

AGRICULTURAL SOIL PRODUCTIVITY MONITORING FOR THE MANITOBA- MINNESOTA TRANSMISSION PROJECT

POST-CONSTRUCTION YEAR 2 (2021)

SEPTEMBER 12, 2022





**AGRICULTURAL SOIL PRODUCTIVITY
MONITORING FOR THE MANITOBA-
MINNESOTA TRANSMISSION PROJECT:
POST-CONSTRUCTION YEAR 2 (2021)**

Final Report

September 12, 2022

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Manitoba Hydro

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Agricultural Soil Productivity Monitoring for the Manitoba-Minnesota Transmission Project: Post-Construction Year 2 (2021)

September 12, 2022

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Executive Summary

Manitoba Hydro retained Stantec Consulting Ltd. (Stantec) and AgriEarth Consulting Ltd. (AgriEarth) to conduct monitoring of soil productivity along the portion of the Manitoba-Minnesota Transmission Project (the “Project”) under agricultural crop production. Monitoring of soil productivity during pre-construction and post-construction Project phases was a commitment made in the Project Environmental Monitoring Plan (EMP; Manitoba Hydro, 2019). This report represents the second annual report on this monitoring component and includes monitoring information on the second year of the post-construction or operation phase (2021) of the Project. Trends relative to pre-construction (2019) and post-construction year 1 (2020) are also presented and discussed. Results for 2019 and 2020 were previously reported by Stantec (2022).

In agri-Manitoba the productivity of soils for arable agriculture is valued by agricultural producers as a primary source of income. Soil productivity on lands in the Project right of way (RoW) can be adversely affected by the use of construction machinery, including vehicles and heavy equipment, and disturbance of surface materials during grading and excavation for tower structure foundations. Effects on soil productivity are typically manifested in vegetation productivity. Therefore, a vegetation productivity indicator can be used as an effective proxy for soil productivity. As such, a vegetation productivity index, the Normalized Difference Vegetation Index (NDVI), was used as a screening tool to assess the effects on soil productivity in the Project RoW following construction activities in areas of agricultural production. The NDVI provides a relative measure of vegetation health or productivity and is calculated from remotely-sensed reflectance data captured from satellite imagery.

The objective of the monitoring program is to monitor soil productivity along portions of the Project RoW under agricultural land use to confirm the effectiveness of mitigation in the maintenance and rehabilitation of soil productivity. This objective is consistent with that presented for the soil productivity monitoring activity in the EMP.

As documented in the assessment of potential environmental effects on agriculture within the Project Environmental Impact Statement (EIS; Manitoba Hydro, 2015), physical degradation of soils from Project activities are expected, primarily due to compaction in work areas within the RoW, and those effects may result in reduced crop productivity. While effects are expected, the effects to agricultural capability class resulting in a reduced ability for the land to support crop production are expected to be minimal following mitigation. These residual effects are anticipated to be limited to localized areas within the RoW. Where degradation of land does occur due to soil compaction from construction activities, these effects are expected to extend beyond construction activities and could persist for a few years following remedial action.

Manitoba Hydro’s landowner compensation program includes a structure impact compensation which considers reduced crop productivity in an area of overlap around each tower. Beyond these areas, in the event of damage to property, including to land, Manitoba Hydro is committed to working with landowners to repair damages. This may include construction damage compensation for residual effects to soil productivity in instances where remedial work requires farm machinery and the landowner’s expertise.



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To assess Project effects on soil productivity, differences in NDVI values were compared between areas within the RoW and adjacent, comparable off RoW areas within a defined agricultural evaluation area. The agricultural evaluation area is comprised of areas of annual crop, forage (hay) and pasture (grassland, grazing) production traversed by the Project. Specific agricultural evaluation areas were delineated, including:

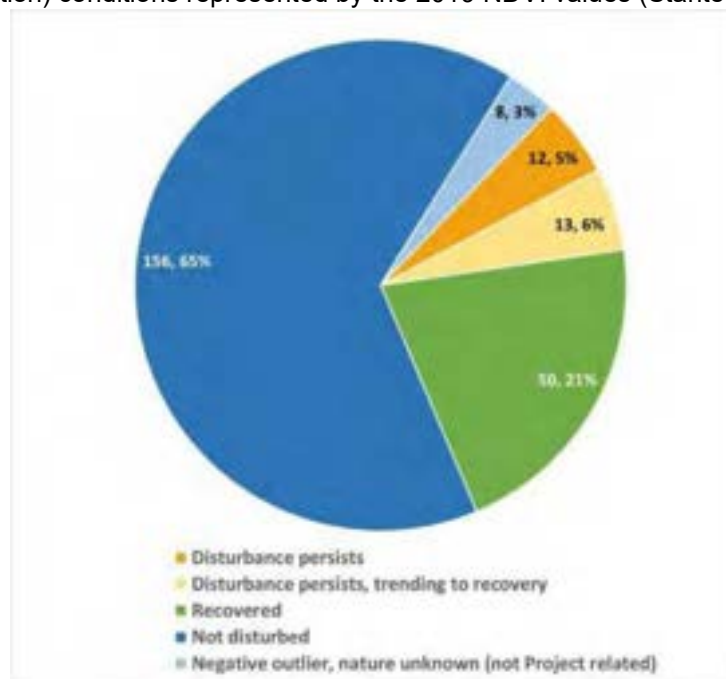
- Discrete agricultural field management units (FMUs) within a 20 m corridor within the Project right-of-way (RoW) and centered along the transmission line (On RoW FMUs), to capture effects to soil productivity within the RoW between towers.
- Tower work areas (TWAs), or 80 m diameter buffer areas around tower structures, to capture effects to soil productivity from tower structure construction activities.

The Project includes a 213 km long transmission line and 499 tower structures. The transmission line originates at Dorsey station northwest of Winnipeg and terminates at the Manitoba to Minnesota border southeast of Piney, Manitoba. For the purposes of this evaluation:

- Of the 213 km of transmission line, a total of 114 km (53.5% of total) were determined to be within the agricultural evaluation area and a total of 239 On RoW FMUs were delineated.
- Of the 499 total tower structures, 306 tower structures (61.3 % of total) were considered within the agricultural evaluation area and a total of 337 discrete TWAs were delineated (note: the higher TWA number relative to tower structures in the agricultural evaluation area is due to field management unit splits where towers straddle more than one field management unit).

An evaluation of NDVI differences was completed for 2019 and 2020 growing seasons using NDVI values captured in July to represent peak crop growth conditions. Threshold values were determined using baseline or pre-disturbance (pre-construction) conditions represented by the 2019 NDVI values (Stantec, 2022), and were used to identify negative outliers for NDVI difference values in 2021. Negative outliers for the 2021 growing season were visually reviewed to confirm whether they were likely the result of Project-related disturbance or if differences were attributable to other factors (e.g., natural variability in soil conditions, agricultural field management operations).

A summary of counts and proportions of individual On RoW FMUs in each of the disturbance categories in post-construction year 2 (2021) is found in the figure on the right. A total of 25 of the 239 On RoW FMUs (10.4% of all

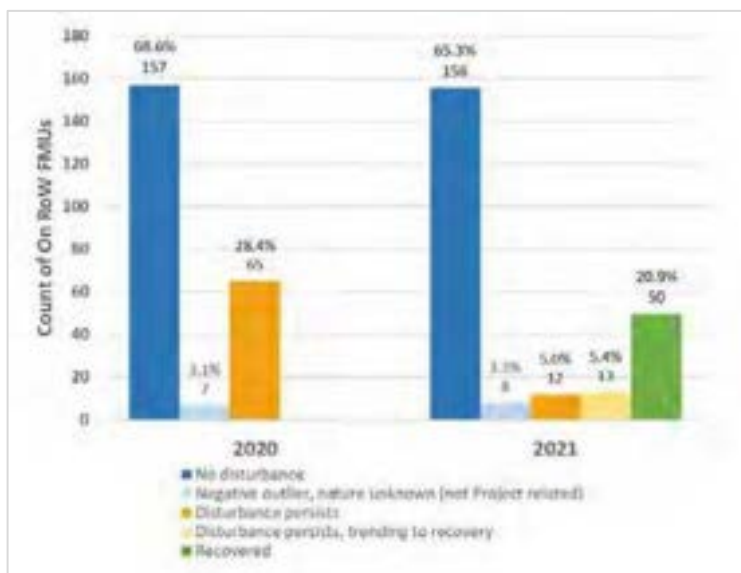


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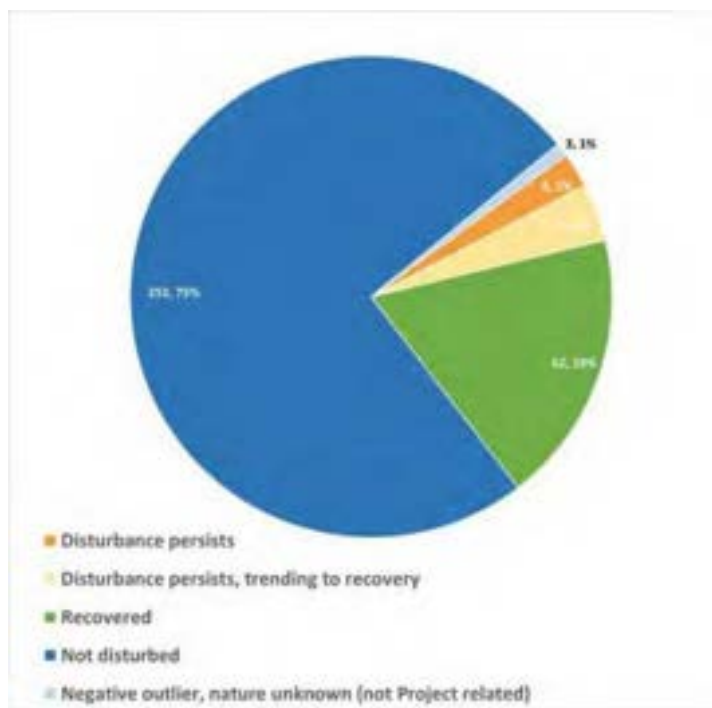
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FMUs) were considered to have lower soil productivity due to Project-related disturbances, while 50 FMUs (20.9% of all FMUs) were considered to have recovered from disturbances identified in the post-construction year 1 (2020) monitoring season.

A summary of disturbance categories for On RoW FMUs for the post-construction year 1 (2020) and post-construction year 2 (2021) monitoring seasons are presented in the figure to the right. This provides a useful summary and visual support for the reduction in FMUs considered to have Project-related disturbances persisting. There was a reduction in On RoW FMUs in disturbance persists categories from 65 FMUs (28.4% of all FMUs) in the post-construction year 1 (2020) monitoring season to 25 FMUs (10.4% of all FMUs) in the post-construction year 2 (2021) monitoring season. Of the 25 FMUs still considered disturbed in 2021, 13 were considered to be trending toward recovery (i.e., positive trend in NDVI difference between On RoW FMU and Off RoW comparable areas). As noted above, a total of 50 On RoW FMUs (20.9% of all FMUs) considered disturbed by Project activities in the 2020 monitoring season were considered recovered in 2021.



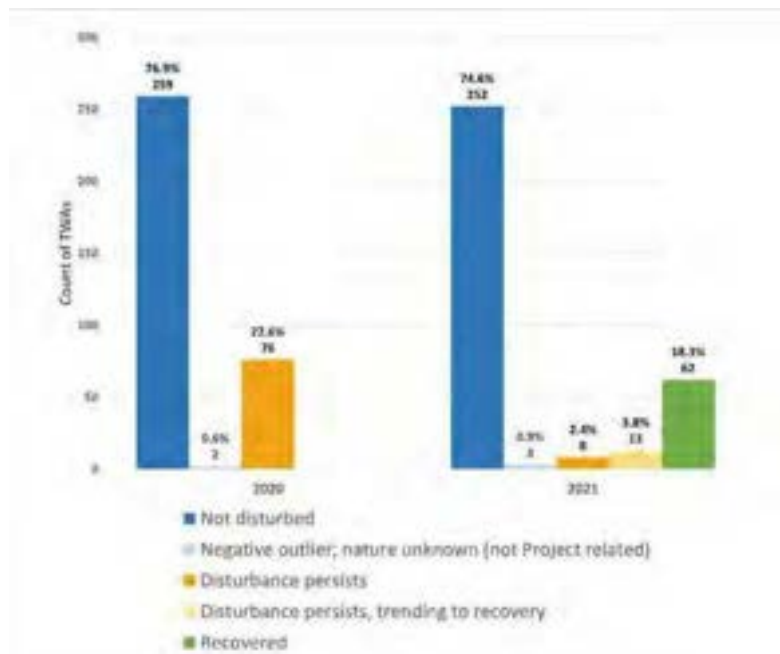
A summary of counts and proportions of individual TWAs in each of the disturbance categories in post-construction year 2 (2021) is provided in the figure on the right. A total of 21 of the 337 TWAs (6.2% of all TWAs) were considered to have lower soil productivity due to Project-related disturbances, while 62 FMUs (18.3% of all TWAs) were considered to have recovered from disturbances identified in the post-construction year 1 (2020) monitoring season.



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A summary of disturbance categories for TWAs for the post-construction year 1 (2020) and post-construction year 2 (2021) monitoring seasons are presented in the figure to the right. This provides a useful summary and visual support for the reduction in TWAs considered to have Project-related disturbances persisting. There was a reduction in TWAs considered disturbed by Project activities from 76 TWAs (23% of all TWAs) in post-construction year 1 (2020) to 21 (6% of all TWAs) in post-construction year 2 (2021). Of these 21 TWAs, 13 were considered to be trending toward recovery (i.e., positive trend in NDVI difference between TWAs and Off RoW comparable areas), while the remaining 8 were found to have disturbances persisting with NDVI difference values not trending in the direction of recovery. A total of 62 TWAs (18.3% of all TWAs) considered disturbed by Project activities in the 2020 monitoring season were considered recovered in 2021.



An evaluation of Project-related disturbance categories relative to Project construction and environmental factors was completed to explore relationships between these factors and the degree and persistence of effects to soil and crop productivity. Key findings are summarized as follows:

- The construction of the Self-Supporting Dead-End (D-E) Angle structures appear to result in a higher degree of disturbance and effects appear to be longer lasting, relative to Self Supporting Suspension structures, and Guyed Towers appear to result in less disturbance compared with Self Supporting structures.
- For self-supporting towers, it appears that cast-in place (CIP) concrete foundations may result in longer lasting effects to soil and crop productivity, relative to helical pile or concrete mat foundations. Data for Guyed Towers suggest that the nature or degree of disturbance are not as long lasting as for self-supporting towers.
- Seasonality of tower installation appears to have an influence on disturbances to soil and crop productivity, with the occurrence of TWAs with disturbances persisting through 2021 appearing to decrease by months of tower installation from fall to winter as follows: September 11% , October 10%, November 5%, December 5%, January 6% and February 7%. Whether this is related to frost conditions, or some other factors (e.g., soil moisture status), is unknown.



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- When disturbances were evaluated against soil compaction risk ratings and timing of tower structure installation, results suggest:
 - a higher degree of effects to soil productivity in soils rated with high compaction risk in the Fall (September to November) period and the Winter (December to February) period, compared to soils with moderate and low compaction risk.
 - effects to soil productivity may be longer lasting following construction in the Fall period (i.e., non-frozen conditions) in soils rated with high compaction risk, compared to soils with moderate and low compaction risk. Further, mixed results across compaction risk categories for TWAs with construction in the Winter period suggest that compaction risk may be less of a determinant of lasting effects to soil and crop productivity during winter construction (i.e., frozen soil conditions).

Therefore, while Project activities have resulted in disturbance to crop productivity and soil productivity within the RoW, the level of disturbance persisting was found to be much lower in post-construction year 2 (2021) relative to post-construction year 1 (2020). Effects were found to be limited to the RoW and associated with areas of construction activity (e.g., tower work areas, construction access and trails) within the RoW. As documented in the EIS, effects to soil productivity due to compaction from construction activities within the RoW were anticipated, and where effects from compaction occur, they could persist for a few years following construction. So, results from the monitoring program are consistent with the predictions made in the EIS. Results suggest the mitigation program has been effective as 72% of FMUs and 77% of TWAs were considered to not have negative effects to soil productivity following post-construction year 1 (2020), and 89% of FMUs and 94% of TWAs were considered to not have negative effects following post-construction year 2 (2021). No unexpected effects were determined through the monitoring program through the 2020 and 2021 monitoring seasons. Future monitoring could be used to confirm that areas where effects have persisted through 2021 are recovering or trending to recovery.

While the two-year post-construction soil productivity monitoring commitment made in the Project Environmental Monitoring Plan (EMP; Manitoba Hydro, 2019) has been completed, additional monitoring in subsequent years could confirm trends and conclusions to 2021.



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Acronyms / Abbreviations

EMP	Environmental Monitoring Plan
FMU	Farm management unit
MMTP	Manitoba-Minnesota Transmission Project
NDVI	Normalized Difference Vegetation Index
NIR	Near-infrared
RoW	Right-of-way
TWA	Tower work area



Glossary

Normalized Difference Vegetation Index	A quantified measure of vegetation health or productivity determined using near-infrared and red light wavelengths.
Field management unit	An agricultural crop production area defined as being managed as a single field cropping management unit.
Off RoW Comparable Area	A discrete comparable area located off of the right-of-way (RoW) and considered not disturbed by the Project, and used to compare against potentially-disturbed areas including On RoW field management units (FMUs) and tower work areas (TWAs).
On RoW FMU	A discrete FMU located within the RoW, specifically within a 20 m corridor centered on the transmission line centreline.
Outlier (NDVI difference)	A value considered to be outside of the expected normal range of variation. For the purposes of this evaluation, outliers were determined for NDVI difference values between areas within the RoW that are potentially disturbed (i.e., On RoW FMUs and TWAs) and comparable areas outside of the RoW not disturbed by the Project.
Outlier, minor	An outlier between defined “inner fence” and “outer fence” limits using quartiles. Minor outliers are considered less extreme than major outliers. Negative outliers are of interest to this evaluation, and the negative inner fence is determined as: $Q1 - (1.5 \times IQR)$, where $Q1$ = first quartile (25 th percentile) and IQR = interquartile range ($Q3$ [third quartile or 75 th percentile] – $Q1$).
Outlier, major	An outlier beyond a defined “outer fence” limit using quartiles. Major outliers are considered more extreme than minor outliers. Negative outliers are of interest to this evaluation, and the negative outer fence limit is determined as: $Q1 - (3 \times IQR)$, where $Q1$ = first quartile (25 th percentile) and IQR = interquartile range ($Q3$ [third quartile or 75 th percentile] – $Q1$).
Threshold (NDVI difference)	Threshold values established to determine outliers in NDVI difference values between areas within the RoW that are potentially disturbed by the Project (i.e., On RoW FMUs and TWAs) and comparable areas outside of the RoW not disturbed by the Project. Negative thresholds are of interest to this evaluation to identify where soil and crop productivity within the RoW is lower than comparable areas outside of the RoW. Thresholds for minor negative outliers and major negative outliers were established using “inner fences” and “outer fences”.



1 Introduction

Manitoba Hydro retained Stantec Consulting Ltd. (Stantec) and AgriEarth Consulting Ltd. (AgriEarth) to conduct monitoring of soil productivity along the portion of the Manitoba-Minnesota Transmission Project (the “Project”) under agricultural crop production. Monitoring of soil productivity during pre-construction and post-construction Project phases is a commitment made in the Project Environmental Monitoring Plan (EMP; Manitoba Hydro, 2019). This report represents the second annual report on this monitoring component and includes monitoring information on the second year of the post-construction or operation phase (2021) of the Project. Trends relative to pre-construction (2019) and post-construction year 1 (2020) are also presented and discussed. Results for 2019 and 2020 were previously reported by Stantec (2022).

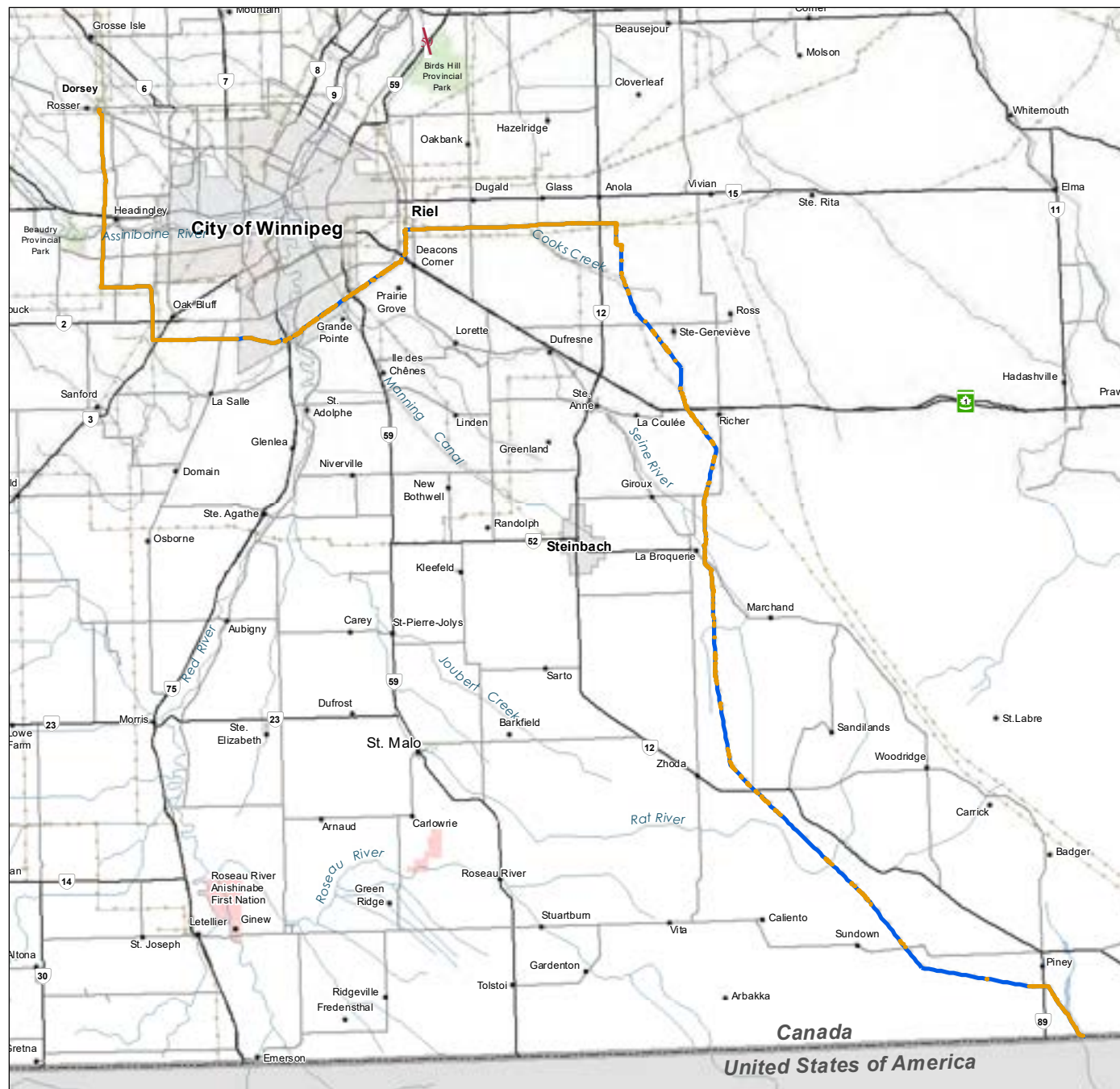
In agri-Manitoba the productivity of soils for arable agriculture is valued by agricultural producers as a primary source of income. Agricultural production is also of general benefit to society. Soil productivity on lands in the Project right of way (RoW) can be affected by the use of construction machinery, including vehicles and heavy equipment, and disturbance of surface materials during grading and excavation for tower foundations. The effects mechanisms for construction activities on soil productivity are primarily physical, but secondary or indirect effects to productivity may occur through chemical and biological changes as a result of physical disturbances. Soil productivity is a result of numerous soil environmental factors and conditions and is difficult to measure or assess. However, these direct effects on soil properties are typically manifested in vegetation productivity. Therefore, a vegetation productivity indicator can be used as an effective proxy for soil productivity. As such, vegetation productivity was used as a screening tool to assess the effectiveness of prescribed mitigation in the maintenance and reclamation of soil productivity in the Project RoW following construction activities in areas of agricultural production.

For the purposes of this evaluation, the Project consists of a transmission line 213 km in length with 499 tower structures. The transmission line originates at Dorsey station northwest of Winnipeg and terminates at the Manitoba to Minnesota border southeast of Piney, Manitoba. An overview of the Project is provided in **Map 1.1**.

As documented in the assessment of potential environmental effects on agriculture within the Project Environmental Impact Statement (EIS; Manitoba Hydro, 2015), physical degradation of soils from Project activities are expected, primarily due to compaction in work areas within the RoW, and those effects may result in reduced crop productivity. While effects are expected, the effects to agricultural capability class resulting in a reduced ability for the land to support crop production are expected to be minimal following mitigation. These residual effects are anticipated to be limited to localized areas within the RoW. Where degradation of land does occur due to soil compaction from construction activities, these effects are expected to extend beyond the construction and could persist for a few years following remedial action.

Manitoba Hydro’s landowner compensation includes a structure impact compensation which considers reduced crop productivity in an area of overlap around each tower. Beyond these areas, in the event of damage to property, including to land, Manitoba Hydro is committed to working with landowners to repair damages. This may include construction damage compensation for residual effects where remedial work





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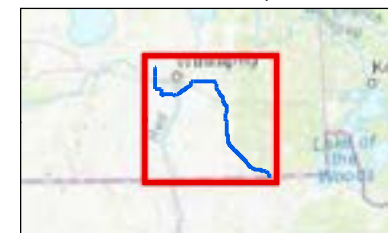
- Manitoba-Minnesota Transmission Line
- Agricultural Land Use Along the Transmission
- Provincial Highway
- Provincial Road
- Existing Transmission Lines
- Community
- First Nation Lands
- Provincial Park
- City



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Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Government of Manitoba, Government of Canada, Manitoba Hydro
3. Background: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community



Project Location Winnipeg, Manitoba	Prepared by JH on 2021-05-15 TR by DW on 2021-05-15 IR Review by GK on 2021-05-15
Client/Project Manitoba Hydro Manitoba-Minnesota Transmission Line Soil Performance & Crop Performance Monitoring	111477020-003 REV3
Figure No. 1.1	

Title

Manitoba Minnesota Transmission Line - Project Overview

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1 Introduction

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requires farm machinery and the landowner's expertise. More information can be found in the Manitoba-Minnesota Project Landowner Compensation Information brochure included in the EIS (Appendix 15C; Manitoba Hydro 2015).

The Project soil productivity monitoring program relies primarily on the use of the Normalized Difference Vegetation Index (NDVI), a relative measure of vegetation health or productivity. NDVI is calculated from remotely-sensed reflectance data collected through satellite imagery, and assessment is based on the difference between NDVI values on the RoW and adjacent, comparable off RoW areas.

1.1 Objective

The objective of the monitoring program is to monitor soil productivity along portions of the Project RoW under agricultural land use to confirm the effectiveness of mitigation in the maintenance and rehabilitation of soil productivity. This objective is consistent with that presented for the soil productivity monitoring activity in the EMP (EMP Section 4.7.1, p. 64).

To achieve the commitment made in the EMP, the soil productivity monitoring program has been structured to:

- use crop performance as the parameter for evaluating soil productivity along the RoW, access roads, and other temporary project footprints within areas of agricultural land use, including annual crop, forage (hay) and grassland (grazing) production.
- include monitoring for one year prior to construction (2019), and up to two-years post-construction (2020 and 2021) or until suitable knowledge is acquired.

The monitoring approach relies on desktop-based activities, namely remote sensing of vegetative productivity based on computed NDVI values.

As identified in the EMP (EMP Table 4-21), field assessments by resource specialists may be completed, as required. Field assessments would be completed on a site-specific basis if warranted due to residual effects to soil productivity determined through monitoring activities or as identified by landowners, and as directed by Manitoba Hydro.



2 Methodology

The methods used to conduct the 2021 soil productivity monitoring program are consistent with those presented in the EMP (EMP Section 7.7) and are summarized below.

2.1 Image Acquisition and Processing

Imagery was collected from the PlanetScope satellite constellation to support the evaluation. The PlanetScope sensors provide sufficient radiometric and spatial resolution to capture crop conditions across a broad landscape, such as the agricultural portion of the Project, in a cost-effective manner.

The PlanetScope satellites collect multispectral data, including blue (455-515 µm), green (500-590 µm), red (590-670 µm) and near infrared (NIR) (780-860 µm) wavelengths at 3 m by 3.5 m resolution. The sensors are affected by atmospheric interference such as clouds, fog, rain or smoke and requires cloud-free conditions to collect reliable surface spectral reflectance information.

Satellite image acquisition for the Project RoW required multiple orbital paths due to the extent of the area of interest. Due to cloud cover, a long repeat coverage period and a high level of orbital overlap, multiple orbital tracks were required over varying dates to compile a single, cloud-free image mosaic for the RoW. Acquisition dates for 2019, 2020 and 2021 were all within the month of July.

All satellite imagery was atmospherically corrected by PlanetScope's parent company Planet Labs Inc. ("Planet"). Haze removal was performed as part of the atmospheric correction allowing for precise vegetation measurements. Planet normalized solar illumination conditions at different time periods allowing for accurate change detection analysis. Individual images were clipped and combined, creating continuous coverages of agricultural land use areas across the entire RoW.

2.2 Normalized Difference Vegetation Index

Imagery was processed to quantify agricultural crop health by implementing the NDVI formula. NDVI is a measure of vegetative vigor or plant health using the Red and Near-Infrared (NIR) channels of the electromagnetic spectrum. NIR energy is highly reflected by healthy vegetation while Red wavelengths are highly absorbed by vibrant vegetation (**Figure 2.1**). This relationship is not as strong in stressed vegetation and is non-existent in dead vegetation. This unique vegetative property provides detail on vegetation health and is exemplified in the NDVI formula:

$$(NIR - RED) / (NIR + RED) = NDVI$$

NDVI values range from 1 (healthy vegetation) to -1 (non-vegetation). Results of the NDVI formula can vary from one landscape to another but typically areas of water, sand, or infrastructure show very low NDVI values (for example, -0.5 or less). For instance, bare soil usually scores near 0.0 on the NDVI scale range; sparse vegetation such as shrubs and grasslands or senescing crops may result in moderate NDVI values (approximately 0.1 to 0.4); and high NDVI values (approximately 0.5 to 0.9) correspond to dense vegetation such as that found in temperate and tropical forests or crops at their peak growth stage.



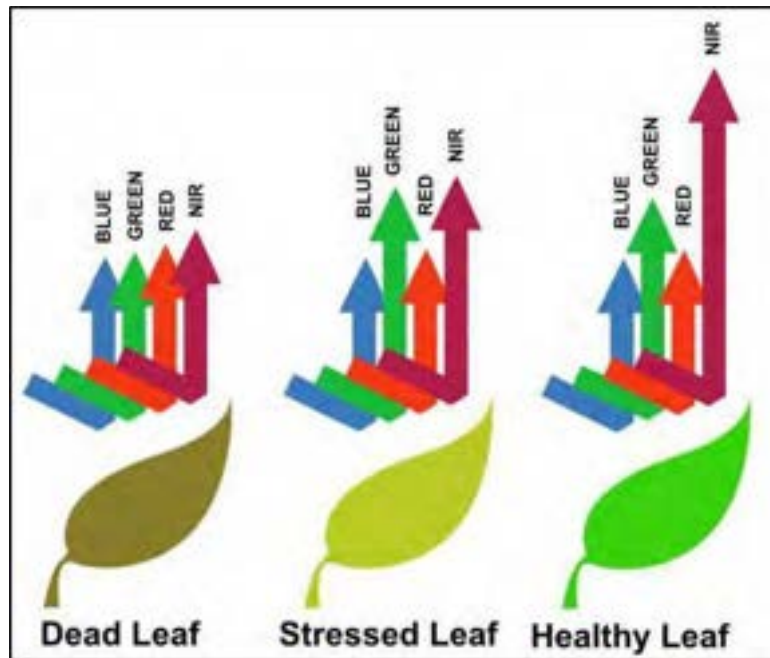


Figure 2.1 Spectral Reflectance Amount Variations for Blue, Green, Red and NIR Energy of Dead, Stressed and Healthy Crop Leaves

2.3 Evaluation Areas Definition

2.3.1 ON ROW, TOWER WORK AREA AND OFF ROW STUDY AREA DELINEATION

Construction activities within and along the transmission RoW vary in nature and intensity around tower structure installations and between towers. Generally, a higher degree of impact occurs around tower structures than between towers. Around tower work structures, there is a relatively high level of construction vehicle and heavy equipment activity, resulting in a potential disturbance area extending across the RoW around each tower location. Between towers, much of the activity is construction machinery (vehicles and heavy equipment) traversing from one tower to the next, hence the potential disturbance in areas between towers typically occurs in a more confined area of the RoW along a centreline or near-centerline travel corridor.

Recognizing these differences and based on a similar evaluation conducted on a previous transmission project (Stantec, 2019)¹, two evaluation areas within the RoW were established: 1) an On RoW construction corridor, and 2) tower work areas (TWAs).

¹ Stantec completed a similar evaluation for the Bipole III Transmission Project. Through this evaluation, it was determined that a 20 m corridor centered on the transmission line provided a more reliable means of identifying potential effects between towers when compared with evaluating the entire RoW area.

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Delineation of these features was completed in the ArcGIS environment using known locations of existing project components including the current transmission centreline, tower locations and Project RoW extents. The On RoW construction corridor was delineated by generating a 20 m wide corridor along the current transmission line, and TWAs were delineated by generating 80 m buffers around tower locations.

Off RoW evaluation areas were delineated by generating an 80 m buffer from the outer extents of the current Project RoW. A width of 80 m for these Off RoW evaluation areas was selected to approximate the average RoW width.

The study areas are displayed in a conceptual diagram in **Figure 2.2**.



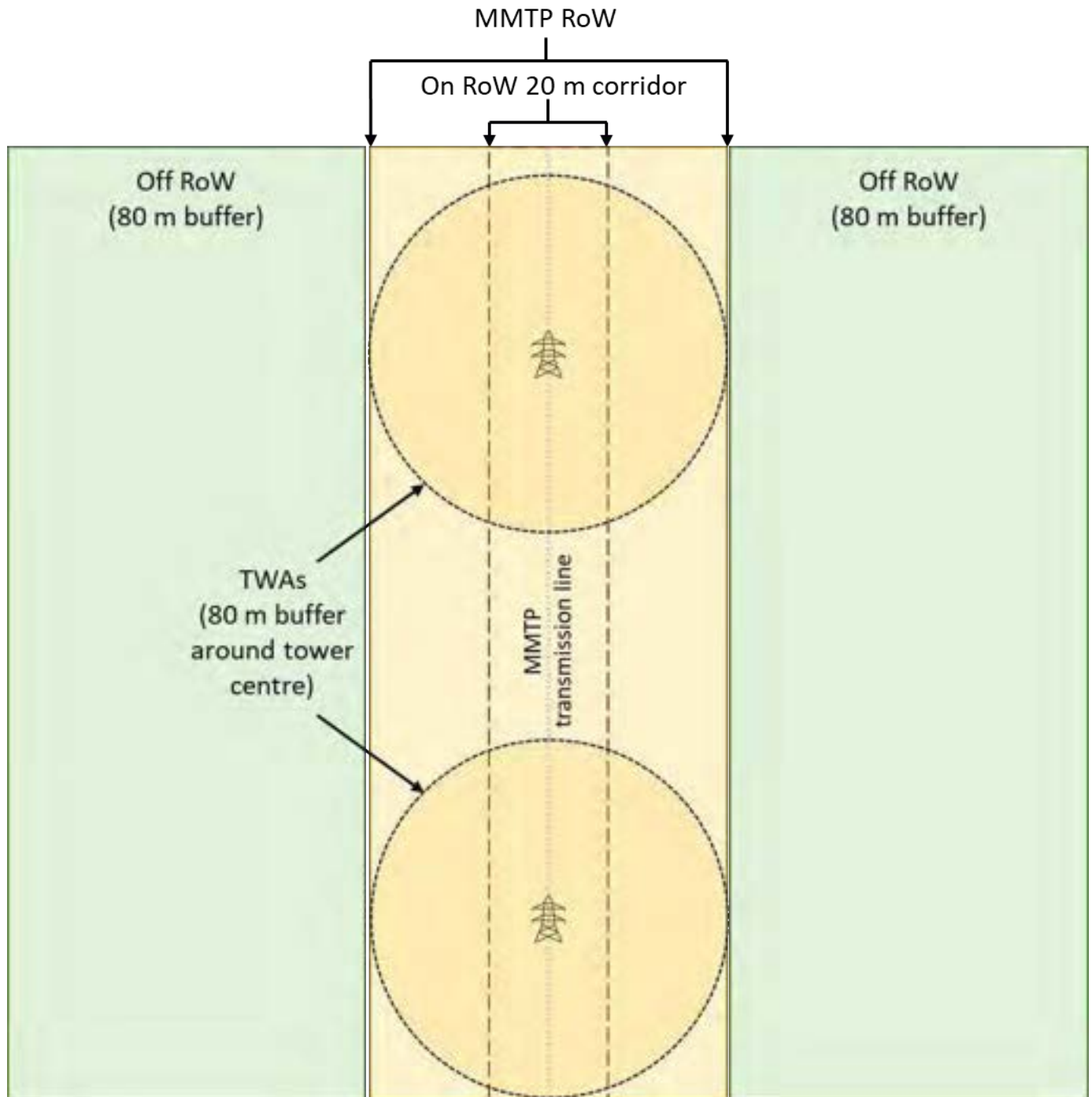


Figure 2.2 Conceptual Drawing of On RoW, TWA and Off RoW Study Areas

2.3.2 AGRICULTURAL EVALUATION AREA DELINEATION

In order to analyze data and evaluate potential for effects to soil productivity within the RoW from construction activities, On RoW, TWA and Off RoW agricultural evaluation areas were established within portions of the Project traversing agricultural land. This was accomplished within the ArcGIS software environment as follows:

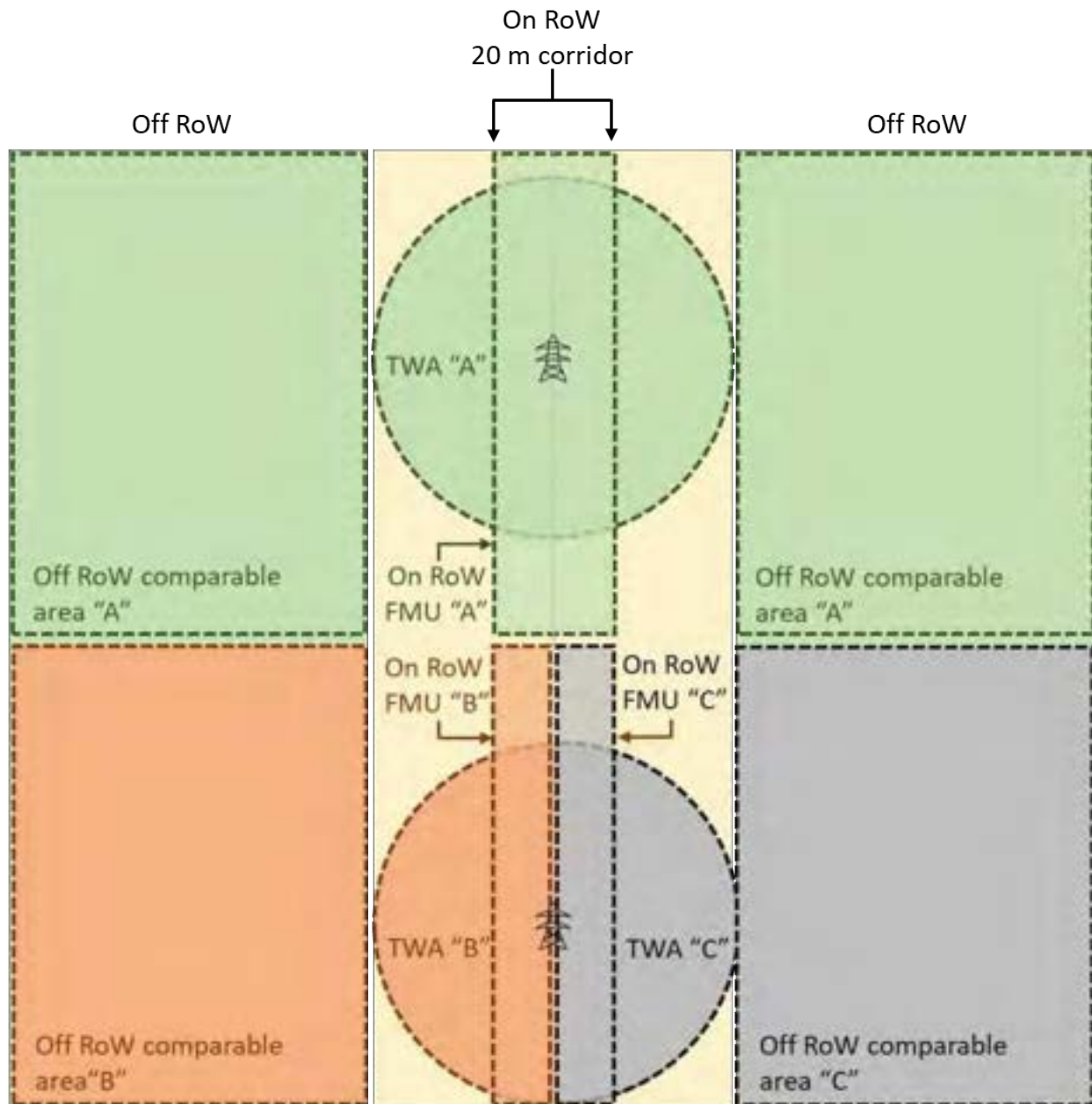
1. Delineating areas of agricultural land use using agricultural crop inventory data (AAFC, 2021), specifically areas of land under annual crop, forage (hay) or grassland (pasture). This resulted in the elimination of non-agricultural land uses (e.g., infrastructure such as roads, rail and other transmission lines, tree/forest/bush cover, wetlands, abandoned land, etc.).
2. Eliminating portions of On Row, TWA and Off RoW study areas in areas of non-agricultural land uses.
3. Dividing the resulting agricultural evaluation area according to discrete agricultural field management units (FMUs) using the land ownership grid (i.e., quarter section, river lots, etc.) as a basis combined with heads-up digitizing, supported with orthoimagery and agricultural crop inventory data (AAFC, 2021). This resulted in the delineation of discrete On RoW FMUs (i.e., portions of the 20 m corridor within a discrete FMU) and TWAs paired with comparable Off RoW evaluation areas within the discrete FMU area.
4. Identifying and labeling individual On RoW FMUs and TWAs, and comparable Off RoW evaluation area counterparts. In cases where multiple FMU areas were delineated within a given quarter section, these evaluation areas were labelled successively with “A”, “B”, “C”, etc. to yield unique identifiers for data management and for comparative evaluation purposes.

The establishment of On RoW FMUs, TWAs, and comparable Off RoW evaluation areas provided the basis for comparison of soil productivity within agricultural areas potentially disturbed by the Project against comparable agricultural areas not disturbed by the Project.

A conceptual drawing of On ROW FMUs, TWAs and Off RoW comparable areas is displayed in **Figure 2.3**.

An example of these evaluation areas for a select quarter section is presented in **Figure 2.4**.





Within FMU "A" (dark green outline), the On RoW FMU "A" area is compared against the Off RoW comparable area "A" to determine the NDVI difference. Within FMU B (dark orange outline), the On RoW FMU "B" area is compared against the Off RoW comparable area "B" to determine the NDVI difference. Within FMU C (black outline), the On RoW FMU "C" area is compared against the Off RoW comparable area "C" to determine the NDVI difference. For TWAs, TWA "A" is compared against Off RoW comparable area "A", TWA "B" is compared against Off RoW comparable area "B" and TWA "C" is compared against Off RoW comparable area "C".

Figure 2.3 Conceptual Drawing of On RoW FMUs, TWAs and Off RoW Comparable Areas

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On RoW FMUs shown in solid gray and blue outlines; TWAs shown in solid gray and blue circular outlines; Off RoW FMUs shown in dashed gray outlines. Note SW-17-1-12-E has two, discrete On RoW FMUs (i.e., "A" and "B"), and On RoW FMUs and TWAs have corresponding Off RoW comparable areas denoted as "A" and "B".

Figure 2.4 Screen Capture from ArcGIS showing On RoW FMUs, TWAs and Off RoW Comparable Areas within a Select Quarter Section



2.4 Data Analysis

2.4.1 NDVI EVALUATION

NDVI evaluation was completed for the entire agricultural portion of the Project RoW in order to develop an understanding of the differences in NDVI values between individual On RoW FMUs and TWAs, and their corresponding Off RoW comparable areas. This understanding was then used to:

- identify areas within the Project RoW where Project-related disturbances may be negatively affecting soil productivity; and
- track the post-construction recovery of soil productivity in these areas of potential Project-related disturbances.

Difference values were determined for each individual On RoW FMU and TWA as follows:

- On RoW FMU NDVI mean value – Off RoW comparable area NDVI mean value = FMU NDVI difference value
- TWA NDVI mean value – TWA comparable area mean value = TWA NDVI difference value

Statistical analyses were completed on NDVI mean values and NDVI difference values to characterize the NDVI data. The use of threshold values for NDVI differences was employed to identify potential practically-meaningful NDVI differences within individual On RoW FMUs and TWAs. Statistical analyses approaches and NDVI difference thresholds are discussed further in the sections below.

In addition, a visual assessment of imagery data was completed, as discussed below.

A total of 239 On RoW FMUs and 337 TWAs were evaluated in 2021.

2.4.2 STATISTICAL ANALYSES

Basic statistical analyses were conducted on NDVI mean values for On RoW FMUs and TWAs, and Off RoW comparable areas, and NDVI difference values. Statistical analyses included frequency histograms and quartile analyses to understand the character and distribution of mean values for On RoW FMUs, TWAs and Off RoW comparable areas. For difference values, values were plotted against the expected normal distribution, quartiles were determined, and percentiles were examined to characterize the data distributions.

2.4.3 NDVI DIFFERENCE THRESHOLDS

To support the remotely-sensed NDVI approach to identify potential Project-related disturbances to soil productivity within the RoW, thresholds for NDVI difference values were established. Difference value thresholds were used to identify individual On RoW FMUs and TWAs whose NDVI difference values were considered outliers relative to the normal variation in NDVI difference values expected if there were no disturbances to soil productivity.



The threshold values were established in both the positive and negative difference directions; therefore, both positive and negative outliers in the NDVI difference values were identified. In other words, the thresholds were established such that NDVI difference values between the positive and negative thresholds were considered to be within the normal variation of differences between On RoW and Off RoW areas. NDVI difference values for individual On RoW FMUs and TWAs exceeding the positive threshold were considered positive outliers (i.e., soil and crop productivity was higher in the On RoW area vs. Off RoW area) and values below the negative threshold were considered negative outliers (i.e., soil and crop productivity was lower in the ON RoW area vs. Off RoW area). Negative outliers are of more interest to this evaluation as they are indicative of potential Project-related disturbances resulting in reduced soil productivity On RoW relative to comparable Off RoW areas.

Threshold values were established using quartile data, specifically inter-quartile ranges. Quartiles were used to divide the NDVI difference value data into four segments according to where the values fall in relation to the overall range of values. Quartiles are defined as follows:

- Q1 (lower quartile or 25th percentile) – 25% of values fall below this quartile value
- Q2 (50th percentile or the median value) – 50% of values are above this quartile value and 50% are below
- Q3 (upper quartile or 75th percentile) – 25% of values fall above this quartile value

The interquartile range (IQR) is defined as $Q3 - Q1$, and provides an indication of the spread of the middle 50% of values, as well as a means to identify outliers (below).

Quartiles were used to identify what's called inner and outer fences for NDVI difference values, as an indicator of minor and major outliers, respectively. These inner and outer fences were determined in the negative (lower) and positive (upper) directions as follows:

- Inner lower fence (minor negative outlier threshold): $Q1 - (1.5 \times IQR)$
- Outer lower fence (major negative outlier threshold): $Q1 - (3 \times IQR)$
- Inner upper fence (minor positive outlier threshold): $Q3 + (1.5 \times IQR)$
- Outer upper fence (major positive outlier threshold): $Q3 + (3 \times IQR)$

A conceptual diagram illustrating the inner fences (minor outlier thresholds) and outer fences (major outlier thresholds) is presented in **Figure 2.5**.

Thresholds were developed based on the pre-construction (2019) NDVI difference values for On RoW FMUs and TWAs. These 2019 threshold values were used to evaluate post-construction year 2 (2021) difference values, as the 2019 values present the baseline or pre-disturbance (i.e., pre-construction) conditions.

NDVI threshold values are presented in **Table 2.1** and are visualized in **Figure 2.6**.



