectify the problem.

The ground electrode requires moist soils to function properly. The preferred site has promising soil moisture attributes and has a viable groundwater supply if pumping and irrigation is necessary to maintain moisture of the soil.

The electrode will be buried underground and only routine maintenance of access roads is required.

Once the ground electrode is operational, agricultural activities directly above the electrode site will not be permitted. However, the area around the electrode site, within the section, can return to its original use.

Contact us

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