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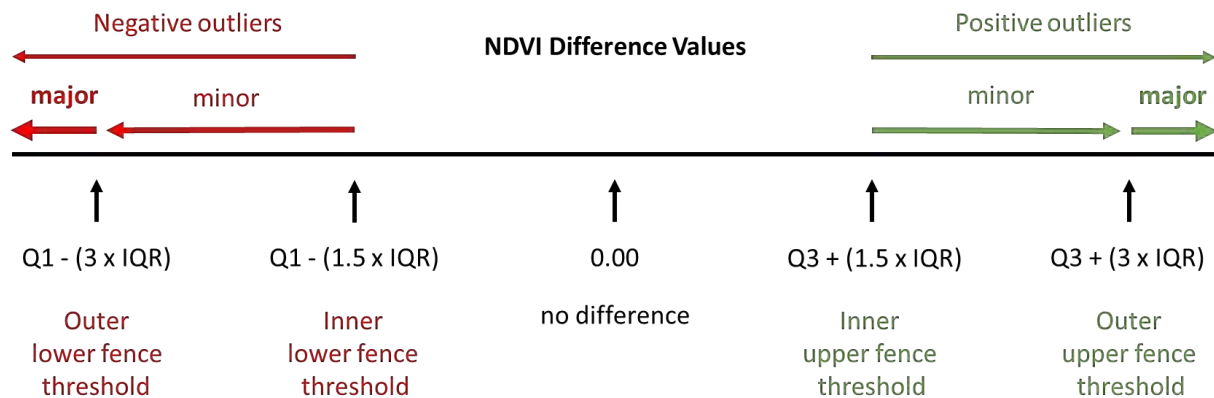


Figure 2.5 Conceptual Drawing of NDVI Difference Thresholds

Table 2.1 NDVI Difference Threshold Values for On RoW FMUs and TWAs Determined Using 2019 Results

Evaluation Component	Negative threshold		Positive threshold	
	Outer Upper Fence	Outer Upper Fence	Outer Upper Fence	Outer Lower Fence
	Major positive difference threshold	Major positive difference threshold	Major positive difference threshold	Major negative difference threshold
On RoW FMUs	-0.052	-0.090	0.090	0.052
TWAs	-0.084	-0.145	0.140	0.079

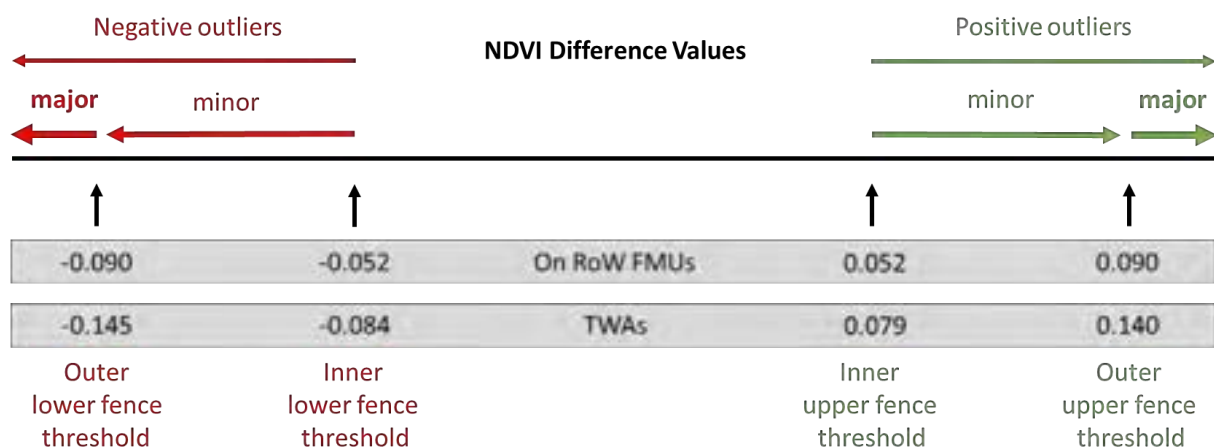


Figure 2.6 NDVI Difference Threshold Values for On RoW FMUs and TWAs Determined Using 2019 Results



2.4.4 VISUAL ASSESSMENT

A manual visual imagery review of all On RoW FMUs and TWAs considered to be negative outliers in 2021 was conducted to characterize the nature of the NDVI differences and confirm visual evidence of potential construction effects to soil productivity along the agricultural portions of the Project RoW. This visual assessment was used to confirm that negative outliers were considered to be the result of Project-related disturbances to soil productivity. In some cases, the visual assessment indicated that negative outliers were the result of factors not related to Project activities, for example in cases where it was apparent that differences were due to variable status of agricultural field management within an FMU [e.g., crop partially harvested], or natural variability in soil capability or productivity [e.g., soil drainage, fertility or salinity]).

2.5 Field Assessment

No field assessments were conducted during the 2021 post-construction monitoring season, as these were not deemed necessary to support the monitoring program.

Methods for field assessments would be developed as necessitated by the site-specific assessment requirements.



3 Results and Discussion

Summaries and discussions of NDVI soil productivity analyses are presented for On RoW FMUs in Section 3.1 and TWAs in Section 3.2. For the purposes of this evaluation:

- Of the total transmission line length of 213 km, 114 km (53.5%) were determined to be within the agricultural evaluation area and a total of 239 On RoW FMUs were delineated.
- Of the 499 total tower structures, 305 tower structures (61.1%) were considered within the agricultural evaluation area and a total of 337 discrete TWAs were delineated (note: the higher TWA number relative to tower structures in the agricultural evaluation area is due to field management unit splits where towers straddle management units).

NDVI difference values for individual agricultural evaluation areas for pre-construction (2019), post-construction year 1 (2020), and post-construction year 2 (2021) monitoring seasons are in Tables A.1.1 for FMUs and Table A.1.2 for TWAs. (Appendix A.1). Statistical analyses are presented in the sections below and in Appendix B.

Tabular summaries, figures and discussions of results are supplemented with a mapbook displaying NDVI values, and FMU and TWA outliers for the 2020 and 2021 monitoring seasons (Appendix C).

3.1 Soil Productivity within Farm Management Units (FMUs)

3.1.1 POST-CONSTRUCTION YEAR 2 (2021) MONITORING SEASON

3.1.1.1 Summary of NDVI Values and Negative Difference Outliers

A summary of basic statistics for On RoW FMUs, Off RoW comparable areas and difference values is provided in **Table 3.1**. The mean and median values were found to be lower for On RoW FMUs relative to Off RoW comparable areas, resulting in negative difference values across the Project RoW. Of the 239 On RoW FMUs, differences were found to be negative in 174 (72.8%) and positive in 65 (27.2%). These results demonstrate a negative “skewness” in the data, in other words, the NDVI values are shifted in a negative direction relative to the pre-construction monitoring season.

These data indicate that soil productivity, as represented by NDVI, is lower in On RoW areas relative to Off RoW areas within the 20 m corridor along the transmission centreline in the post-construction year 2 (2021) monitoring season. This suggests that persisting Project-related disturbances have resulted in reduced soil productivity in portions of the RoW. However, they are less skewed in the negative direction relative to 2020 results (discussed later), suggesting FMUs are recovering from Project disturbance.

Further statistical support that NDVI values are lower in On RoW FMUs relative to Off RoW comparable areas is provided in Figures B.1.1 to B.1.4 (Appendix B.1).



Table 3.1 Basic Statistics for 2021 NDVI Results for On RoW FMUs

Parameter	On RoW FMU	Off RoW Comparable Areas	Difference (On RoW – Off RoW)
Count	239	239	239
Mean	0.580	0.595	-0.015
Minimum	0.321	0.337	-0.204
Median	0.591	0.611	-0.014
Maximum	0.864	0.886	0.209
Range	0.543	0.549	0.412
Count of Negatives	n/a	n/a	174
% Negatives	n/a	n/a	72.8%
Count of Positives	n/a	n/a	65
% Positives	n/a	n/a	27.2%

Outliers were identified using the thresholds presented in Section 2.4.3. As noted in Section 2.4:

- NDVI difference values that exceed the positive threshold are considered positive outliers and are likely the result of factors not related to Project activities. For example, they may be due to incorrect FMU delineation or natural variability in soil capability or productivity, such as differing soil drainage, fertility, or salinity conditions in the On RoW and Off RoW evaluation areas. These positive outliers are of little interest to this evaluation and are not discussed further.
- NDVI difference values for individual FMUs that are below the negative threshold are likely the result of a Project-related disturbance within the RoW reducing soil productivity. However, it is possible that even the negative outliers may be the result of other factors, hence the need for further evaluation of data for individual FMUs where NDVI difference values are below the negative threshold.

A summary of outliers in 2021 is presented in **Table 3.2** as follows:

- There was a total of 12 positive outliers (5.0% of total), 6 of which were considered minor positive outliers (2.5% of total) and 6 of which were considered major positive outliers (2.5% of total).
- There was a total of 33 negative outliers (13.8% of total), 18 of which were considered minor negative outliers (7.5% of total) and 15 of which were considered major negative outliers (6.3% of total).

A visual representation of the number and percentage of On RoW FMUs considered negative outliers and remaining FMUs with NDVI difference values above the threshold is presented in **Figure 3.1**.



Table 3.2 Summary of NDVI Difference Outliers for 2021 NDVI for On RoW FMUs

Outlier Direction	Outlier Category	Threshold Value	Count	% of Total	Count	% of Total
Positive	Major positive outlier	>0.091	6	2.5	12	5.0
	Minor positive outlier	>0.052 to 0.091	6	2.5		
Negative	Minor negative outlier	<-0.052 to -0.091	18	7.5	33	13.8
	Major negative outlier	<-0.091	15	6.3		

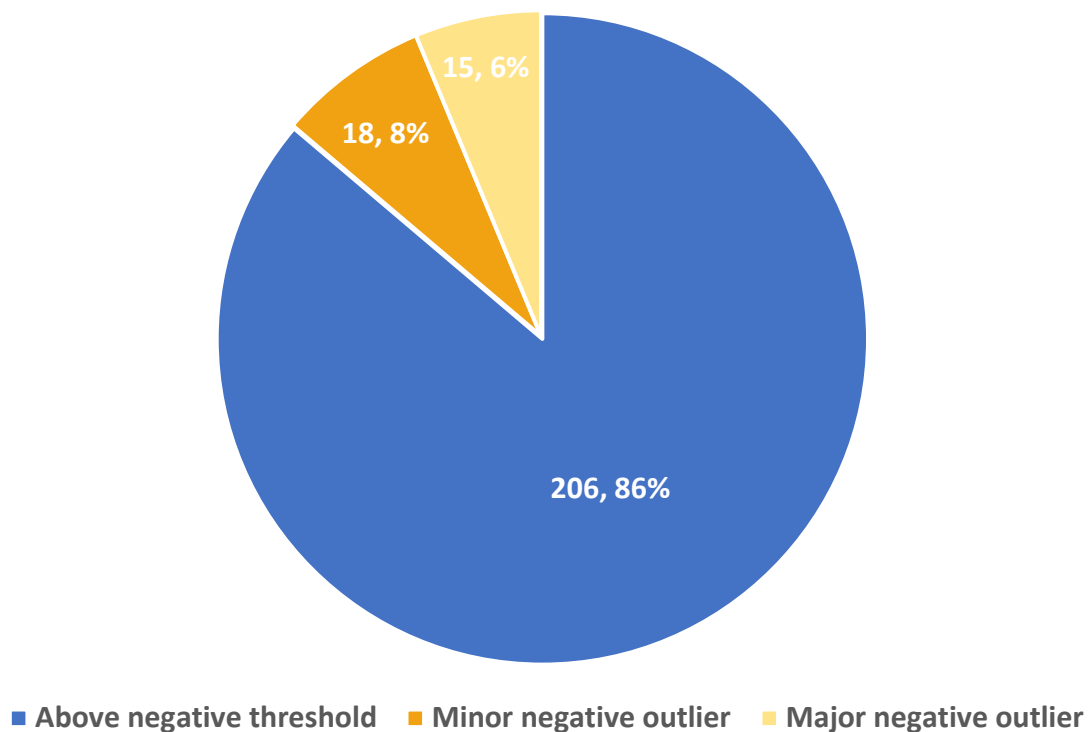


Figure 3.1 On RoW FMUs Considered Negative Outliers in 2021

3.1.1.2 Project Related Disturbance Category Summary

A visual review and evaluation of negative outliers in 2021 was completed to classify On RoW NDVI results in the following negative outlier categories:

- **Project-related disturbance persists** – Project-related disturbance has resulted in a difference below negative threshold persisting through 2021, in the minor negative outlier category or major negative outlier category; or

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- **Recovered** – NDVI difference values were found to be below the negative threshold in 2020 but above the threshold in 2021, indicating recovery of NDVI values to a level similar to undisturbed Off RoW comparable areas; or
- **No Project Related Disturbance**
 - **No disturbance** – NDVI difference values were above the negative threshold in 2020 and 2021.
 - **Negative outlier, nature unknown (not Project related)** – NDVI difference below negative threshold in 2021, but the difference does not appear to be a result of the Project (i.e., related to other factors, such as variable status of agricultural field management with the FMU [e.g., field partially harvested], or natural variability in soil capability or productivity [e.g., soil drainage, fertility, or salinity]).

A summary of counts and proportions of individual On RoW FMUs in each of the disturbance categories is found in **Table 3.3** and **Figure 3.2**. Following visual review and evaluation of negative outliers:

- Of the 165 On RoW FMUs (68.6%) considered to have no Project-related disturbance:
 - A total of 8 On RoW FMUs (3.3%) were found to have been negative outliers but not due to Project-related effects, rather low NDVI difference values are due to systematic errors (e.g., inappropriate FMU delineation, field management variability) or are assumed to be outliers due to random, natural variability (e.g., soil moisture conditions/soil drainage variation).
 - A total of 156 On RoW FMUs (65.3%) were found to have no Project-related disturbance in 2020 or 2021.
- A total of 50 On RoW FMUs (20.9%) were found to have Project-related disturbance in 2020 but were not found to be negative outliers in 2021 and are considered to have recovered from Project-related disturbance.
- A total of 25 On RoW FMUs (10.4%) are considered to have lower crop and soil productivity due to Project-related disturbances, 13 of which (5.4%) are considered trending towards recovery (i.e., positive trend in negative NDVI difference values between 2020 and 2021) and 12 of which (5.0%) are considered to have Project-related disturbance in 2021 with NDVI values not trending toward recovery (i.e., negative trend in difference values between 2020 and 2021).

Table 3.3 Summary of Disturbance Status for On RoW FMUs

Disturbance Category	On RoW FMU Count	% of Total FMUs
Project-related disturbance persists	25	10.4
<i>Disturbance persists</i>	12	5.0
<i>Disturbed persists, trending to recovery</i>	13	5.4
Recovered	50	20.9
No Project-related disturbance	164	68.6
<i>Negative outlier, nature unknown (not Project related)</i>	8	3.3
<i>No disturbance</i>	156	65.3



Total	239	100.0
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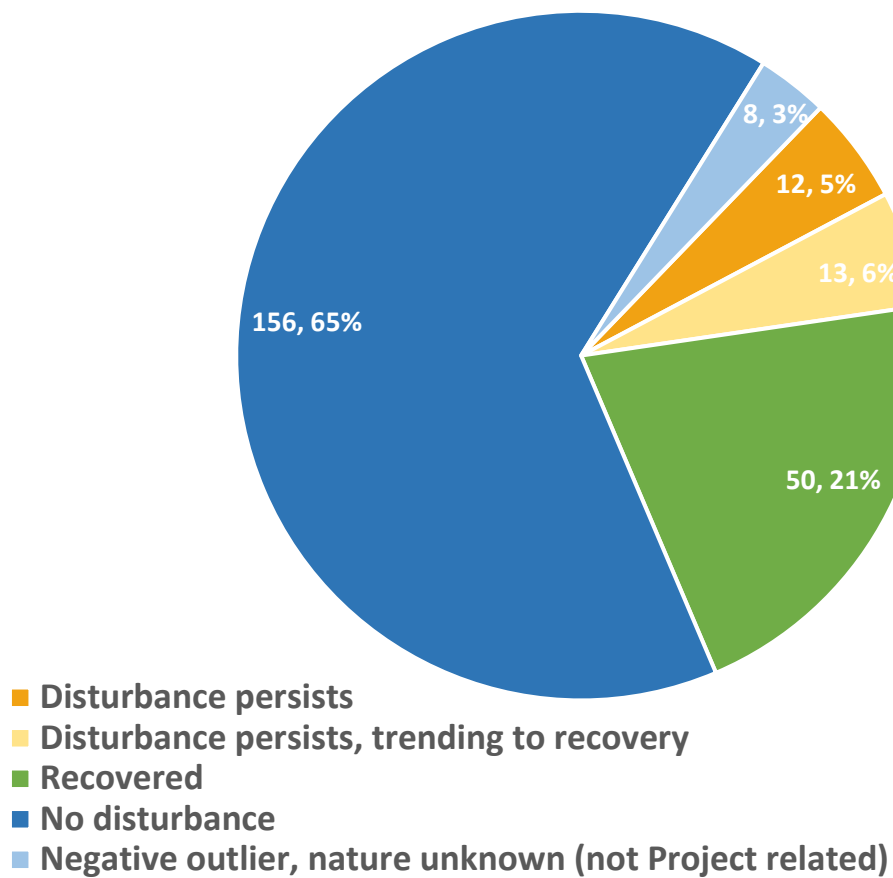


Figure 3.2 **Proportion of On RoW FMUs by Recovery Category**



3.1.1.3 Visual Examples

The following examples are presented to provide an indication of visual confirmation of NDVI evaluation scenarios. Two examples are presented for the evaluation of On RoW FMUs against Off RoW comparable areas:

- An example of an On RoW FMU that was considered disturbed (minor negative outlier) in post-construction year 1 (2020) and recovered in post-construction year 2 (2021) is presented in Figure 3.3. The relatively low NDVI values (yellow and orange) within the 20 m On RoW FMU corridor are indicative of disturbance along the construction trail between towers. In post-construction year 2 (2021), the On RoW FMU has similar NDVI values to the comparable Off RoW areas, indicating the crop and soil productivity within the RoW corridor has returned to pre-disturbance levels.
- Another example of an On RoW FMU that was considered disturbed (minor negative outlier) in post-construction year 1 (2020) and recovered in post-construction year 2 (2021) is presented in Figure 3.4. The 20 m On RoW FMU corridor has lower NDVI values (yellow, orange and red) relative to the comparable Off RoW areas due to disturbance along the 20 m corridor, around towers and associated with access into the field at the north end of the FMU close to tower D604I_014. In post-construction year 2 (2021), the NDVI values within most of the FMU have returned to similar values to comparable Off RoW areas, indicating the crop and soil productivity within the RoW corridor has mostly returned to pre-disturbance levels. The NDVI difference value for the FMU was similar to the comparable areas Off RoW, therefore this FMU is considered recovered in 2021.

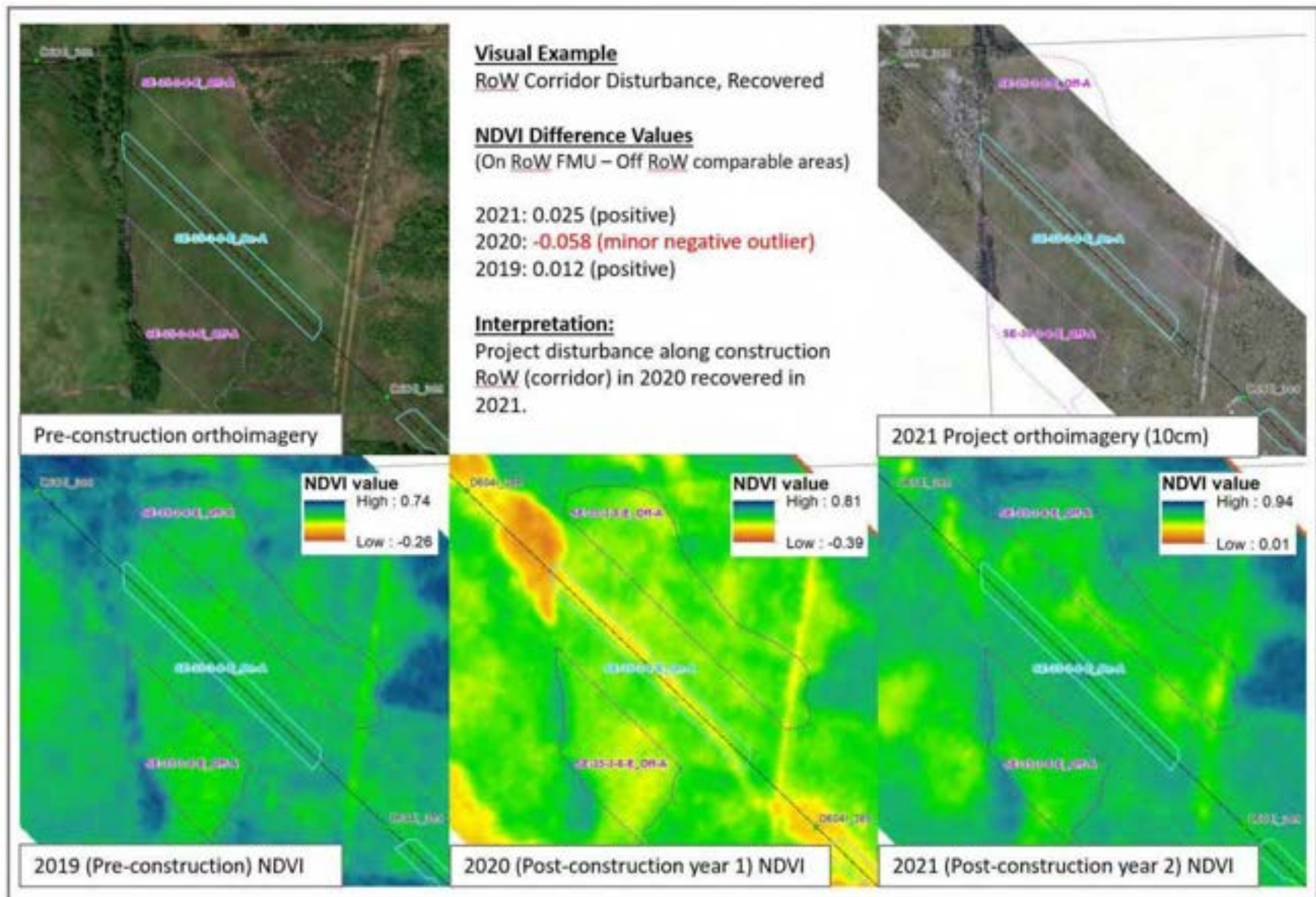


Figure 3.3 Example of On RoW FMU (SE-35-3-8-E_On-A) considered disturbed by the Project in 2020 and recovered in 2021



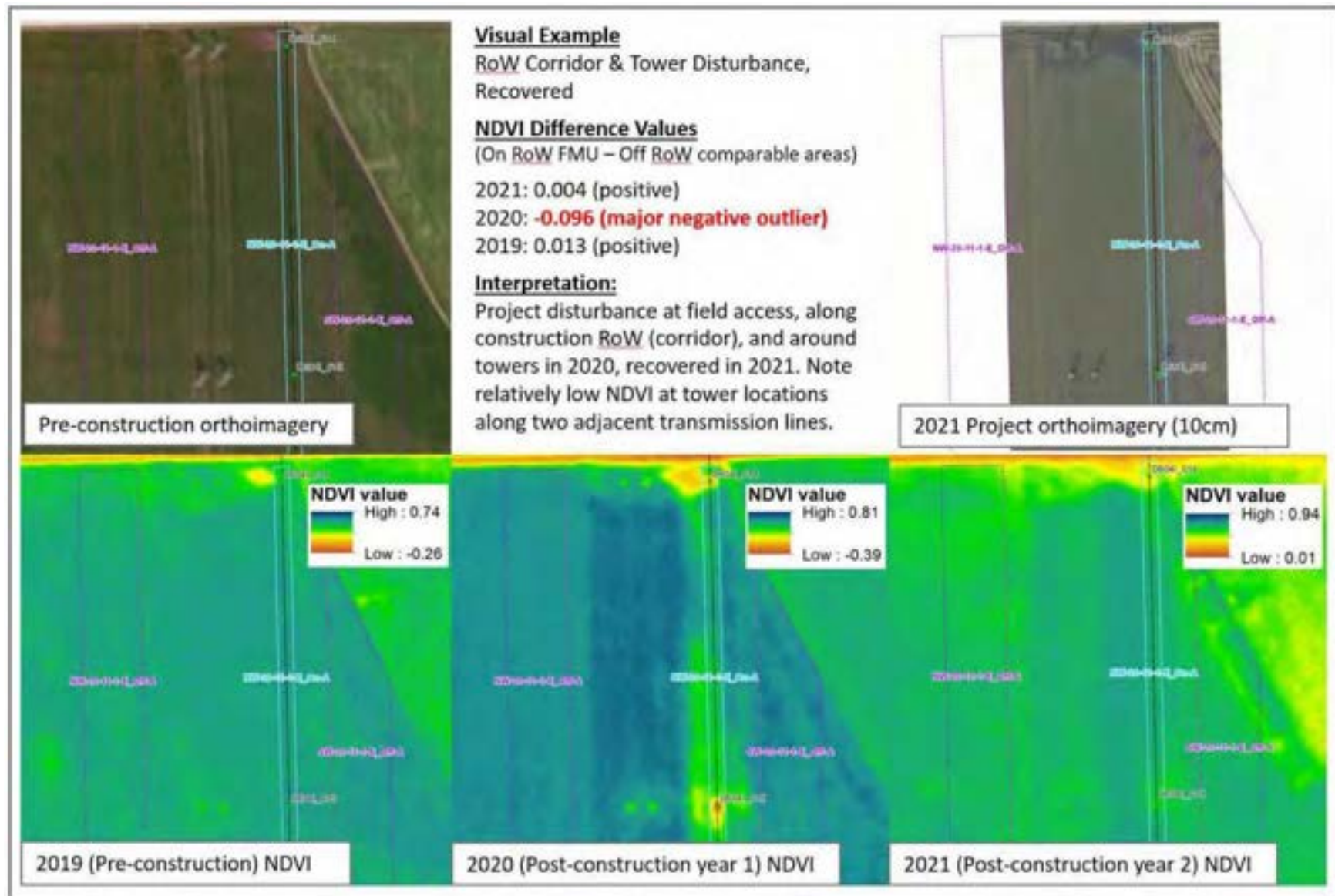


Figure 3.4 Example of On RoW FMU (NW-24-1-11-E_On-A) considered disturbed in 2020 and recovered in 2021



3.1.2 TREND ANALYSIS FOR FARM MANAGEMENT UNITS (FMUs)

3.1.2.1 Summary of Negative Difference Outliers

Notably but as expected, there was a decrease in On RoW FMUs with NDVI differences below the negative threshold from the post-construction year 1 (2020; 72 On RoW FMUs or 31.4%) to post-construction year 2 (2021; 33 On RoW FMUs or 13.8%), although there was still a higher incidence of occurrences than in pre-construction (2019; 9 On RoW FMUs). A summary of counts of On RoW FMUs with NDVI differences considered negative outliers is presented in **Table 3.4** and **Figure 3.5**.

While not presented in Table 3.4, the count of positive outliers in 2021 (12) was found to be similar to 2020 (13) and slightly higher than 2019 (19); however, these results are not expected to be Project-related, rather are assumed to be related to random variability.

These data suggest that Project disturbances have affected soil productivity On RoW and have persisted through the post-construction year 2 monitoring season. However, the level of disturbance persisting is lower relative to post-construction year 1, suggesting some recovery of soil productivity. A review of individual On RoW FMUs was required to confirm the nature of disturbances, specifically if negative outliers are the result of Project-related disturbances.



Table 3.4 On RoW FMUs with NDVI Difference Below Negative Thresholds in 2019, 2020 and 2021

Year	Total count	Negatives		Total Negative Outliers		Minor Negative Outliers		Major Negative Outliers	
		Count	%	Count	%	Count	%	Count	%
2019	229	113	49.3	9	3.9	6	2.6	3	1.3
2020	229	182	79.5	72	31.4	36	15.7	36	15.7
2021	239	174	72.8	33	13.8	18	7.5	15	6.3

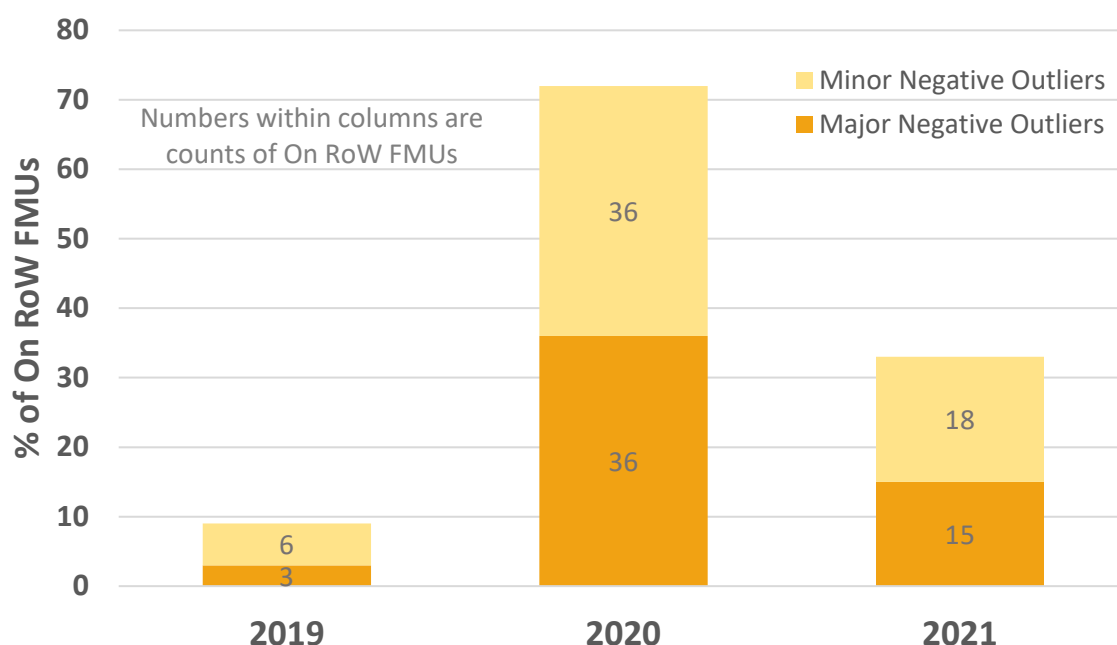


Figure 3.5 On RoW FMUs below the Negative Thresholds in 2019, 2020 and 2021

3.1.2.2 Project Related Disturbance Category Summary

A summary of disturbance categories for On RoW FMUs for the post-construction year 1 (2020) and post-construction year 2 (2021) monitoring seasons are presented in **Figure 3.6**. This provides a useful summary and visual support for the reduction in FMUs considered to have Project-related disturbances persisting. In 2020, a total of 65 On RoW FMUs were considered disturbed by Project activities within the 20 m evaluation corridor, representing 28% of all FMUs evaluated. In 2021, the total number of On RoW FMUs considered disturbed had dropped to 25, or 10% of all FMUs evaluated. Of these 25 FMUs, 13 were considered to be trending toward recovery (i.e., positive trend in NDVI difference between On RoW FMU and Off RoW comparable areas), while the remaining 12 were found to have disturbances persisting with NDVI difference values not trending in the direction of recovery. A total of 50 On RoW FMUs considered disturbed by Project activities in the 2020 monitoring season were considered recovered in 2021.



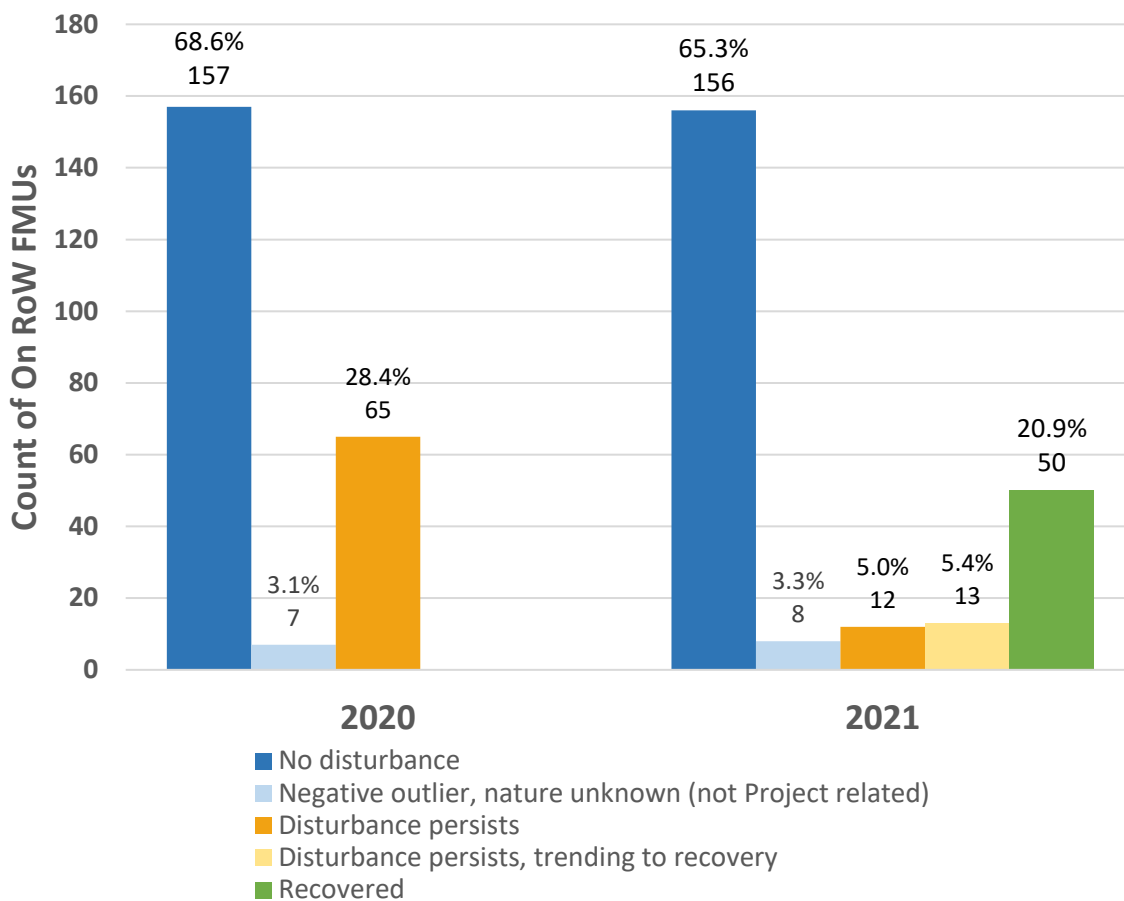


Figure 3.6 Disturbance Category Summary for On RoW FMUs for 2020 and 2021

3.2 Soil Productivity within Tower Work Areas (TWAs)

3.2.1 POST-CONSTRUCTION YEAR 2 (2021) MONITORING SEASON

3.2.1.1 Summary of NDVI Values and Negative Difference Outliers

A summary of basic statistics for TWAs, Off RoW comparable areas and difference values is provided in **Table 3.5**. The mean and median values were found to be lower for TWAs relative to Off RoW comparable areas resulting in negative difference values. Of the 337 TWAs, differences were found to be negative in 232 (68.8%) and positive in 105 (31.2%). These results demonstrate a negative “skewness” in the data, in other words, the NDVI values have shifted in a negative direction relative to the pre-construction monitoring season.



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These data indicate soil productivity, as represented by NDVI, is lower in areas represented by TWAs relative to Off RoW areas in the post-construction year 2 (2021) monitoring season. This suggests that persisting Project-related disturbances have resulted in reduced soil productivity in TWAs. However, they are less skewed in the negative direction relative to 2020 results (discussed later), suggesting TWAs are recovering from Project disturbance.

Further statistical support that NDVI values are lower in TWAs relative to Off RoW comparable areas is provided in Figures B.2.1 to B.2.4 (Appendix B.2).

Table 3.5 Basic Statistics for 2021 NDVI Results for TWAs

Parameter	TWAs	Off RoW Comparable Areas	Difference (On RoW - Off RoW)
Count	337	337	337
Mean	0.563	0.581	-0.018
Minimum	0.305	0.337	-0.289
Median	0.576	0.588	-0.019
Maximum	0.874	0.886	0.272
Range	0.569	0.549	0.561
Count of Negatives	n/a	n/a	232
% Negatives	n/a	n/a	68.8%
Count of Positives	n/a	n/a	105
% Positives	n/a	n/a	31.2%

Outliers were identified using the thresholds presented in Section 2.4.3. As noted in Section 2.4:

- NDVI difference values that exceed the positive threshold are considered positive outliers and are likely the result of factors not related to Project activities. For example, they may be due to incorrect delineation of Off RoW comparable areas relative to TWAs, variable management of the land within the TWA and corresponding Off RoW comparable area, or natural variability in soil capability or productivity, such as differing soil drainage, fertility, or salinity conditions in the On RoW and Off RoW evaluation areas. These positive outliers are not of interest to this evaluation and are not discussed further.
- NDVI difference values for individual TWAs that are below the negative threshold are likely the result of a Project-related disturbance within TWAs reducing soil productivity. However, it is possible that even the negative outliers may be the result of other factors, hence the need for further evaluation of data for individual TWAs where NDVI difference values are below the negative threshold.

A summary of outliers in 2021 is presented in **Table 3.6** as follows:

- there was a total of 14 positive outliers (4.2% of total), 12 of which were considered minor positive outliers (3.6% of total) and 2 of which were considered major positive outliers (0.6% of total).



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- there was a total of 23 negative outliers (6.8% of total), 21 of which were considered minor negative outliers (6.2% of total) and 2 of which were considered major negative outliers (0.6% of total).

A visual representation of the number and percentage of TWAs considered negative outliers and remaining TWAs with NDVI difference values above the threshold is presented in **Figure 3.7**.

Table 3.6 Summary of NDVI Difference Outliers for 2021 NDVI for TWAs

Outlier Direction	Outlier Category	Threshold Value	Count	% of Total	Count	% of Total
Positive	Major positive outlier	>0.140	2	0.6	14	4.2
	Minor positive outlier	>0.079 to 0.140	12	3.6		
Negative	Minor negative outlier	<-0.084 to -0.145	21	6.2	23	6.8
	Major negative outlier	<-0.145	2	0.6		

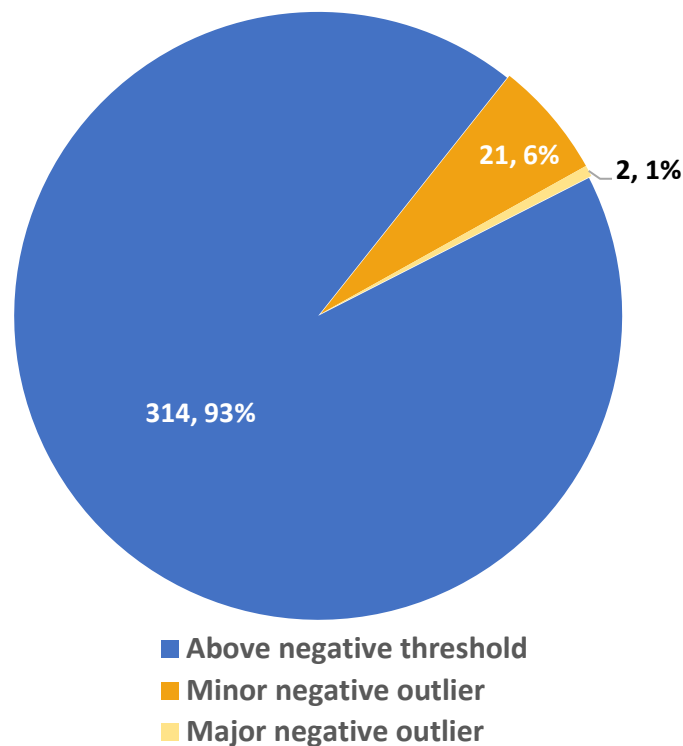


Figure 3.7 TWAs Considered Negative Outliers in 2021



3.2.1.2 Project Related Disturbance Summary

A visual review and evaluation of negative outliers in 2021 was completed to classify TWAs in the following negative outlier categories:

- **Project-related disturbance persists** – Project-related disturbance has resulted in an NDVI difference below negative threshold persisting through 2021, in the minor negative outlier category or major negative outlier category; or
- **Recovered** – NDVI difference values were found to be below the negative threshold in 2020 but above the threshold in 2021, indicating recovery of NDVI values to a level similar to undisturbed Off RoW comparable areas. In some cases, a TWA may remain below the negative threshold but through visual assessment the low NDVI values within the TWA were determined to be not Project related; or
- **No Project Related Disturbance**
 - **No disturbance** – NDVI difference values were above the negative threshold in 2020 and 2021.
 - **Negative outlier, nature unknown (not Project related)** – NDVI difference below negative threshold in 2021, but the difference does not appear to be a result of the Project (i.e., related to other factors, such as variable status of agricultural field management with the TWA [e.g., field partially harvested], or natural variability in soil capability or productivity [e.g., soil drainage, fertility, or salinity]).

A summary of counts and proportions of individual TWAs in each of the disturbance categories is provided in **Table 3.7** and **Figure 3.8**. Following visual review and evaluation of negative outliers:

- Of the 255 TWAs (75.4%) considered to have no Project-related disturbance through 2020 and 2021:
 - A total of 2 TWAs (0.6%) were found to have been negative outliers but not due to Project-related effects rather low NDVI difference values are due to systematic errors (e.g., inappropriate TWA or comparable Off RoW FMU delineation, field management variability) or are assumed to be outliers due to random, natural variability (e.g., soil moisture conditions/soil drainage variation).
 - A total of 252 TWAs (74.6%) were found to have no Project-related disturbance in 2020 or 2021.
- A total of 21 TWAs (6.2%) are considered to have lower crop and soil productivity due to Project-related disturbances, 13 of which (3.8%) are considered trending towards recovery (i.e., positive trend in negative NDVI difference values between 2020 and 2021) and 8 of which (2.4%) are considered to have Project-related disturbance in 2021 with NDVI values not trending toward recovery (i.e., negative trend in difference values between 2020 and 2021).
- A total of 62 TWAs (18.3%) are now considered recovered after being considered disturbed in 2020, including 2 TWAs (0.6%) which were considered disturbed in 2020 and still found to be negative outliers in 2021 but whose depressed NDVI values were determined through visual assessment to be not related to project activities.



Table 3.7 Summary of Disturbance Status for TWAs

Disturbance Category	TWA Count	% of Total TWAs
Project-related disturbance persists	21	6.2
<i>Disturbance persists</i>	8	2.4
<i>Disturbed persists, trending to recovery</i>	13	3.8
Recovered	62	18.3
<i>Recovered</i>	60	17.8
<i>Negative outlier, nature unknown (not Project related)</i>	2	0.6
No disturbance	255	75.4
<i>Negative outlier, not project related</i>	2	0.6
<i>No disturbance</i>	252	74.6
Total	337	100.0

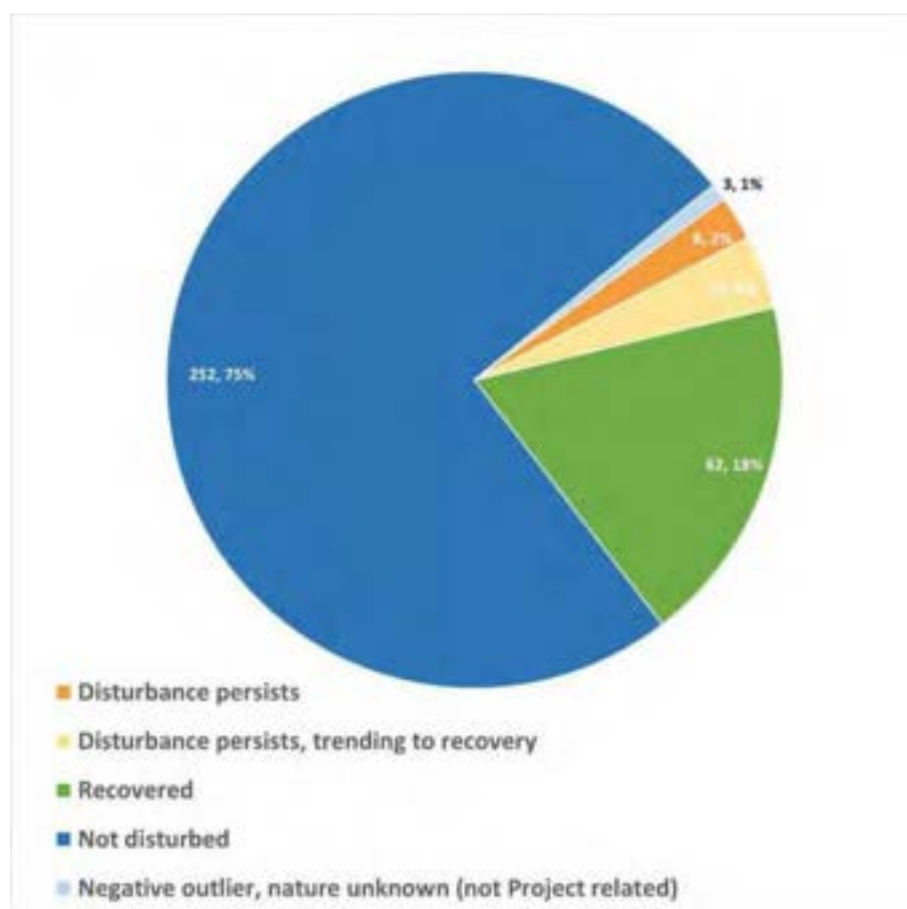


Figure 3.8 Proportion of TWAs by Disturbance Category



3.2.1.3 Visual Examples

The following examples are presented to provide an indication of visual confirmation of NDVI evaluation scenarios. Two examples are presented for the evaluation of TWAs against Off RoW comparable areas:

- An example of two TWAs – one that was below the negative threshold (minor negative outlier) in post-construction year 1 (2020) and one that presented a negative difference value but not below the negative threshold – that were considered to have disturbance persisting through post-construction year 2 (2021) is presented in **Figure 3.9**. The relatively low NDVI values (yellow, orange and light green) within the 80 m diameter TWAs are indicative of disturbance around the tower structures.
- An example of a TWA that was considered disturbed (minor negative outlier) in post-construction year 1 (2020) and recovered in post-construction year 2 (2021) is presented in **Figure 3.10**. Relatively low NDVI values (yellow and orange) relative to the comparable Off RoW areas are apparent in a large area around the tower structure due to construction disturbance. In post-construction year 2 (2021), the NDVI values within most of the TWA have returned to similar values to comparable Off RoW areas, indicating the crop and soil productivity within the TWA has mostly returned to pre-disturbance levels, with the exception of a small area around the tower footprint. The NDVI difference value for the TWA was similar to the comparable areas Off RoW, therefore this TWA is considered recovered in 2021.

3.2.1.4 Evaluation of Project Disturbance Category Relative to Project Construction and Environmental Factors

It is of interest to understand environmental and construction-related factors influencing the degree of disturbance and recovery of TWAs. This understanding can assist Manitoba Hydro in evaluating the effectiveness of construction mitigation approaches and measures and assist in improving mitigation of effects to soil productivity and crop productivity.

To achieve a better understanding, TWA disturbance categories for post-construction year 2 (2021) were evaluated against the following factors:

- Project construction related:
 - Tower structure type
 - Tower foundation type
 - Tower installation timing
- Environmental factors:
 - Soil compaction risk (combination of soil texture and soil drainage classes)
 - Agricultural capability class
 - Land cover class



Tower structure type

Disturbance categories were evaluated against three tower structure types – Self-Supporting Suspension (251 TWAs), Self-Supporting Dead-End (D-E) Angle (31 TWAs) and Guyed Towers (17 TWAs). In terms of self-supporting towers, the D-E Angle is a larger and heavier structure and is generally understood to



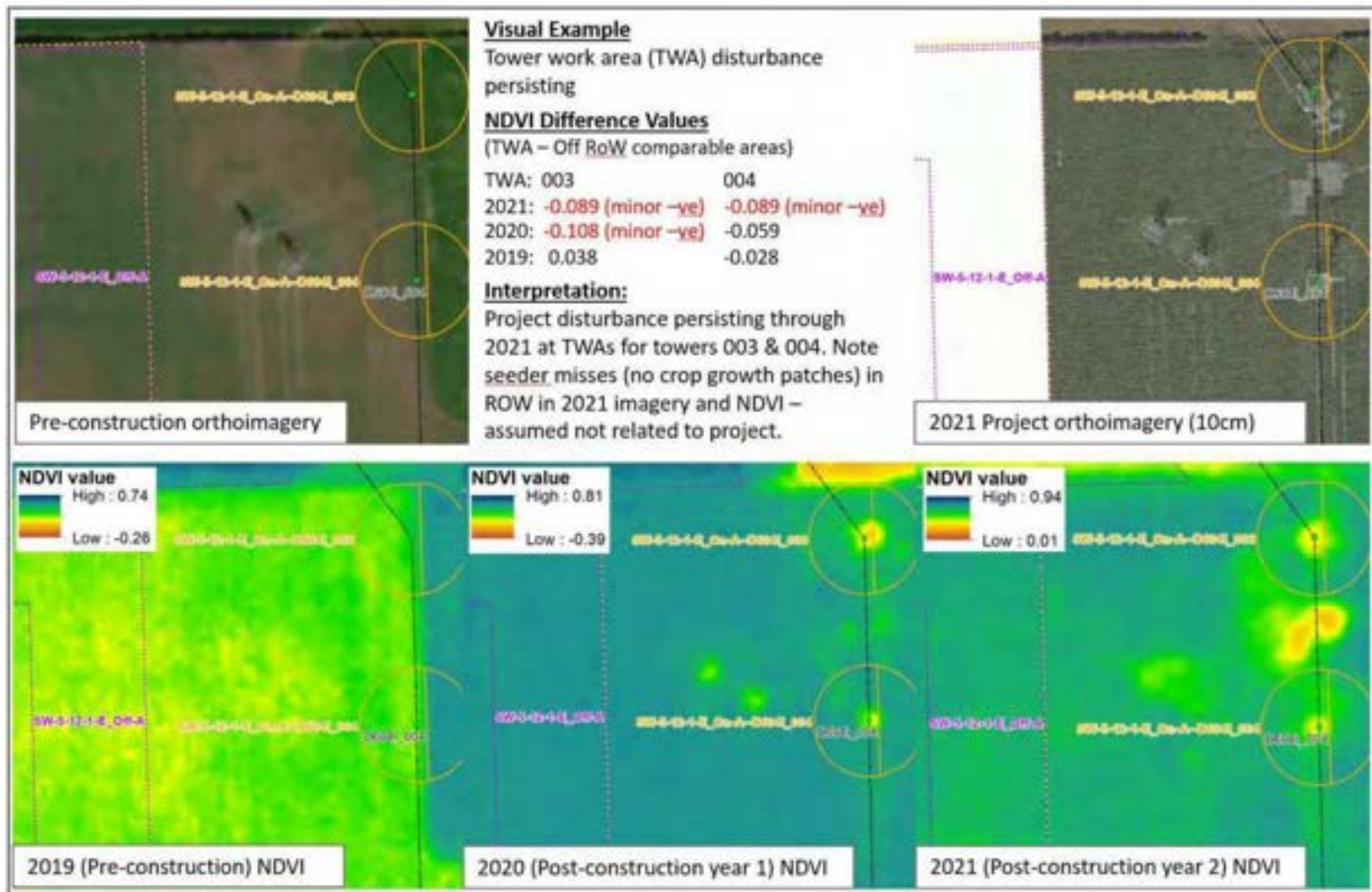


Figure 3.9 Example of TWAs (D604I_003 & D604I_004) Considered to Disturbances Persisting Through 2021

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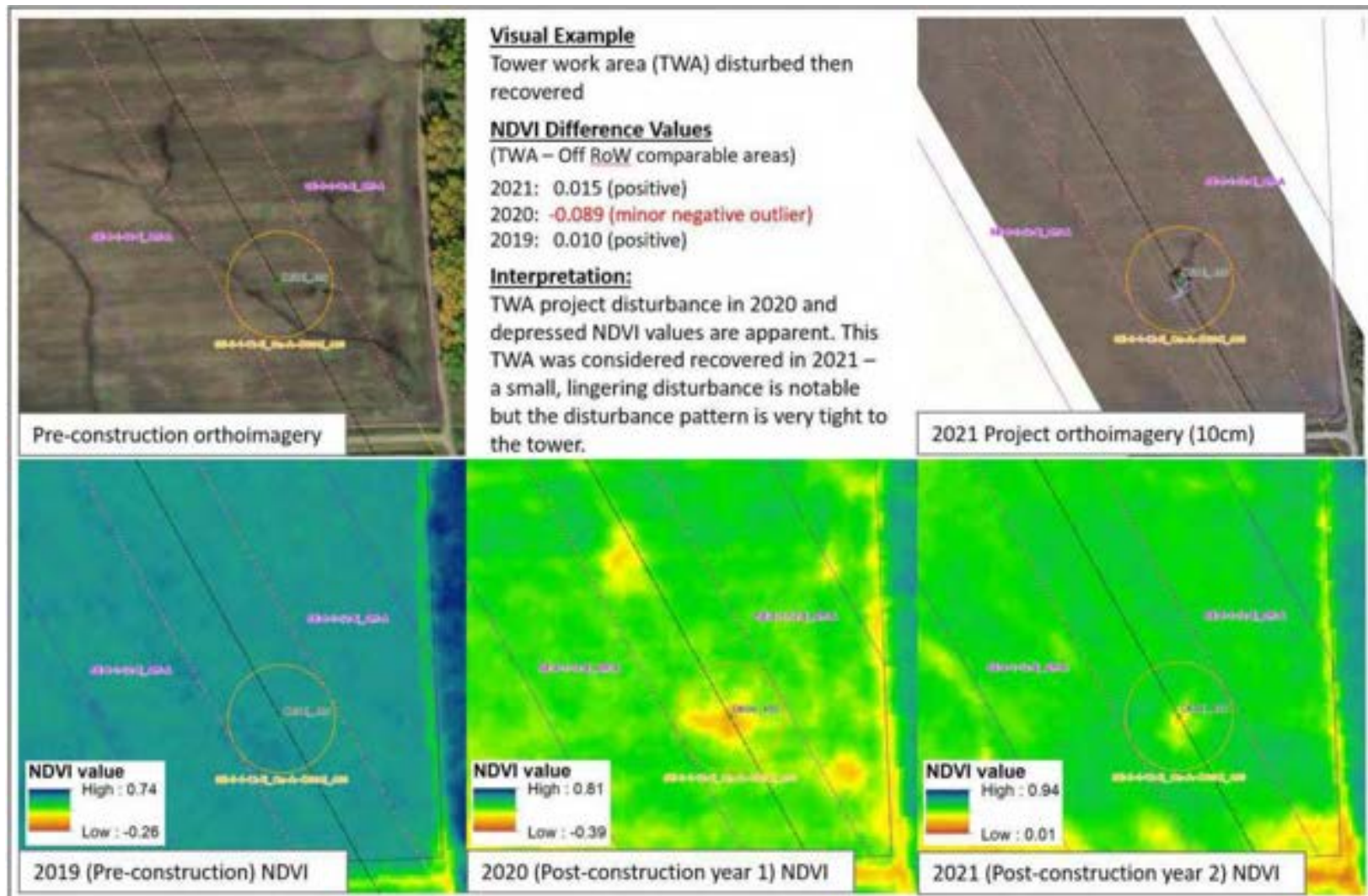


Figure 3.10 Example of TWA (D604I_490) Considered Disturbed in 2020 and Recovered in 2021

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require a higher level of construction intensity. Results of the evaluation are presented in Table A.2.1 (Appendix A.2) and summarized as follows:

- 19% of the 31 Self-Supporting D-E Angle structures included in the evaluation were determined to be in the disturbance persists category in 2021, while only 5% of the 251 Self-Supporting Suspension were considered to have disturbances persisting.
- 58% of the 31 Self-Supporting D-E Angle structures included in the evaluation were considered to be undisturbed through 2020 and 2021, while 74% of the 251 Self-Supporting Suspension were considered to be undisturbed.
- While 47% of the 17 Guyed Towers were considered disturbed in 2020, all of these were considered recovered in 2021.
- Therefore, the construction of the Self-Supporting D-E Angle structures appear to result in a higher degree of disturbance and effects appear to be longer lasting, relative to Self Supporting Suspension structures, and Guyed Towers appear to result in less disturbance compared with Self Supporting structures.

Tower foundation type

Disturbance categories were evaluated against five foundation types. Three types of foundations for self supporting towers included: Self-Supporting Cast-in-Place (CIP) Concrete Foundation (TWAs), Self-Supporting Helical Pile Foundation (183 TWAs) and Self-Supporting Tower Concrete Mat Foundation (18 TWAs). Two types of guyed tower foundations were evaluated: Guyed Tower Foundation Bridge (12 TWAs) and Guyed Tower Concrete Mat Foundation (5 instances evaluated). Results of the evaluation are presented in Table A.2.2 (Appendix A.2) and summarized as follows:

- For guyed towers, no structures were in the disturbance persists category in 2021.
- For self supporting towers, 12% of the 64 Self-Supporting CIP Concrete Foundations included in the evaluation were determined to be in the disturbance persists category in 2021, while only 6% of the 183 Self-Supporting Helical Pile Foundations, and 6% of the 18 Self-Supporting Tower Concrete Mat Foundations were still considered disturbed in 2021. Disturbance levels in 2020 were approximately 23% for Self-Supporting CIP Concrete Foundations, 27% for Self-Supporting Helical Pile Foundations, and 34% for Self-Supporting Tower Concrete Mat Foundations.
- Therefore, while disturbance levels were relatively similar across self-supporting foundation types in post-construction year 1 (2020), it appears that CIP concrete foundations may result in effects to soil and crop productivity that may be longer lasting, relative to helical pile or concrete mat foundations. Data for Guyed Towers suggest that the nature or degree of disturbance are not as long lasting as for self-supporting towers.

Soil compaction and tower installation timing

Soil compaction from construction activities was identified in the Project EIS as one of the primary mechanisms of soil degradation with the potential for reducing agricultural capability, and, in turn, reduced soil and crop productivity (Manitoba Hydro, 2015). In the Project EIS, it is stated that construction in the



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winter when soils are frozen, during the summer if soils are dry, or in the late fall after harvest if soils are dry, will reduce the effects from compaction (Manitoba Hydro, 2015). Soil moisture conditions, soil temperature and frost status, and weather data, were not considered in this evaluation. However, frost generally starts to develop in Manitoba in late fall (typically October through December) and develops into deeper frost in early winter (typically December through January).

As a first step in evaluating relationships between construction timing and potential effects from construction-related soil compaction on soil and crop productivity, disturbance categories were evaluated against the month of tower installation. Results of the evaluation are presented in Table A.2.3 (Appendix A.2) and summarized as follows:

- When individual months were examined, a trend appeared as the occurrence of the disturbance persists category appeared to decrease through months later in the season as follows: September (47 TWAs) – 11% , October (31 TWAs) – 10%, November (65 TWAs)– 5%, December (57 TWAs) – 5%, January (68 TWAs) – 6% and February (14 TWAs) – 7%. This trend suggests that there are relationships between construction timing (seasonality) and soil compaction and crop productivity. Whether this is related to frost conditions, or some other factors (e.g., soil moisture status), is unknown.

Compaction risk ratings were developed for soils traversed by the Project to support the assessment of potential effects by construction activities within the Project EIS (Manitoba Hydro, 2015). The generalized ratings were developed using two criteria – soil textural class and soil drainage, with soils given a rating of low, moderate or high compaction risk (Manitoba Hydro, 2015). To explore the relationship between soil compaction risk ratings and timing of construction on disturbances to soil and crop productivity, disturbance categories were evaluated against compaction risk ratings and two tower installation timing categories – Fall period (2019) including September, October and November installations, and Winter period (2020) including December, January and February installations. Results of the evaluation are presented for all disturbance categories in Table A.2.4 (Appendix A.2), considering only TWAs that were in disturbed or recovered categories in 2021 (i.e., those considered disturbed in 2020 and/or 2021) in Table A.2.5 (Appendix A.2), and considering only those with persisting disturbances in 2021 in Table A.2.6 (Appendix A.2). A summary of results is as follows:

- Of the 233 TWAs evaluated, 108 (46%) had towers installed in the Fall period, while 125 (54%) had towers installed in the Winter period (Table A.2.4, Appendix A.2). Approximately 63% (146) of the 233 TWAs had towers installed in soils considered high risk for compaction.
- When only TWAs categorized as disturbance persists or recovered in 2021 were considered (i.e., TWAs considered disturbed in 2020 and/or 2021), 71% of the 24 TWAs with Fall period installations were in high compaction risk soils compared to 8% and 21% for moderate and low risk soils, respectively (Table A.2.5, Appendix A.2), suggesting a higher degree of effects to soil productivity in soils rated with high compaction risk. In the Winter period, High compaction risk soils had a higher proportion of TWAs considered disturbed in 2020 and/or 2021, with 46% of the 39 TWAs considered disturbed, compared with 21% and 33% of TWAs considered in moderate and low compaction risk soils, respectively.



- When only TWAs categorized as disturbance persists in 2021 were considered, 100% of the 8 TWAs with Fall period installations were in high compaction risk soils, (Table A.2.5, Appendix A.2), suggesting effects to soil productivity may be longer lasting following construction in non-frozen conditions in soils rated with high compaction risk. In the Winter period, when soils are assumed to have been frozen, the results are mixed with 38% of the 8 TWAs considered to have persisting disturbances being in soils considered to have a high compaction risk, and 13% and 50% in areas of moderate and low soil compaction risk, respectively. This suggests that compaction risk may be less of a determinant of lasting effects to soil and crop productivity during winter construction and frozen soil conditions.

Agricultural capability class

Soil capability for agriculture class ('agricultural capability') ratings provide an indication of the lands inherent ability to support agricultural cropping. Agricultural capability classes range from class 1 to class 7 with decreasing capability due to increasing limitations from 1 to 7. Organic soils are not given a class number and are simply classified as Organic. Manitoba recognizes two main categories of agricultural lands (Manitoba, no date):

- Prime agricultural lands
 - Class 1, 2 and 3
- Viable lower-class land
 - Mainly class 4, 5
 - Class 6 lands are considered capable of sustaining native grazing

Agricultural capability ratings were used in the Project EIS (Manitoba Hydro, 2015) to support the understanding of the capability of the land traversed by the Project to support agriculture, and to support the assessment of potential degradation of land capability a result of construction activities.

To explore the relationship between agricultural capability classes and Project disturbance from tower construction activities, disturbance categories were evaluated against agricultural capability categories within the agricultural evaluation area. Four agricultural capability class categories were included in the evaluation:

- Prime agricultural land (Class 1, 2 and 3) – 160 TWAs (69% of TWAs evaluated)
- Viable lower-class land (Class 4 and 5) – 36 TWAs (15% of TWAs evaluated)
- Viable lower-class land (Class 6) – 26 TWAs (11% of TWAs evaluated)
- Organic (Class Organic) – 11 TWAs (5% of TWAs evaluated)

Results of the evaluation are presented in Table A.2.7 (Appendix A.2) and summarized as follows:

- TWAs in the disturbance persists category in the post-construction year 2 (2021) monitoring season were generally similar in proportion by agricultural capability class category, ranging from 8% of TWAs in the prime agricultural land (class 1, 2 and 3) and viable lower class land (class 4 and 5)



categories to 4% in the viable lower class land (class 6) category, while the Organic category had the highest proportion considered to have persisting disturbances at 9% of TWAs in this category.

- When recovered disturbance categories are included in the evaluation (i.e., those considered disturbed in 2020 but recovered in 2021), the viable lower class land categories had a higher proportion of TWAs considered to be disturbed in 2020 and/or 2021, with 50% of viable lower-class land (class 4 and 5) category TWAs and 42% of viable lower class land (class 6) category TWAs. This compares to only 21% of prime agricultural land (class 1, 2 and 3) category TWAs and 27% of organic category TWAs.
- While the results summarized above suggest that land in the viable lower class agricultural capability categories may be more susceptible to short-term disturbances (i.e., one-year post-construction), the results do not suggest an obvious relationship between agricultural capability class categories and longer lasting (i.e., two-years post construction) effects to soil and crop productivity.

Land cover class

Disturbance categories were evaluated against land cover classes within the agricultural evaluation area. Three land cover class categories were included in the evaluation, with most TWAs falling in cropland (annual cropping; 177 TWAs) and grassland (generally pasture/grazing; 70 TWAs), with a few TWAs in the grassland/hayland (generally forage for hay and improved pasture; TWAs). Results of the evaluation are presented in Table A.2.8 (Appendix A.2) and summarized as follows:

- Within the cropland class, 6% of TWA remained in the disturbance persists category, while for the grassland class, 7% of TWAs remain considered disturbed.
- Therefore, a similar level of disturbance is considered between the two major cover classes during the post-construction year 2 (2021) monitoring season, suggesting that these broad land cover classes did not influence the level of disturbance persisting in the second growing season following construction.



3.2.2 TREND ANALYSIS FOR TOWER WORK AREAS (TWAs)

3.2.2.1 Summary of Negative Difference Outliers

Applying the negative threshold values yielded 23 negative outlier values (6.8% of TWAs), including 21 (6.2%) considered minor outliers and 2 (0.6%) considered major outliers (**Table 3.8**). Notably, but as expected, there was a significant decrease in TWAs with NDVI differences below the negative threshold from the post-construction year 1 monitoring (2020; 78 TWAs) to post-construction year 2 (2021; 23 TWAs). However, the count of negative outliers remains higher in 2021 relative to the pre-construction year (2019; 16 TWAs) suggesting productivity hasn't returned to pre-disturbance levels. A summary of counts of TWAs with NDVI differences considered negative outliers is presented in **Figure 3.11**.

While not presented in Table 3.8, the count of positive outliers was found to be similar between 2021 (14), 2020 (11) and 2019 (13). These results are not expected to be Project-related; rather, they are attributable to random variability.

These data suggest that Project disturbances have continued to affect soil productivity within TWAs and have persisted through the post-construction year 2 monitoring season. However, the reduction in negative outliers in 2021 relative to 2020 suggest that productivity in TWAs is trending to recovery. A review of individual TWAs was conducted to confirm the nature of disturbances, specifically if negative outliers are a result of Project-related disturbances.

Table 3.8 TWAs with NDVI Difference Below Negative Thresholds in 2019, 2020 and 2021

Year	Total Count	Negatives		Total Negative Outliers		Minor Negative Outliers		Major Negative Outliers	
		Count	%	Count	%	Count	%	Count	%
2019	337	165	49.0	16	4.7	14	4.2	2	0.6
2020	337	273	81.0	78	23.1	47	13.9	31	9.2
2021	337	232	68.8	23	6.8	21	6.2	2	0.6



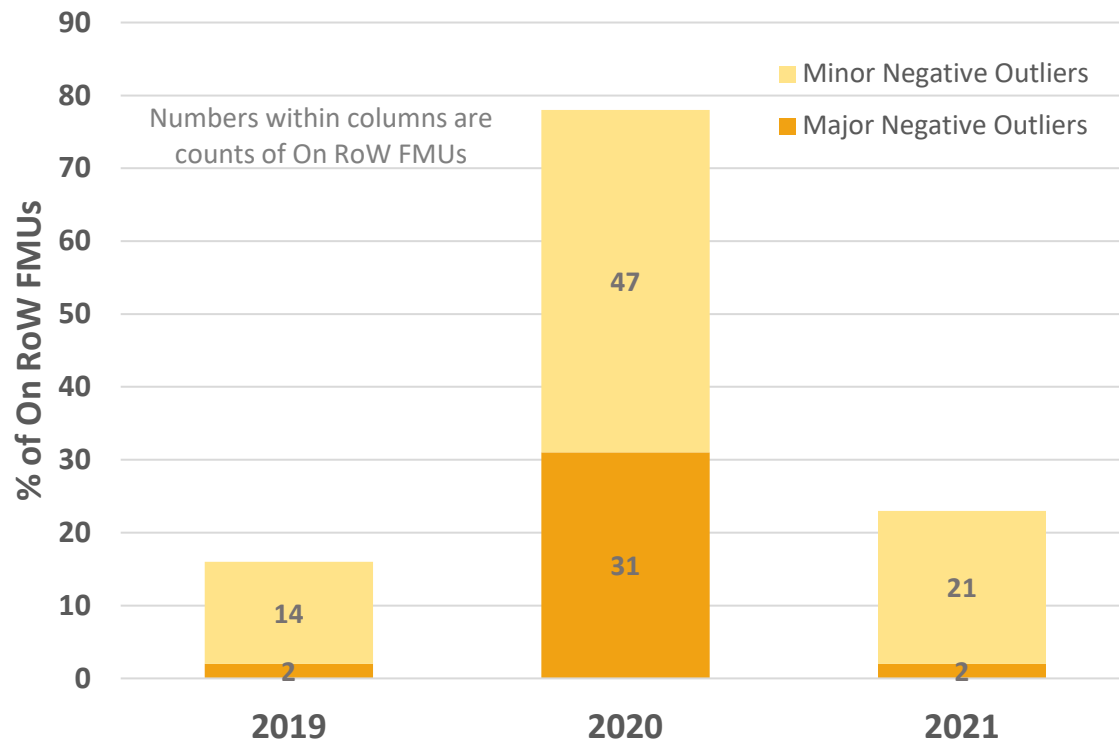


Figure 3.11 TWAs Below the Negative Thresholds in 2019, 2020 and 2021

3.2.2.2 Project Related Disturbance Category Summary

A summary of disturbance categories for TWAs for the post-construction year 1 (2020) and post-construction year 2 (2021) monitoring seasons is presented in **Figure 3.12**. This provides a useful summary and visual support for the reduction in TWAs considered to have Project-related disturbances persisting. In 2020, a total of 76 TWAs were considered disturbed by Project activities, representing 23% of all TWAs evaluated. In 2021, the total number of TWAs considered disturbed had dropped to 21, or 6% of all TWAs s evaluated. Of these 21 TWAs, 13 were considered to be trending toward recovery (i.e., positive trend in NDVI difference between TWAs and Off RoW comparable areas), while the remaining 8 were found to have disturbances persisting with NDVI difference values not trending in the direction of recovery. A total of 62 TWAs considered disturbed by Project activities in the 2020 monitoring season were considered recovered in 2021.

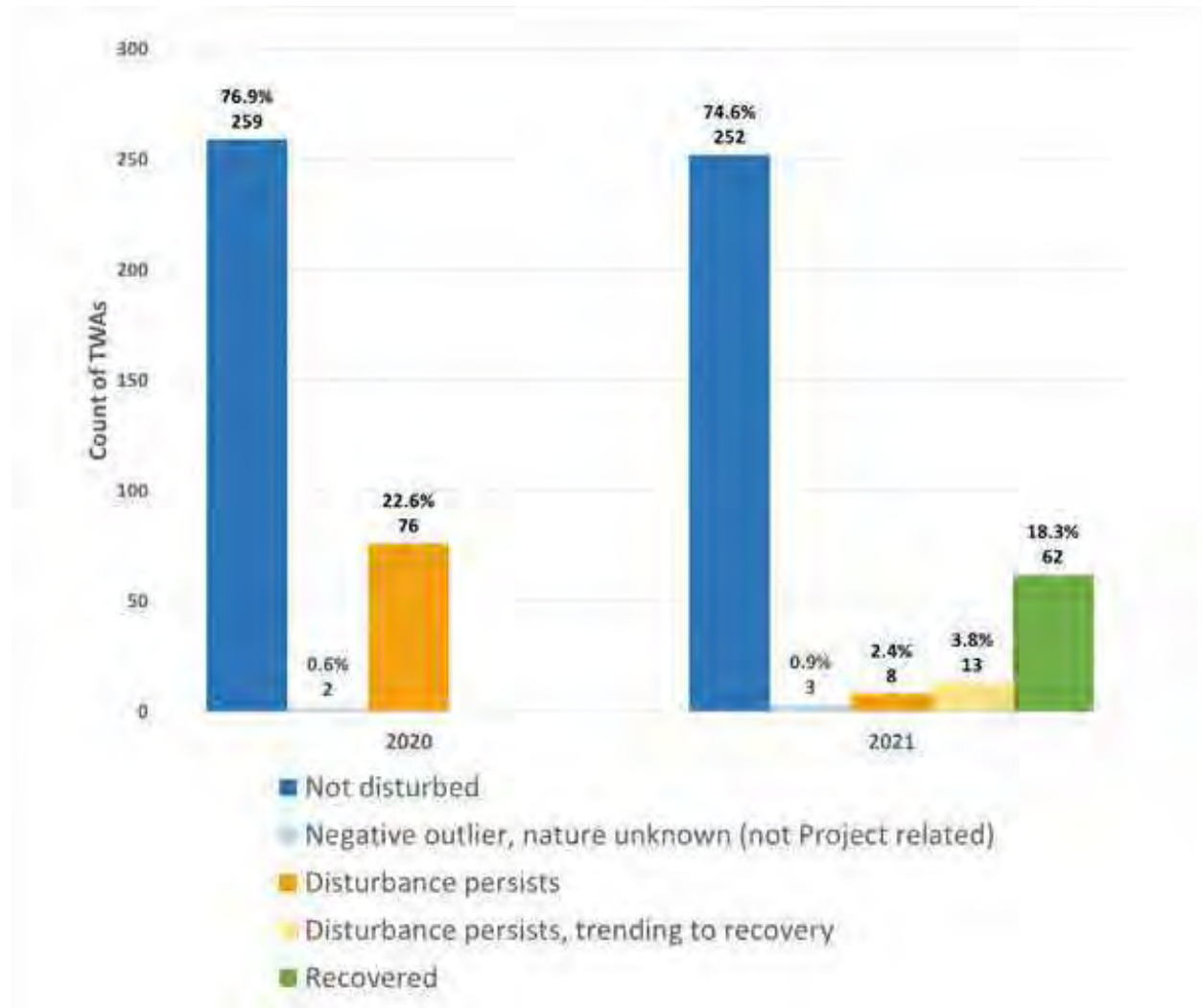


Figure 3.12 Disturbance Category Summary for TWAs for 2020 and 2021

4 Summary and Conclusions

The analysis and evaluation of NDVI values have demonstrated good recovery of On RoW FMUs and TWAs considered disturbed following the 2021 monitoring program. In 2021, there were substantial reductions in On RoW FMUs, as measured within a 20 m corridor along the transmission centreline, and in TWAs with NDVI difference values considered to have reduced NDVI values due to Project-related disturbances.

NDVI difference thresholds between On RoW FMUs and TWAs, and their Off RoW comparable areas, were established from pre-construction (2019) or pre-Project disturbance baseline NDVI analysis (Stantec 2022). Unique threshold values were established for On RoW FMUs and for TWAs. These threshold values were used to identify negative outliers in differences between individual On RoW FMUs and TWAs, and their Off RoW comparable areas, during the post-construction year 1 (2020) monitoring season (Stantec 2022) and the post-construction year 2 (2021) monitoring season. Minor and major negative outliers were determined to better understand the magnitude of the differences in NDVI values for evaluation areas determined to be outliers.

In 2021, a total of 239 On RoW FMUs were evaluated and 33 (13.8%) were considered to be negative outliers, which represented a substantial reduction from 2020 when 72 of 229 On RoW FMUs (31.4%) were considered negative outliers. Major and minor outliers were as follows:

- In 2021, 18 On RoW FMUs (7.5%) were considered minor negative outliers
 - In 2020, 36 On RoW FMUs (15.7%) were considered minor negative outliers.
- In 2021, 15 On RoW FMUs (6.3%) were considered major negative outliers
 - In 2020, 36 On RoW FMUs (15.7%) were considered major negative outliers.

In 2021, total of 337 TWAs were evaluated and 23 (6.8%) were considered to be negative outliers. Similar to the summary of On RoW FMUs, above, this represented a substantial reduction from 2020 when 78 of 337 TWAs (23.1%) were considered negative outliers. Major and minor outliers were as follows:

- In 2021, 21 TWAs (6.2%) were considered minor negative outliers.
 - In 2020, 47 TWAs (13.9%) were considered minor negative outliers.
- In 2021, 2 TWAs (0.6%) were considered major negative outliers.
 - In 2020, 31 TWAs (9.2%) were considered major negative outliers.

While these results suggest that Project-related disturbances determined in 2020 to have negatively affected soil and crop productivity in areas within the RoW are trending toward recovery, further evaluation was completed to confirm the nature of differences in NDVI values to confirm that results were Project-related. Individual On RoW FMUs and TWAs were visually evaluated to provide this confirmation.



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Following confirmation, the following conclusions are presented on Project-related disturbances to On RoW FMUs and TWAs in the post-construction year 2 (2021) monitoring season in relation to the post-construction year 1 (2020) monitoring season:

- In 2021, 25 On RoW FMUs (10.5%) were considered to have persisting Project disturbances, which was substantially less than in 2020 when 65 On RoW FMUs (28.4%) were considered to have persisting Project disturbances. Of these 25 On RoW FMUs considered disturbed in 2021, 13 FMUs were considered to be trending to recovery as they had NDVI difference values trending in the positive direction between 2020 and 2021.
- In 2021, 21 TWAs (6.2%) were considered to have persisting Project disturbances, which was substantially less than in 2020 when 77 TWAs (22.8%) were considered to have persisting Project disturbances. Of these 21 TWAs considered disturbed in 2021, 13 TWAs were considered to be trending to recovery as they had NDVI difference values trending in the positive direction between 2020 and 2021.

Therefore, while Project activities have resulted in disturbance to crop productivity and soil productivity within the RoW, the level of disturbance persisting was found to be much lower in post-construction year 2 (2021) relative to post-construction year 1 (2020). Project-related disturbances were found to persist in both On RoW FMUs and TWAs, however, a substantial reduction in these occurrences were found in 2021 relative to 2020. A total 11% of On RoW FMUs and 6% of TWAs were found to have persisting disturbances in 2021, down from 28% and 23%, respectively, in 2020.

An evaluation of Project-related disturbance categories relative to Project construction and environmental factors was completed to explore relationships between these factors and the degree and persistence of effects to soil and crop productivity. Key findings are summarized as follows:

- The construction of the Self-Supporting Dead-End (D-E) Angle structures appear to result in a higher degree of disturbance and effects appear to be longer lasting, relative to Self Supporting Suspension structures, and Guyed Towers appear to result in less disturbance compared with Self Supporting structures.
- For self-supporting towers, it appears that cast-in place (CIP) concrete foundations may result in longer lasting effects to soil and crop productivity, relative to helical pile or concrete mat foundations. Data for Guyed Towers suggest that the nature or degree of disturbance are not as long lasting as for self-supporting towers.
- Seasonality of tower installation appears to have an influence on disturbances to soil and crop productivity, with the occurrence of TWAs with disturbances persisting through 2021 appearing to decrease by months of tower installation from fall to winter as follows: September 11% , October 10%, November 5%, December 5%, January 6% and February 7%. Whether this is related to frost conditions, or some other factors (e.g., soil moisture status), is unknown.



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- When disturbances were evaluated against soil compaction risk ratings and timing of tower structure installation, results suggest:
 - a higher degree of effects to soil productivity in soils rated with high compaction risk in the Fall (September to November) period and the Winter (December to February) period, compared to soils with moderate and low compaction risk.
 - effects to soil productivity may be longer lasting following construction in the Fall period (i.e., non-frozen conditions) in soils rated with high compaction risk, compared to soils with moderate and low compaction risk. Further, mixed results across compaction risk categories for TWAs with construction in the Winter period suggest that compaction risk may be less of a determinant of lasting effects to soil and crop productivity during winter construction (i.e., frozen soil conditions).

Effects were found to be limited to the RoW and associated with areas of construction activity (e.g., tower work areas, construction access and trails) within the RoW. As documented in the EIS, effects to soil productivity due to compaction from construction activities within the RoW were anticipated, and where effects from compaction occur, they could persist for a few years following construction. Results from the monitoring program are consistent with the predictions made in the EIS. Results suggest the mitigation program has been effective as 72% of FMUs and 77% of TWAs were considered to not have negative effects to soil productivity following post-construction year 1 (2020), and 89% of FMUs and 94% of TWAs were considered to not have negative effects following post-construction year 2 (2021). No unexpected effects were determined through the monitoring program through the 2020 and 2021 monitoring seasons. ***Future monitoring could be used to confirm that areas where effects have persisted through 2021 are recovering or trending to recovery.***

No field assessments were conducted during the 2021 post-construction monitoring season, as these were not deemed necessary to support the monitoring program.



5 Recommendations

While the two-year post-construction soil productivity monitoring commitment made in the Project Environmental Monitoring Plan (EMP; Manitoba Hydro, 2019) has been completed, additional monitoring in subsequent years could confirm trends and conclusions documented in this report. The following recommendations are presented for the soil productivity monitoring program:

- Evaluate NDVI values in 2022 relative to 2019, 2020 and 2021 data to confirm that crop productivity in On RoW FMUs and TWAs continues to trend towards pre-construction levels. This monitoring would represent a post-construction monitoring period longer than the minimum two years recommended in the EMP (Manitoba Hydro, 2019). However, the EMP (Manitoba Hydro, 2019; p. 64, Table 4-21) indicates that the duration of post-construction phase monitoring is “up to 2 years or until suitable knowledge acquired”. Should additional monitoring occur in 2022, the following actions are recommended:
 - Continue review and revision of On RoW FMUs, TWAs and Off RoW comparable areas using NDVI data and up-to-date orthoimagery, as available. Delineations that are kept current relative to agricultural field management units will provide more reliable soil productivity evaluation results; and,
 - Additional evaluation of NDVI data collected up to and including 2019 be completed in order to remove those individual FMUs and tower structure work areas considered recovered from subsequent assessments.
- Implement object-based image analysis of individual NDVI pixels to identify and delineate areas within On RoW FMUs and TWAs that are considered disturbed by the Project. These delineated areas could be monitored over time to track recovery and return to pre-disturbance crop and soil productivity levels.

There are currently no recommendations for additional monitoring activities (e.g., field assessment), mitigation activities or alterations to the monitoring program, except for those items noted above.



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APPENDICES



Appendix A Tables

A.1 NDVI Difference Values, Visual Assessment Comments and Disturbance Categories

Table A.1 NDVI Difference Values, Visual Assessment Comments and Disturbance Categories for On RoW FMUs

On ROW FMU Label	2021 Diff OnROW- OffROW	2020 Diff OnROW- OffROW	2019 Diff OnROW- OffROW	2020 Visual Assessment Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
E-8-1-12-E_On-A	-0.034	-0.021	-0.004		No disturbance		No disturbance
N-17-5-8-E_On-A	0.209	0.162	0.073		No disturbance		No disturbance
NE-10-9-7-E_On-A	0.013	-0.018	-0.016		No disturbance		No disturbance
NE-13-9-1-E_On-A	0.006	-0.003	0.033		No disturbance		No disturbance
NE-13-9-1-E_On-B	-0.005	-0.040	0.016		No disturbance		No disturbance
NE-14-9-1-E_On-A	-0.020	-0.029	0.001		No disturbance		No disturbance
NE-14-9-1-E_On-B	-0.032	-0.058	-0.004	twa and corridor dist	Project related disturbance persists		Recovered
NE-14-9-1-E_On-C	-0.017	-0.053	-0.007	twa and access dist	Project related disturbance persists		Recovered
NE-15-9-2-E_On-A	-0.007	-0.028	0.004		No disturbance		No disturbance
NE-15-9-7-E_On-A	-0.063	-0.044	0.025		No disturbance	TWA, access and corridor dist persists	Project related disturbance persists
NE-16-9-2-E_On-A	-0.006	-0.033	-0.001		No disturbance		No disturbance
NE-17-9-2-E_On-A	-0.001	-0.023	0.001		No disturbance		No disturbance
NE-17-9-2-E_On-B	-0.002	-0.029	0.000		No disturbance		No disturbance
NE-18-1-12-E_On-A	-0.037	-0.011	-0.013		No disturbance		No disturbance
NE-18-1-12-E_On-B	-0.013	-0.061	0.004	corridor and twa disturbance	Project related disturbance persists		Recovered



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On ROW FMU Label	2021 Diff OnROW- OffROW	2020 Diff OnROW- OffROW	2019 Diff OnROW- OffROW	2020 Visual Assessment Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
NE-18-7-8-E_On-A	-0.150	-0.022	-0.117		No disturbance	agricultural mgmt related - different timing of hay cutting; OFF ROW FMU TO BE SPLIT ACCORDING TO SUB-FIELD MGMT UNIT	Negative outlier, nature unknown (not Project related)
NE-18-7-8-E_On-B	0.004	-0.036	-0.020		No disturbance		No disturbance
NE-18-9-2-E_On-A	0.002	-0.043	-0.001		No disturbance		No disturbance
NE-18-9-2-E_On-B	-0.011	-0.046	0.002		No disturbance		No disturbance
NE-20-5-8-E_On-A	-0.005	0.125	0.042		No disturbance		No disturbance
NE-20-5-8-E_On-A	0.123				No data in 2020		No disturbance
NE-23-9-1-E_On-A	-0.043	-0.010	0.001		No disturbance		No disturbance
NE-24-1-11-E_On-A	-0.017	-0.036	0.026		No disturbance		No disturbance
NE-24-8-7-E_On-A	-0.029	-0.031	-0.001		No disturbance		No disturbance
NE-26-9-1-E_On-A	-0.004	-0.032	0.002		No disturbance		No disturbance
NE-3-10-1-E_On-A	-0.016	-0.020	-0.006		No disturbance		No disturbance
NE-31-9-4-E_On-A	0.011	-0.106	-0.045	marshalling yard (?) and twa	Project related disturbance persists		Recovered
NE-31-9-4-E_On-B	-0.002	0.030	0.049		No disturbance		No disturbance
NE-32-4-8-E_On-A	-0.042	-0.149	-0.031	corridor dist	Project related disturbance persists		Recovered
NE-32-5-8-E_On-A	0.024	0.160	-0.022		No disturbance		No disturbance
NE-32-5-8-E_On-B	-0.099	-0.115	-0.006	corridor and twa dist	Project related disturbance persists	primarily TWA dist; hay or grazing bush removal	Project related disturbance persists
NE-32-5-8-E_On-C	0.026	-0.028	0.028		No disturbance		No disturbance



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NE-32-9-7-E_On-A	-0.020	-0.040	0.014		No disturbance		No disturbance
NE-34-3-8-E_On-A	-0.113	-0.084	0.045	small fmu corner of field; corridor dist	Project related disturbance persists	small FMU field corner; lower capability in hay?	Project related disturbance persists
NE-35-9-1-E_On-A	-0.014	-0.025	-0.008		No disturbance		No disturbance
NE-4-3-9-E_On-A	0.018	-0.071	-0.010	doesn't appear project related	Negative outlier, nature unknown (not Project related)	does not appear project related; low productivity pasture	No disturbance
NE-4-3-9-E_On-B	-0.022	-0.033	0.008		No disturbance		No disturbance
NE-5-1-12-E_On-A	-0.097	-0.039	-0.042		No disturbance	small FMU in field corner; negative difference does not appear project related; REMOVE OR MODIFY FMU	Negative outlier, nature unknown (not Project related)
NE-5-6-8-E_On-A	-0.186	0.113	-0.076		No disturbance	appears to be soil moisture related not project related; some bush along headland of FMU; same NDVI pattern in 2020 & 2019 except along headland bushline; MODIFY ON ROW FMU DELINEATION	Negative outlier, nature unknown (not Project related)
NE-5-6-8-E_On-B	-0.031	-0.102	0.116	sliver fmu adjacent to bush clearing	Project related disturbance persists		Recovered
NE-6-7-8-E_On-B	-0.074				No data in 2020	TWA, access and corridor dist persists (south loop - floodway)	Project related disturbance persists



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NE-6-7-8-E_On-B	-0.068	-0.068	-0.038	some corridor and twa dist	Project related disturbance persists	some TWA dist lingering in corner of field	Project related disturbance persists
NE-7-7-8-E_On-A	0.017	-0.032	0.012		No disturbance		No disturbance
NE-7-7-8-E_On-B	-0.013	-0.046	-0.005		No disturbance		No disturbance
NE-7-8-8-E_On-A	-0.013	0.005	-0.008		No disturbance		No disturbance
NE-8-5-8-E_On-A	0.002	0.020	0.181		No disturbance		No disturbance
NE-8-5-8-E_On-B	-0.003	0.012	-0.004		No disturbance		No disturbance
NE-8-6-8-E_On-A	0.048	-0.121	0.093	twa and corridor dist adjacent to bush clearing	Project related disturbance persists		Recovered
NE-9-4-8-E_On-A	0.017	-0.006	0.001		No disturbance		No disturbance
NW-13-9-1-E_On-A	-0.003	-0.012	-0.004		No disturbance		No disturbance
NW-13-9-1-E_On-B	0.006	-0.049	-0.001		No disturbance		No disturbance
NW-14-10-4-E_On-A	-0.016	0.020	0.009		No disturbance		No disturbance
NW-14-9-2-E_On-A	0.000	-0.026	0.005		No disturbance		No disturbance
NW-15-9-2-E_On-A	-0.011	-0.028	0.001		No disturbance		No disturbance
NW-15-9-2-E_On-B	0.009	-0.003	-0.001		No disturbance		No disturbance
NW-16-9-2-E_On-A	-0.039	-0.029	0.004		No disturbance		No disturbance
NW-17-10-7-E_On-A	-0.021	-0.144	-0.026	corridor dist and twa dist	Project related disturbance persists		Recovered
NW-17-11-1-E_On-A	0.012	0.003	0.144		No disturbance		No disturbance
NW-17-11-1-E_On-B	0.039	-0.017	0.033		No disturbance		No disturbance
NW-17-11-1-E_On-C	0.013	-0.117	0.028	small FMU centered on TWA	Project related disturbance persists		Recovered
NW-17-6-8-E_On-A	-0.034	-0.046	0.000		No disturbance		No disturbance



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NW-17-6-8-E_On-A	-0.027				No data in 2020		No disturbance
NW-17-9-2-E_On-A	-0.090	0.086	-0.013		No disturbance	FMU and mgmt (harvest) related; not project related; CHECK and ADJUST FMU	Negative outlier, nature unknown (not Project related)
NW-18-9-2-E_On-A	-0.006	-0.039	0.002		No disturbance		No disturbance
NW-20-10-7-E_On-A	-0.034	-0.150	0.009	large TWA and wide ROW dist	Project related disturbance persists		Recovered
NW-20-10-7-E_On-B	-0.027	-0.087	-0.006	corridor dist	Project related disturbance persists		Recovered
NW-20-11-1-E_On-A	0.004	-0.096	0.013	dist along FMU	Project related disturbance persists		Recovered
NW-20-6-8-E_On-A	-0.041	0.060	0.042		No disturbance		No disturbance
NW-20-6-8-E_On-B	-0.004	-0.043	0.011		No disturbance		No disturbance
NW-23-10-4-E_On-B	-0.025	-0.013	0.049		No disturbance		No disturbance
NW-23-9-1-E_On-A	-0.047	0.045	-0.010		No disturbance		No disturbance
NW-24-1-11-E_On-A	-0.108	-0.242	0.013	corridor dist and TWA; bush clearing in pasture	Project related disturbance persists	corridor & TWA dist persists; cleared bush grazing	Project related disturbance persists
NW-26-9-1-E_On-A	-0.086	0.018	-0.048		No disturbance	TWA, access and corridor dist persists (south loop - floodway)	Project related disturbance persists
NW-29-11-1-E_On-A	-0.065	-0.038	-0.001		No disturbance	TWA, access and corridor dist persists (south loop - floodway)	Project related disturbance persists
NW-29-6-8-E_On-A	-0.017	0.021	0.113		No disturbance		No disturbance



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NW-3-10-1-E_On-A	-0.008	-0.031	0.000		No disturbance		No disturbance
NW-3-10-1-E_On-B	-0.004	-0.022	-0.014		No disturbance		No disturbance
NW-31-9-4-E_On-A	-0.024	-0.040	0.041		No disturbance		No disturbance
NW-32-11-1-E_On-B	-0.036	-0.012	-0.001		No disturbance		No disturbance
NW-32-11-1-E_On-C	-0.026	-0.016	0.004		No disturbance		No disturbance
NW-32-11-1-E_On-D	-0.012	-0.010	-0.004		No disturbance		No disturbance
NW-32-5-8-E_On-A	-0.067	-0.106	0.013	corridor and twa dist	Project related disturbance persists	large TWA dist likely	Project related disturbance persists
NW-32-6-8-E_On-A	-0.041	-0.056	-0.017	doesn't appear project related	Negative outlier, nature unknown (not Project related)		Recovered
NW-3-3-9-E_On-A	0.002	0.010	-0.006		No disturbance		No disturbance
NW-35-3-8-E_On-A	-0.014	-0.045	-0.003		No disturbance		No disturbance
NW-4-1-12-E_On-A	-0.006	-0.037	0.005		No disturbance		No disturbance
NW-4-2-10-E_On-A	-0.136	-0.134	-0.037	twa dist in small FMU	Project related disturbance persists	some lingering TWA dist; some inherent low capability apparent south portion of ROW	Project related disturbance persists
NW-5-10-7-E_On-A	0.031	0.052	0.054		No disturbance		No disturbance
NW-5-12-1-E_On-A	-0.034	-0.118	-0.007	dist adjacent to dorsey incl tower	Project related disturbance persists		Recovered
NW-5-12-1-E_On-B	-0.034	-0.102	0.003	dist along entire corridor	Project related disturbance persists	EXAMPLE OF CONSTRUCTION TRAIL NOT ADEQUATELY CAPTURED BY 20 M CORRIDOR	Recovered



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NW-5-12-1-E_On-C	-0.101	0.016	0.050		No disturbance	TWA, access and corridor dist persists (south loop - floodway)	Project related disturbance persists
NW-5-6-8-E_On-A	-0.037	-0.039	-0.021		No disturbance		No disturbance
NW-8-10-7-E_On-A	-0.024	-0.072	0.075	small fmu; corridor dist	Project related disturbance persists		Recovered
NW-8-10-7-E_On-B	-0.006	-0.046	0.005		No disturbance		No disturbance
NW-8-1-12-E_On-A	0.002	0.018	0.007		No disturbance		No disturbance
NW-8-1-12-E_On-B	0.139	-0.110	-0.024	small FMU, shallow angle TWA dist	Project related disturbance persists		Recovered
NW-8-6-8-E_On-A	0.053	-0.201	0.104	corrid dist adjacent to bush clearing	Project related disturbance persists		Recovered
NW-9-4-8-E_On-A	-0.026	0.050	-0.038		No disturbance		No disturbance
OT-172-NO_On-A	-0.050	-0.157	-0.085	twa and constr trail (not all captured in corr)	Project related disturbance persists		Recovered
OT-174-NO_On-A	-0.040	-0.080	0.063	construction trail	Project related disturbance persists		Recovered
OT-26-HE_On-A	-0.006	-0.023	0.003		No disturbance		No disturbance
OT-27-HE_On-A	-0.043	-0.025	-0.005		No disturbance		No disturbance
OT-80-NO_On-A	-0.015	-0.004	0.015		No disturbance		No disturbance
OT-81-NO_On-A	-0.015	-0.021	0.022		No disturbance		No disturbance
OT-83-NO_On-A	-0.039	0.039	-0.027		No disturbance		No disturbance
OT-85-NO_On-A	-0.040	-0.002	0.019		No disturbance		No disturbance
OT-86-NO_On-A	-0.017	-0.088	-0.023	access and twa dist	Project related disturbance persists		Recovered



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RL-174-NO_On-A	0.010	-0.039	0.008		No disturbance		No disturbance
RL-174-NO_On-B	-0.011	-0.117	-0.030	twa and uncertain corridor dist	Project related disturbance persists		Recovered
RL-177-NO_On-A	0.015	-0.007	0.015		No disturbance		No disturbance
RL-178-NO_On-B	-0.001	-0.014	-0.004		No disturbance		No disturbance
RL-179-NO_On-A	0.066	-0.014	-0.007		No disturbance		No disturbance
RL-179-NO_On-B	0.011	0.051	-0.001		No disturbance		No disturbance
RL-179-NO_On-C	-0.011	-0.002	0.008		No disturbance		No disturbance
RL-27-HE_On-A	-0.029	-0.015	0.007		No disturbance		No disturbance
RL-27-HE_On-B	-0.026	-0.035	-0.001		No disturbance		No disturbance
RL-38-HE_On-A	-0.064	-0.096	-0.003	tower and corridor dist	Project related disturbance persists	TWA and corridor dist persists	Project related disturbance persists
RL-39-HE_On-A	-0.013	-0.014	0.025		No disturbance		No disturbance
RL-39-HE_On-B	-0.030	-0.048	0.015		No disturbance		No disturbance
RL-39-HE_On-C	-0.017	-0.043	0.009		No disturbance		No disturbance
RL-73-NO_On-A	0.001	-0.026	-0.002		No disturbance		No disturbance
RL-74-NO_On-A	-0.025	-0.137	-0.087	twa and other irregular dist patters	Project related disturbance persists		Recovered
RL-80-NO_On-A	-0.044	0.010	-0.013		No disturbance		No disturbance
S-17-5-8-E_On-A	0.031	-0.080	0.000	corridor and twa dist	Project related disturbance persists		Recovered
SE-15-9-7-E_On-A	-0.068	-0.104	-0.033	TWA and some corridor dist	Project related disturbance persists	TWA dist remains; vegetation hasn't re- established, sensitive sands?	Project related disturbance persists



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SE-17-6-8-E_On-A	-0.017	-0.167	-0.011	long sliver fmu; twa and corridor dist	Project related disturbance persists		Recovered
SE-18-7-8-E_On-A	0.035	0.011	0.010		No disturbance		No disturbance
SE-19-1-12-E_On-A	-0.018	-0.015	0.001		No disturbance		No disturbance
SE-19-7-8-E_On-A	-0.005	-0.054	-0.013	ltd twa and corridor dist adj to bush clearing	Project related disturbance persists		Recovered
SE-20-5-8-E_On-A	0.199	0.153	0.112		No disturbance		No disturbance
SE-20-5-8-E_On-B	0.167	0.013	0.097		No disturbance		No disturbance
SE-20-5-8-E_On-B	0.049				No data in 2020		No disturbance
SE-23-9-1-E_On-A	0.017	-0.031	0.003		No disturbance		No disturbance
SE-24-8-7-E_On-A	-0.031	-0.026	-0.003		No disturbance		No disturbance
SE-24-8-7-E_On-B	0.030	-0.013	0.014		No disturbance		No disturbance
SE-24-8-7-E_On-C	-0.008	-0.048	0.030		No disturbance		No disturbance
SE-25-10-6-E_On-A	0.035	0.043	0.028		No disturbance		No disturbance
SE-25-2-9-E_On-A	-0.007	-0.107	0.017	corridor and twa dist	Project related disturbance persists		Recovered
SE-26-10-4-E_On-A	-0.007	0.050	0.062		No disturbance		No disturbance
SE-26-10-6-E_On-A	0.010	-0.036	0.005		No disturbance		No disturbance
SE-26-9-1-E_On-A	-0.004	-0.017	-0.011		No disturbance		No disturbance
SE-26-9-1-E_On-B	-0.107	-0.018	-0.028		No disturbance	corner of field not cult; no project disturbance; ADJUST FMU	Negative outlier, nature unknown (not Project related)
SE-27-10-5-E_On-A	-0.001	-0.023	-0.003		No disturbance		No disturbance
SE-27-10-6-E_On-A	-0.030	-0.037	-0.033		No disturbance		No disturbance



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On ROW FMU Label	2021 Diff OnROW- OffROW	2020 Diff OnROW- OffROW	2019 Diff OnROW- OffROW	2020 Visual Assessment Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
SE-28-10-5-E_On-A	-0.007	0.082	-0.017		No disturbance		No disturbance
SE-28-10-6-E_On-A	-0.018	0.007	-0.011		No disturbance		No disturbance
SE-29-10-6-E_On-A	-0.017	-0.031	-0.025		No disturbance		No disturbance
SE-30-10-5-E_On-B	-0.017	-0.037	-0.028		No disturbance		No disturbance
SE-30-10-6-E_On-A	-0.029	-0.021	-0.107		No disturbance		No disturbance
SE-30-10-7-E_On-A	0.019	0.011	0.012		No disturbance		No disturbance
SE-30-10-7-E_On-B	0.037	0.036	-0.001		No disturbance		No disturbance
SE-3-4-8-E_On-A	-0.010	-0.025	-0.001		No disturbance		No disturbance
SE-35-3-8-E_On-A	0.025	-0.058	0.012	corridor const trail dist	Project related disturbance persists		Recovered
SE-35-3-8-E_On-B	0.001	-0.095	-0.089	access, twa and corridor dist	Project related disturbance persists		Recovered
SE-35-9-1-E_On-B	-0.030	-0.026	-0.012		No disturbance		No disturbance
SE-4-10-1-E_On-A	-0.068	-0.018	-0.006		No disturbance	FMU delineation and mgmt related; not project related; CHECK and ADJUST FMU	Negative outlier, nature unknown (not Project related)
SE-4-10-1-E_On-B	-0.056	-0.019	0.012		No disturbance	TWA, access and corridor dist persists (south loop - floodway)	Project related disturbance persists
SE-5-10-1-E_On-A	-0.018	-0.038	-0.004		No disturbance		No disturbance
SE-5-10-7-E_On-A	-0.007	-0.122	-0.014	major corridor dist	Project related disturbance persists		Recovered
SE-5-5-8-E_On-A	-0.054	-0.159	0.000	access and twa dist	Project related disturbance persists	access and twa dist	Project related disturbance persists
SE-5-6-8-E_On-A	-0.010	0.085	0.156		No disturbance		No disturbance



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SE-5-6-8-E_On-B	-0.085	-0.156	0.024	sliver fmu; may be pr adjacent to clearing	Project related disturbance persists	small sliver FMU; cleared bush along ROW & wetland adjacent, not cultivated due to project (example of area cut off by tower)	Project related disturbance persists
SE-6-7-8-E_On-A	-0.015	-0.081	-0.011	TWA and corridor dist	Project related disturbance persists		Recovered
SE-6-7-8-E_On-B	-0.005	-0.058	0.011	shelterbelt removal; other corridor and TWA dist	Project related disturbance persists		Recovered
SE-7-7-8-E_On-A	-0.029	0.003	-0.010		No disturbance		No disturbance
SE-7-7-8-E_On-B	-0.012	0.019	0.092		No disturbance		No disturbance
SE-7-7-8-E_On-C	-0.038				No data in 2020		No disturbance
SE-7-7-8-E_On-D	-0.120	-0.060	0.062	doesn't appear project related	Negative outlier, nature unknown (not Project related)	TWA, access and corridor dist persists (south loop - floodway)	Project related disturbance persists
SE-7-7-8-E_On-D	-0.014				No data in 2020		No disturbance
SE-8-1-12-E_On-A	0.005	-0.046	0.004		No disturbance		No disturbance
SE-8-6-8-E_On-A	-0.204	-0.064	-0.022	tw a and corridor dist	Project related disturbance persists	lingering TWA dist & some drainage related issues	Project related disturbance persists
SE-8-6-8-E_On-A	0.069				No data in 2020		No disturbance
SE-8-6-8-E_On-B	-0.024	-0.082	0.025	corrid dist	Project related disturbance persists		Recovered
SE-8-6-8-E_On-C	-0.155				No data in 2020	CHECK FMU AND NDVI VALUES -	Negative outlier, not project related



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On ROW FMU Label	2021 Diff OnROW- OffROW	2020 Diff OnROW- OffROW	2019 Diff OnROW- OffROW	2020 Visual Assessment Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
						APPEARS LOWER NDVI OFF ROW	
SE-8-6-8-E_On-D	0.034	-0.068	0.118	sliver fmu no obvious dist	Project related disturbance persists		Recovered
SE-8-6-8-E_On-E	0.077	-0.122	-0.023	twa dist primarily	Project related disturbance persists		Recovered
SE-8-6-8-E_On-F	-0.052	-0.086	0.016	twa dist	Project related disturbance persists	some lingering TWA dist; some natural low capability apparent south portion of ROW	Project related disturbance persists
SE-9-10-4-E_On-A	-0.113	-0.168	-0.013	TWAs and cetrerline trail	Project related disturbance persists	some lingering TWA and corridor dist (south loop - floodway)	Project related disturbance persists
SE-9-4-8-E_On-A	-0.032	-0.158	0.082	small fmu, corr dist adjacen to bush clearing	Project related disturbance persists		Recovered
SE-9-4-8-E_On-B	-0.051	-0.128	-0.044	small fmu, corr dist adjacent bush clearing	Project related disturbance persists		Recovered
SW-10-10-4-E_On-A	-0.058	-0.077	0.021	TWAs; MISSED CONSTRUCTI ON TRAIL	Project related disturbance persists	project related dist not obvious due to low NDVI values (corridor did not capture construction trail see 2020 NDVI)	Project related disturbance persists
SW-10-10-4-E_On-B	-0.043	-0.062	0.002	MISSED CONST TRAIL; some TWA; some not PR	Project related disturbance persists		Recovered
SW-10-4-8-E_On-A	-0.021	-0.072	-0.009	dist bush clearing in	Project related disturbance persists		Recovered



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On ROW FMU Label	2021 Diff OnROW- OffROW	2020 Diff OnROW- OffROW	2019 Diff OnROW- OffROW	2020 Visual Assessment Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
				portion of corridor			
SW-11-9-7-E_On-B	0.081	-0.025	0.011		No disturbance		No disturbance
SW-11-9-7-E_On-B	-0.013				No data in 2020		No disturbance
SW-11-9-7-E_On-C	-0.008	0.016	-0.014		No disturbance		No disturbance
SW-14-10-4-E_On-A	-0.042	-0.112	0.003	small FMU with TWA dist	Project related disturbance persists		Recovered
SW-17-1-12-E_On-A	-0.012	-0.025	0.005		No disturbance		No disturbance
SW-17-1-12-E_On-B	0.007	-0.061	-0.001	twa and some corridor dist	Project related disturbance persists		Recovered
SW-17-6-8-E_On-A	-0.014	-0.077	-0.019	limited corridor dist related to bush clearing	Negative outlier, nature unknown (not Project related)	does not appear project related; low productivity pasture	No disturbance
SW-17-6-8-E_On-B	0.002	-0.016	0.036		No disturbance		No disturbance
SW-18-8-8-E_On-A	0.006	-0.031	-0.002		No disturbance		No disturbance
SW-20-10-7-E_On-A	-0.041	-0.077	0.008	small FMU corridor dist	Project related disturbance persists		Recovered
SW-20-11-1-E_On-A	-0.020	-0.037	-0.006		No disturbance		No disturbance
SW-20-5-8-E_On-A	0.192				No data in 2020		No disturbance
SW-20-6-8-E_On-A	0.032	-0.058	-0.069	not project related dist	Negative outlier, nature unknown (not Project related)	does not appear project related	No disturbance
SW-20-6-8-E_On-B	-0.080	-0.024	0.026		No disturbance	low NDVI appears to be soil moisture related with poor crop productivity in upper areas (opposite of crop productivity	Negative outlier, nature unknown (not Project related)



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On ROW FMU Label	2021 Diff OnROW- OffROW	2020 Diff OnROW- OffROW	2019 Diff OnROW- OffROW	2020 Visual Assessment Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
						patterns in 2020 & 2019	
SW-2-10-1-E_On-A	-0.027	-0.099	0.000	twa and corridor dist	Project related disturbance persists		Recovered
SW-23-10-4-E_On-A	0.025	0.193	-0.042		No disturbance		No disturbance
SW-25-10-4-E_On-A	-0.026	-0.116	-0.008	TWAs and corridor dist	Project related disturbance persists		Recovered
SW-25-10-5-E_On-A	-0.012	-0.015	-0.032		No disturbance		No disturbance
SW-25-10-6-E_On-A	-0.029	-0.090	-0.091	neg outlier in 2019; no obvious dist beyond tower	Negative outlier, nature unknown (not Project related)		Recovered
SW-26-10-5-E_On-A	-0.021	-0.041	-0.013		No disturbance		No disturbance
SW-26-10-6-E_On-A	-0.001	-0.017	-0.015		No disturbance		No disturbance
SW-27-10-5-E_On-A	-0.012	-0.017	-0.040		No disturbance		No disturbance
SW-27-10-5-E_On-B	-0.007	-0.017	-0.022		No disturbance		No disturbance
SW-27-10-6-E_On-A	-0.013	-0.014	-0.039		No disturbance		No disturbance
SW-28-10-5-E_On-A	-0.020	0.013	0.018		No disturbance		No disturbance
SW-28-10-6-E_On-A	-0.028	-0.011	-0.024		No disturbance		No disturbance
SW-29-10-5-E_On-A	-0.019	-0.019	-0.005		No disturbance		No disturbance
SW-29-10-6-E_On-A	-0.016	-0.013	-0.017		No disturbance		No disturbance
SW-29-10-7-E_On-A	0.039	-0.089	-0.020	small fmu; unknown dist	Project related disturbance persists		Recovered
SW-29-10-7-E_On-B	-0.068	-0.142	0.001	large TWA dist and large	Project related disturbance persists	large angle tower dist persists; no growth at	Project related disturbance persists



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On ROW FMU Label	2021 Diff OnROW- OffROW	2020 Diff OnROW- OffROW	2019 Diff OnROW- OffROW	2020 Visual Assessment Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
				access (laydown?) area		foundation anchor blocks	
SW-29-6-8-E_On-A	-0.020	0.017	0.003		No disturbance		No disturbance
SW-29-6-8-E_On-B	0.008	0.008	0.009		No disturbance		No disturbance
SW-29-6-8-E_On-C	0.019	0.132	-0.005		No disturbance		No disturbance
SW-30-10-5-E_On-A	-0.023	-0.019	-0.035		No disturbance		No disturbance
SW-30-10-6-E_On-A	-0.042	-0.009	0.008		No disturbance		No disturbance
SW-30-10-7-E_On-A	0.032	0.016	0.003		No disturbance		No disturbance
SW-31-9-4-E_On-A	-0.009	-0.053	0.033	twa and corridor dist	Project related disturbance persists		Recovered
SW-31-9-4-E_On-B	0.009	-0.009	-0.015		No disturbance		No disturbance
SW-31-9-4-E_On-C	0.005	0.011	0.044		No disturbance		No disturbance
SW-32-11-1-E_On-A	-0.016	-0.028	0.004		No disturbance		No disturbance
SW-32-6-8-E_On-A	-0.038	-0.019	-0.013		No disturbance		No disturbance
SW-32-6-8-E_On-B	-0.048	-0.144	-0.035	TWA and corridor dist	Project related disturbance persists		Recovered
SW-32-6-8-E_On-C	0.026	-0.057	-0.012	not obvious project-related dist	Negative outlier, nature unknown (not Project related)	does not appear project related; likely FMU delineation related: CHECK FMU DELINEATION	No disturbance
SW-32-6-8-E_On-D	0.060	-0.006	0.060		No disturbance		No disturbance
SW-4-10-1-E_On-A	-0.060	-0.014	-0.004		No disturbance	TWA, access and corridor dist persists (south loop - floodway)	Project related disturbance persists
SW-4-10-1-E_On-B	-0.008	-0.063	0.001	appears mainly twa dist	Project related disturbance persists		Recovered



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On ROW FMU Label	2021 Diff OnROW-OffROW	2020 Diff OnROW-OffROW	2019 Diff OnROW-OffROW	2020 Visual Assessment Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
SW-4-1-12-E_On-A	-0.015	-0.041	0.009		No disturbance		No disturbance
SW-4-1-12-E_On-B	-0.016	-0.065	0.001	small fmu, corridor dist adjacent to bush removal?	Project related disturbance persists		Recovered
SW-5-10-1-E_On-A	-0.007	-0.045	0.006		No disturbance		No disturbance
SW-5-10-4-E_On-A	0.016	0.045	-0.065		No disturbance		No disturbance
SW-5-10-4-E_On-B	-0.063	-0.075	-0.048	TWAs, access and some centreline	Project related disturbance persists	TWA, access and corridor dist persists (south loop - floodway)	Project related disturbance persists
SW-5-12-1-E_On-A	-0.039	-0.043	0.021		No disturbance		No disturbance
SW-5-12-1-E_On-B	-0.105	-0.069	-0.038	small sliver FMU; dist assoc with TWAs	Project related disturbance persists	small sliver FMU; TWAs & seeder miss area in ROW	Project related disturbance persists
SW-8-6-8-E_On-B	0.003	0.109	0.004		No disturbance		No disturbance
SW-8-6-8-E_On-C	-0.024	0.004	0.018		No disturbance		No disturbance
W-19-1-12-E_On-A	0.017	0.024	0.023		No disturbance		No disturbance
<p>Notes:</p> <p>Diff = difference FMU = farm management unit</p> <p>OnROW = on right of way evaluation area OffROW = off right of way comparable area</p> <p>Shading in cells as follows:</p> <p>Difference values – 2021 Diff OnROW-OffROW & 2020 Diff OnROW-OffROW & 2019 Diff OnROW-OffROW</p> <p>Green = value is above positive threshold and considered a minor positive outlier Green (bold text) = value is above positive threshold or considered a major positive outlier</p> <p>Red = value is below negative threshold or considered a minor negative outlier Red (bold text) = value is below negative threshold or considered a major negative outlier</p>							



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On ROW FMU Label	2021 Diff OnROW- OffROW	2020 Diff OnROW- OffROW	2019 Diff OnROW- OffROW	2020 Visual Assessment Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
Disturbance categories – 2020 Disturbance Category & 2021 Disturbance Category							
Green = Recovered							
Orange = Project-related disturbance persists							
Blue = Negative outlier, nature unknown (not Project related)							



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Table A.2 NDVI Difference Values, Visual Assessment Comments and Disturbance Categories for TWAs

2021_TWA_FMU_ID	2021 Diff TWA-Off ROW FMU	2020 Diff TWA-Off ROW FMU	2019 Diff TWA-Off ROW FMU	2020 Visual Evaluation Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
D604I_001-NW-5-12-1-E_On-A	-0.082	-0.170	-0.005	two disturbance	Project-related disturbance persists		Recovered
D604I_002-NW-5-12-1-E_On-B	-0.046	-0.109	-0.002	two disturbance	Project-related disturbance persists	appears to have dist remaining; visual confirmation of disturbance	Project-related disturbance persists (MB Hydro-owned)
D604I_003-SW-5-12-1-E_On-A	-0.089	-0.108	0.038	two disturbance	Project-related disturbance persists	TWA dist still apparent; access, crop pattern	Project-related disturbance persists
D604I_003-SW-5-12-1-E_On-B	-0.052	-0.076	-0.007		No disturbance		No disturbance
D604I_004-SW-5-12-1-E_On-A	-0.089	-0.059	0.028		No disturbance	TWA dist apparent; crop pattern	Project-related disturbance persists
D604I_004-SW-5-12-1-E_On-B	-0.042	-0.013	0.002		No disturbance		No disturbance
D604I_005-SW-5-12-1-E_On-A	-0.015	-0.039	0.009		No disturbance		No disturbance
D604I_006-NW-32-11-1-E_On-B	-0.045	-0.014	-0.009		No disturbance		No disturbance
D604I_007-NW-32-11-1-E_On-C	-0.024	-0.023	0.002		No disturbance		No disturbance
D604I_008-NW-32-11-1-E_On-D		-0.028	-0.043		No disturbance		No disturbance
D604I_008-SW-32-11-1-E_On-A	-0.028	-0.049	-0.012		No disturbance		No disturbance
D604I_009-SW-32-11-1-E_On-A	-0.035	-0.048	0.022		No disturbance		No disturbance
D604I_010-NW-29-11-1-E_On-A	-0.099	-0.083	-0.073		No disturbance	TWA dist apparent; tight; field cutoff	Project-related disturbance persists
D604I_011-NW-29-11-1-E_On-A	-0.038	-0.047	0.007		No disturbance		No disturbance
D604I_012-NW-29-11-1-E_On-A	-0.063	-0.037	0.000		No disturbance		No disturbance



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2021_TWA_FMU_ID	2021 Diff TWA-Off ROW FMU	2020 Diff TWA-Off ROW FMU	2019 Diff TWA-Off ROW FMU	2020 Visual Evaluation Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
D604I_013-NW-29-11-1-E_On-A	-0.115	-0.054	0.002		No disturbance	TWA dist apparent; tight; no more improvement?	Project-related disturbance persists
D604I_014-NW-20-11-1-E_On-A	-0.144	-0.225	-0.080	twa disturbance	Project-related disturbance persists	TWA dist; no growth corner of field, not all PR	Project-related disturbance persists (MB Hydro-owned)
D604I_015-NW-20-11-1-E_On-A	0.000	-0.243	0.017	twa disturbance	Project-related disturbance persists	good recovery	Recovered
D604I_015-SW-20-11-1-E_On-A	-0.036	-0.189	0.026	twa disturbance	Project-related disturbance persists		Recovered
D604I_016-NW-20-11-1-E_On-A	-0.033	-0.041	0.006		No disturbance		No disturbance
D604I_016-SW-20-11-1-E_On-A	-0.054	-0.045	-0.001		No disturbance		No disturbance
D604I_017-NW-20-11-1-E_On-A	-0.001	-0.054	-0.003		No disturbance		No disturbance
D604I_017-SW-20-11-1-E_On-A	-0.038	-0.071	-0.009		No disturbance		No disturbance
D604I_018-NW-17-11-1-E_On-A	0.032	0.017	0.112		No disturbance		No disturbance
D604I_019-NW-17-11-1-E_On-A	0.024	0.005	0.033		No disturbance		No disturbance
D604I_020-NW-17-11-1-E_On-C	0.017	-0.081	0.027		No disturbance		No disturbance
D604I_021-NW-17-11-1-E_On-B	0.017	-0.008	0.011		No disturbance		No disturbance
D604I_021-RL-39-HE_On-A	-0.049	-0.013	0.010		No disturbance		No disturbance
D604I_022-RL-39-HE_On-A	-0.066	-0.021	0.027		No disturbance		No disturbance
D604I_023-RL-39-HE_On-A	-0.019	-0.042	0.082		No disturbance		No disturbance
D604I_024-RL-39-HE_On-A	-0.030	-0.004	0.043		No disturbance		No disturbance
D604I_025-RL-39-HE_On-A	-0.041	-0.023	0.034		No disturbance		No disturbance
D604I_026-RL-39-HE_On-A	0.039	-0.005	0.021		No disturbance		No disturbance



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2021_TWA_FMU_ID	2021 Diff TWA-Off ROW FMU	2020 Diff TWA-Off ROW FMU	2019 Diff TWA-Off ROW FMU	2020 Visual Evaluation Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
D604I_027-RL-39-HE_On-A	0.035	0.005	0.004		No disturbance		No disturbance
D604I_028-RL-39-HE_On-A	-0.008	-0.027	0.041		No disturbance		No disturbance
D604I_029-RL-39-HE_On-B	-0.028	-0.057	0.016		No disturbance		No disturbance
D604I_030-RL-39-HE_On-B	-0.018	-0.059	0.031		No disturbance		No disturbance
D604I_031-RL-39-HE_On-C	-0.043	-0.067	0.017		No disturbance		No disturbance
D604I_032-RL-39-HE_On-C	-0.005	-0.047	0.015		No disturbance		No disturbance
D604I_033-RL-39-HE_On-C	-0.009	-0.042	0.027		No disturbance		No disturbance
D604I_034-RL-39-HE_On-C	-0.052	-0.054	-0.010		No disturbance		No disturbance
D604I_035-RL-38-HE_On-A	-0.086	-0.147	0.001	two disturbance	Project-related disturbance persists	small corner field; FMU not appropriate as lower productivity relative to Off ROW comparable area	Negative outlier, nature unknown (not Project related)
D604I_036-RL-38-HE_On-A	-0.080	-0.084	0.006		No disturbance		No disturbance
D604I_037-RL-38-HE_On-A	-0.045	-0.087	-0.009	two disturbance	Project-related disturbance persists	looks recovered	Recovered
D604I_040-RL-27-HE_On-A	-0.031	-0.015	0.015		No disturbance		No disturbance
D604I_041-RL-27-HE_On-A	-0.028	-0.018	0.014		No disturbance		No disturbance
D604I_042-RL-27-HE_On-A	-0.010	-0.035	-0.002		No disturbance		No disturbance
D604I_043-RL-27-HE_On-B	-0.071	-0.050	0.000		No disturbance		No disturbance
D604I_044-RL-27-HE_On-B	-0.011	-0.027	-0.004		No disturbance		No disturbance
D604I_045-RL-27-HE_On-B	-0.019	-0.041	-0.008		No disturbance		No disturbance
D604I_046-RL-27-HE_On-B	-0.013	-0.036	0.004		No disturbance		No disturbance
D604I_047-OT-26-HE_On-A	0.006	-0.057	-0.031		No disturbance		No disturbance



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2021_TWA_FMU_ID	2021 Diff TWA-Off ROW FMU	2020 Diff TWA-Off ROW FMU	2019 Diff TWA-Off ROW FMU	2020 Visual Evaluation Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
D604I_048-OT-26-HE_On-A	0.022	-0.018	0.007		No disturbance		No disturbance
D604I_049-OT-26-HE_On-A	-0.006	-0.013	0.010		No disturbance		No disturbance
D604I_050-OT-26-HE_On-A	0.016	-0.026	0.015		No disturbance		No disturbance
D604I_051-OT-27-HE_On-A	-0.045	-0.028	-0.002		No disturbance		No disturbance
D604I_052-OT-27-HE_On-A	-0.028	-0.021	-0.009		No disturbance		No disturbance
D604I_053-OT-27-HE_On-A	-0.047	-0.026	0.005		No disturbance		No disturbance
D604I_054-OT-27-HE_On-A	-0.065	-0.052	-0.011		No disturbance		No disturbance
D604I_055-SW-5-10-1-E_On-A	-0.050	-0.141	-0.012	twa disturbance	Project-related disturbance persists	lingering dist masked by low prod in Off ROW; visual confirmation of disturbance	Project-related disturbance persists (MB Hydro-owned)
D604I_056-SW-5-10-1-E_On-A	0.016	-0.018	0.017		No disturbance		No disturbance
D604I_058-SE-5-10-1-E_On-A	-0.035	-0.030	-0.061		No disturbance		No disturbance
D604I_059-SW-4-10-1-E_On-B	-0.038	-0.090	-0.022	twa disturbance	Project-related disturbance persists	looks recovered	Recovered
D604I_060-SW-4-10-1-E_On-A	-0.077	-0.004	-0.001		No disturbance		No disturbance
D604I_061-SE-4-10-1-E_On-A	0.012	-0.024	0.103		No disturbance		No disturbance
D604I_062-SE-4-10-1-E_On-B	-0.085	-0.036	0.007		No disturbance	large area of dist around 3 adjacent towers (parallel t- lines; poor crop growth around towers (EXAMPLE)	Project-related disturbance persists (MB Hydro-owned)
D604I_063-NW-3-10-1-E_On-A	0.078	-0.045	-0.020		No disturbance		No disturbance
D604I_064-NW-3-10-1-E_On-A	-0.003	-0.021	0.033		No disturbance		No disturbance



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2021_TWA_FMU_ID	2021 Diff TWA-Off ROW FMU	2020 Diff TWA-Off ROW FMU	2019 Diff TWA-Off ROW FMU	2020 Visual Evaluation Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
D604I_065-NW-3-10-1-E_On-B	-0.007	-0.013	-0.013		No disturbance		No disturbance
D604I_066-NE-3-10-1-E_On-A	-0.014	-0.030	-0.033		No disturbance		No disturbance
D604I_067-SW-2-10-1-E_On-A	-0.061	-0.082	-0.009		No disturbance		No disturbance
D604I_068-SW-2-10-1-E_On-A	-0.014	-0.139	-0.014	twa disturbance	Project-related disturbance persists	less dist apparent in 2022	Recovered
D604I_069-SW-2-10-1-E_On-A	-0.025	-0.166	0.010	twa disturbance	Project-related disturbance persists	dist may be masked by low productivity	Recovered
D604I_070-SW-2-10-1-E_On-A	0.007	-0.169	0.028	twa disturbance	Project-related disturbance persists	dist may be masked by low productivity	Recovered
D604I_071-SW-2-10-1-E_On-A	0.008	-0.129	-0.009	twa disturbance	Project-related disturbance persists	dist may be masked by low productivity	Recovered
D604I_072-NE-35-9-1-E_On-A	0.029	-0.034	-0.005		No disturbance		No disturbance
D604I_073-NE-35-9-1-E_On-A	0.003	-0.022	-0.009		No disturbance		No disturbance
D604I_074-SE-35-9-1-E_On-B	-0.027	-0.022	-0.010		No disturbance		No disturbance
D604I_075-SE-35-9-1-E_On-B	-0.062	-0.038	-0.027		No disturbance		No disturbance
D604I_076-NE-26-9-1-E_On-A	-0.015	-0.024	0.006		No disturbance		No disturbance
D604I_077-NW-26-9-1-E_On-A	-0.077	-0.001	-0.057		No disturbance		No disturbance
D604I_077-SE-26-9-1-E_On-A	-0.064	-0.040	-0.039		No disturbance		No disturbance
D604I_078-SE-26-9-1-E_On-A	-0.011	0.021	-0.004		No disturbance		No disturbance
D604I_079-NE-23-9-1-E_On-A	-0.016	0.012	0.009		No disturbance		No disturbance
D604I_080-NE-23-9-1-E_On-A	-0.033	0.004	0.002		No disturbance		No disturbance
D604I_081-SE-23-9-1-E_On-A	0.016	-0.019	0.005		No disturbance		No disturbance
D604I_082-SE-23-9-1-E_On-A	0.009	-0.034	0.009		No disturbance		No disturbance



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2021_TWA_FMU_ID	2021 Diff TWA-Off ROW FMU	2020 Diff TWA-Off ROW FMU	2019 Diff TWA-Off ROW FMU	2020 Visual Evaluation Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
D604I_083-NE-14-9-1-E_On-A	-0.021	-0.034	-0.003		No disturbance		No disturbance
D604I_084-NE-14-9-1-E_On-B	-0.053	-0.087	-0.001	two disturbance	Project-related disturbance persists	looks recovered	Recovered
D604I_085-NE-14-9-1-E_On-B	-0.037	-0.046	-0.004		No disturbance		No disturbance
D604I_086-NE-14-9-1-E_On-C	-0.022	-0.043	0.004		No disturbance		No disturbance
D604I_087-NW-13-9-1-E_On-B	0.001	-0.020	0.000		No disturbance		No disturbance
D604I_088-NE-13-9-1-E_On-A	0.006	-0.028	0.035		No disturbance		No disturbance
D604I_088-NW-13-9-1-E_On-B	0.109	-0.038	-0.005		No disturbance		No disturbance
D604I_089-NE-13-9-1-E_On-A	-0.017	0.020	0.029		No disturbance		No disturbance
D604I_090-NW-18-9-2-E_On-A	-0.034	-0.047	0.003		No disturbance		No disturbance
D604I_091-NW-18-9-2-E_On-A	0.009	-0.043	0.002		No disturbance		No disturbance
D604I_092-NE-18-9-2-E_On-A	0.017	-0.052	0.002		No disturbance		No disturbance
D604I_093-NE-18-9-2-E_On-B	0.007	-0.032	0.017		No disturbance		No disturbance
D604I_094-NW-17-9-2-E_On-A	-0.075	0.095	-0.017		No disturbance		No disturbance
D604I_095-NE-17-9-2-E_On-A	0.002	-0.017	0.030		No disturbance		No disturbance
D604I_095-NW-17-9-2-E_On-A	-0.084	0.091	0.013		No disturbance	no apparent proj dist in 2021, some dist apparent in 2020; Off FMU NEEDS CORRECTED	Negative outlier, nature unknown (not Project related)
D604I_096-NE-17-9-2-E_On-B	0.031	-0.015	-0.021		No disturbance		No disturbance
D604I_097-NW-16-9-2-E_On-A	-0.035	-0.040	0.064		No disturbance		No disturbance
D604I_098-NW-16-9-2-E_On-A	-0.052	-0.059	-0.007		No disturbance		No disturbance
D604I_099-NE-16-9-2-E_On-A	-0.009	-0.028	-0.001		No disturbance		No disturbance
D604I_100-NE-16-9-2-E_On-A	0.009	-0.026	-0.007		No disturbance		No disturbance



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2021_TWA_FMU_ID	2021 Diff TWA-Off ROW FMU	2020 Diff TWA-Off ROW FMU	2019 Diff TWA-Off ROW FMU	2020 Visual Evaluation Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
D604I_101-NW-15-9-2-E_On-A	-0.042	-0.020	0.004		No disturbance		No disturbance
D604I_102-NW-15-9-2-E_On-B	0.012	-0.028	0.002		No disturbance		No disturbance
D604I_103-NE-15-9-2-E_On-A	0.011	-0.015	0.000		No disturbance		No disturbance
D604I_104-NW-14-9-2-E_On-A	0.001	-0.014	0.006		No disturbance		No disturbance
D604I_105-NW-14-9-2-E_On-A	-0.010	-0.033	0.006		No disturbance		No disturbance
D604I_106-OT-86-NO_On-A	-0.008	-0.101	0.013	twa disturbance	Project-related disturbance persists	looks recovered, may be masked by low prod	Recovered
D604I_107-OT-86-NO_On-A	0.042	-0.068	0.009		No disturbance		No disturbance
D604I_108-OT-85-NO_On-A	-0.047	0.014	0.003		No disturbance		No disturbance
D604I_109-OT-83-NO_On-A	-0.030	0.066	-0.046		No disturbance		No disturbance
D604I_110-OT-80-NO_On-A	0.006	-0.041	0.001		No disturbance		No disturbance
D604I_111-OT-80-NO_On-A	-0.003	0.026	-0.016		No disturbance		No disturbance
D604I_112-OT-81-NO_On-A	-0.003	-0.008	0.027		No disturbance		No disturbance
D604I_113-RL-80-NO_On-A	-0.040	0.039	0.007		No disturbance		No disturbance
D604I_114-RL-80-NO_On-A	-0.066	0.010	-0.019		No disturbance		No disturbance
D604I_115-RL-80-NO_On-A	-0.047	0.027	0.001		No disturbance		No disturbance
D604I_116-RL-74-NO_On-A	-0.042	-0.083	-0.078		No disturbance		No disturbance
D604I_119A-RL-73-NO_On-A	0.077	-0.019	0.038		No disturbance		No disturbance
D604I_119B-RL-73-NO_On-A	-0.036	0.016	0.007		No disturbance		No disturbance
D604I_122-RL-179-NO_On-B	0.040	0.044	0.015		No disturbance		No disturbance
D604I_123-RL-177-NO_On-A	0.046	0.038	0.075		No disturbance		No disturbance
D604I_124-RL-174-NO_On-A	-0.010	-0.058	0.039		No disturbance		No disturbance
D604I_125-RL-174-NO_On-A	-0.017	0.046	0.062		No disturbance		No disturbance
D604I_126-RL-174-NO_On-A	0.021	0.009	0.018		No disturbance		No disturbance



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D604I_127-RL-174-NO_On-A	0.004	-0.108	-0.038	two disturbance	Project-related disturbance persists	dist may be masked by low productivity	Recovered
D604I_128-RL-174-NO_On-B	-0.045	-0.197	-0.089	two disturbance	Project-related disturbance persists	dist may be masked by low productivity	Recovered
D604I_129-OT-174-NO_On-A	-0.021	-0.005	0.061		No disturbance		No disturbance
D604I_130-OT-174-NO_On-A	-0.031	-0.122	0.036	two disturbance	Project-related disturbance persists	dist may be masked by low productivity	Recovered
D604I_131-OT-174-NO_On-A	-0.037	0.006	0.052		No disturbance		No disturbance
D604I_132-OT-172-NO_On-A	0.027	-0.054	-0.063		No disturbance		No disturbance
D604I_133-OT-172-NO_On-A	-0.033	-0.235	-0.106	two disturbance	Project-related disturbance persists	dist may be masked by low productivity	Recovered
D604I_134-OT-172-NO_On-A	-0.108	-0.172	-0.126	two disturbance	Project-related disturbance persists	proj dist not apparent, some apparent in 2020; ON FMU needs corrected as it includes a maintenance road/trail for floodway; low productivity hay area	Negative outlier, nature unknown (not Project related)
D604I_135-OT-172-NO_On-A	-0.076	-0.135	-0.078	two disturbance	Project-related disturbance persists	dist may be masked by low productivity	Recovered
D604I_136-OT-172-NO_On-A	-0.016	-0.155	-0.105	two disturbance	Project-related disturbance persists	dist may be masked by low productivity	Recovered



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D604I_137-SW-31-9-4-E_On-B	0.003	-0.083	-0.051		No disturbance		No disturbance
D604I_138-SW-31-9-4-E_On-A	-0.001	-0.048	0.034		No disturbance		No disturbance
D604I_139-NW-31-9-4-E_On-A	0.012	-0.025	0.058		No disturbance		No disturbance
D604I_140-NE-31-9-4-E_On-B	-0.014	-0.049	-0.016		No disturbance		No disturbance
D604I_141-NE-31-9-4-E_On-A	0.052	-0.222	-0.028	two disturbance	Project-related disturbance persists	dist may be masked by low productivity	Recovered
D604I_142-SW-5-10-4-E_On-A	-0.003	0.053	-0.066		No disturbance		No disturbance
D604I_143-SW-5-10-4-E_On-B	-0.059	-0.039	-0.043		No disturbance		No disturbance
D604I_144-SW-5-10-4-E_On-B	-0.038	-0.064	-0.051		No disturbance		No disturbance
D604I_145-SW-5-10-4-E_On-B	-0.064	-0.076	-0.038		No disturbance		No disturbance
D604I_146-SE-9-10-4-E_On-A	-0.070	-0.077	-0.083		No disturbance	dist may be masked by low productivity	No disturbance
D604I_147-SE-9-10-4-E_On-A	-0.115	-0.143	-0.024	two disturbance	Project-related disturbance persists	project dist apparent at tower base; but low NDVI in hay (maybe just after cut or low productivity due to dry conditions) may be masking lingering project effects	Project-related disturbance persists (Floodway-owned)



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D604I_148-SE-9-10-4-E_On-A	-0.123	-0.147	0.023	twa disturbance	Project-related disturbance persists	project dist apparent at tower base, more dist at tower base and along construction trail in 2020; but low NDVI in hay (maybe just after cut or low productivity due to dry conditions) may be masking lingering project effects	Project-related disturbance persists (Floodway-owned)
D604I_149-SE-9-10-4-E_On-A	-0.129	-0.171	0.052	twa disturbance	Project-related disturbance persists	project dist apparent at tower base and lingering along construction trail, more dist at tower base and along construction trail in 2020; but low NDVI in hay (maybe just after cut or low productivity due to dry conditions) may be masking lingering project effects	Project-related disturbance persists (Floodway-owned)
D604I_150-SW-10-10-4-E_On-A	-0.075	-0.139	0.041	twa disturbance	Project-related disturbance persists	dist may be masked by low productivity	Recovered



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2021_TWA_FMU_ID	2021 Diff TWA-Off ROW FMU	2020 Diff TWA-Off ROW FMU	2019 Diff TWA-Off ROW FMU	2020 Visual Evaluation Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
D604I_151-SW-10-10-4-E_On-A	-0.038	-0.120	0.019	two disturbance	Project-related disturbance persists	dist may be masked by low productivity	Recovered
D604I_152-SW-10-10-4-E_On-A	-0.057	-0.137	0.022	two disturbance	Project-related disturbance persists	dist may be masked by low productivity	Recovered
D604I_153-SW-10-10-4-E_On-A	-0.062	-0.148	0.015	two disturbance	Project-related disturbance persists	less dist apparent in 2022	Recovered
D604I_154-SW-10-10-4-E_On-B	-0.059	-0.080	-0.022		No disturbance		No disturbance
D604I_155-SW-10-10-4-E_On-B	0.028	0.053	0.018		No disturbance		No disturbance
D604I_156-SW-14-10-4-E_On-A	-0.009	-0.065	0.023		No disturbance		No disturbance
D604I_157-NW-14-10-4-E_On-A	-0.008	0.000	0.017		No disturbance		No disturbance
D604I_158-NW-14-10-4-E_On-A	-0.015	0.066	0.034		No disturbance		No disturbance
D604I_159-NW-14-10-4-E_On-A	-0.015	-0.027	0.003		No disturbance		No disturbance
D604I_160-NW-14-10-4-E_On-A	-0.004	0.001	0.006		No disturbance		No disturbance
D604I_161-SW-23-10-4-E_On-A	0.054	0.213	-0.049		No disturbance		No disturbance
D604I_163-NW-23-10-4-E_On-B	-0.053	-0.037	0.045		No disturbance		No disturbance
D604I_164-NW-23-10-4-E-On-A	-0.006				No disturbance		No disturbance
D604I_166-SE-26-10-4-E_On-A	-0.076	0.001	0.039		No disturbance		No disturbance
D604I_167-SE-26-10-4-E_On-A	0.051	0.090	0.065		No disturbance		No disturbance
D604I_168-SW-25-10-4-E_On-A	-0.009	-0.136	-0.037	two disturbance	Project-related disturbance persists	dist may be masked by low productivity	Recovered
D604I_169-SW-25-10-4-E_On-A	-0.005	-0.187	-0.005	two disturbance	Project-related disturbance persists		Recovered



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D604I_170-SW-25-10-4-E_On-A	-0.001	-0.128	0.008	two disturbance	Project-related disturbance persists	appears recovered	Recovered
D604I_171-SW-25-10-4-E_On-A	0.010	-0.280	-0.017	two disturbance	Project-related disturbance persists		Recovered
D604I_172-SW-30-10-5-E_On-A	-0.043	-0.013	-0.034		No disturbance		No disturbance
D604I_173-SW-30-10-5-E_On-A	-0.023	-0.022	-0.034		No disturbance		No disturbance
D604I_174-SE-30-10-5-E_On-B	-0.035	-0.057	-0.015		No disturbance		No disturbance
D604I_175-SE-30-10-5-E_On-B	-0.037	-0.050	-0.031		No disturbance		No disturbance
D604I_176-SW-29-10-5-E_On-A	-0.008	-0.002	-0.025		No disturbance		No disturbance
D604I_177-SW-29-10-5-E_On-A	-0.013	-0.032	-0.049		No disturbance		No disturbance
D604I_178-SW-29-10-5-E_On-A	-0.014	-0.034	-0.020		No disturbance		No disturbance
D604I_179-SW-29-10-5-E_On-A	-0.009	-0.060	-0.021		No disturbance		No disturbance
D604I_180-SW-28-10-5-E_On-A	-0.020	0.012	-0.078		No disturbance		No disturbance
D604I_181-SE-28-10-5-E_On-A	0.090	0.166	0.099		No disturbance		No disturbance
D604I_181-SW-28-10-5-E_On-A	-0.037	-0.072	0.003		No disturbance		No disturbance
D604I_182-SE-28-10-5-E_On-A	-0.034	0.080	-0.037		No disturbance		No disturbance
D604I_183-SE-28-10-5-E_On-A	0.019	0.077	-0.013		No disturbance		No disturbance
D604I_184-SW-27-10-5-E_On-A	-0.026	-0.047	-0.070		No disturbance		No disturbance
D604I_185-SE-27-10-5-E_On-A	0.037	-0.076	-0.085		No disturbance		No disturbance
D604I_185-SW-27-10-5-E_On-A	-0.052	-0.102	-0.036	two disturbance	Project-related disturbance persists	good recovery	Recovered
D604I_186-SE-27-10-5-E_On-A	0.001	-0.038	-0.035		No disturbance		No disturbance
D604I_187-SE-27-10-5-E_On-A	0.041	-0.036	-0.038		No disturbance		No disturbance
D604I_188-SW-26-10-5-E_On-A	-0.034	-0.041	-0.005		No disturbance		No disturbance



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D604I_189-SW-26-10-5-E_On-A	-0.023	-0.012	0.005		No disturbance		No disturbance
D604I_190-SW-26-10-5-E_On-A	-0.031	-0.046	0.010		No disturbance		No disturbance
D604I_191-SW-26-10-5-E_On-A	-0.060	-0.097	-0.007	twa disturbance	Project-related disturbance persists	good recovery	Recovered
D604I_192-SW-25-10-5-E_On-A	-0.036	-0.055	-0.030		No disturbance		No disturbance
D604I_193-SW-25-10-5-E_On-A	-0.019	-0.035	-0.086	below negative threshold in 2019; not outlier in 2020	No disturbance		No disturbance
D604I_194-SW-25-10-5-E_On-A	0.022	0.012	-0.050		No disturbance		No disturbance
D604I_195-SW-25-10-5-E_On-A	0.006	-0.026	-0.040		No disturbance		No disturbance
D604I_196-SW-30-10-6-E_On-A	-0.031	0.027	0.027		No disturbance		No disturbance
D604I_197-SW-30-10-6-E_On-A	-0.026	0.032	0.010		No disturbance		No disturbance
D604I_198-SE-30-10-6-E_On-A	0.003	-0.022	-0.077		No disturbance		No disturbance
D604I_199-SE-30-10-6-E_On-A	-0.015	-0.017	-0.132	below negative threshold in 2019; not outlier in 2020	No disturbance		No disturbance
D604I_200-SE-30-10-6-E_On-A	0.010	-0.006	-0.106	below negative threshold in 2019; not outlier in 2020	No disturbance		No disturbance
D604I_201-SW-29-10-6-E_On-A	-0.072	-0.039	0.011		No disturbance		No disturbance
D604I_202-SW-29-10-6-E_On-A	-0.022	-0.022	0.017		No disturbance		No disturbance
D604I_203-SE-29-10-6-E_On-A	-0.025	-0.039	-0.037		No disturbance		No disturbance
D604I_204-SE-29-10-6-E_On-A	-0.089	-0.093	-0.022	twa disturbance	Project-related disturbance persists	tower dist apparent; dist extends across ROW around adjacent t-line tower, no access	Project-related disturbance persists (MB Hydro-owned)



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						dist apparent at field edge tower	
D604I_205--SW-28-10-6-E_On-A	-0.062	-0.022	-0.082		No disturbance	good example of productivity around mult towers	No disturbance
D604I_206--SE-28-10-6-E_On-A	-0.064	-0.006	-0.036		No disturbance		No disturbance
D604I_206--SW-28-10-6-E_On-A	-0.079	-0.046	-0.147	below negative threshold in 2019; not outlier in 2020	No disturbance		No disturbance
D604I_207--SE-28-10-6-E_On-A	-0.064	-0.018	-0.036		No disturbance		No disturbance
D604I_208--SE-28-10-6-E_On-A	-0.051	-0.022	-0.012		No disturbance		No disturbance
D604I_209--SW-27-10-6-E_On-A	0.002	-0.078	-0.004		No disturbance		No disturbance
D604I_210--SE-27-10-6-E_On-A	-0.078	0.041	-0.252	below negative threshold in 2019; not outlier in 2020	No disturbance		No disturbance
D604I_210--SW-27-10-6-E_On-A	-0.088	-0.041	-0.088	below negative threshold in 2019; not outlier in 2020	No disturbance	TWA dist apparent in two adjacent towers; more dist around tower on adjacent t-line to north; ADJUST ON FMU to remove out of production area	Project-related disturbance persists (MB Hydro-owned)
D604I_211--SE-27-10-6-E_On-A	-0.029	-0.080	-0.003		No disturbance		No disturbance
D604I_212--SE-27-10-6-E_On-A	-0.068	-0.053	-0.045		No disturbance		No disturbance
D604I_213--SW-26-10-6-E_On-A	-0.029	-0.067	-0.029		No disturbance		No disturbance
D604I_214--SW-26-10-6-E_On-A	0.059	0.007	0.086		No disturbance		No disturbance



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2021_TWA_FMU_ID	2021 Diff TWA-Off ROW FMU	2020 Diff TWA-Off ROW FMU	2019 Diff TWA-Off ROW FMU	2020 Visual Evaluation Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
D604I_218-SW-25-10-6-E_On-A	-0.022	-0.083	-0.063		No disturbance		No disturbance
D604I_219-SE-25-10-6-E_On-A	0.109	0.112	0.060		No disturbance		No disturbance
D604I_220-SE-25-10-6-E_On-A	0.032	-0.016	0.023		No disturbance		No disturbance
D604I_221-SW-30-10-7-E_On-A	0.091	0.022	0.019		No disturbance		No disturbance
D604I_222-SE-30-10-7-E_On-A	-0.034	-0.027	0.047		No disturbance		No disturbance
D604I_222-SW-30-10-7-E_On-A	0.065	0.012	-0.022		No disturbance		No disturbance
D604I_223-SE-30-10-7-E_On-B	-0.005	-0.018	0.023		No disturbance		No disturbance
D604I_224-SE-30-10-7-E_On-B	0.046	0.011	-0.005		No disturbance		No disturbance
D604I_225-SW-29-10-7-E_On-B	-0.078	-0.307	0.013	twa disturbance	Project-related disturbance persists	disturbance perists; visual confirmation of disturbance	Project-related disturbance persists
D604I_226-NW-20-10-7-E_On-A	-0.057	-0.211	-0.011	twa disturbance	Project-related disturbance persists	still some disturbance evident; visual confirmation of disturbance	Project-related disturbance persists (RM-owned)
D604I_227-NW-20-10-7-E_On-B	-0.003	-0.096	0.018	twa disturbance	Project-related disturbance persists	good recovery	Recovered
D604I_228-NW-20-10-7-E_On-B	0.024	-0.002	0.081		No disturbance		No disturbance
D604I_230-NW-17-10-7-E_On-A	0.050	-0.096	0.022	twa disturbance	Project-related disturbance persists	good recovery	Recovered
D604I_231-NW-17-10-7-E_On-A	0.013	-0.163	0.016	twa disturbance	Project-related disturbance persists	good example of angle tower recovery in grazing	Recovered



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2021_TWA_FMU_ID	2021 Diff TWA-Off ROW FMU	2020 Diff TWA-Off ROW FMU	2019 Diff TWA-Off ROW FMU	2020 Visual Evaluation Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
D604I_232-NW-17-10-7-E_On-A	0.009	-0.109	-0.023	twa disturbance	Project-related disturbance persists	good recovery	Recovered
D604I_233-NW-17-10-7-E_On-A	-0.017	-0.162	0.061	twa disturbance	Project-related disturbance persists	much less dist in 2022	Recovered
D604I_242-SE-5-10-7-E_On-A	-0.033	-0.136	-0.042	twa disturbance	Project-related disturbance persists	good recovery	Recovered
D604I_243-NE-32-9-7-E_On-A	-0.006	-0.020	0.014		No disturbance		No disturbance
D604I_258-NE-15-9-7-E_On-A	-0.024	0.019	0.047		No disturbance		No disturbance
D604I_259-SE-15-9-7-E_On-A	-0.045	-0.164	0.016	twa disturbance	Project-related disturbance persists	lingering proj dist masked by low prod	Recovered
D604I_263-SW-11-9-7-E_On-B	-0.077	-0.192	-0.043	twa disturbance	Project-related disturbance persists	dist may be masked by low productivity	Recovered
D604I_278-NE-24-8-7-E_On-A	-0.055	-0.060	0.010		No disturbance		No disturbance
D604I_279-NE-24-8-7-E_On-A	-0.023	-0.062	0.009		No disturbance		No disturbance
D604I_285-SW-18-8-8-E_On-A	0.081	-0.070	0.042		No disturbance		No disturbance
D604I_286-NE-7-8-8-E_On-A	-0.062	0.038	-0.051		No disturbance		No disturbance
D604I_305-SE-19-7-8-E_On-A	-0.033	-0.115	0.002	twa disturbance	Project-related disturbance persists	looks recovered	Recovered
D604I_306-SE-19-7-8-E_On-A	-0.032	-0.049	-0.055		No disturbance		No disturbance
D604I_307-NE-18-7-8-E_On-B	0.032	-0.046	-0.007		No disturbance		No disturbance
D604I_308-NE-18-7-8-E_On-A	-0.052	0.034	-0.105	below negative threshold in 2019; not outlier in 2020	No disturbance		No disturbance



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2021_TWA_FMU_ID	2021 Diff TWA-Off ROW FMU	2020 Diff TWA-Off ROW FMU	2019 Diff TWA-Off ROW FMU	2020 Visual Evaluation Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
D604I_308-SE-18-7-8-E_On-A	0.059	0.068	0.001		No disturbance		No disturbance
D604I_309-SE-18-7-8-E_On-A	0.015	0.028	-0.006		No disturbance		No disturbance
D604I_310-SE-18-7-8-E_On-A	0.041	-0.030	0.003		No disturbance		No disturbance
D604I_311-NE-7-7-8-E_On-A	0.035	-0.021	0.029		No disturbance		No disturbance
D604I_312-SE-7-7-8-E_On-A	-0.029	-0.030	-0.005		No disturbance		No disturbance
D604I_313-SE-7-7-8-E_On-B	-0.052	0.040	0.094		No disturbance		No disturbance
D604I_313-SE-7-7-8-E_On-C	-0.058	-0.087	-0.040	twa disturbance	Project-related disturbance persists	looks recovered	Recovered
D604I_314-NE-6-7-8-E_On-A	-0.289	-0.409	-0.134	appears natural low productivity in field corner	Negative outlier, nature unknown (not Project related)	low productivity area in corner of field; may be some lingering project effects but predominantly "natural" variability	Negative outlier, nature unknown (not Project related)
D604I_314-NE-6-7-8-E_On-B	-0.131	-0.198	-0.073	twa disturbance	Project-related disturbance persists	dist at twr apparent; low productivity corner of field contributing to low NDVI	Project-related disturbance persists
D604I_315-NE-6-7-8-E_On-A	-0.180	-0.061	-0.026		No disturbance	dist appears filed mgmt related	Negative outlier, nature unknown (not Project related)
D604I_316-SE-6-7-8-E_On-A	-0.010	-0.049	-0.018		No disturbance		No disturbance
D604I_317-SE-6-7-8-E_On-B	-0.040	-0.098	-0.014	twa disturbance	Project-related disturbance persists	good recovery	Recovered



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2021_TWA_FMU_ID	2021 Diff TWA-Off ROW FMU	2020 Diff TWA-Off ROW FMU	2019 Diff TWA-Off ROW FMU	2020 Visual Evaluation Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
D604I_317-SE-6-7-8-E_On-B	0.006	-0.098	-0.014	two disturbance	Project-related disturbance persists	good recovery	Recovered
D604I_319-NW-32-6-8-E_On-A	-0.040	-0.048	-0.020		No disturbance		No disturbance
D604I_320-SW-32-6-8-E_On-A	-0.021	-0.007	-0.014		No disturbance		No disturbance
D604I_321-SW-32-6-8-E_On-B	-0.020	-0.110	-0.023	two disturbance	Project-related disturbance persists	good recovery	Recovered
D604I_322-NW-29-6-8-E_On-A	0.067	0.132	0.211		No disturbance		No disturbance
D604I_323-NW-29-6-8-E_On-A	0.001	0.030	0.152		No disturbance		No disturbance
D604I_324-SW-29-6-8-E_On-B	-0.002	0.025	-0.004		No disturbance		No disturbance
D604I_325-SW-29-6-8-E_On-C	0.054	0.083	0.022		No disturbance		No disturbance
D604I_326-NW-20-6-8-E_On-B	-0.002	-0.047	0.002		No disturbance		No disturbance
D604I_327-NW-20-6-8-E_On-A	-0.070	-0.041	0.055		No disturbance		No disturbance
D604I_328-NW-20-6-8-E_On-A	-0.008	0.072	0.070		No disturbance		No disturbance
D604I_329-SW-20-6-8-E_On-B	0.004	-0.062	-0.026		No disturbance		No disturbance
D604I_330-SW-20-6-8-E_On-B	-0.065	-0.104	0.045	two disturbance	Project-related disturbance persists	looks recovered	Recovered
D604I_331-NW-17-6-8-E_On-A	-0.031	-0.013	-0.017		No disturbance		No disturbance
D604I_332-NE-17-6-8-E_On-A	-0.011	-0.018	-0.067		No disturbance		No disturbance
D604I_332-NW-17-6-8-E_On-A	-0.042	-0.091	0.044	two disturbance	Project-related disturbance persists		Recovered
D604I_333-SE-17-6-8-E_On-A	0.033	-0.117	0.018	two disturbance	Project-related disturbance persists	looks recovered	Recovered



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2021_TWA_FMU_ID	2021 Diff TWA-Off ROW FMU	2020 Diff TWA-Off ROW FMU	2019 Diff TWA-Off ROW FMU	2020 Visual Evaluation Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
D604I_334-SE-17-6-8-E_On-A	-0.066	-0.087	-0.106	limited project dist	Project-related disturbance persists	looks recovered	Recovered
D604I_334-SW-17-6-8-E_On-B	-0.025	-0.046	-0.006		No disturbance		No disturbance
D604I_335-NE-8-6-8-E_On-A	0.011	-0.016	0.010		No disturbance		No disturbance
D604I_335-NW-8-6-8-E_On-A	-0.014	-0.063	0.100		No disturbance		No disturbance
D604I_336-SE-8-6-8-E_On-A	-0.002	-0.117	-0.020	twa disturbance	Project-related disturbance persists	no obvious proj dist; natural low prod	Recovered
D604I_336-SW-8-6-8-E_On-A	-0.132	-0.155	0.005	twa disturbance	Project-related disturbance persists	low ndvi not proj related; soil variability	Negative outlier, nature unknown (not Project related)
D604I_337-SE-8-6-8-E_On-E	0.093	-0.092	-0.037	additional project dist	Negative outlier, nature unknown	looks recovered	Recovered
D604I_337-SE-8-6-8-E_On-F	-0.010	-0.069	-0.039		No disturbance		No disturbance
D604I_337-SW-8-6-8-E_On-B	-0.076	0.032	-0.091		No disturbance		No disturbance
D604I_338-NE-5-6-8-E_On-A	-0.031	-0.027	-0.047		No disturbance		No disturbance
D604I_338-NW-5-6-8-E_On-A	0.056	-0.069	-0.019		No disturbance		No disturbance
D604I_339-NE-5-6-8-E_On-B	-0.090	-0.105	0.073	twa disturbance	Project-related disturbance persists	low NDVI in portion of TWA does not appear project; attributable to naturally lower productivity soils	Negative outlier, nature unknown (not Project related)
D604I_340-NE-5-6-8-E_On-B	-0.060	-0.074	0.085		No disturbance		No disturbance
D604I_341-SE-5-6-8-E_On-A	0.020	0.098	0.132		No disturbance		No disturbance



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2021_TWA_FMU_ID	2021 Diff TWA-Off ROW FMU	2020 Diff TWA-Off ROW FMU	2019 Diff TWA-Off ROW FMU	2020 Visual Evaluation Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
D604I_342-NE-32-5-8-E_On-B	-0.142	-0.170	-0.033	twa disturbance	Project-related disturbance persists	may be project related dist in TWA; low prod grazing land; effects may be exacerbated by natural low productivity area SE of tower	Project-related disturbance persists
D604I_342-NW-32-5-8-E_On-A	-0.109	-0.123	-0.052	twa disturbance	Project-related disturbance persists	may be project related dist in TWA; low prod grazing land; effects may be exacerbated by natural low productivity; TWA does not include tower base	Project-related disturbance persists
D604I_349-NW-20-5-8-E_On-A	0.030	0.022	-0.052		No disturbance		No disturbance
D604I_350-SE-20-5-8-E_On-A	0.116	0.038	0.060		No disturbance		No disturbance
D604I_350-SW-20-5-8-E_On-A	0.122	-0.013	-0.013		No disturbance		No disturbance
D604I_351-SE-20-5-8-E_On-B	0.083	-0.070	0.051		No disturbance		No disturbance
D604I_351-SW-20-5-8-E_On-B	0.027	0.015	-0.007		No disturbance		No disturbance
D604I_352-N-17-5-8-E_On-A	0.216	0.074	0.009		No disturbance		No disturbance
D604I_353-N-17-5-8-E_On-A	0.272	0.183	0.078		No disturbance		No disturbance
D604I_354-S-17-5-8-E_On-A	0.029	-0.110	0.030	twa disturbance	Project-related disturbance persists	good recovery	Recovered
D604I_355-S-17-5-8-E_On-A	0.021	-0.084	0.000		No disturbance		No disturbance
D604I_356-NE-8-5-8-E_On-B	0.042	0.048	0.026		No disturbance		No disturbance



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2021_TWA_FMU_ID	2021 Diff TWA-Off ROW FMU	2020 Diff TWA-Off ROW FMU	2019 Diff TWA-Off ROW FMU	2020 Visual Evaluation Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
D604I_357-NE-8-5-8-E_On-B	-0.072	-0.100	0.016	twa disturbance	Project-related disturbance persists	looks recovered	Recovered
D604I_362-SE-5-5-8-E_On-A	-0.014	-0.149	0.000	twa disturbance	Project-related disturbance persists	less dist apparent in 2022	Recovered
D604I_363-NE-32-4-8-E_On-A	-0.068	-0.160	-0.090	twa disturbance	Project-related disturbance persists	appears recovered	Recovered
D604I_378-NE-9-4-8-E_On-A	0.026	0.024	0.016		No disturbance		No disturbance
D604I_379-SE-9-4-8-E_On-A	-0.013	-0.120	0.067	twa disturbance	Project-related disturbance persists	some recovery apparent	Recovered
D604I_381-SW-10-4-8-E_On-A	-0.025	-0.028	-0.022		No disturbance		No disturbance
D604I_386-NW-35-3-8-E_On-A	-0.026	-0.062	-0.001		No disturbance		No disturbance
D604I_387-NW-35-3-8-E_On-A	0.066	-0.049	0.058		No disturbance		No disturbance
D604I_389-SE-35-3-8-E_On-B	0.071	-0.101	-0.078	twa disturbance	Project-related disturbance persists	good recovery	Recovered
D604I_390-SE-35-3-8-E_On-B	-0.015	-0.171	-0.066	twa disturbance	Project-related disturbance persists	good recovery	Recovered
D604I_411-NE-4-3-9-E_On-B	-0.011	-0.041	-0.010		No disturbance		No disturbance
D604I_424-SE-25-2-9-E_On-A	0.046	-0.081	0.021		No disturbance		No disturbance
D604I_440-NW-4-2-10-E_On-A	-0.072	-0.139	0.016	twa disturbance	Project-related disturbance persists	good recovery	Recovered



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2021_TWA_FMU_ID	2021 Diff TWA-Off ROW FMU	2020 Diff TWA-Off ROW FMU	2019 Diff TWA-Off ROW FMU	2020 Visual Evaluation Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
D604I_474-NW-24-1-11-E_On-A	-0.103	-0.259	-0.008	two disturbance	Project-related disturbance persists	TWA dist around tower apparent; recovering from 2020 with much reduced dist footprint in 2021 (GOOD EXAMPLE OF RECOVERY)	Project-related disturbance persists
D604I_475-NE-24-1-11-E_On-A	-0.091	-0.052	0.104		No disturbance	not proj related; headland effects around field	Negative outlier, nature unknown (not Project related)
D604I_475-NW-24-1-11-E_On-A	-0.030	-0.106	0.029	two disturbance	Project-related disturbance persists	good recovery	Recovered
D604I_476-NE-24-1-11-E_On-A	-0.009	-0.055	0.025		No disturbance		No disturbance
D604I_478-W-19-1-12-E_On-A	0.016	0.034	0.057		No disturbance		No disturbance
D604I_479-SE-19-1-12-E_On-A	-0.047	-0.056	0.011		No disturbance		No disturbance
D604I_479-W-19-1-12-E_On-A	0.095	0.063	-0.006		No disturbance		No disturbance
D604I_480-SE-19-1-12-E_On-A	-0.009	-0.064	0.003		No disturbance		No disturbance
D604I_481-NE-18-1-12-E_On-A	-0.031	0.000	-0.037		No disturbance		No disturbance
D604I_482-NE-18-1-12-E_On-B	0.003	-0.088	0.010	two disturbance	Project-related disturbance persists	looks recovered	Recovered
D604I_484-SW-17-1-12-E_On-A	-0.035	-0.051	0.010		No disturbance		No disturbance
D604I_485-SW-17-1-12-E_On-B	0.021	-0.120	-0.010	two disturbance	Project-related disturbance persists	good recovery	Recovered
D604I_486-NW-8-1-12-E_On-A	0.009	-0.045	0.017		No disturbance		No disturbance
D604I_487-NW-8-1-12-E_On-A	0.079	0.007	-0.084		No disturbance		No disturbance



Table A.2 NDVI Difference Values, Visual Assessment Comments and Disturbance Categories for TWAs

2021_TWA_FMU_ID	2021 Diff TWA-Off ROW FMU	2020 Diff TWA-Off ROW FMU	2019 Diff TWA-Off ROW FMU	2020 Visual Evaluation Comments	2020 Disturbance Category	2021 Visual Assessment Comments	2021 Disturbance Category
D604I_487-NW-8-1-12-E_On-B	0.094	-0.029	-0.023		No disturbance		No disturbance
D604I_488-E-8-1-12-E_On-A	-0.059	-0.044	0.028		No disturbance		No disturbance
D604I_489-E-8-1-12-E_On-A	-0.064	-0.080	-0.023		No disturbance		No disturbance
D604I_490-SE-8-1-12-E_On-A	0.015	-0.089	0.010	twa disturbance	Project-related disturbance persists	good recovery	Recovered
D604I_491-NW-4-1-12-E_On-A	-0.030	-0.020	0.005		No disturbance		No disturbance
D604I_492-NW-4-1-12-E_On-A	0.014	-0.037	0.012		No disturbance		No disturbance
D604I_493-SW-4-1-12-E_On-A	-0.019	-0.054	0.021		No disturbance		No disturbance
<p>Notes:</p> <div> <div>Diff = difference</div> <div>ROW = right of way</div> <div>TWA = tower work area</div> <div>FMU = farm management unit</div> </div> <p>Shading in cells as follows:</p> <p>Difference values – 2021 Diff TWA-Off ROW FMU & 2020 Diff TWA-Off ROW FMU & 2019 Diff TWA-Off ROW FMU</p> <p>Green = value is above positive threshold and considered a minor positive outlier</p> <p>Green (bold text) = value is above positive threshold or considered a major positive outlier</p> <p>Red = value is below negative threshold or considered a minor negative outlier</p> <p>Red (bold text) = value is below negative threshold or considered a major negative outlier</p> <p>Disturbance categories – 2020 Disturbance Category & 2021 Disturbance Category</p> <p>Green = Recovered</p> <p>Orange = Project-related disturbance persists</p> <p>Blue = Negative outlier, nature unknown (not Project related)</p>							



A.2 Evaluation of Project Disturbance Categories Relative to Project Construction and Environmental Factors

Table A.2.1 2021 Disturbance Category for TWAs Relative to Tower Structure Type

Disturbance Category by Tower Type	TWA Count	% of Tower Type
Self Supporting D-E Angle	31	11% of total
Disturbance persists	6	19%
Recovered	7	23%
No disturbance	18	58%
Self Supporting Suspension	234	83% of total
Disturbance persists	7	3%
Recovered	6	3%
No disturbance	44	19%
Guyed	17	6% of total
Recovered	8	47%
No disturbance	9	53%
Total	282	100%
Note: Does not include 56 TWAs associated with towers that were pre-existing and installed as part of the M602F transmission line.		



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Table A.2.2 2021 Disturbance Category for TWAs Relative to Foundation Type

Disturbance Category by Foundation Type	TWA Count	% of Foundation Type
Guyed Tower Concrete Mat Foundation	5	1% of total
Recovered	1	20%
No disturbance	4	80%
Guyed Tower Foundation Bridge	12	4% of total
Recovered	7	58%
No disturbance	5	42%
SS CIP Concrete Foundation	64	19% of total
Disturbance persists	8	12%
Recovered	7	11%
No disturbance	49	77%
SS Helical Pile Foundation	183	54% of total
Disturbance persists	10	6%
Recovered	39	21%
No disturbance	134	73%
SS Tower Concrete Mat Foundation	18	5% of total
Disturbance persists	1	6%
Recovered	5	28%
No disturbance	12	67%
Total	282	100%
Notes: Does not include 56 TWAs associated with towers that were pre-existing and installed as part of the M602F transmission line.		



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Table A.2.3 2021 Disturbance Category for TWAs Relative to Tower Installation Month

Disturbance Category by Tower Installation Month	TWA Count	% of Installation Month
September 2019	47	17%% of total
Disturbance persists	5	11%
No disturbance	34	72%
Recovered	8	17%
October 2019	31	11%% of total
Disturbance persists	3	10%
No disturbance	24	77%
Recovered	4	13%
November 2019	65	23%% of total
Disturbance persists	3	5%
Negative outlier, not project related	1	2%
No disturbance	46	71%
Recovered	15	23%
December 2019	57	20%% of total
Disturbance persists	3	5%
Negative outlier, not project related	2	4%
No disturbance	45	79%
Recovered	7	12%
January 2020	68	24%% of total
Disturbance persists	4	6%
No disturbance	46	68%
Recovered	18	26%
February 2020	14	5%% of total
Disturbance persists	1	7%
No disturbance	6	43%
Recovered	7	50%
Total	282	100%
Notes: Does not include 56 TWAs associated with towers that were pre-existing and installed as part of the M602F transmission line.		



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Table A.2.4 2021 Disturbance Categories for TWAs Relative to Installation Season and Soil Compaction Risk

Season	Compaction Risk						Totals	
	High		Moderate		Low			
	No. of TWAs	%	No. of TWAs	%	No. of TWAs	%	No. of TWAs	%
Fall period (Sep-Nov)	68	47%	10	29%	30	58%	108	46%
Disturbance persists	8	12%		0%		0%	8	7%
Recovered	9	13%	2	20%		0%	16	15%
Negative outlier, not project related	1	1%		0%	25	83%	1	1%
No disturbance	50	74%	8	80%	5	17%	83	77%
Winter period (Dec-Feb)	78	53%	25	71%	22	42%	125	54%
Disturbance persists	3	4%	1	4%	4	18%	8	6%
Recovered	15	19%	7	28%		0%	31	25%
Negative outlier, not project related	1	1%	1	4%	9	41%	2	2%
No disturbance	59	76%	16	64%	9	41%	84	67%
Totals	146	100%	35	100%	52	100%	233	100%
Notes:								
Does not include 56 TWAs associated with towers that were pre-existing and installed as part of the M602F transmission line.								



Table A.2.5 TWAs in Disturbance Persists or Recovered Categories in 2021 Relative to Installation Season and Soil Compaction Risk

Season	No. of TWAs	%
Fall	24	38% of total
High	17	71%
Moderate	2	8%
Low	5	21%
Winter	39	62% of total
High	18	46%
Moderate	8	21%
Low	13	33%
Totals	63	100% of total
Notes: Does not include 56 TWAs associated with towers that were pre-existing and installed as part of the M602F transmission line.		

Table A.2.6 TWAs in the Disturbance Persists Category in 2021 Relative to Installation Season and Soil Compaction Risk

Season	No. of TWAs	%
Fall	8	50% of total
High	8	100%
Winter	8	50% of total
High	3	38%
Moderate	1	13%
Low	4	50%
Totals	16	100% of total
Notes: Does not include 56 TWAs associated with towers that were pre-existing and installed as part of the M602F transmission line.		



Agricultural Soil Productivity Monitoring for the Manitoba-Minnesota Transmission Project: Post-Construction Year 2 (2021)
Appendix A Tables
September 12, 2022

Table A.2.8 2021 Disturbance Category for TWAs Relative to Agricultural Capability Class Categories

Agricultural Capability Class Category	No. of TWAs	%
Prime agricultural land (Class 1, 2 and 3)	160	69% of total
Disturbance persists	12	8%
Negative outlier, not project related	1	1%
No disturbance	127	79%
Recovered	20	13%
Viable lower class land (Class 4 and 5)	36	15% of total
Disturbance persists	3	8%
No disturbance	18	50%
Recovered	15	42%
Viable lower class land (Class 6)	26	11% of total
Negative outlier, not project related	1	4%
No disturbance	15	58%
Recovered	10	38%
Organic	11	5% of total
Disturbance persists	1	9%
Negative outlier, not project related	1	9%
No disturbance	7	64%
Recovered	2	18%
Total	233	100%



Table A.2.9 2021 Disturbance Category for TWAs Relative to Land Cover Class

Disturbance Category by Land Cover Class	TWA Count	% of Class
Cropland	177	71%
Disturbance persists	10	6%
Recovered	23	13%
No disturbance	141	80%
Grassland	70	28%
Disturbance persists	5	7%
Recovered	27	39%
No disturbance	38	54%
Grassland/Hayland	4	2%
Recovered	1	25%
No disturbance	3	75%
Total	251	100%
Note: Does not include 31 TWAs without an assigned land cover class.		



Appendix B Statistical Analyses

B.1 On RoW Field Management Units (On RoW FMUs) Post-Construction Year 2 (2021)

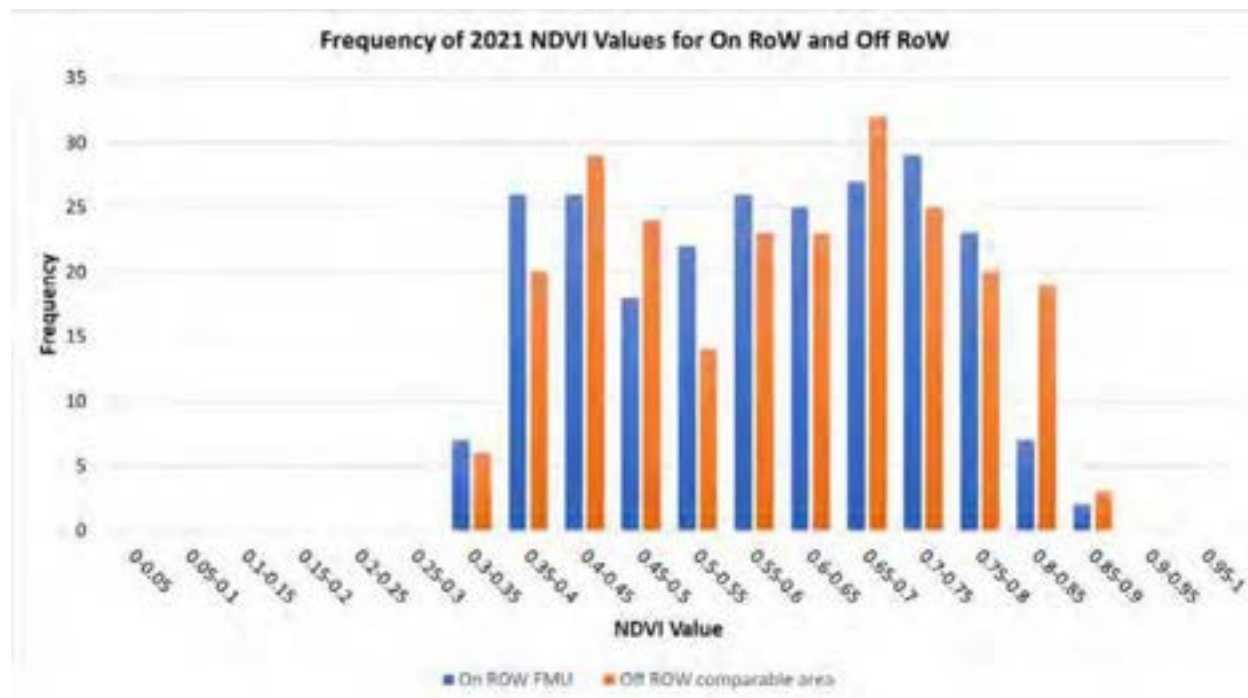
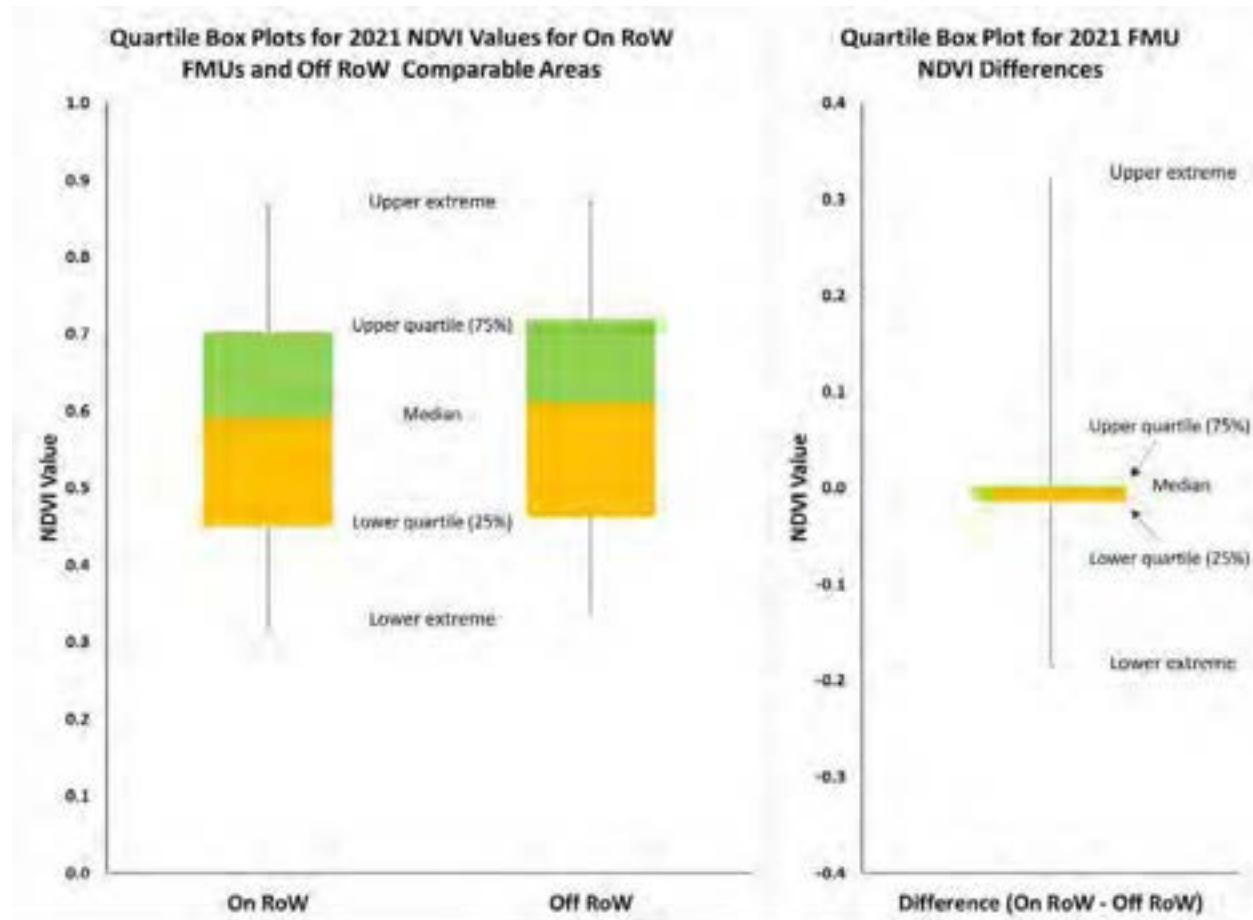
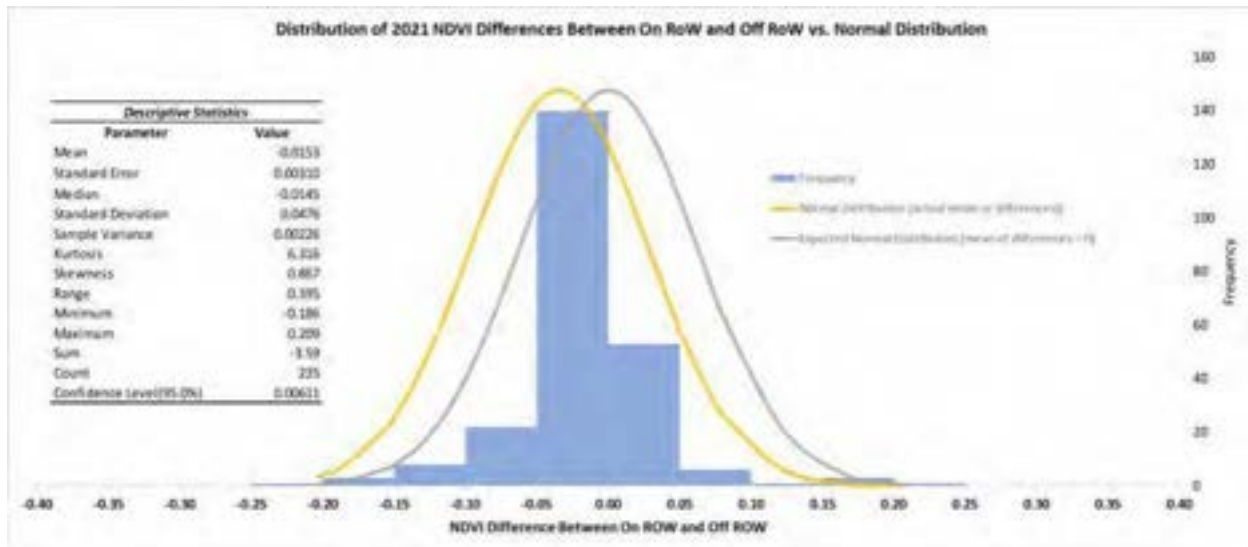


Figure B.1.1 Frequency of 2021 NDVI Values for On RoW FMUs and Off RoW Comparable Areas



The quartile box plots for On RoW FMUs and Off RoW comparable areas indicate that the ranges (between minimum and maximum values shown by the “whiskers”) are fairly similar between On RoW FMUs and Off RoW comparable areas. The median value (centre of box) as well as the lower or first quartile (25th percentile; orange) and upper or third quartile (75th percentile; green) are lower for On RoW FMUs compared with Off RoW comparable areas, suggesting lower productivity On RoW relative to Off RoW. When the box plot for NDVI differences (On RoW – Off RoW comparable areas) is examined, it shows the median is below zero and 50% of the data (between 25th and 75th percentile) are below zero, indicating a negative skew in the NDVI difference data.

Figure B.1.2 Quartile Box Plots for 2021 NDVI Values for On RoW FMUs, Off RoW Comparable Areas, and NDVI Differences Values

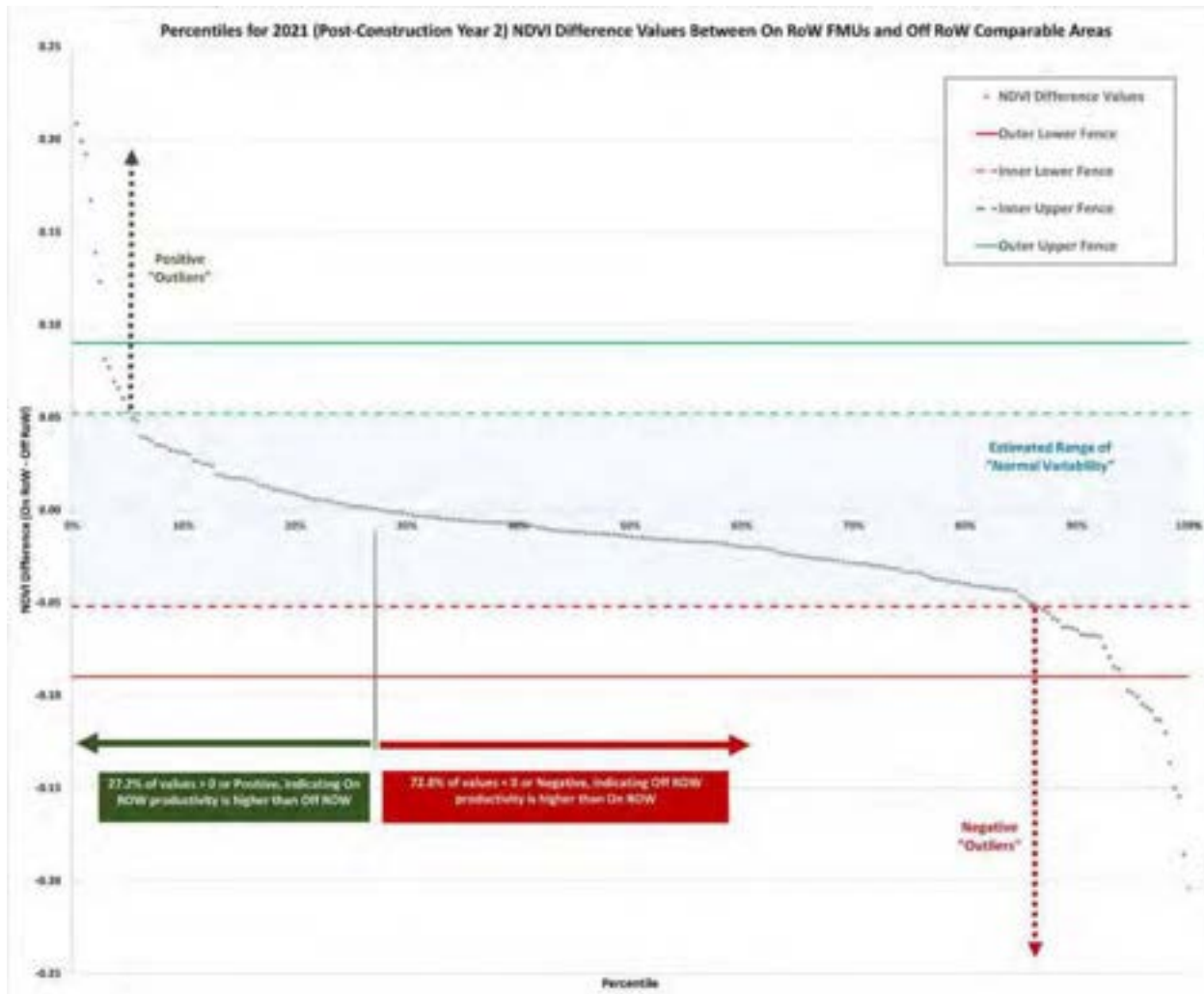


The frequency of difference values is displayed in columns (blue bars) relative to the:

- normal distribution curve (orange line; based on actual data around the actual mean value of 0.004), and,
- “expected” normal distribution curve (grey line; assumed mean difference of 0 and same shape of curve as the actual normal distribution).

These data demonstrate that the actual difference values are shifted in the negative difference direction relative to the expected normal distribution.

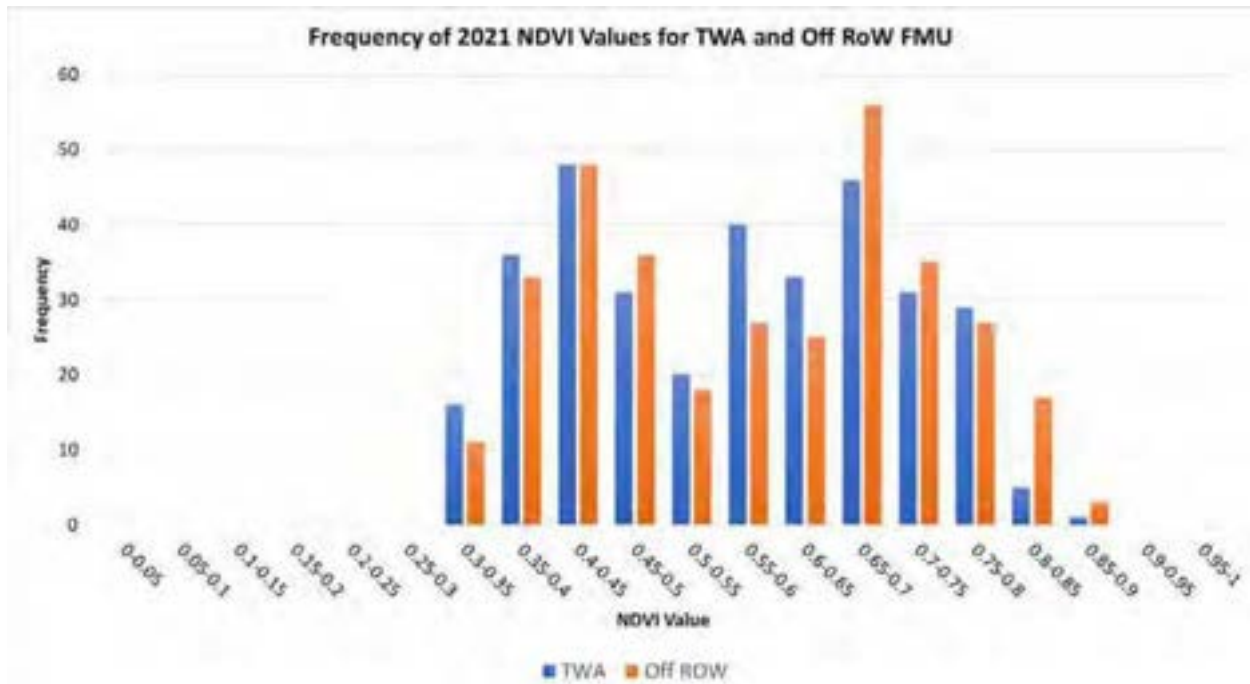
Figure B.1.3 Distribution of 2021 NDVI Differences Between On RoW FMUs and Off RoW Comparable Areas



The percentiles chart provides a visual display of the difference values for individual FMUs. Approximately 27% of differences were found to be positive (On RoW FMU – Off RoW comparable area = ≥ 0), while 73% were found to be negative (On RoW FMU – Off RoW comparable area = ≤ 0). This is further evidence of the negative skewness of the data. The estimated range of “normal variability” around an expected difference of 0 is estimated to be -0.052 to +0.052. Therefore, values above 0.052 can be considered “positive outliers” while values below -0.052 can be considered “negative outliers”. Based on this analysis there are many more “negative outliers” than “positive outliers”. Approximately 13.8% of On RoW FMUs (33) are considered in the “negative outlier” range, while 5.0% of On RoW FMUs (12) are considered in the “positive outlier” range.

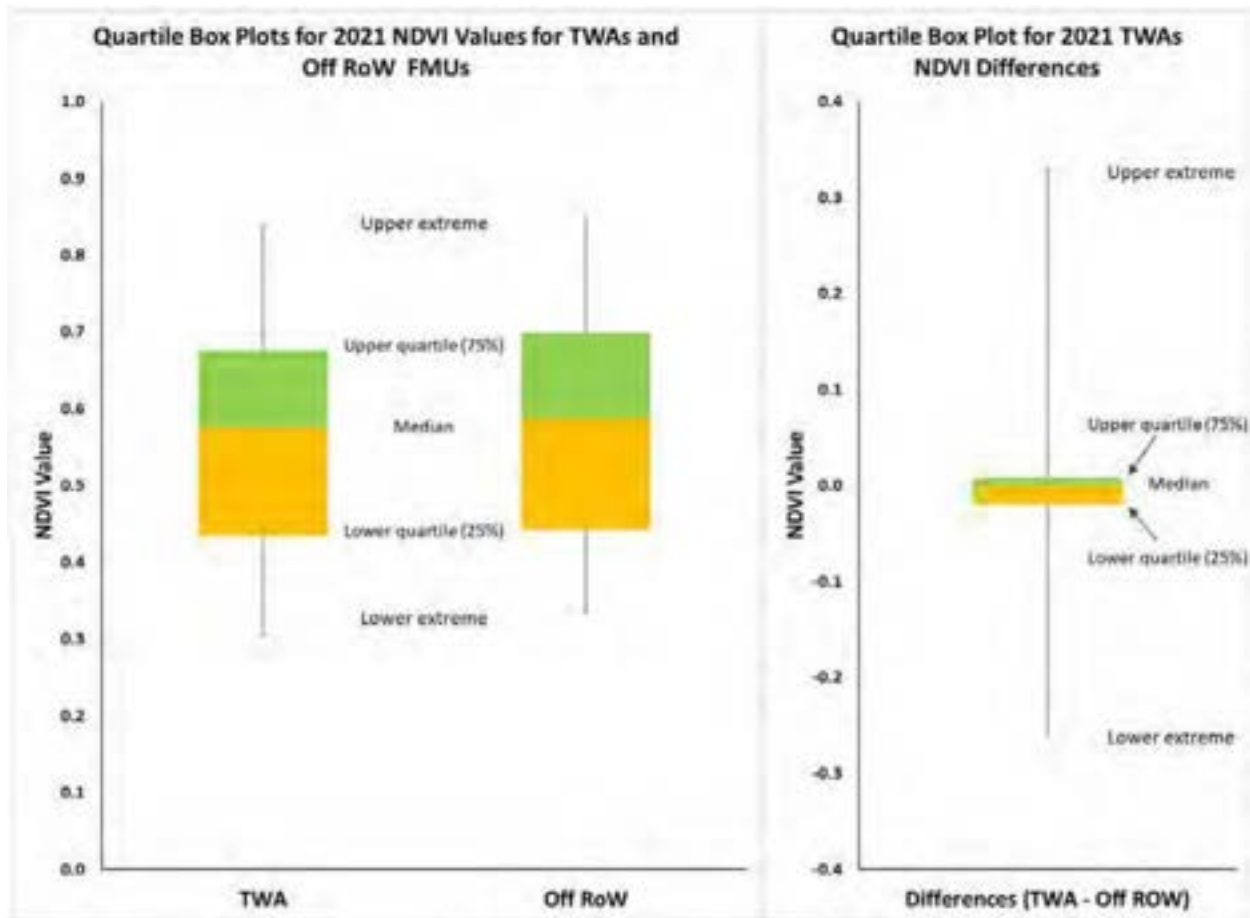
Figure B.1.4 Percentiles for 2021 NDVI Differences Between On RoW FMUs and Off RoW Comparable Areas

B.2 Tower Work Areas (TWAs) Post-Construction Year 2 (2021)



The frequency histogram above shows that there is a higher frequency of NDVI values in lower NDVI value classes for TWAs relative to Off RoW comparable areas. This demonstrates reduced soil productivity On RoW relative to Off RoW.

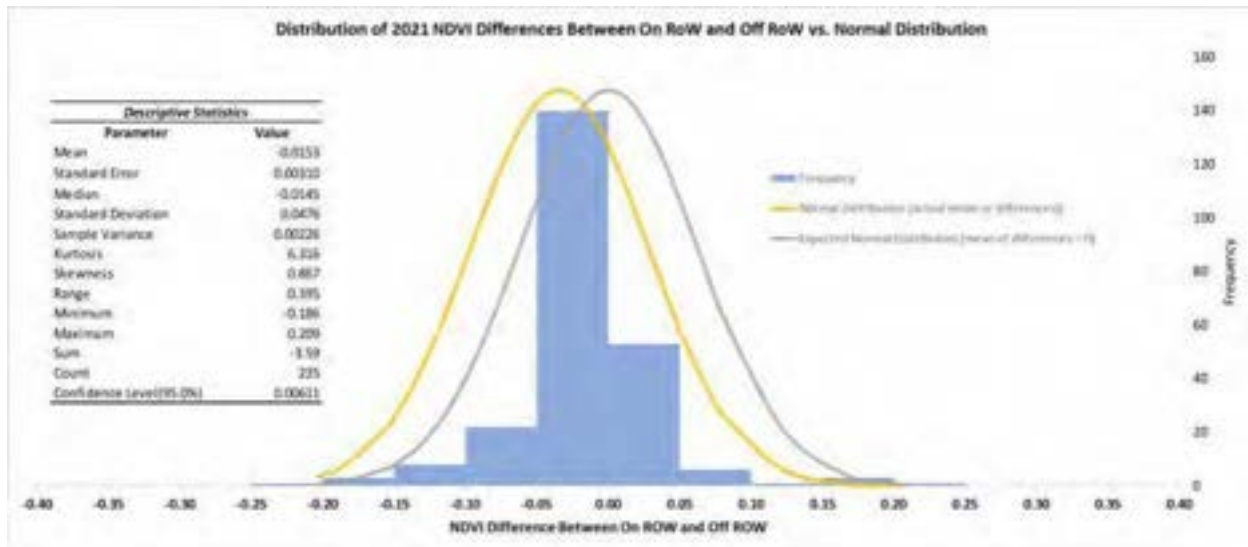
Figure B.2.1 Frequency of 2021 NDVI Values for TWAs and Off RoW Comparable Areas



The quartile box plots for TWAs and Off RoW comparable areas indicate that the ranges (between minimum and maximum values shown by the “whiskers”) are similar for TWAs and Off RoW comparable areas. However, the median value (centre of box) as well as the lower or first quartile (25th percentile; orange) and upper or third quartile (75th percentile; green) are lower for TWAs than Off RoW comparable areas. When the box plot for NDVI differences (TWA – Off RoW) is examined, it shows the median is below zero and 50% of the data (between 25th and 75th percentile) are below zero, indicating a negative skew in the NDVI difference data.

Figure B.2.2 Quartile Box Plots for 2021 NDVI Values for TWAs, Off RoW Comparable Areas, and NDVI Differences Values

Agricultural Soil Productivity Monitoring for the Manitoba-Minnesota Transmission Project: Post-Construction Year 2 (2021)
Appendix B Statistical Analyses
September 12, 2022



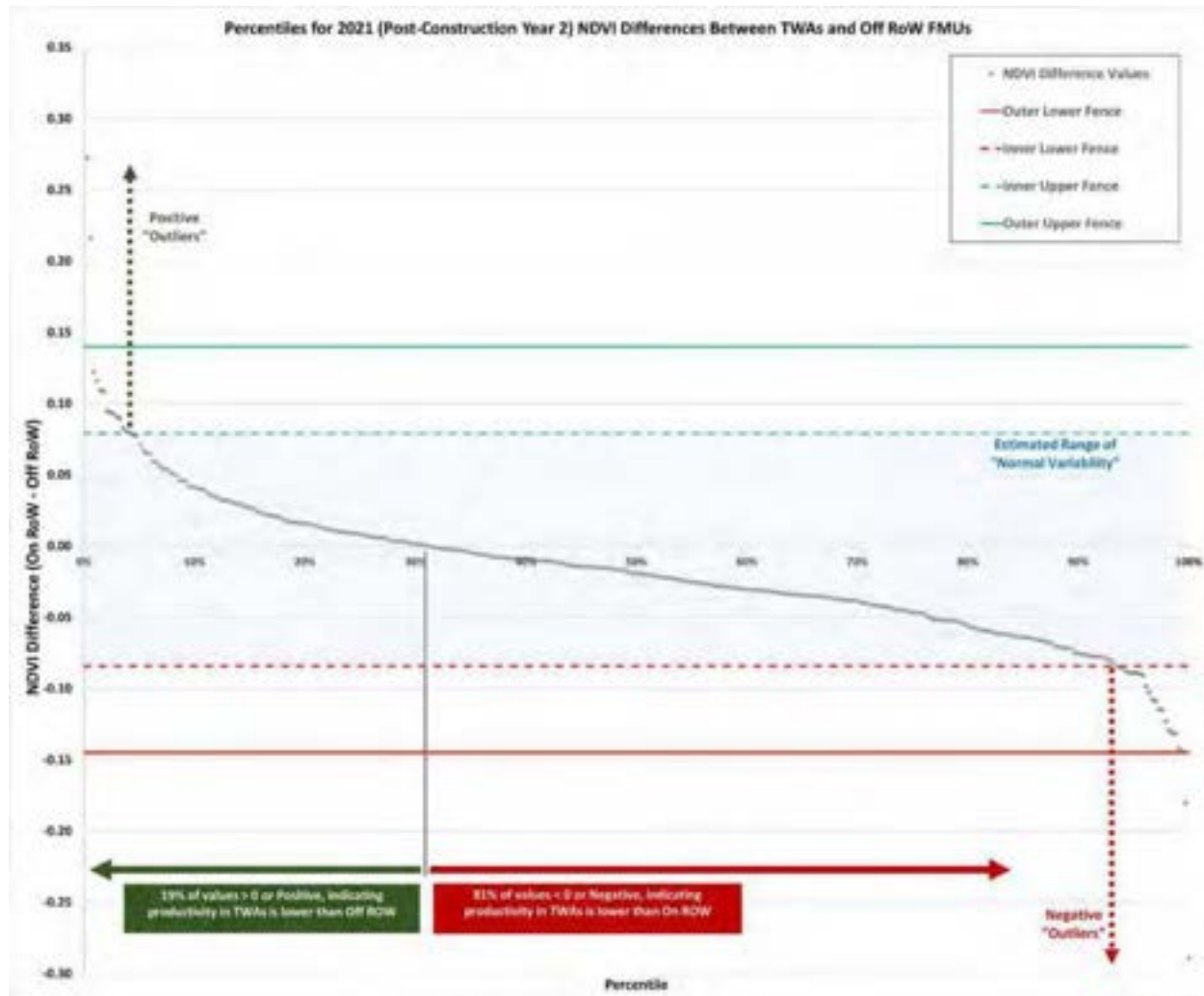
The frequency of difference values is displayed in columns (blue bars) relative to the:

- normal distribution curve (orange line; based on actual data around the actual mean value of 0.004), and,
- “expected” normal distribution curve (grey line; assumed mean difference of 0 and same shape of curve as the actual normal distribution).

These data demonstrate that the actual difference values shifted in the negative difference direction relative to the expected normal distribution.

Figure B.2.3 Distribution of 2021 NDVI Differences Between TWAs and Off RoW Comparable Areas





The percentiles chart provides a visual display of the difference values for individual TWAs. Approximately 19% of differences were found to be positive (TWA – Off RoW comparable area = >0), while 81% were found to be negative (TWA – Off RoW comparable area = <0). This is further evidence of the negative skewness of the data. The estimated range of “normal variability” around an expected difference of 0 is estimated to be -0.052 to +0.052. Therefore, values above 0.052 can be considered “positive outliers” while values below -0.052 can be considered “negative outliers”. Based on this analysis there are many more “negative outliers” than “positive outliers”. Approximately 6.8% of TWAs (23 individual TWAs) are considered in the “negative outlier” range, while 4.2% of TWAs (14 individual TWAs) are considered in the “positive outlier” range.

Figure B.2.4 Percentiles for 2021 NDVI Differences Between TWAs and Off RoW Comparable Areas

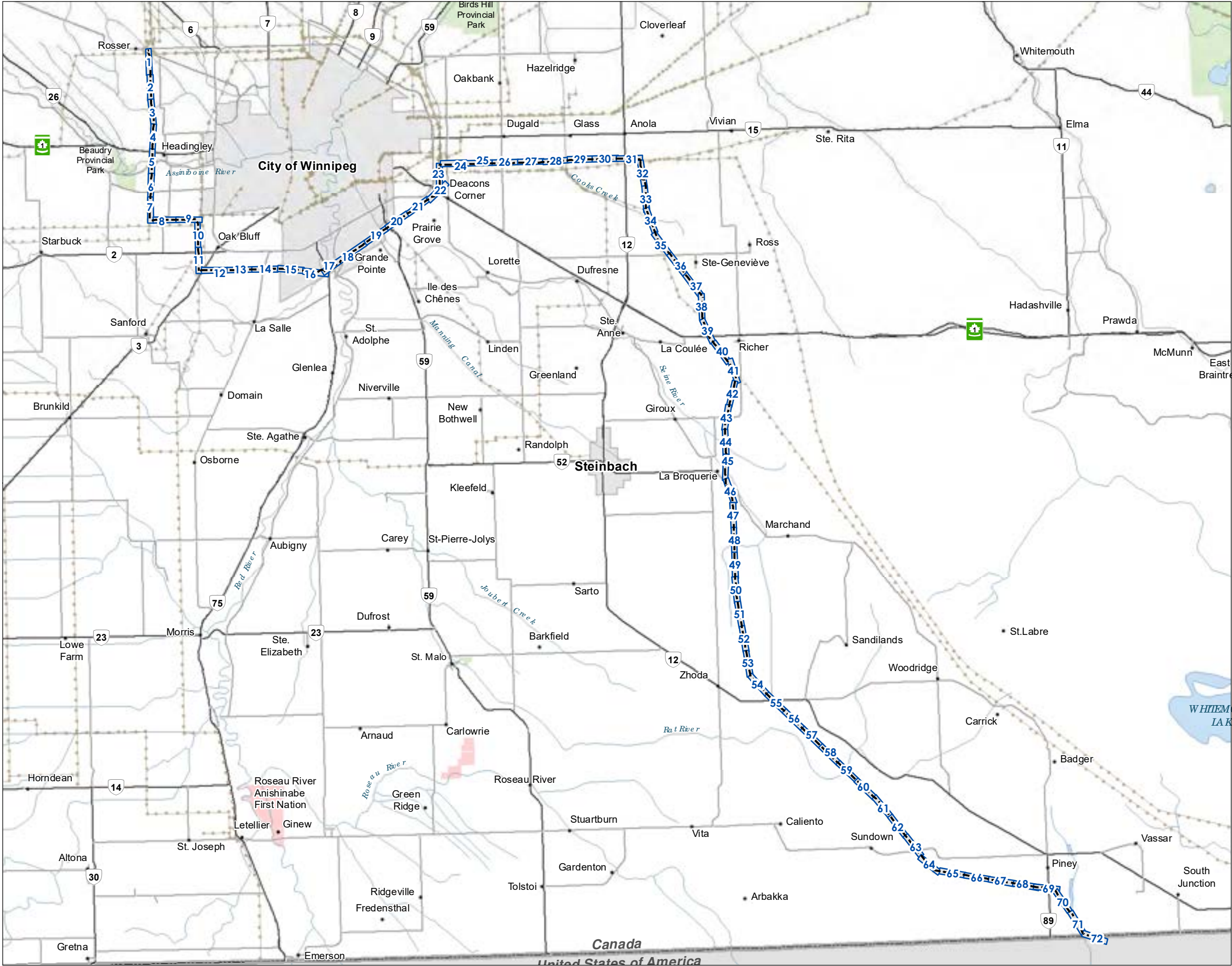


Appendix C Mapbook

C.1 Mapbook Overview

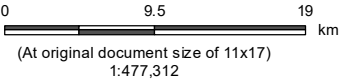


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Legend

- Manitoba-Minnesota Transmission Line
- Map Grid (1:8,000)
- Existing 500kV Transmission Line
- Existing 230kV Transmission Line
- First Nation Lands
- Provincial Park
- Railway
- Provincial Highway
- Waterbody
- Watercourse



- Notes**
- Coordinate System: NAD 1983 UTM Zone 14N
 - Data Sources:
 - Background: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community



Project Location
Near Winnipeg,
Manitoba

Prepared by on 2021-05-10
TR by DW on 2021-05-10
IR Review by GK on 2021-05-10

Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Soil Productivity & Crop Performance Monitoring

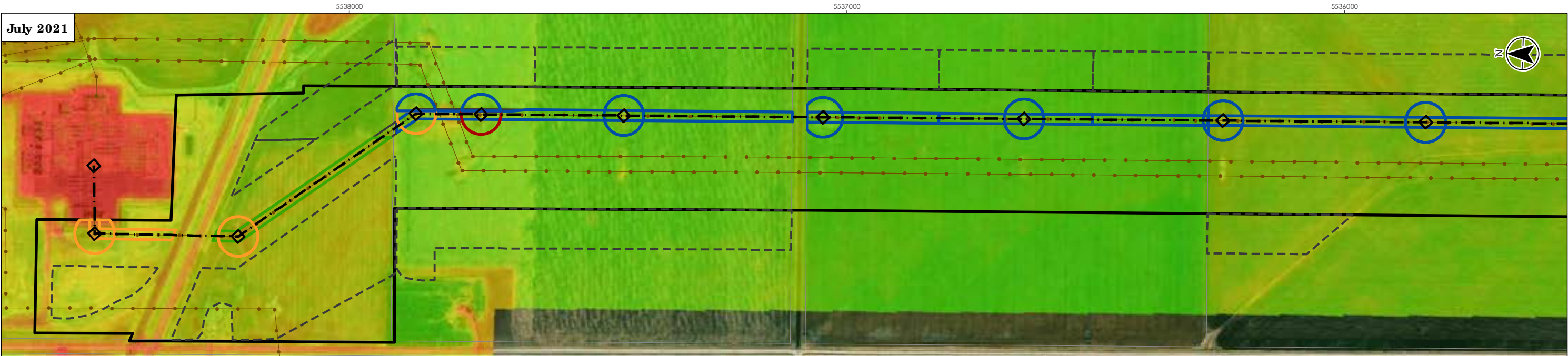
111477020-001 REV01

Figure No.
C.1

Title
**Manitoba Minnesota Transmission Line -
NDVI 1:8,000 Map Grid Overview**

C.2 Mapbook





Legend

- Manitoba-Minnesota Transmission Line
- MMTP Tower
- Right-of-Way
- Evaluation
 - On RoW Farm Management Unit (On RoW FMU)
 - Tower Work Area (TWA)
 - Off RoW Comparison

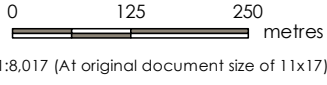
Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

- Project Related Disturbance Category
- Negative Outlier, Not Project Related
 - No Disturbance
 - Project-Related Disturbance Persists
 - Project-Related Disturbance Persists, Trending to
 - Recovered

- Existing Transmission Lines
- Quarter Sections



Project Location
Near Winnipeg,
Manitoba

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

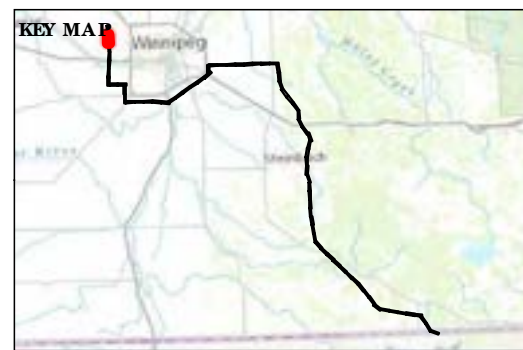
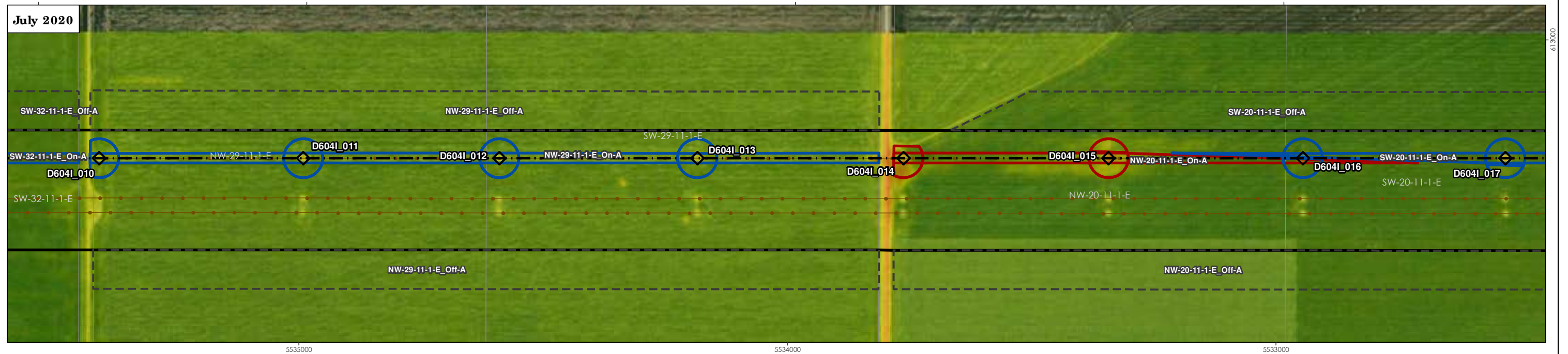
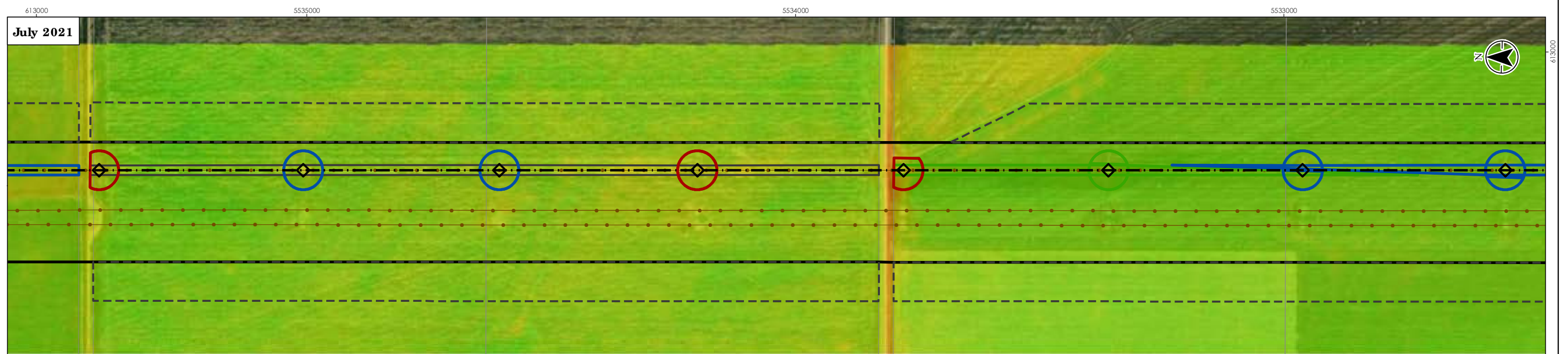
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Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

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Revised: 2022-07-25 By: ACampigotto

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Data obtained from Government of Canada, Government of Manitoba, Manitoba Hydro, Stantec Consulting
3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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Legend

— · — Manitoba-Minnesota Transmission Line

◆ MMTP Tower

Right-of-Way

Evaluation

☐ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

☐ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

☐ Negative Outlier, Not Project Related

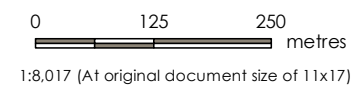
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☐ Project-Related Disturbance Persists

 Project-Related Disturbance Persists, Trending to

☐ Recovered

Existing Transmission Lines

☐ Quarter Sections

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Project Location

Near Winnipeg,
Manitoba

Prepared by JH on 2022-07-25

TR by DW on 2022-07-25

R Review by GK on 2022-07-25

Client/Project

111477020-001-REVA

Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No. _____

Map No. _____

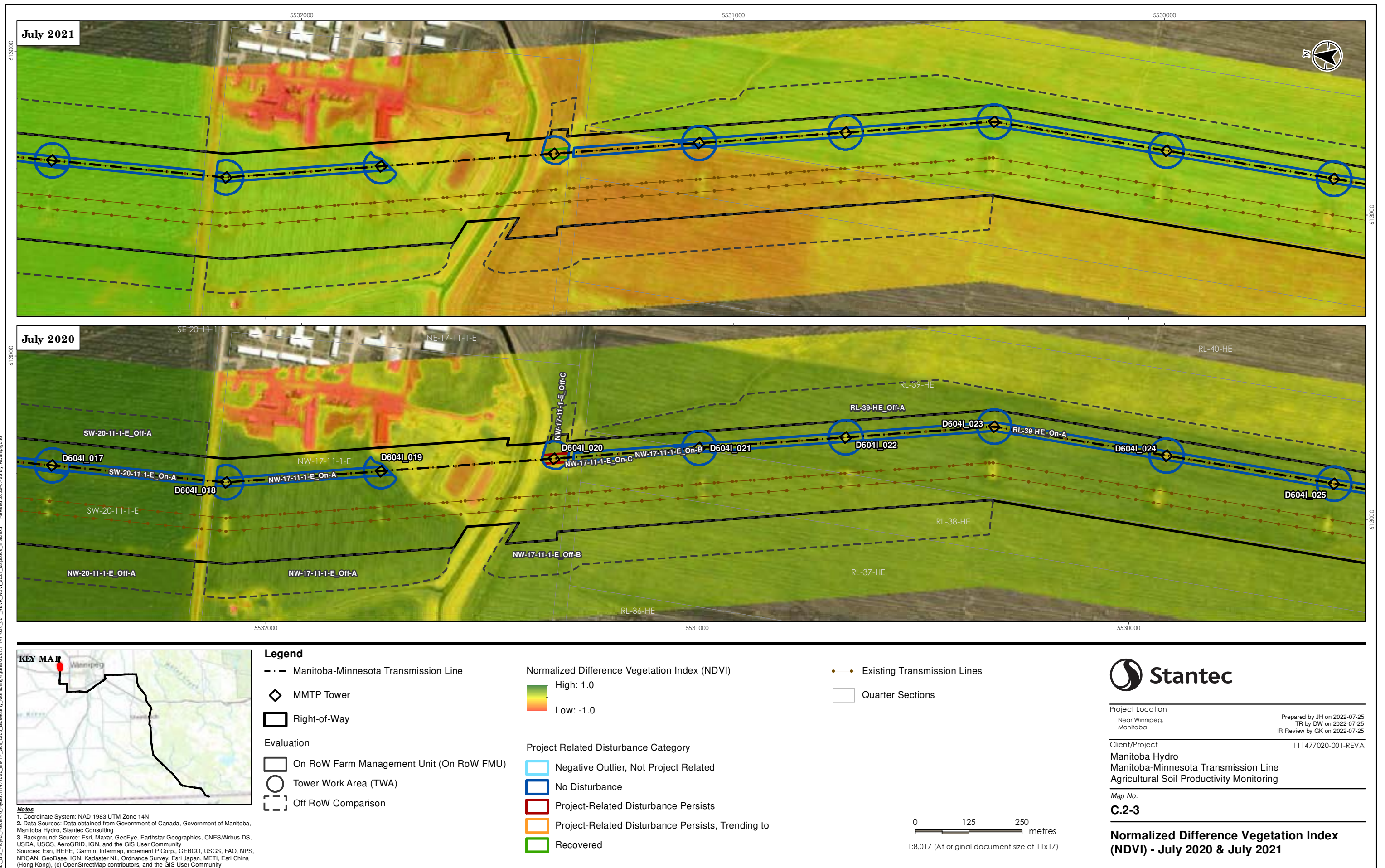
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Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

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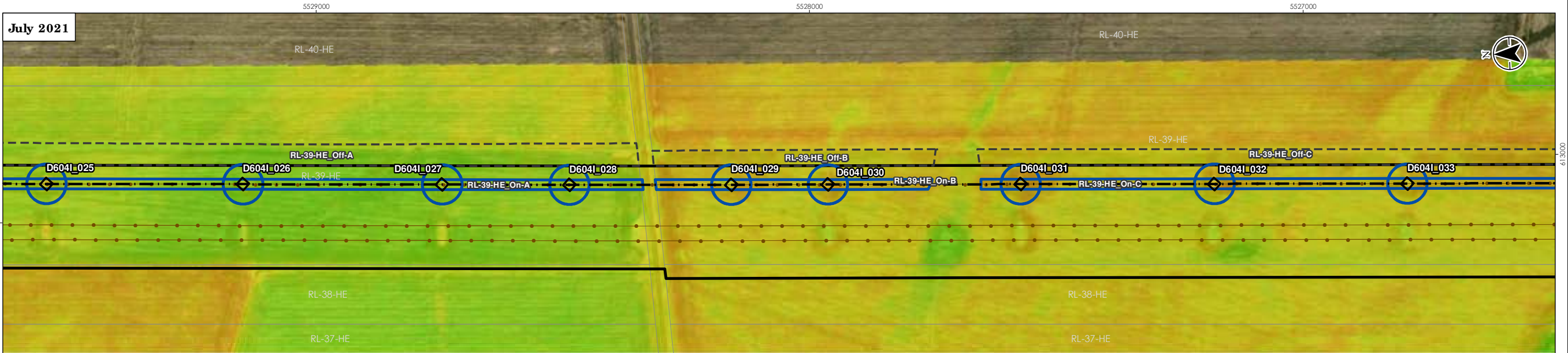
Revised: 2022-07-25 By: ACampigotto

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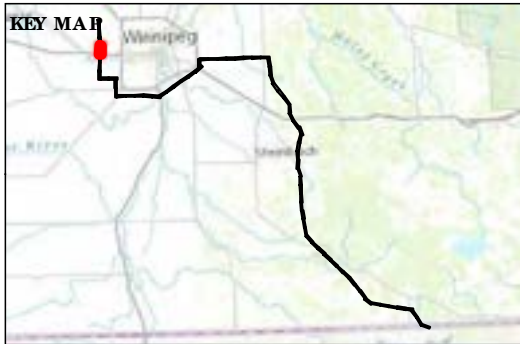
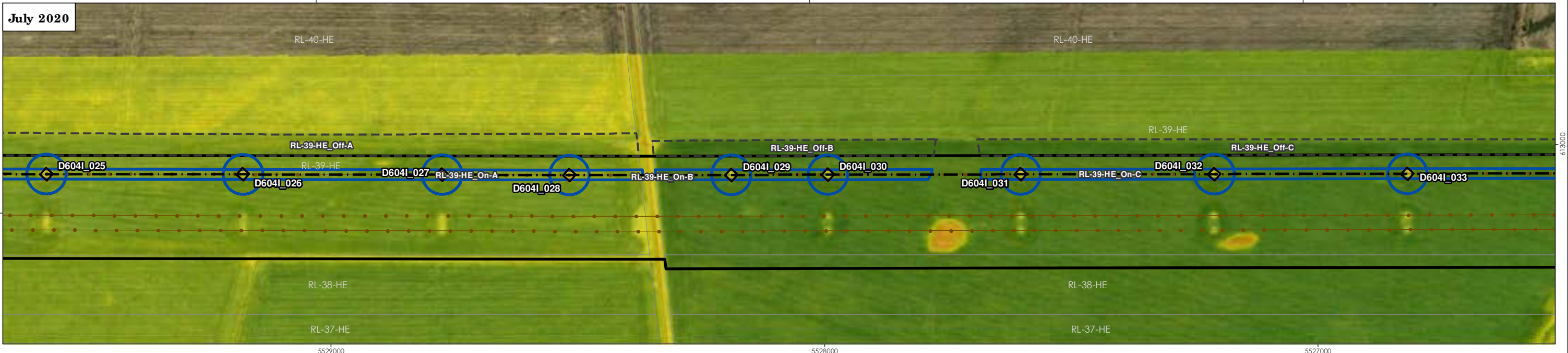


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Revised: 2022-07-25 By: ACampigotto

July 2021



July 2020



Notes
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3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

— Existing Transmission Lines

□ Quarter Sections

0 125 250 metres

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Project Location

Near Winnipeg,
Manitoba

Client/Project

Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

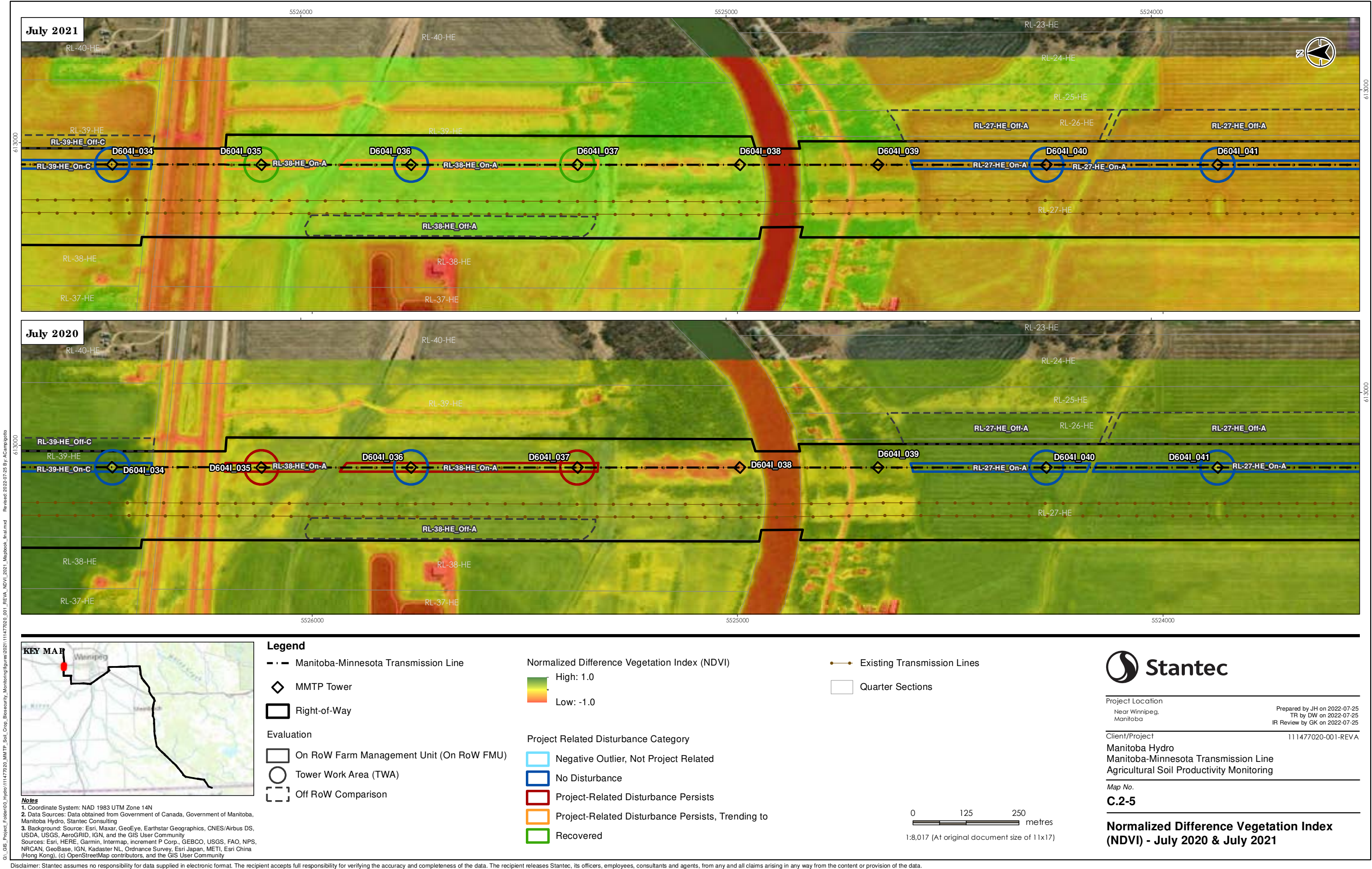
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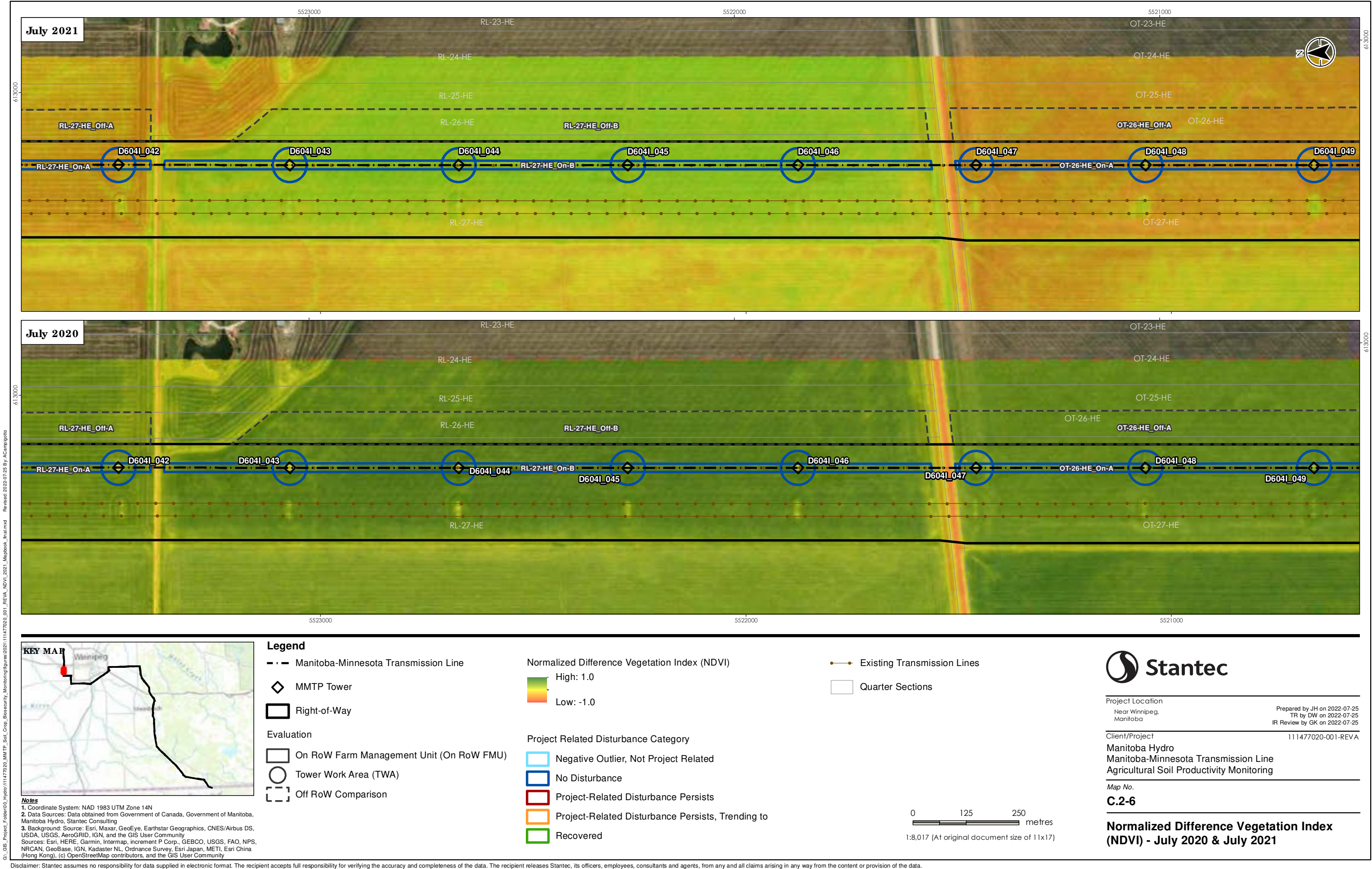
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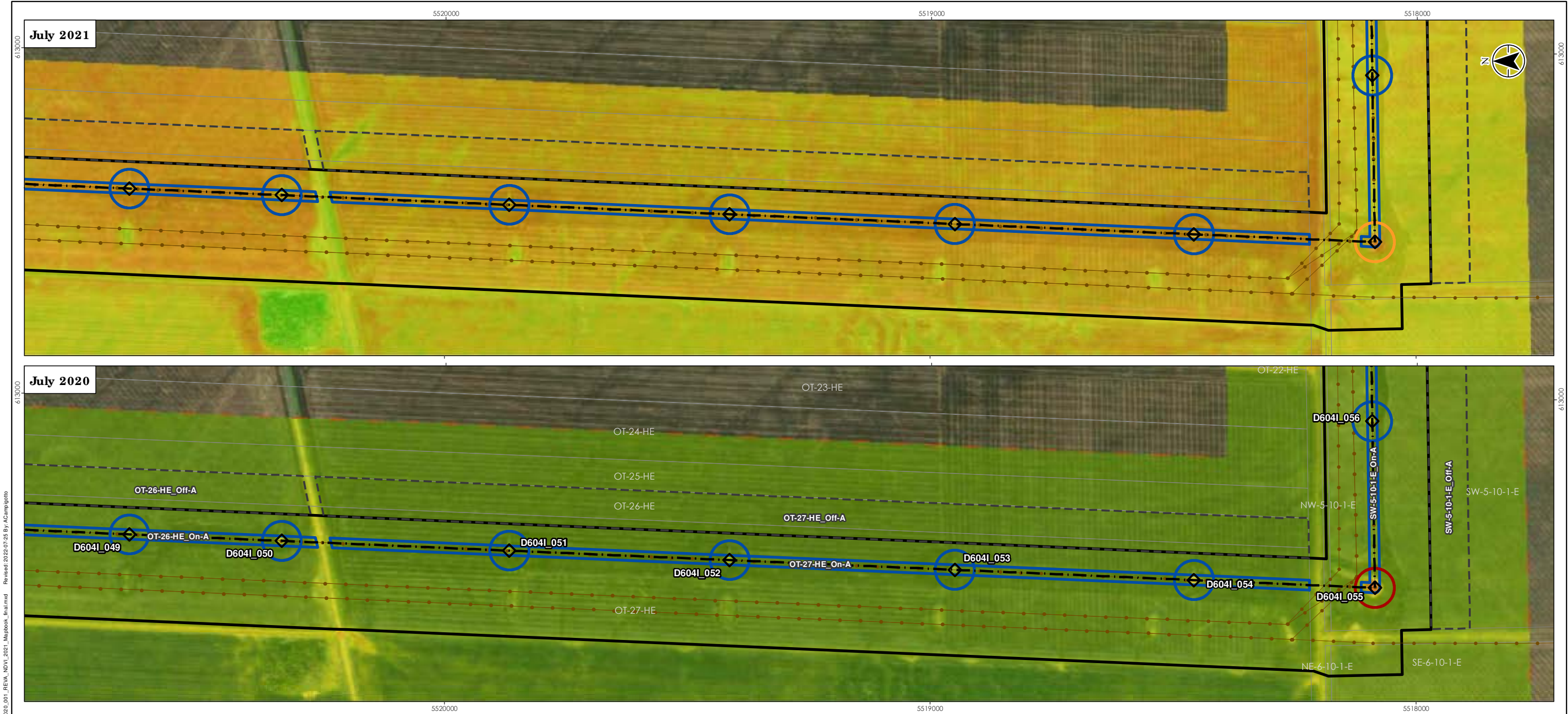
Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

111477020-001-REVA







KEY MAP

Legend

- Manitoba-Minnesota Transmission Line
- MMTP Tower
- Right-of-Way
- On RoW Farm Management Unit (On RoW FMU)
- Tower Work Area (TWA)
- Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0
Low: -1.0

Project Related Disturbance Category

- Negative Outlier, Not Project Related
- No Disturbance
- Project-Related Disturbance Persists
- Project-Related Disturbance Persists, Trending to
- Recovered

Existing Transmission Lines

Quarter Sections

Notes

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2. Data Sources: Data obtained from Government of Canada, Government of Manitoba, Manitoba Hydro, Stantec Consulting
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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Scale

0 125 250 metres

1:8,017 (At original document size of 11x17)

Stantec

Project Location
Near Winnipeg,
Manitoba

Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

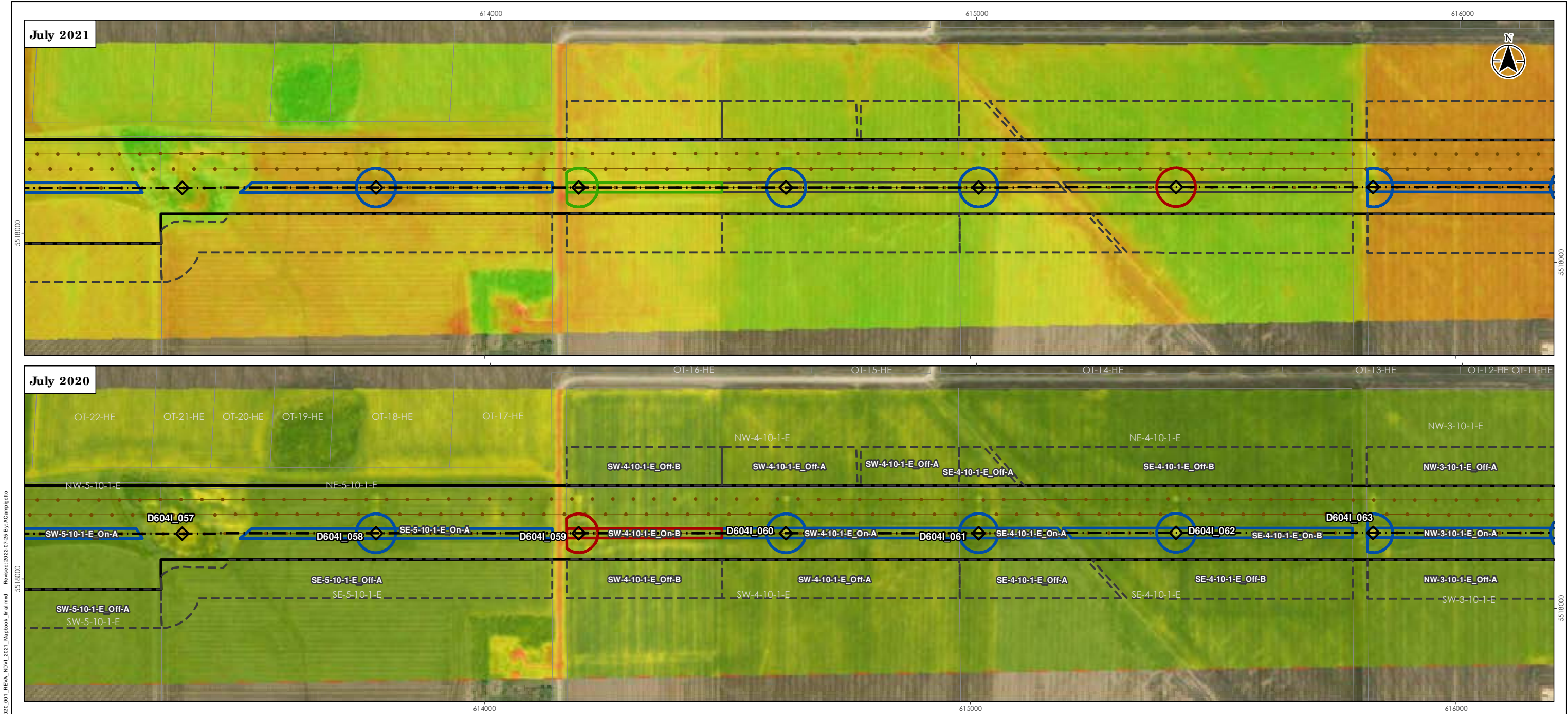
Map No.
C.2-7

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

111477020-001-REVA

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KEY MAP

Legend

- Manitoba-Minnesota Transmission Line
- MMTP Tower
- Right-of-Way
- On RoW Farm Management Unit (On RoW FMU)
- Tower Work Area (TWA)
- Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

- Negative Outlier, Not Project Related
- No Disturbance
- Project-Related Disturbance Persists
- Project-Related Disturbance Persists, Trending to
- Recovered

Existing Transmission Lines

Quarter Sections

Notes

- Coordinate System: NAD 1983 UTM Zone 14N
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- Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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Scale

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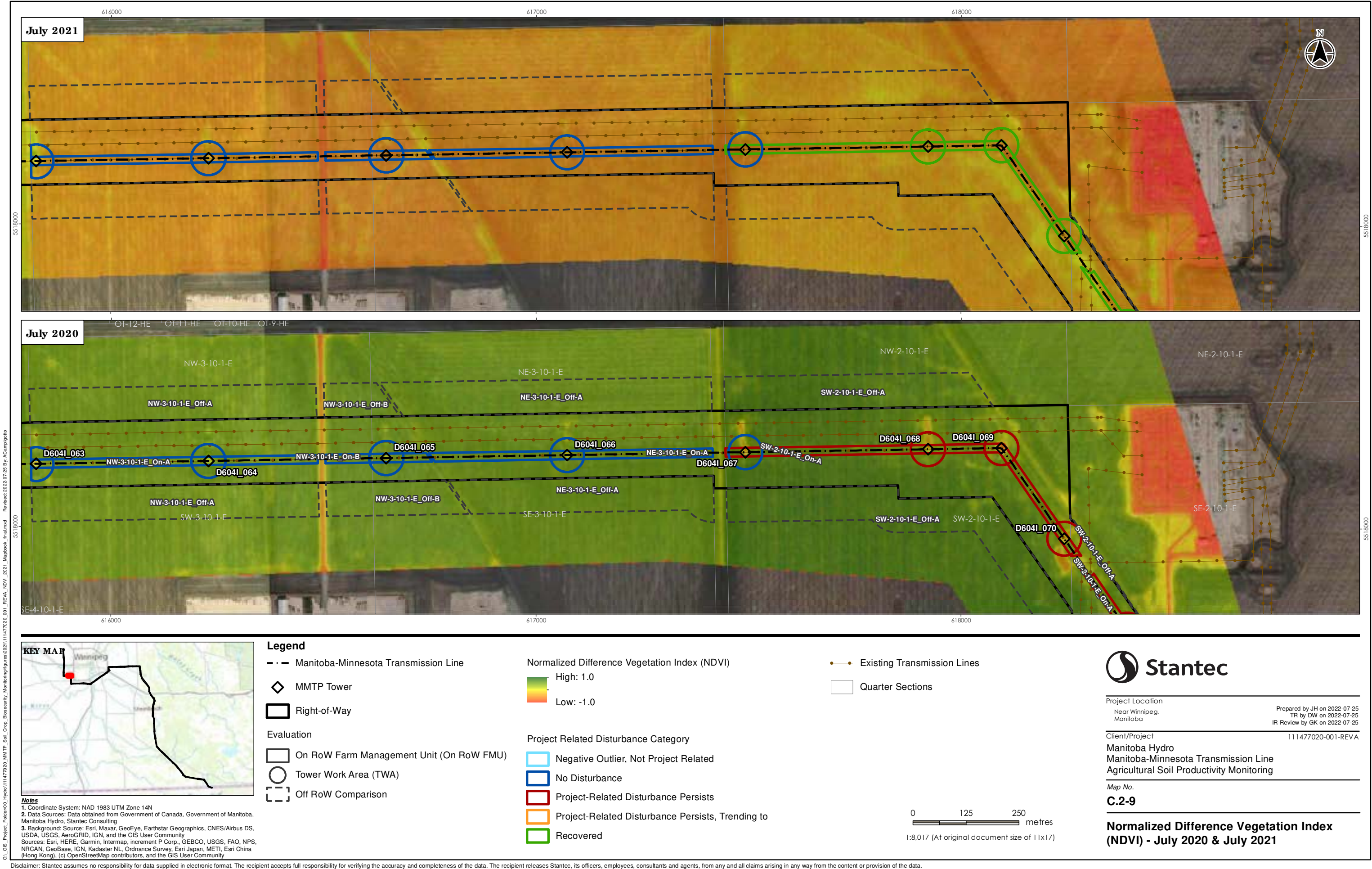
Project Location
Near Winnipeg,
Manitoba

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

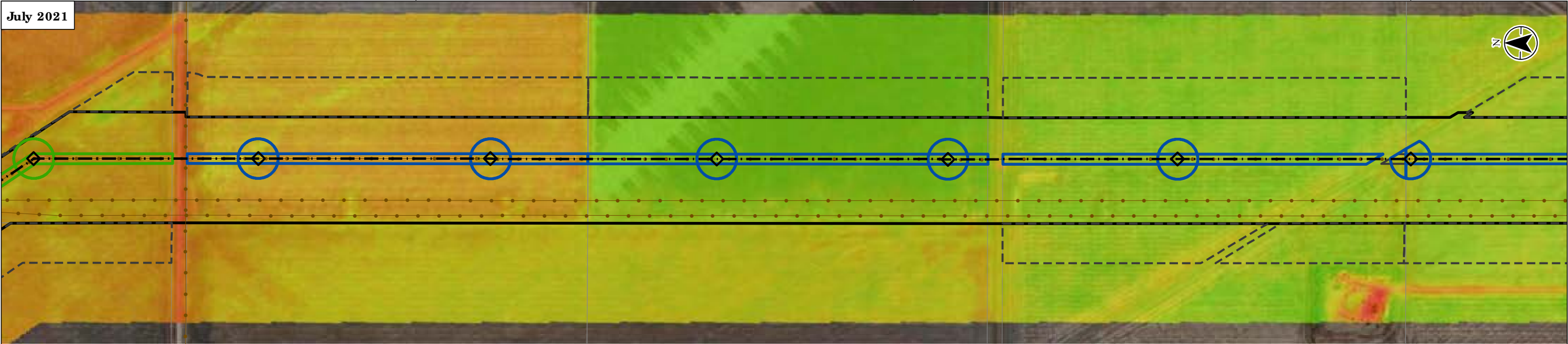
Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.
C.2-8

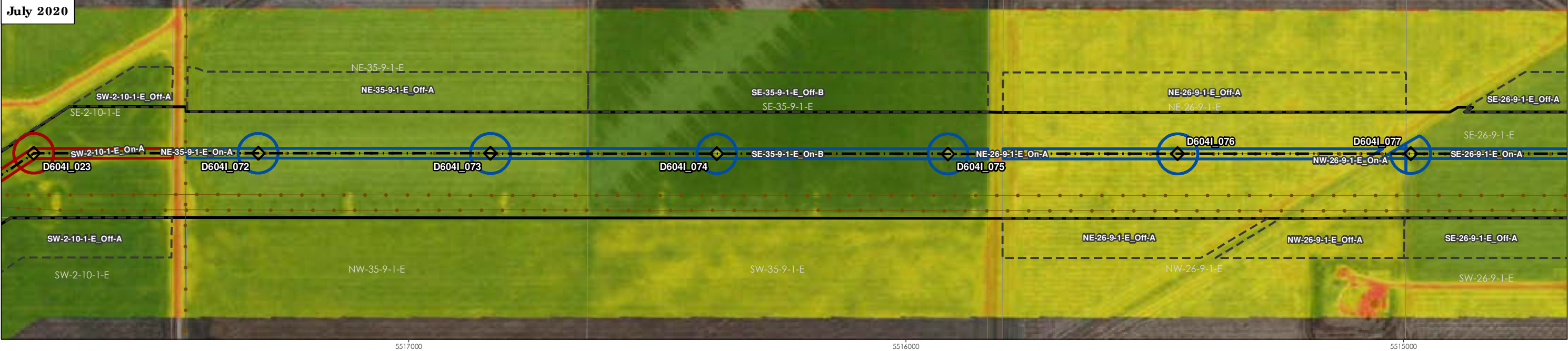
Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021



July 2021



July 2020



Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Data obtained from Government of Canada, Government of Manitoba, Manitoba Hydro, Stantec Consulting
3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

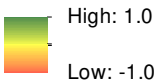
Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)



Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

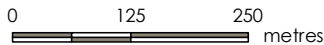
□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

--- Existing Transmission Lines

□ Quarter Sections



1:8,017 (At original document size of 11x17)



Project Location

Near Winnipeg,
Manitoba

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

Client/Project

Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

111477020-001-REVA

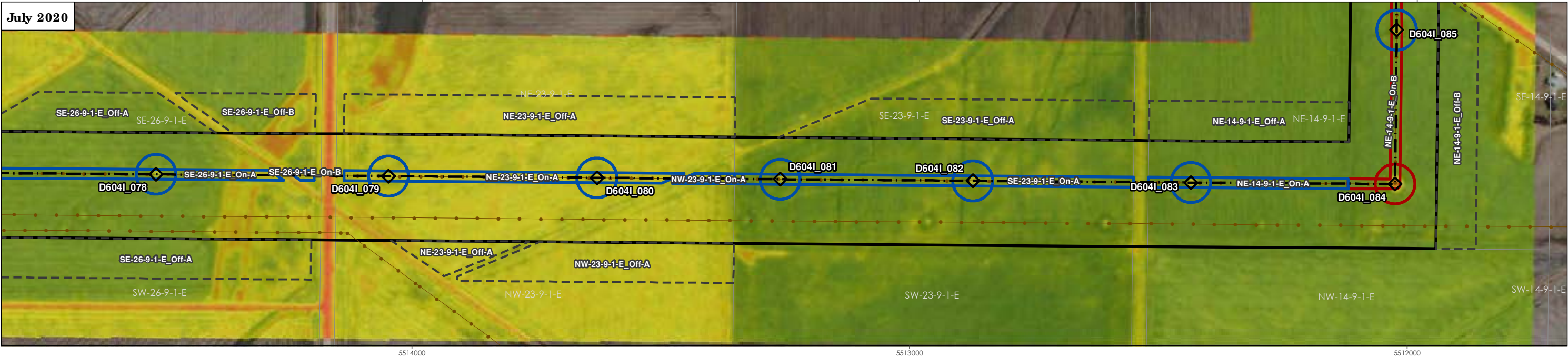
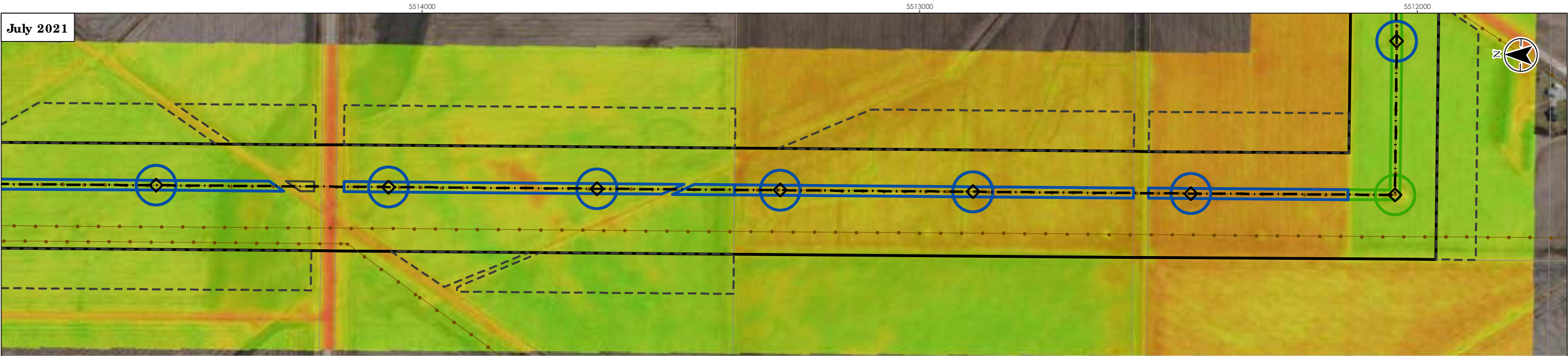
Map No.

C.2-10

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

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Revised: 2022-07-25 By: ACampigotto

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Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Data obtained from Government of Canada, Government of Manitoba, Manitoba Hydro, Stantec Consulting
3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Legend

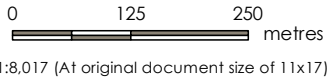
- Manitoba-Minnesota Transmission Line
- ◇ MMTP Tower
- Right-of-Way
- Evaluation
 - On RoW Farm Management Unit (On RoW FMU)
 - Tower Work Area (TWA)
 - Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0
Low: -1.0

- Project Related Disturbance Category
- Negative Outlier, Not Project Related
 - No Disturbance
 - Project-Related Disturbance Persists
 - Project-Related Disturbance Persists, Trending to
 - Recovered

- Existing Transmission Lines
- Quarter Sections



Project Location
Near Winnipeg,
Manitoba

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

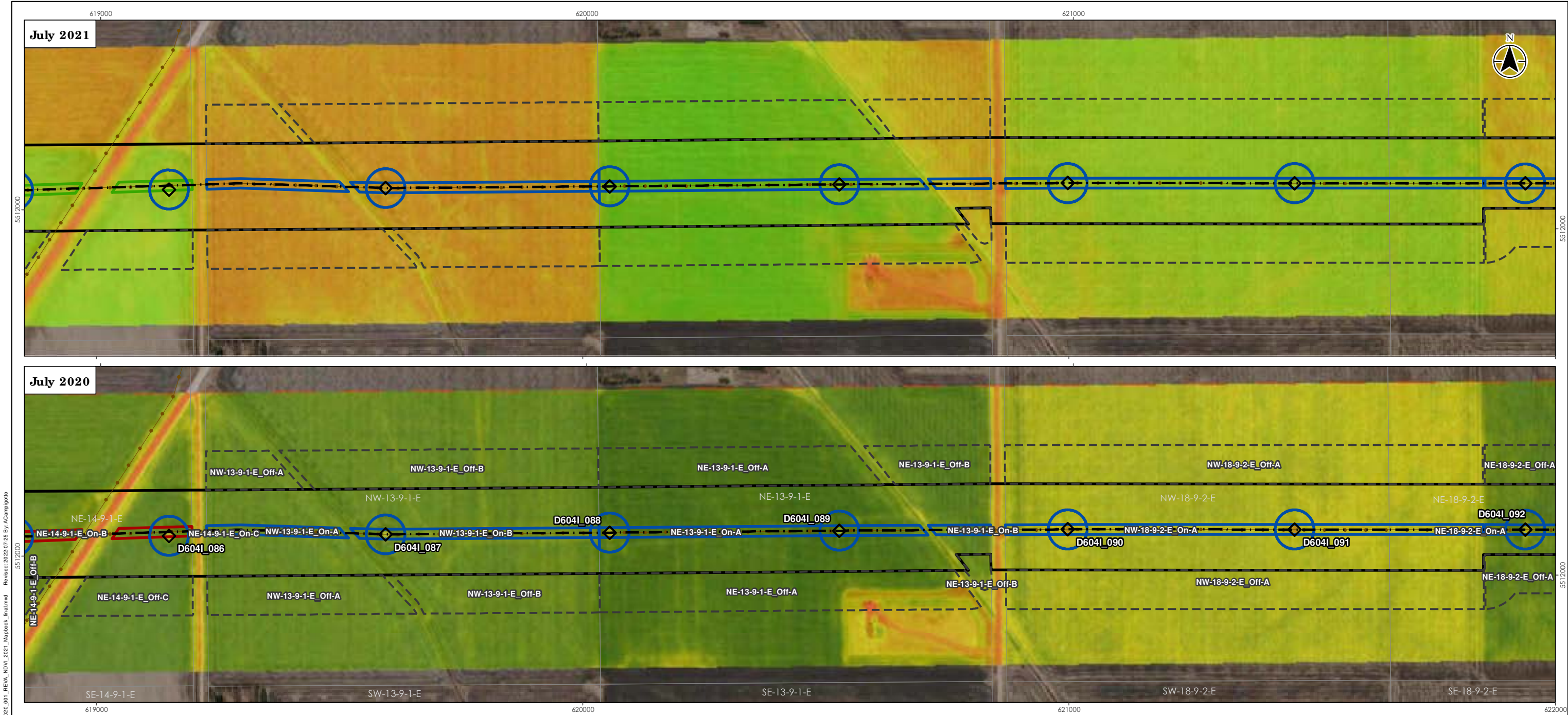
Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.
C.2-11

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

G:_GIS_Project_Folder\0_Hydro\111477020_MMTP_Soil_Crop_Biosecurity_Monitoring\Figures\2021\111477020_001_REVA_NDVI_2021_Mapbook_1.mxd Revised: 2022-07-25 By: ACampigotto

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KEY MAP

Legend

- Manitoba-Minnesota Transmission Line
- MMTP Tower
- Right-of-Way
- On RoW Farm Management Unit (On RoW FMU)
- Tower Work Area (TWA)
- Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0
Low: -1.0

Project Related Disturbance Category

- Negative Outlier, Not Project Related
- No Disturbance
- Project-Related Disturbance Persists
- Project-Related Disturbance Persists, Trending to
- Recovered

Existing Transmission Lines

Quarter Sections

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Data obtained from Government of Canada, Government of Manitoba, Manitoba Hydro, Stantec Consulting
3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Scale

0 125 250 metres

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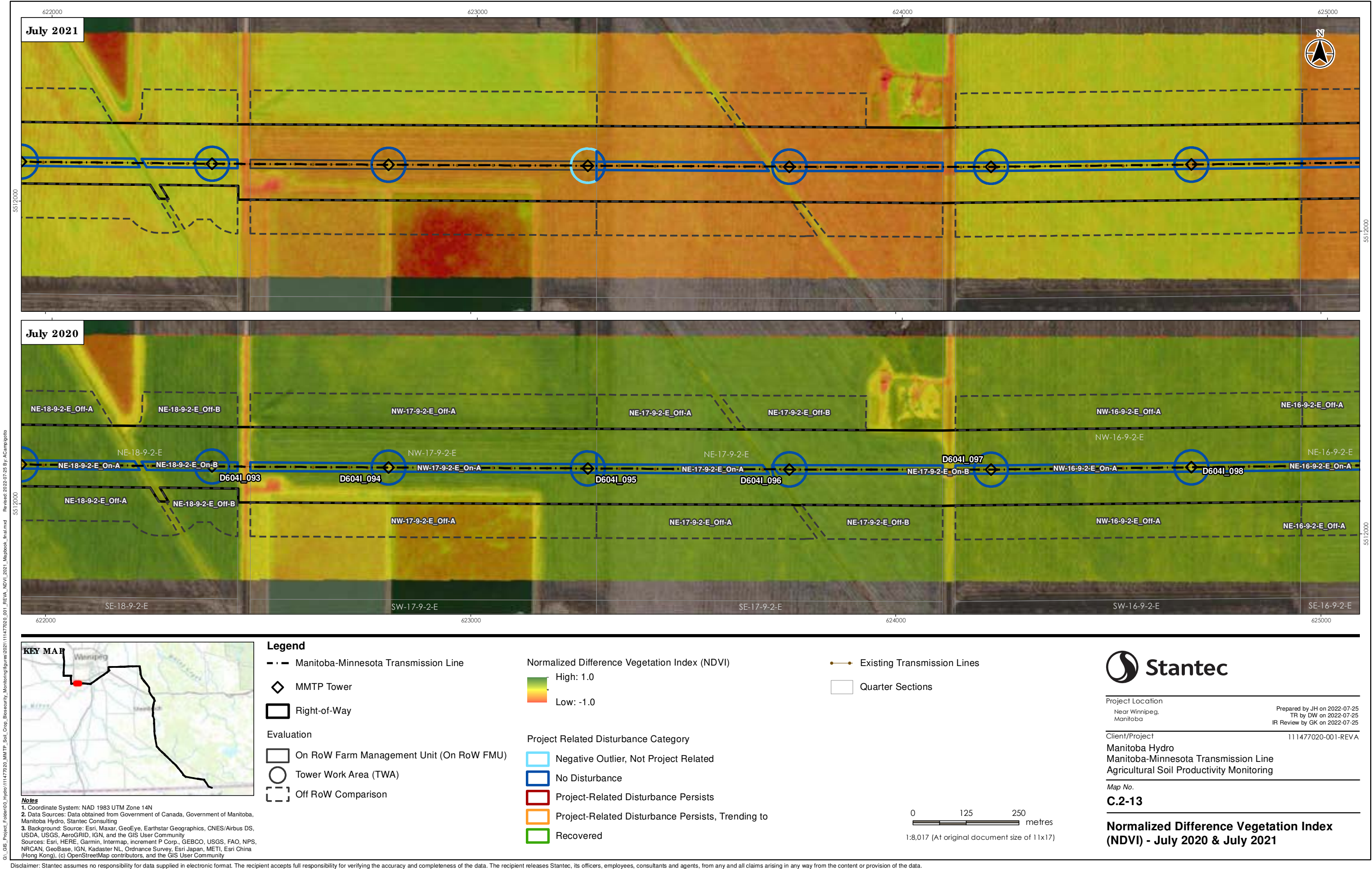
Stantec

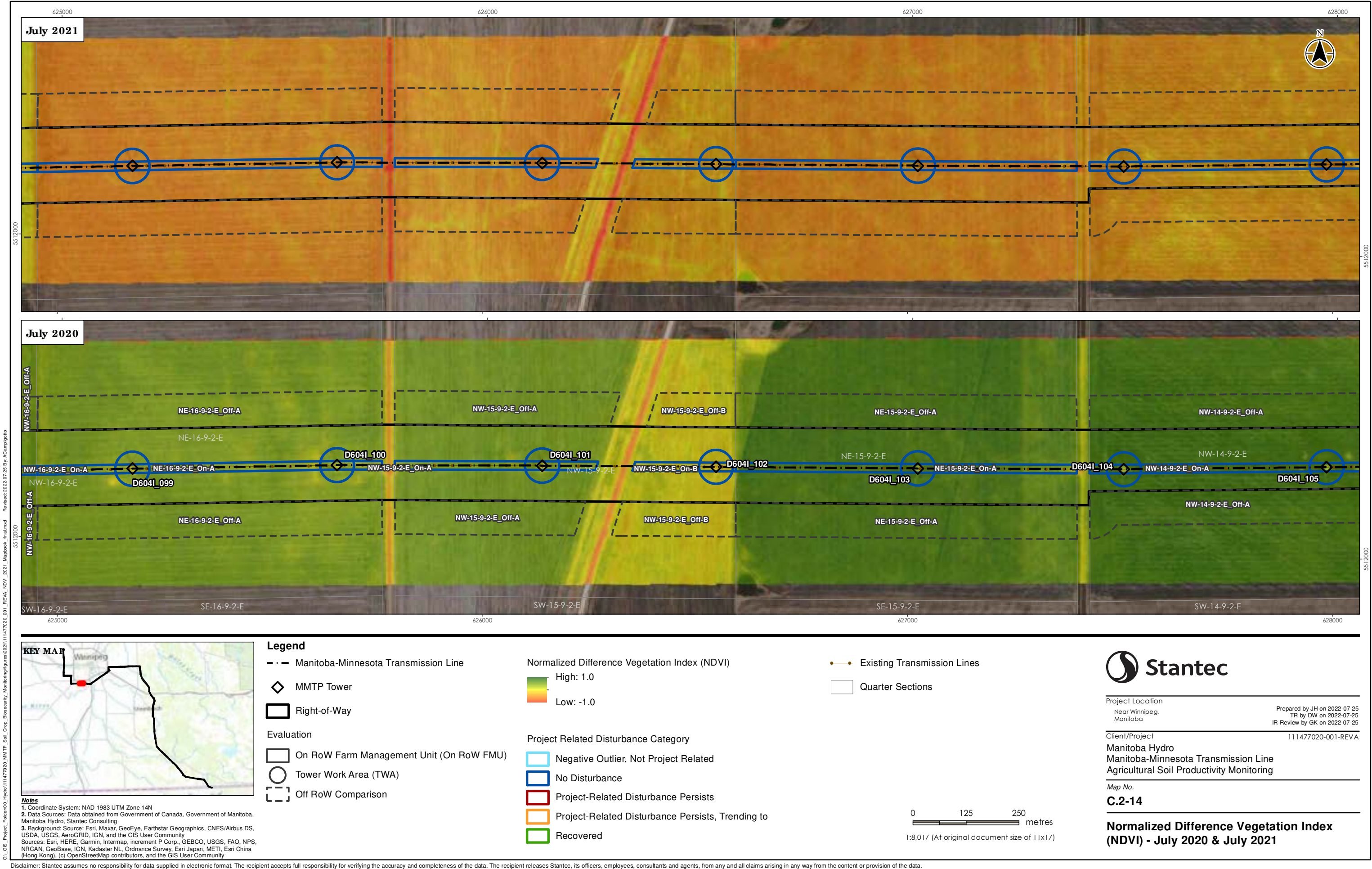
Project Location
Near Winnipeg,
Manitoba

Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

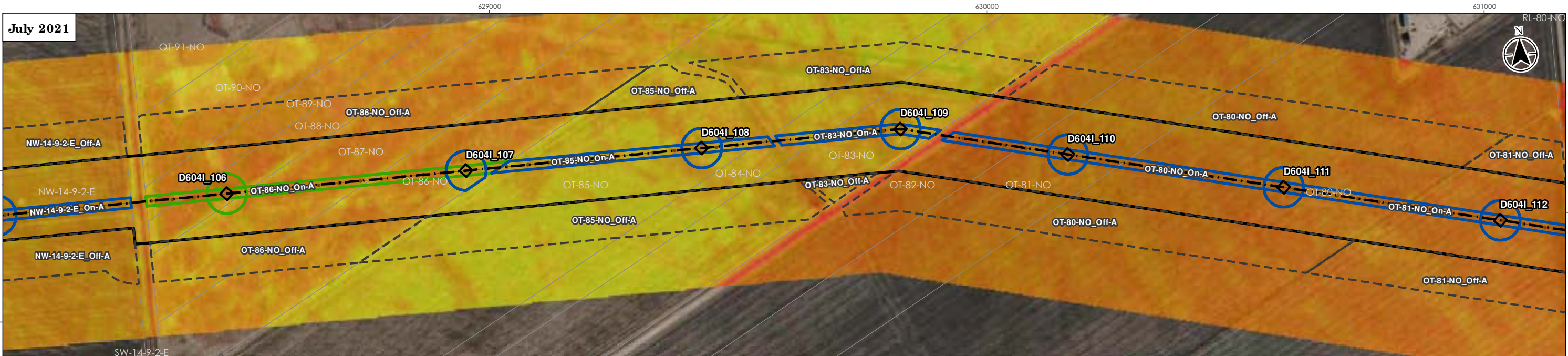
Map No.
C.2-12

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

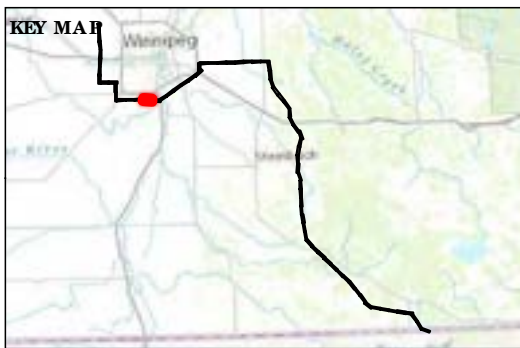




July 2021



July 2020

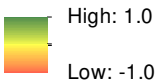


Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Data obtained from Government of Canada, Government of Manitoba, Manitoba Hydro, Stantec Consulting
3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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Legend

- Manitoba-Minnesota Transmission Line
- MMTP Tower
- Right-of-Way
- Evaluation
 - On RoW Farm Management Unit (On RoW FMU)
 - Tower Work Area (TWA)
 - Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

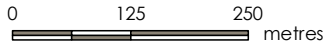


Project Related Disturbance Category

- Negative Outlier, Not Project Related
- No Disturbance
- Project-Related Disturbance Persists
- Project-Related Disturbance Persists, Trending to
- Recovered

Existing Transmission Lines

- Quarter Sections



1:8,017 (At original document size of 11x17)



Project Location
Near Winnipeg,
Manitoba

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

Client/Project
111477020-001-REVA

Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

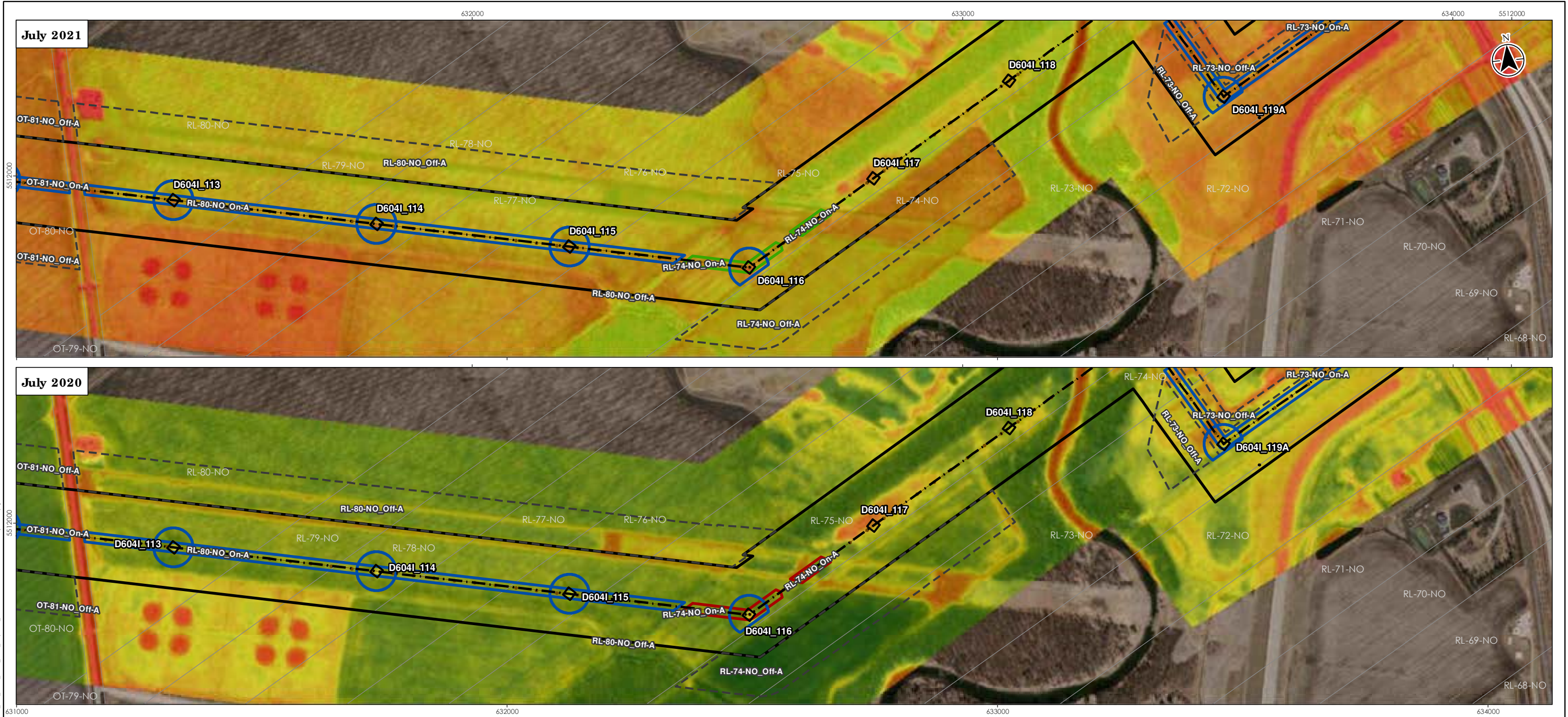
Map No.

C.2-15

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

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Revised: 2022-07-25 By: ACampigotto

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KEY MAP

Legend

- Manitoba-Minnesota Transmission Line
- MMTP Tower
- Right-of-Way
- Evaluation
 - On RoW Farm Management Unit (On RoW FMU)
 - Tower Work Area (TWA)
 - Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0
Low: -1.0

Project Related Disturbance Category

- Negative Outlier, Not Project Related
- No Disturbance
- Project-Related Disturbance Persists
- Project-Related Disturbance Persists, Trending to
- Recovered

Existing Transmission Lines

Quarter Sections

0 125 250 metres

1:8,017 (At original document size of 11x17)

Stantec

Project Location
Near Winnipeg,
Manitoba

Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

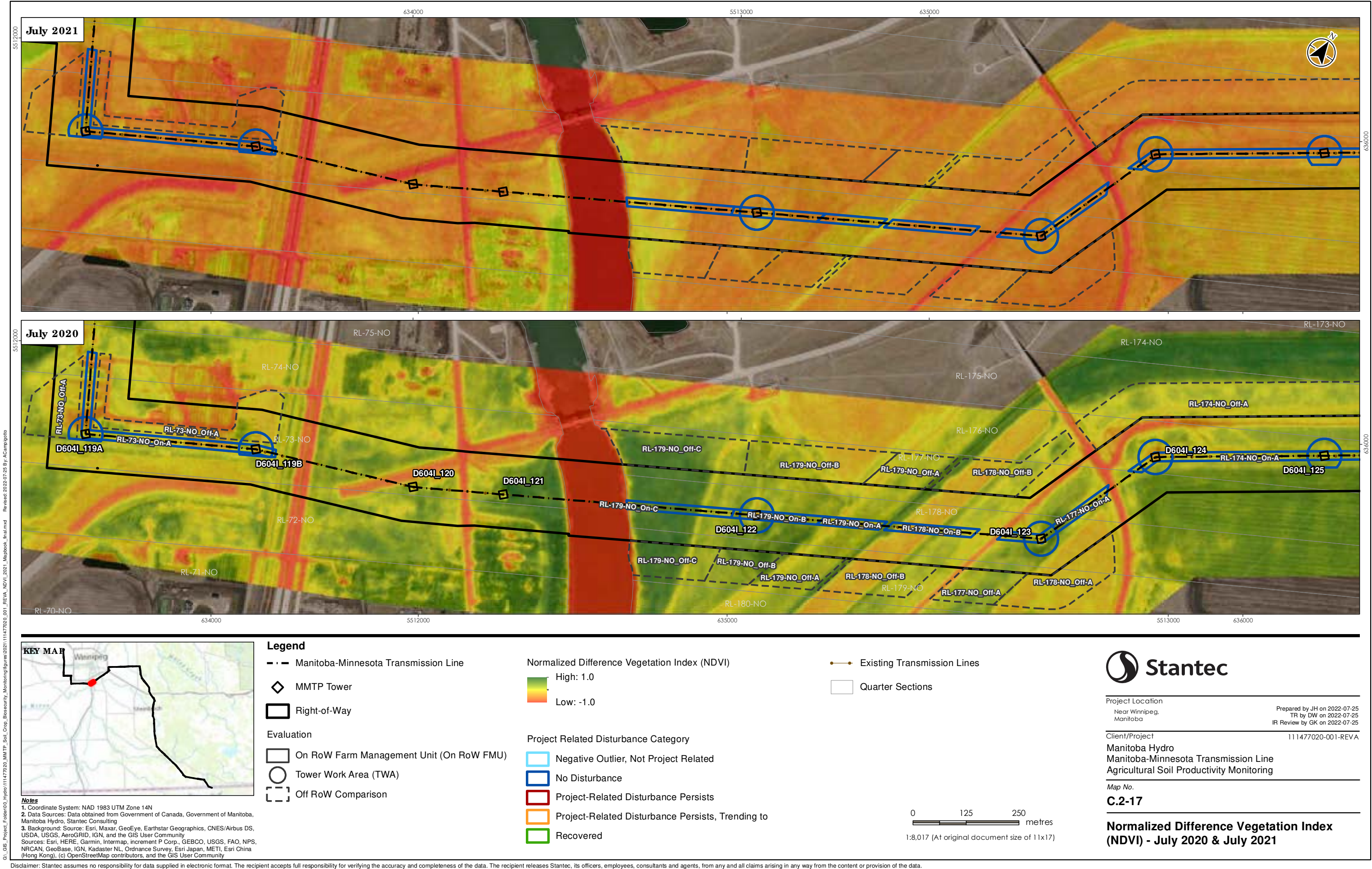
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C.2-16

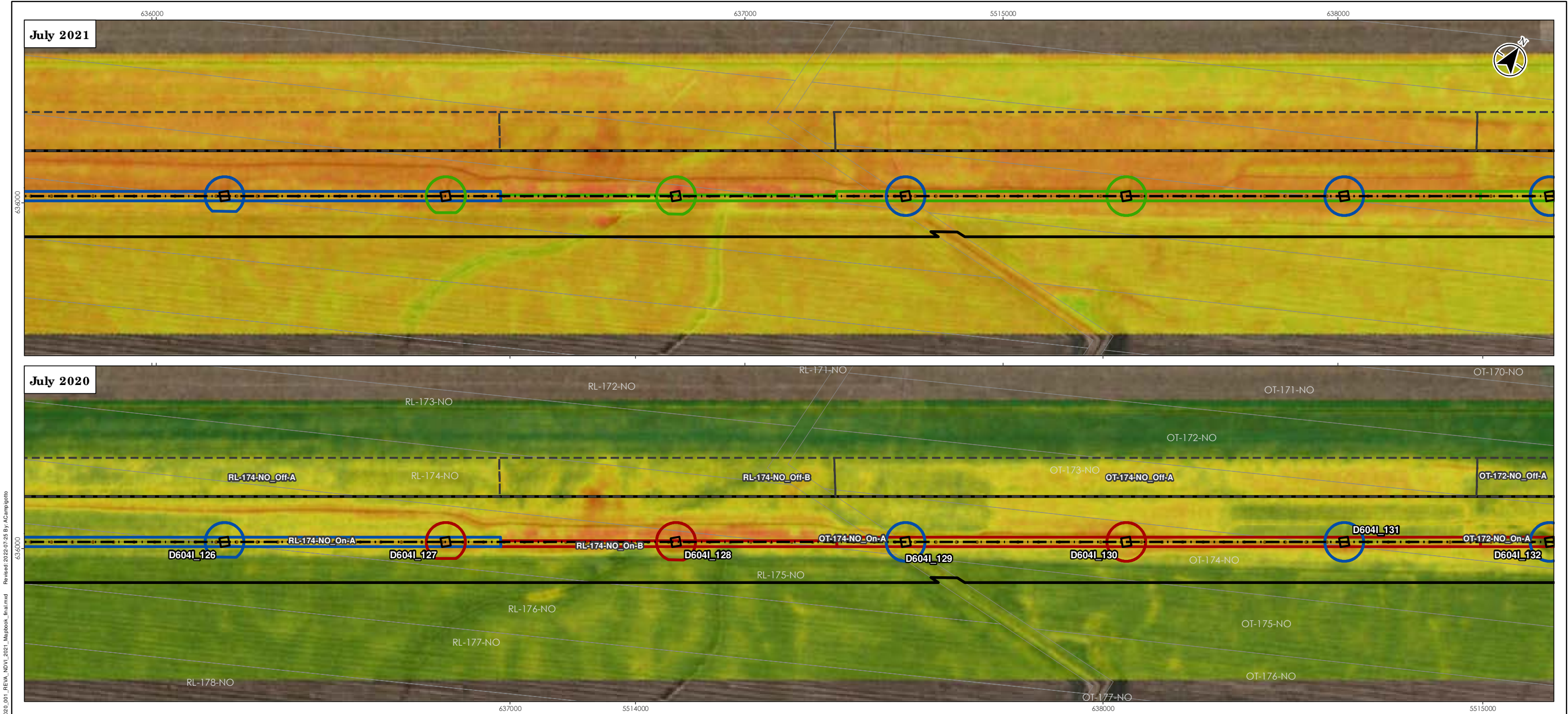
Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

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Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

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KEY MAP



Notes

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3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

Existing Transmission Lines

Quarter Sections

0 125 250 metres

1:8,017 (At original document size of 11x17)

Stantec

Project Location
Near Winnipeg,
Manitoba

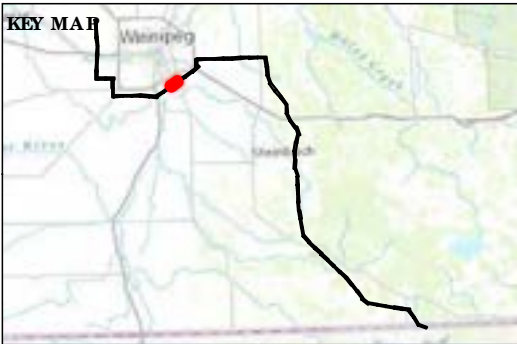
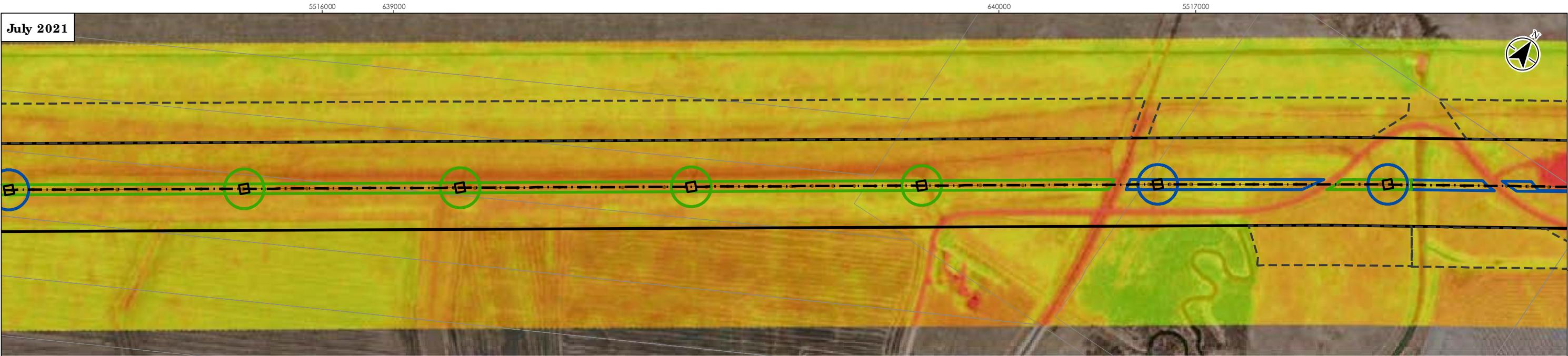
Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.
C.2-18

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

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Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

— Existing Transmission Lines

□ Quarter Sections

0 125 250 metres

1:8,017 (At original document size of 11x17)



Project Location

Near Winnipeg,
Manitoba

Client/Project

Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.

C.2-19

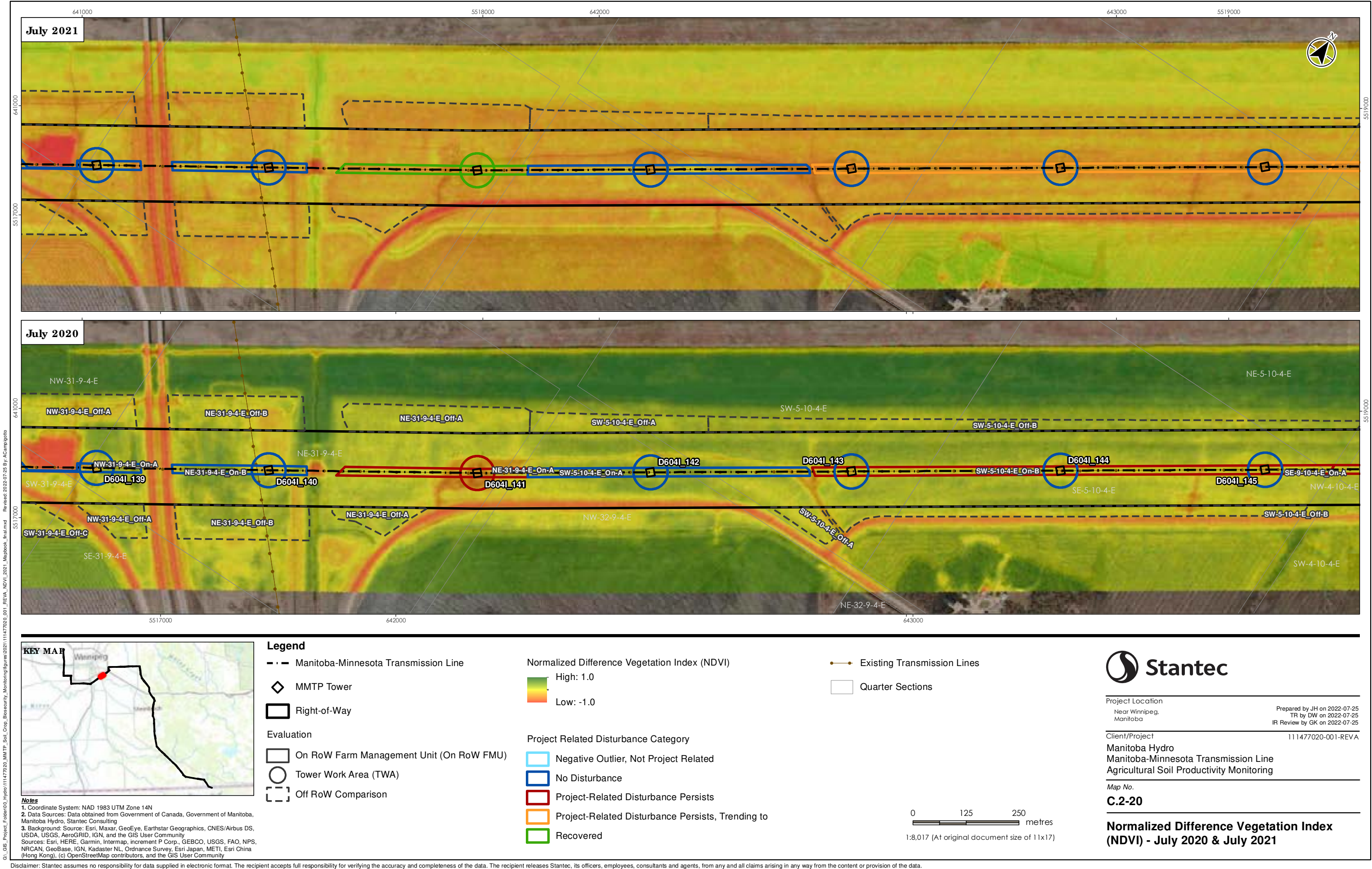
Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

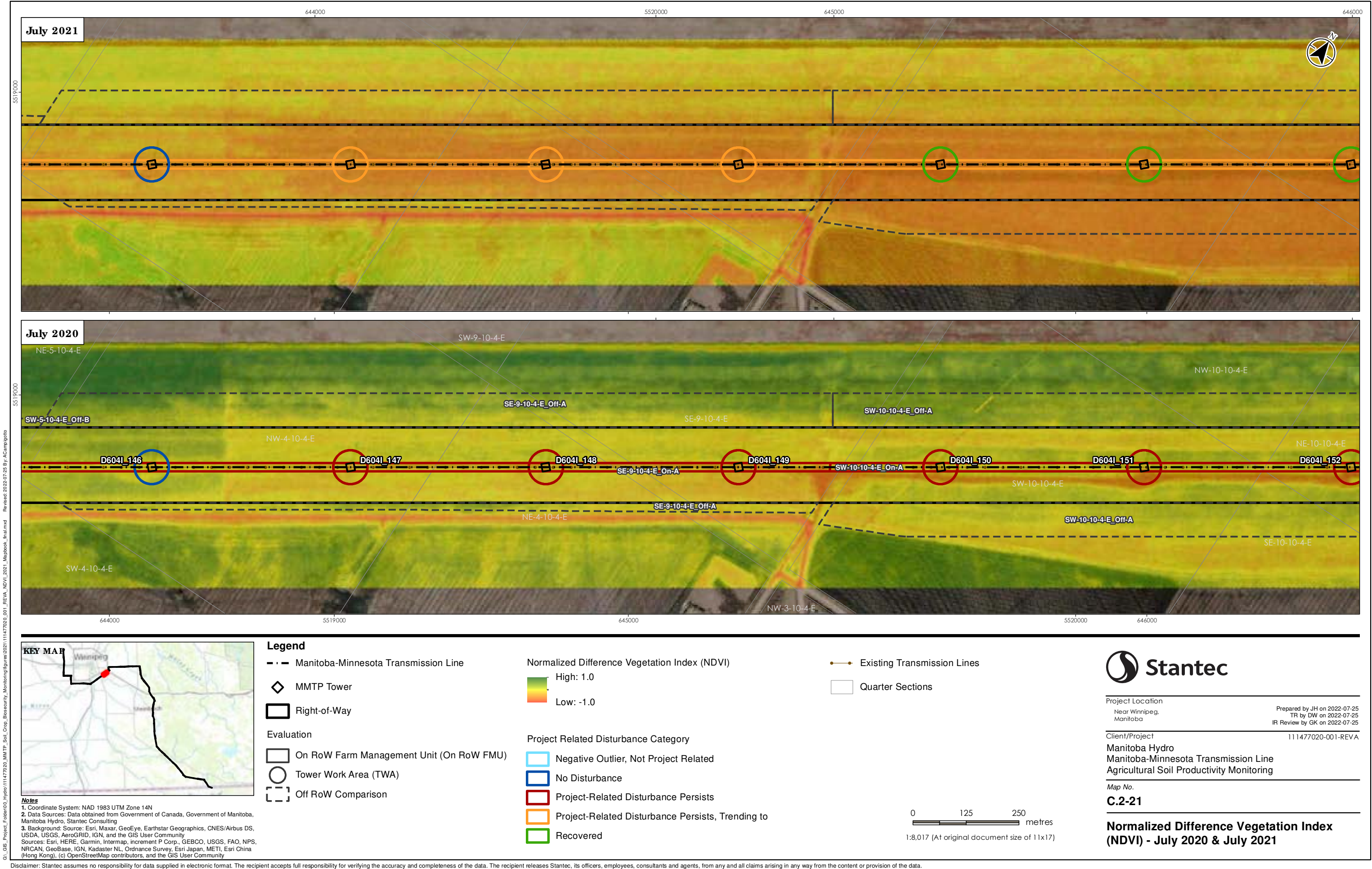
Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

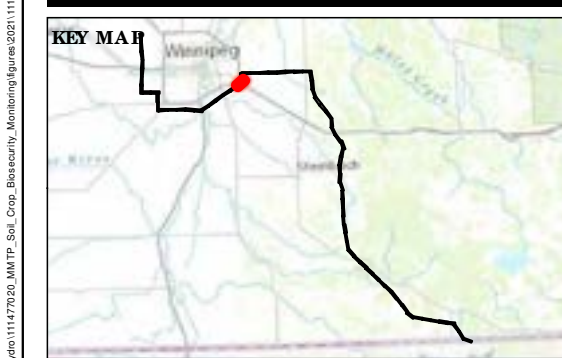
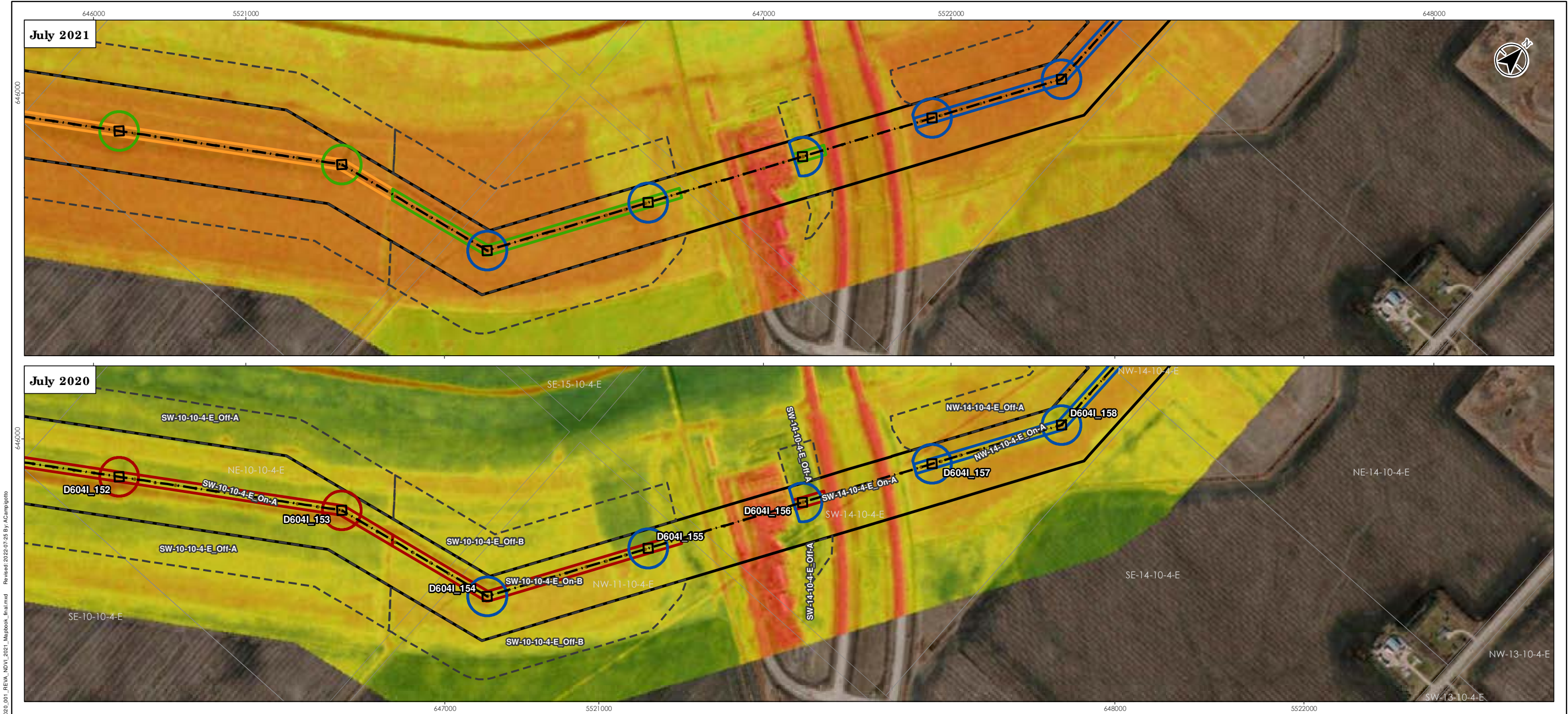
111477020-001-REVA

G:_GIS_Project_Folder\00_Hydro\111477020_MMTP_Soil_Crop_Biosecurity_Monitoring\Figures\2021\111477020_001_REVA_NDVI_2021_Mapbook_11x17.mxd Revised: 2022-07-25 By: ACampigotto

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Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

Existing Transmission Lines

□ Quarter Sections

0 125 250 metres

1:8,017 (At original document size of 11x17)



Project Location

Near Winnipeg,
Manitoba

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

Client/Project

Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

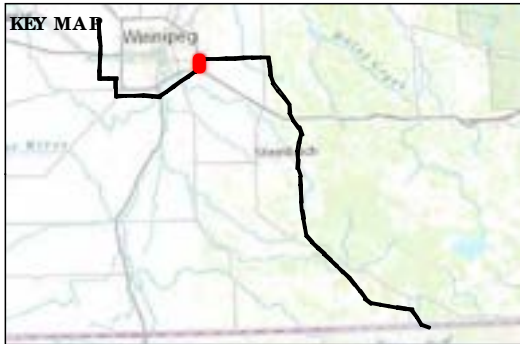
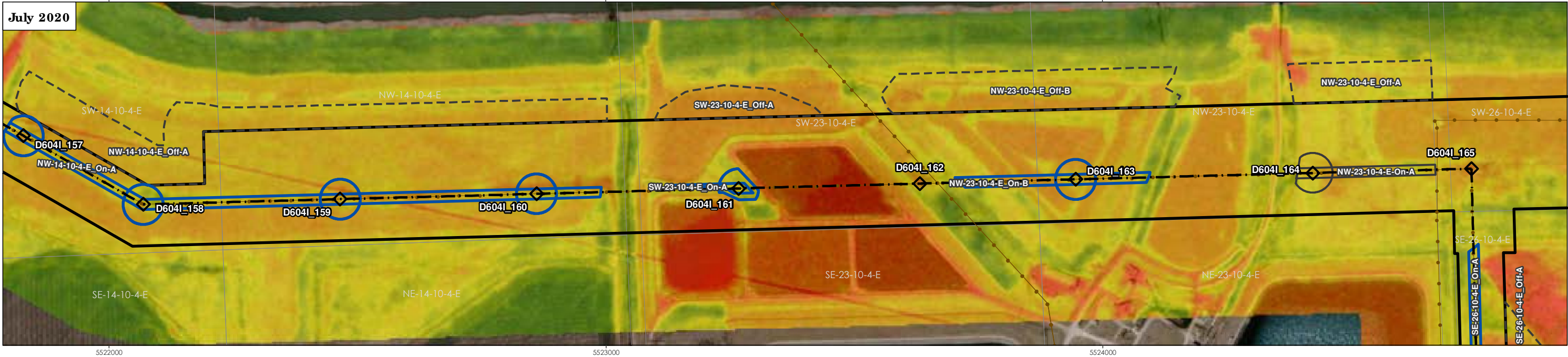
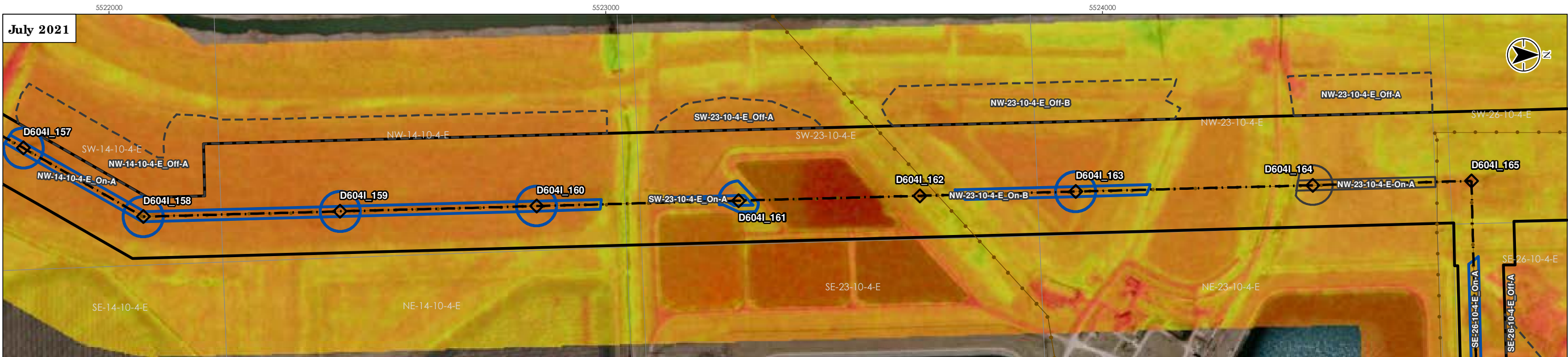
111477020-001-REVA

Map No.

C.2-22

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

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Notes

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Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

— Existing Transmission Lines

□ Quarter Sections

0 125 250 metres

1:8,017 (At original document size of 11x17)



Project Location

Near Winnipeg,
Manitoba

Client/Project

Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.

C.2-23

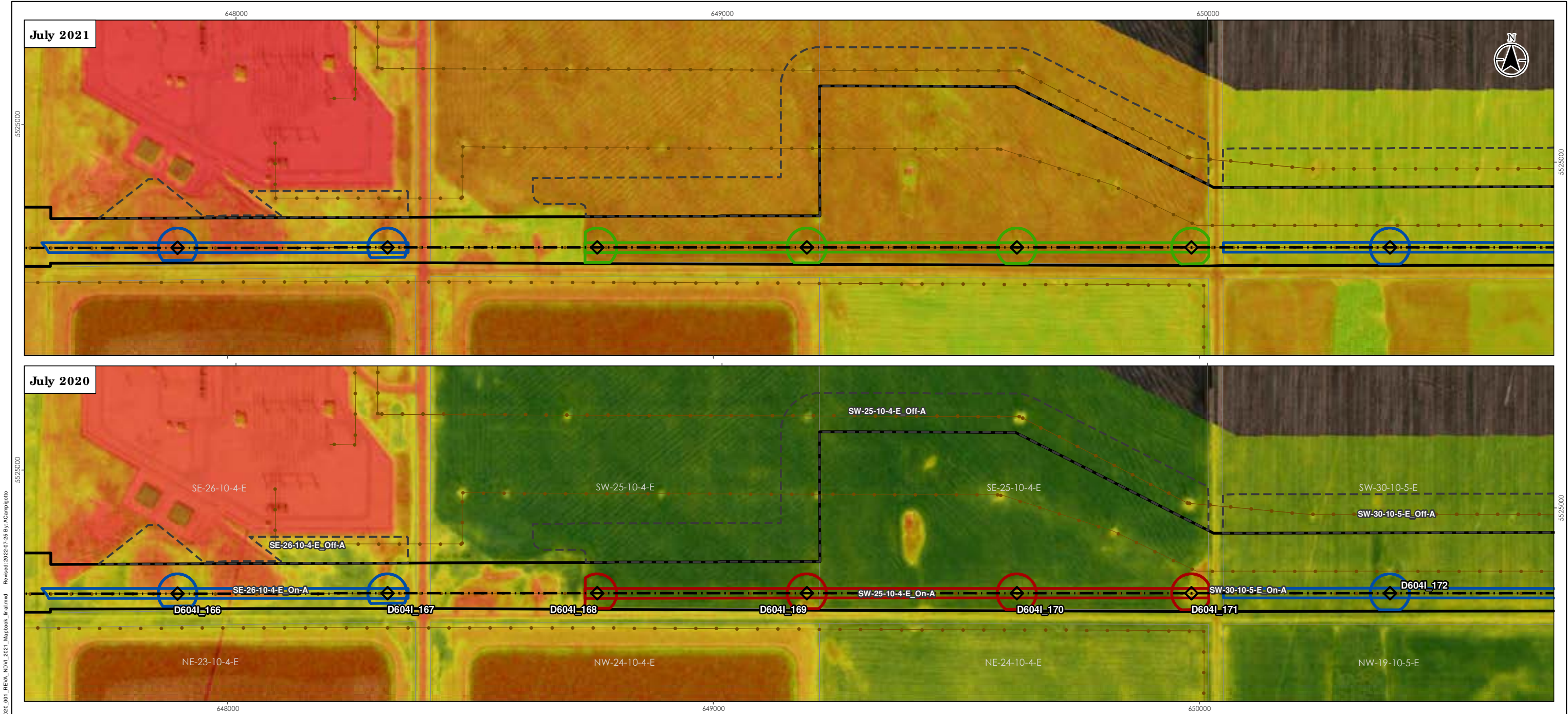
Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

111477020-001-REVA

G:_GIS_Project_Folder\00_Hydro\111477020_MMTP_Soil_Crop_Biosecurity_Monitoring\Figures\2021\111477020_001_REVA_NDVI_2021_Mapbook_Infra.mxd Revised: 2022-07-25 By: ACampigotto

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KEY MAP

Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

Existing Transmission Lines

□ Quarter Sections

0 125 250 metres

1:8,017 (At original document size of 11x17)

Stantec

Project Location
Near Winnipeg,
Manitoba

Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.
C.2-24

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

111477020-001-REVA

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

Notes

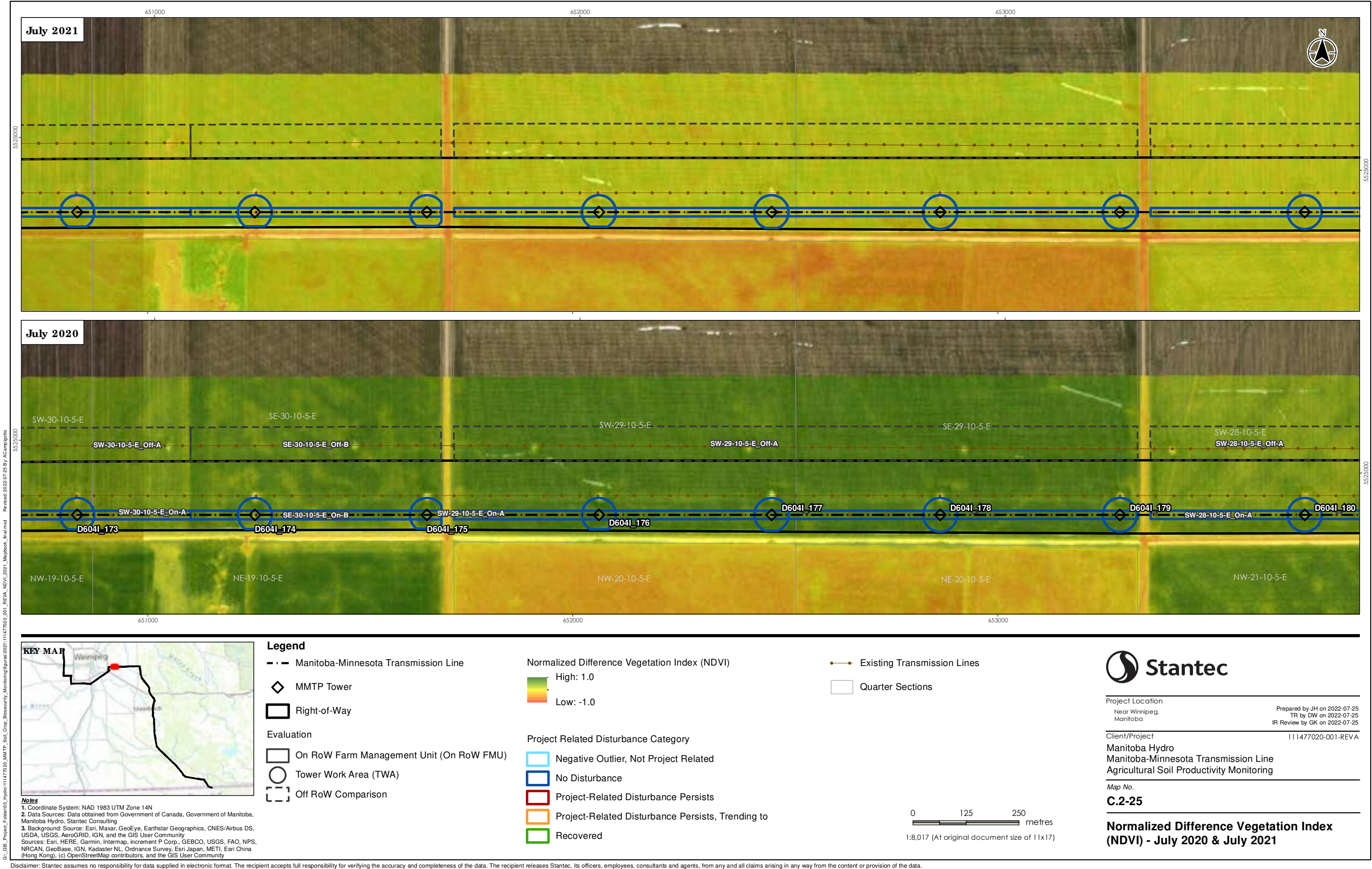
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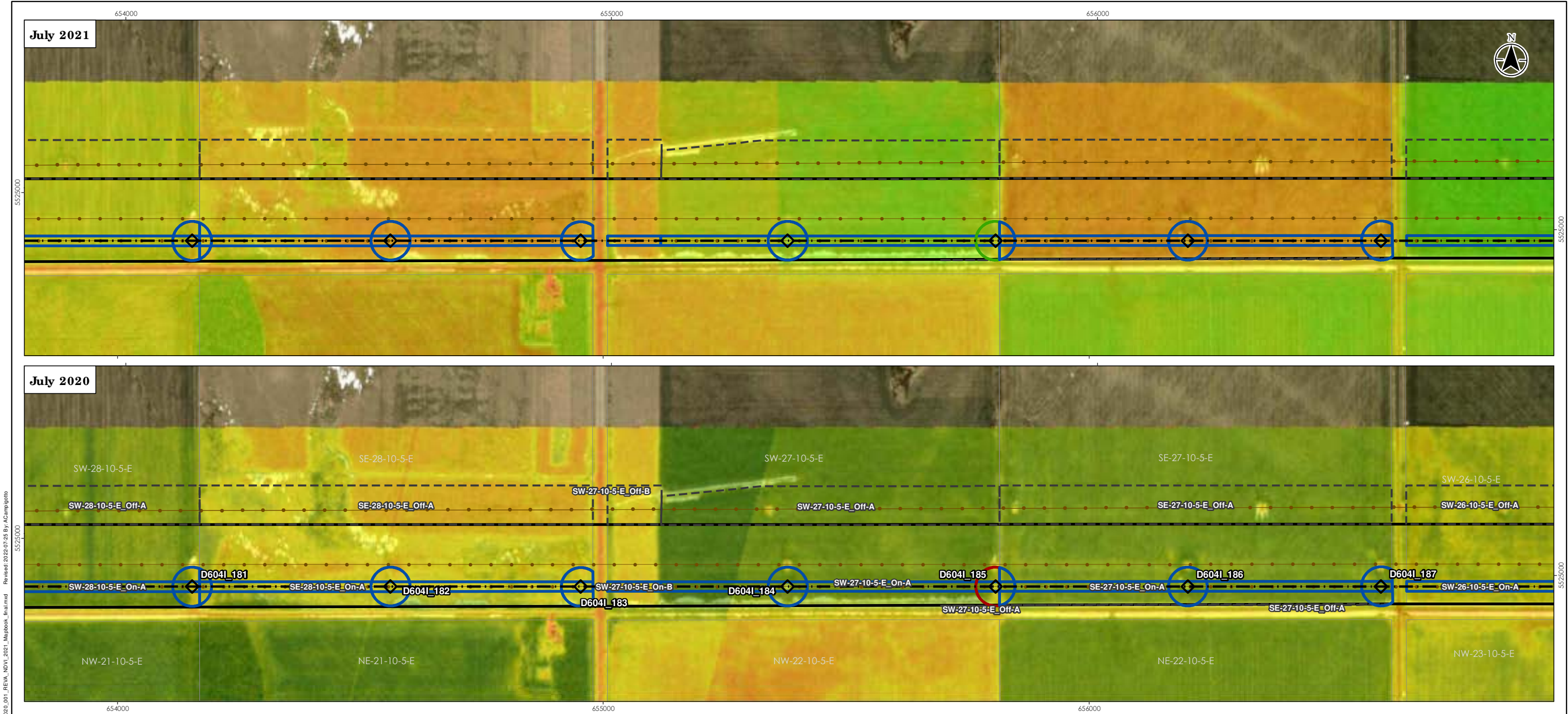
2. Data Sources: Data obtained from Government of Canada, Government of Manitoba, Manitoba Hydro, Stantec Consulting

3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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KEY MAP

Legend

- Manitoba-Minnesota Transmission Line
- MMTP Tower
- Right-of-Way
- On RoW Farm Management Unit (On RoW FMU)
- Tower Work Area (TWA)
- Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

- Negative Outlier, Not Project Related
- No Disturbance
- Project-Related Disturbance Persists
- Project-Related Disturbance Persists, Trending to
- Recovered

Existing Transmission Lines

Quarter Sections

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N

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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Scale

0 125 250 metres

1:8,017 (At original document size of 11x17)

Stantec

Project Location
Near Winnipeg,
Manitoba

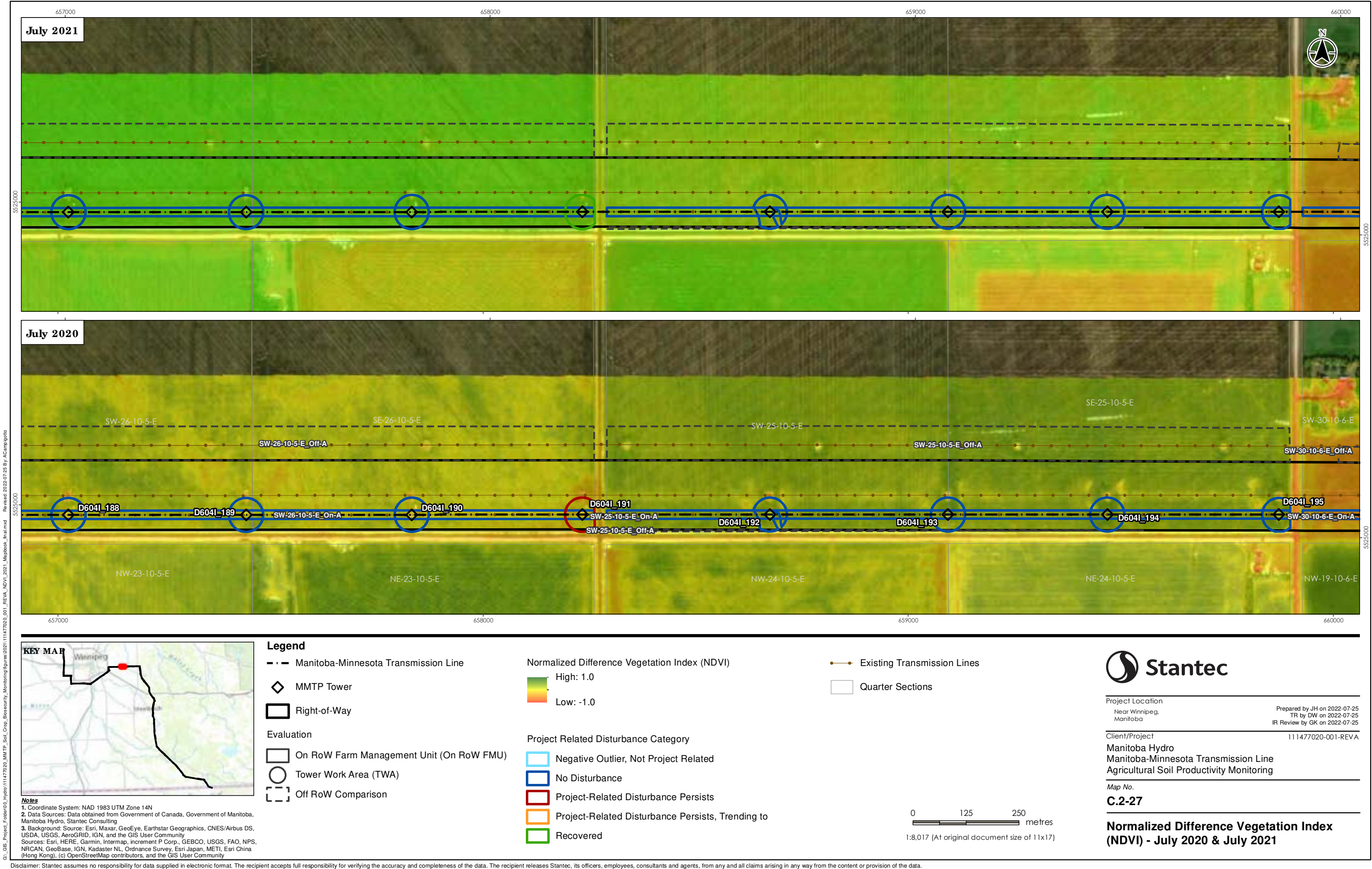
Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

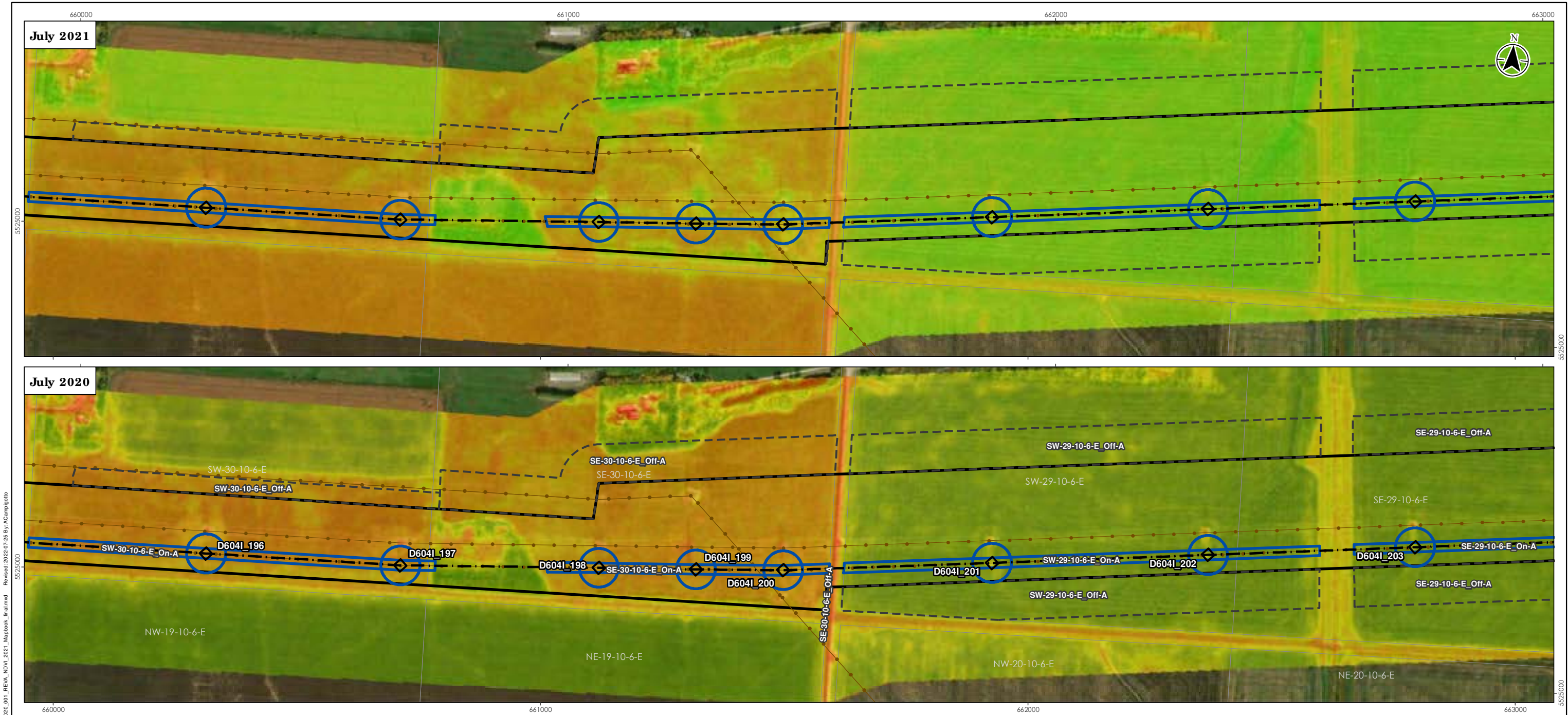
Map No.
C.2-26

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

111477020-001-REVA

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021





KEY MAP

Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N

2. Data Sources: Data obtained from Government of Canada, Government of Manitoba, Manitoba Hydro, Stantec Consulting

3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

Existing Transmission Lines

□ Quarter Sections

Scale

0 125 250 metres

1:8,017 (At original document size of 11x17)

Stantec

Project Location

Near Winnipeg,
Manitoba

Client/Project

Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.

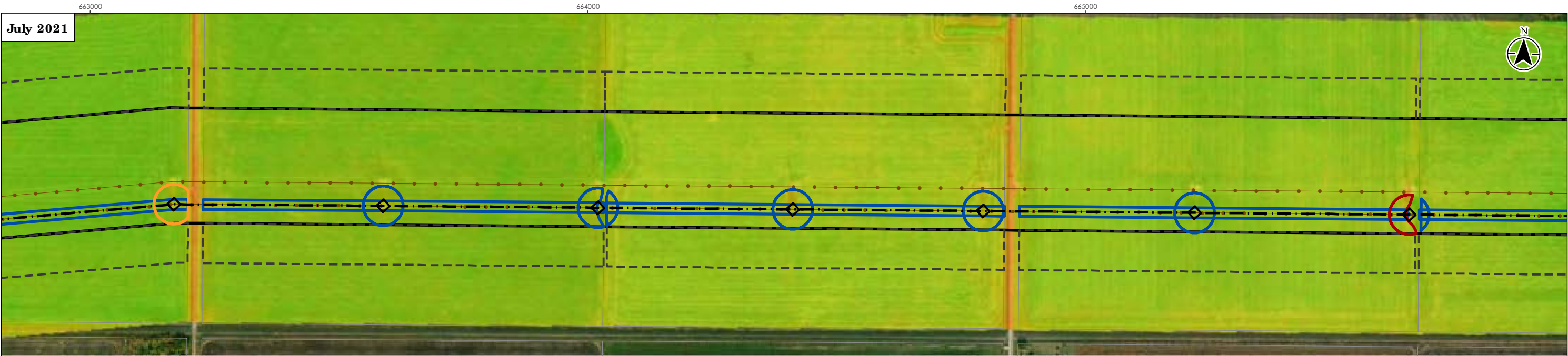
C.2-28

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

111477020-001-REVA

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Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

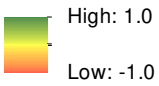
Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

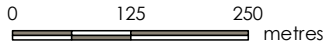


Project Related Disturbance Category

- Negative Outlier, Not Project Related
- No Disturbance
- Project-Related Disturbance Persists
- Project-Related Disturbance Persists, Trending to
- Recovered

Existing Transmission Lines

□ Quarter Sections



1:8,017 (At original document size of 11x17)



Project Location
Near Winnipeg,
Manitoba

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

111477020-001-REVA

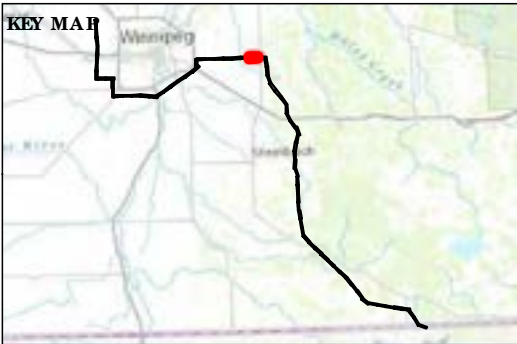
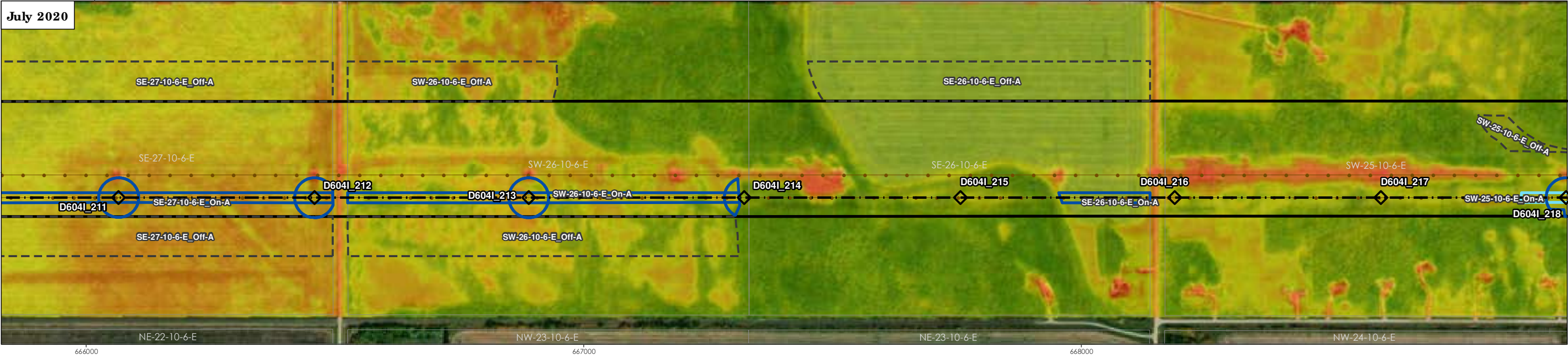
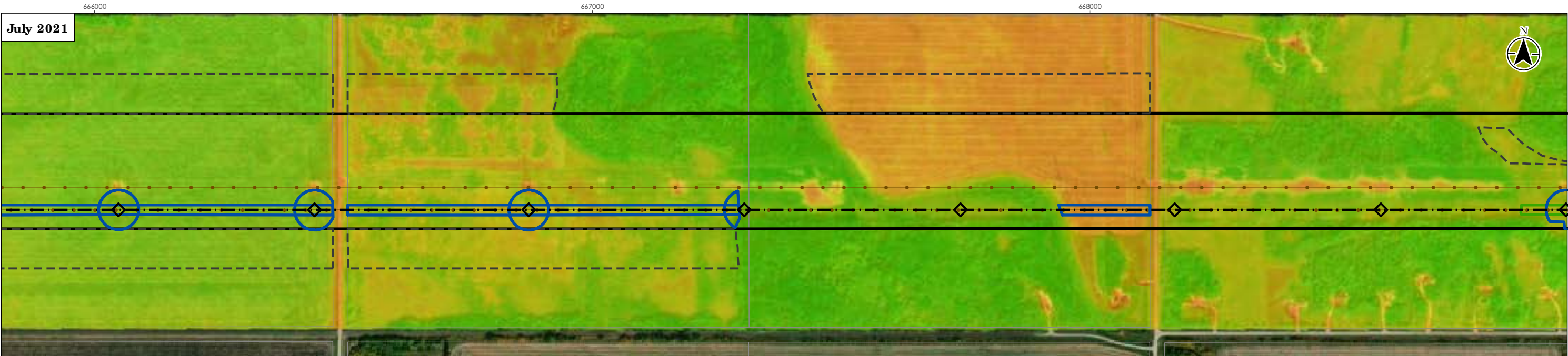
Map No.

C.2-29

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

G:_GIS_Project_Folder\0_Hydro\111477020_MMTP_Soil_Crop_Biosecurity_Monitoring\Figures\2021\111477020_001_REVA_NDVI_2021_Mapbook_11x17.mxd Revised: 2022-07-25 By: ACampigotto

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3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

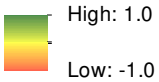
Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

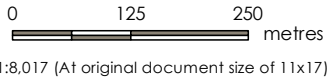


Project Related Disturbance Category

- Negative Outlier, Not Project Related
- No Disturbance
- Project-Related Disturbance Persists
- Project-Related Disturbance Persists, Trending to
- Recovered

— Existing Transmission Lines

□ Quarter Sections



Project Location

Near Winnipeg,
Manitoba

Client/Project

Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.

C.2-30

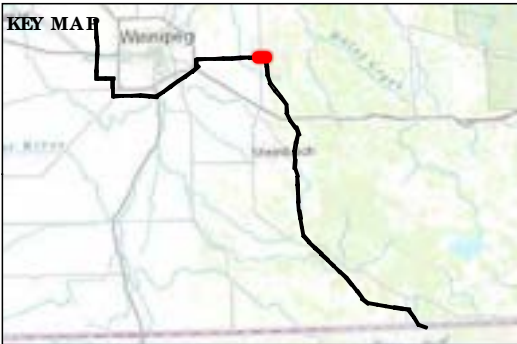
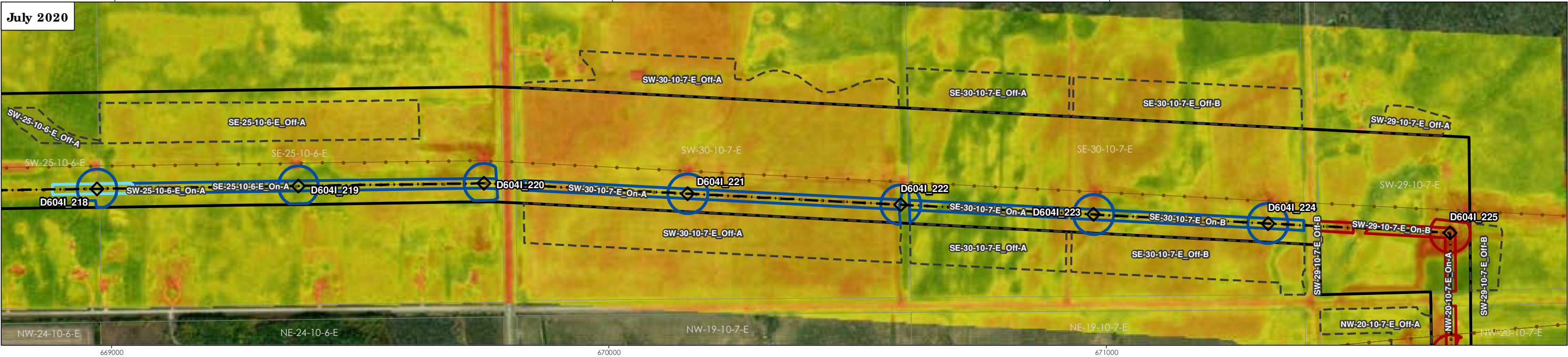
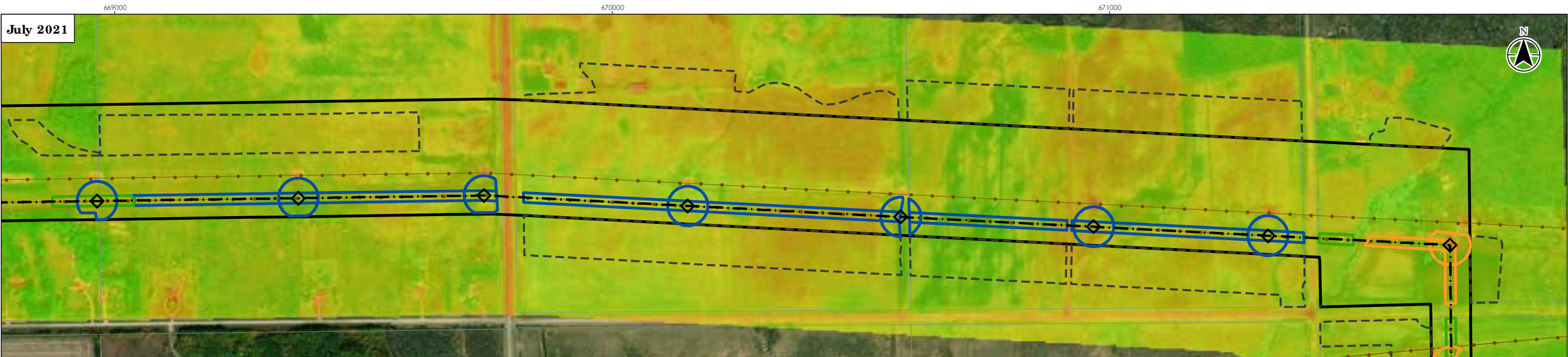
Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

111477020-001-REVA

G:_GIS_Project_Folder\00_Hydro\111477020_MMTP_Soil_Crop_Biossecurity_Monitoring\Figures\2021\111477020_001_REVA_NDVI_2021_Mapbook_Infra.mxd Revised: 2022-07-25 By: ACampigotto

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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

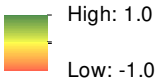
Legend

- Manitoba-Minnesota Transmission Line
- ◇ MMTP Tower
- Right-of-Way

Evaluation

- On RoW Farm Management Unit (On RoW FMU)
- Tower Work Area (TWA)
- Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

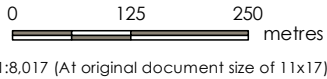


Project Related Disturbance Category

- Negative Outlier, Not Project Related
- No Disturbance
- Project-Related Disturbance Persists
- Project-Related Disturbance Persists, Trending to
- Recovered

Existing Transmission Lines

- Quarter Sections



1:8,017 (At original document size of 11x17)



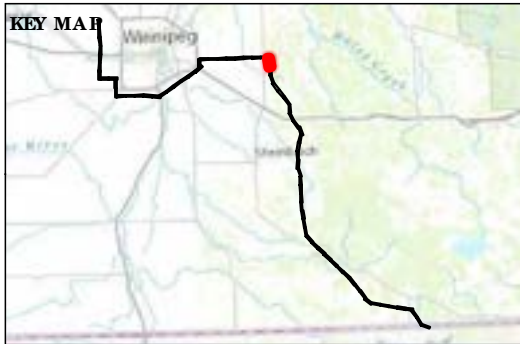
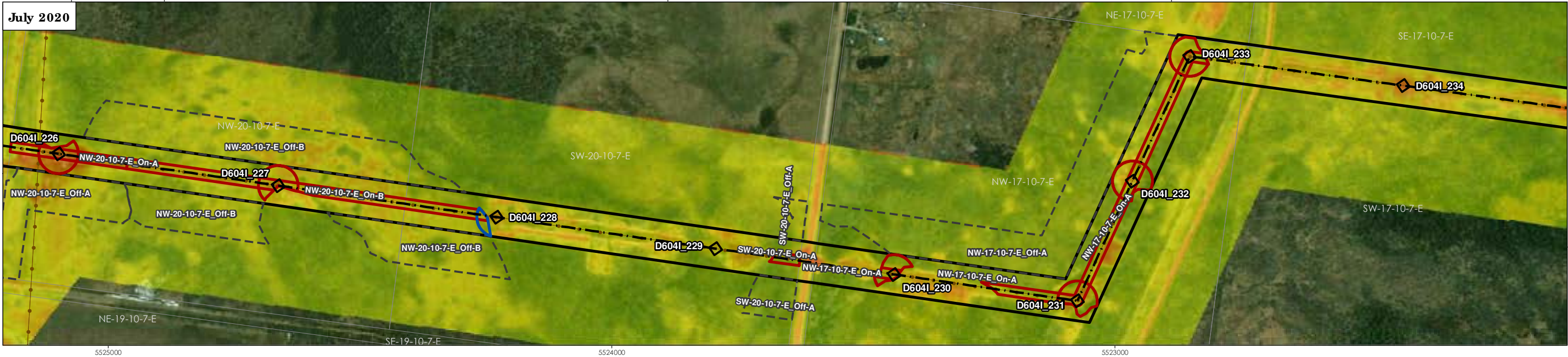
Project Location
Near Winnipeg,
Manitoba

Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.

C.2-31

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021



Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Data obtained from Government of Canada, Government of Manitoba, Manitoba Hydro, Stantec Consulting
3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

— Existing Transmission Lines

□ Quarter Sections

0 125 250 metres

1:8,017 (At original document size of 11x17)



Project Location

Near Winnipeg,
Manitoba

Client/Project

Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

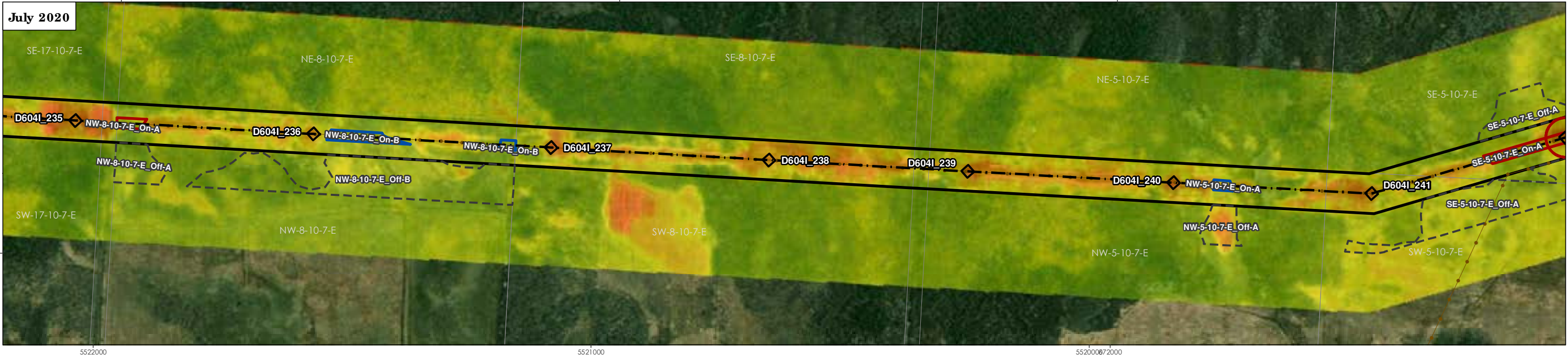
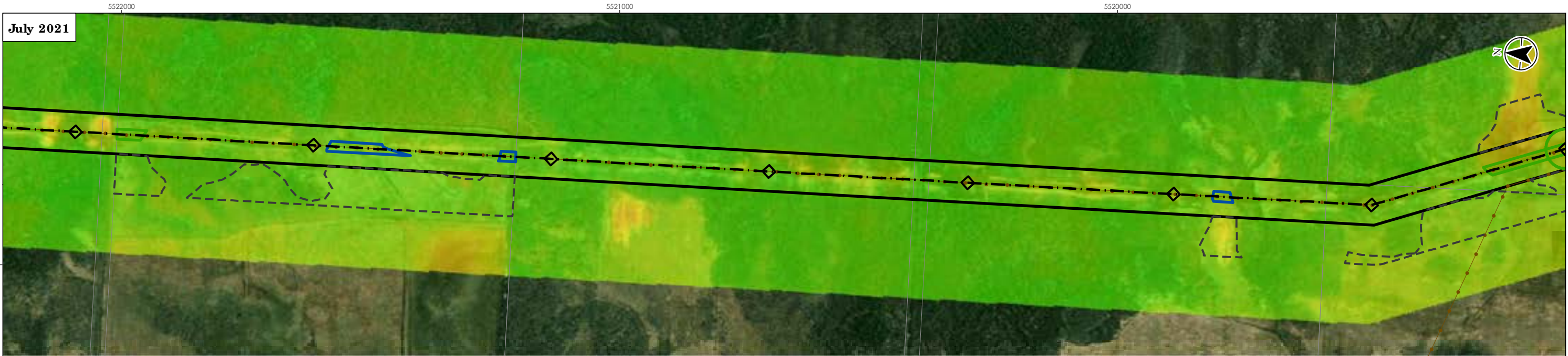
Map No.

C.2-32

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

G:_GIS_Project_Folder\00_Hydro\111477020_MMTP_Soil_Crop_Biosecurity_Monitoring\Figures\2021\111477020_001_REVIA_NDVI_2021_Mapbook_Infra.mxd Revised: 2022-07-25 By: ACampigotto

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Notes

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Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0
Low: -1.0

Project Related Disturbance Category

□ Negative Outlier, Not Project Related
□ No Disturbance
□ Project-Related Disturbance Persists
□ Project-Related Disturbance Persists, Trending to
□ Recovered

--- Existing Transmission Lines

□ Quarter Sections

0 125 250 metres
1:8,017 (At original document size of 11x17)



Project Location
Near Winnipeg,
Manitoba

Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

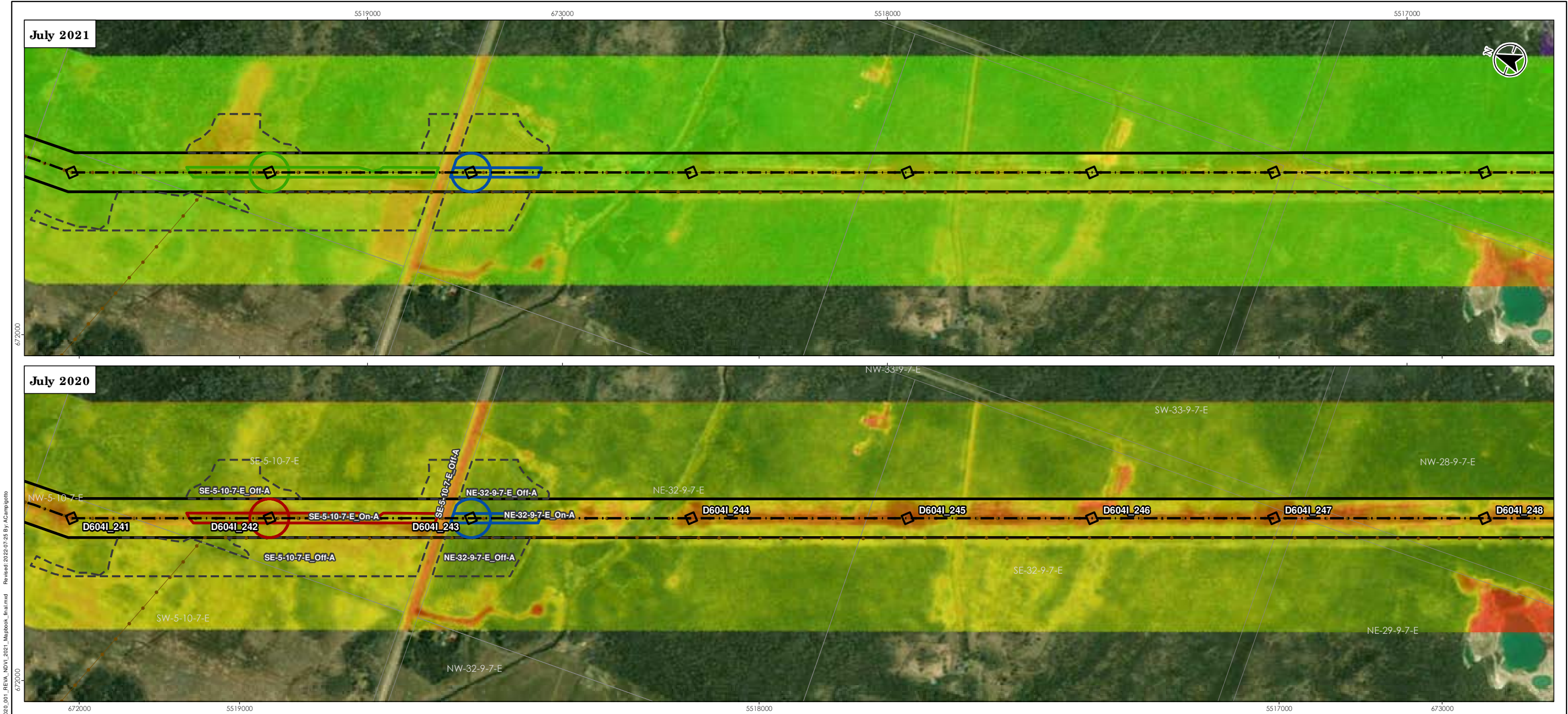
Map No.

C.2-33

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

G:_GIS_Project_Folder\00_Hydro\111477020_MMTP_Soil_Crop_Biossecurity_Monitoring\Figures\2021\111477020_001_REVA_NDVI_2021_Mapbook_Infra.mxd Revised: 2022-07-25 By: ACampigotto

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KEY MAP

Notes

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Legend

- Manitoba-Minnesota Transmission Line
- MMTP Tower
- Right-of-Way
- On RoW Farm Management Unit (On RoW FMU)
- Tower Work Area (TWA)
- Off RoW Comparison

Evaluation

- On RoW Farm Management Unit (On RoW FMU)
- Tower Work Area (TWA)
- Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

- Negative Outlier, Not Project Related
- No Disturbance
- Project-Related Disturbance Persists
- Project-Related Disturbance Persists, Trending to
- Recovered

Existing Transmission Lines

Quarter Sections

Scale: 0, 125, 250 metres

1:8,017 (At original document size of 11x17)

Stantec

Project Location
Near Winnipeg,
Manitoba

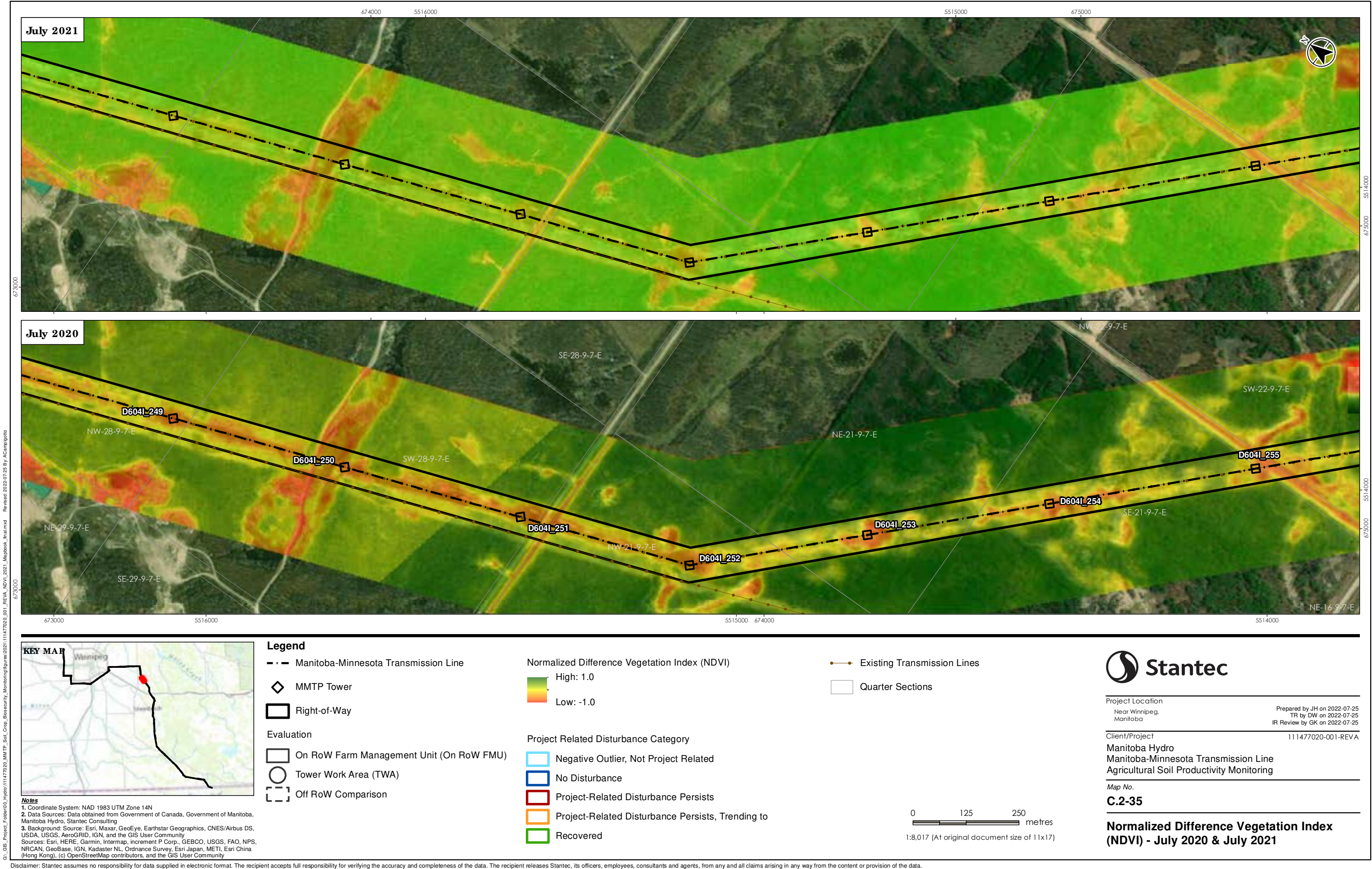
Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

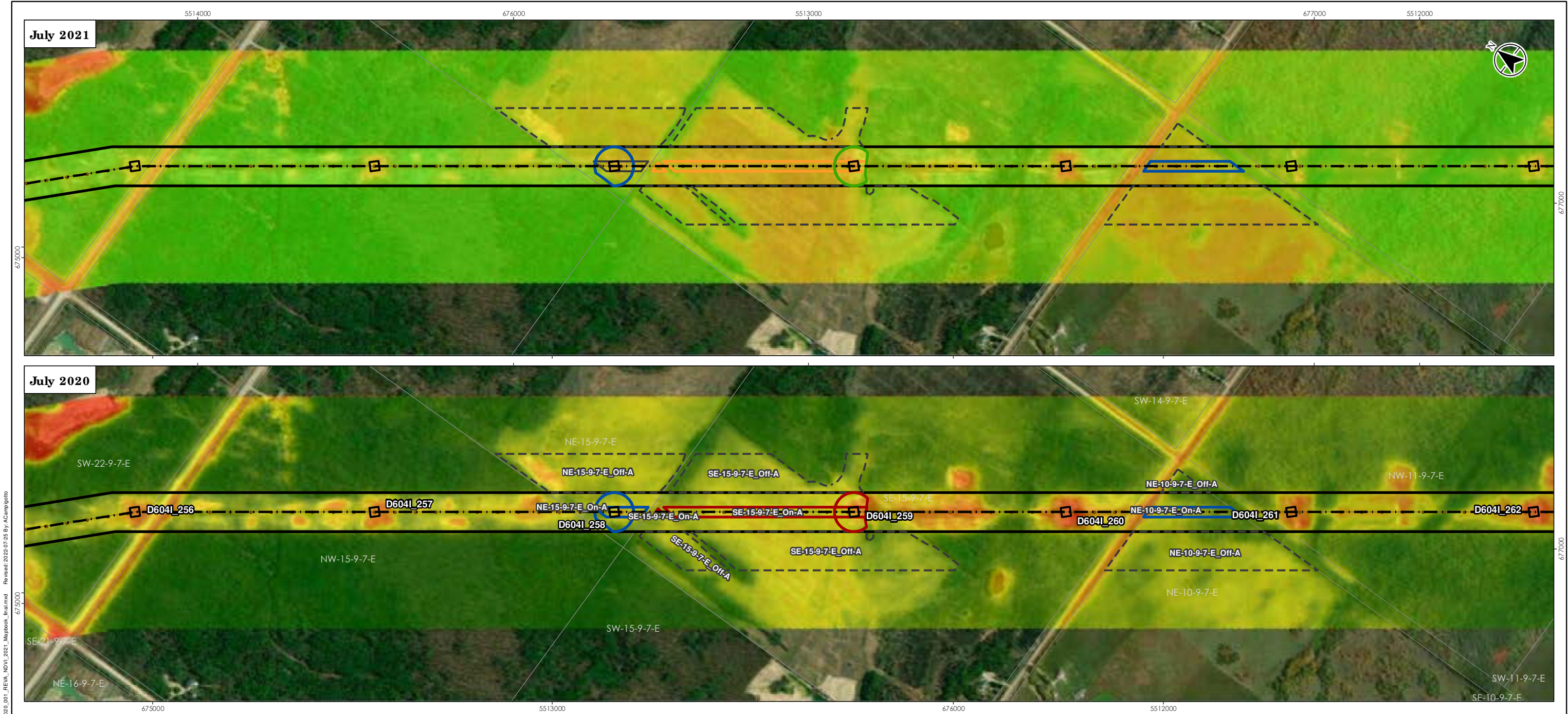
Map No.
C.2-34

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

111477020-001-REVA

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021





KEY MAP

Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

Existing Transmission Lines

□ Quarter Sections

Notes

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Scale

0 125 250 metres

1:8,017 (At original document size of 11x17)

Stantec

Project Location
Near Winnipeg,
Manitoba

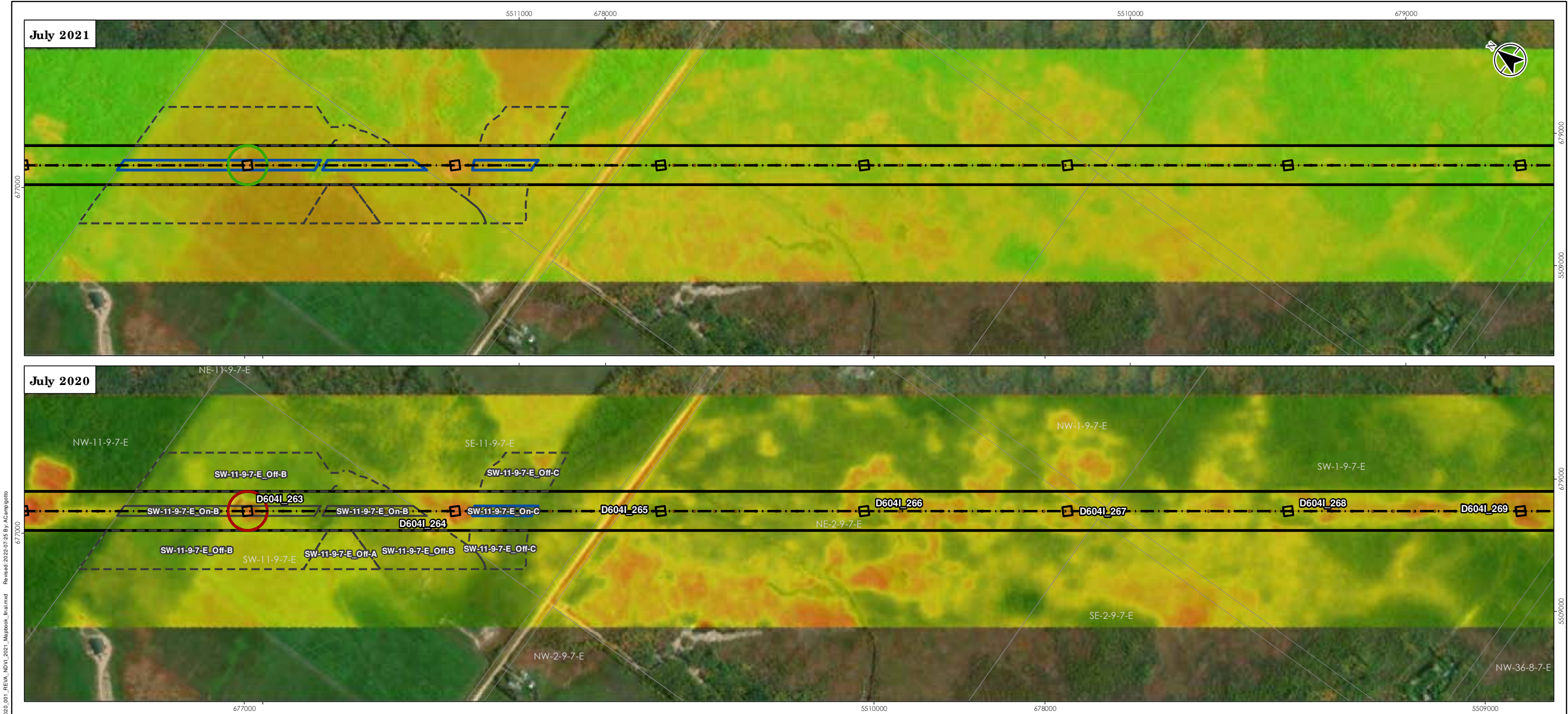
Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.
C.2-36

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

111477020-001-REVA

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021



G:_GIS_Project_Folder\00_Hydro\111477020_MMTP_Soil_Crop_Biosecurity_Monitoring\Figures\2021\111477020_001_REVA_NDVI_2021_Mapbook_1.mxd
Revised: 2022-07-25 By: ACampitello



Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
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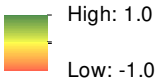
Legend

- Manitoba-Minnesota Transmission Line
- MMTP Tower
- Right-of-Way

Evaluation

- On RoW Farm Management Unit (On RoW FMU)
- Tower Work Area (TWA)
- Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

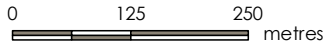


Project Related Disturbance Category

- Negative Outlier, Not Project Related
- No Disturbance
- Project-Related Disturbance Persists
- Project-Related Disturbance Persists, Trending to
- Recovered

Existing Transmission Lines

- Quarter Sections



1:8,017 (At original document size of 11x17)



Project Location

Near Winnipeg,
Manitoba

Client/Project

Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.

C.2-37

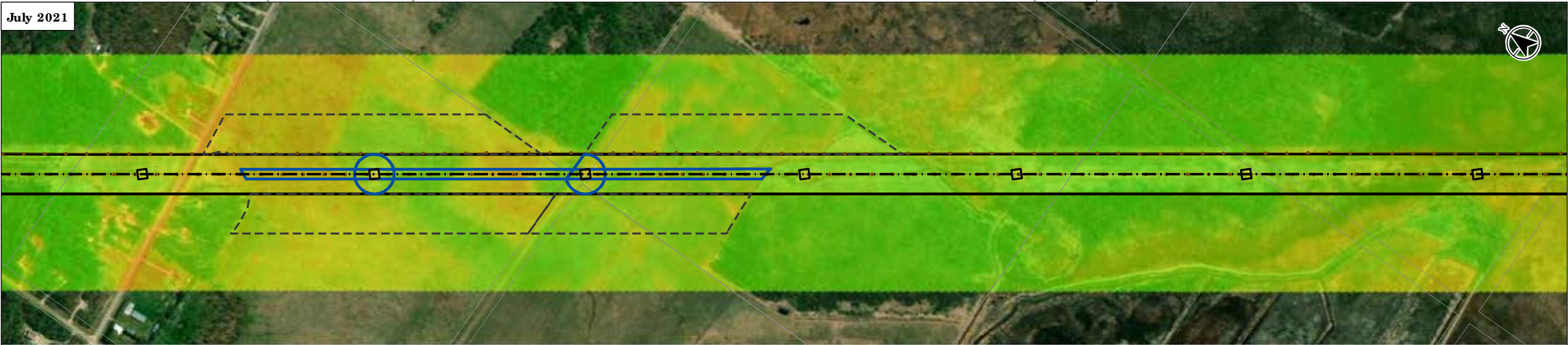
Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

111477020-001-REVA



July 2021



July 2020



Notes
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Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

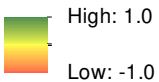
Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

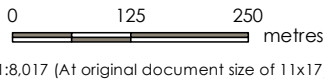


Project Related Disturbance Category

- Negative Outlier, Not Project Related
- No Disturbance
- Project-Related Disturbance Persists
- Project-Related Disturbance Persists, Trending to
- Recovered

— Existing Transmission Lines

□ Quarter Sections



Project Location
Near Winnipeg,
Manitoba

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

Client/Project
111477020-001-REVA

Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.

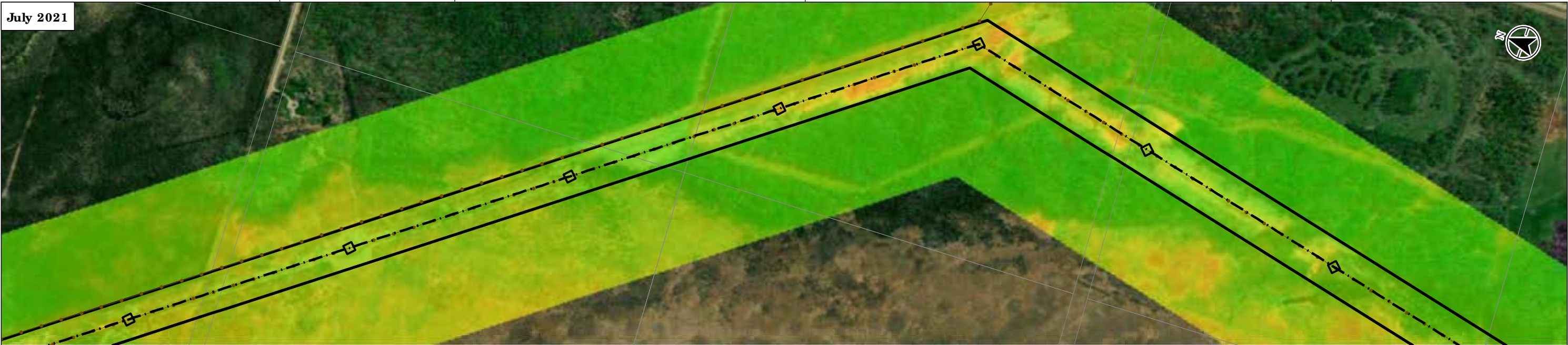
C.2-40

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

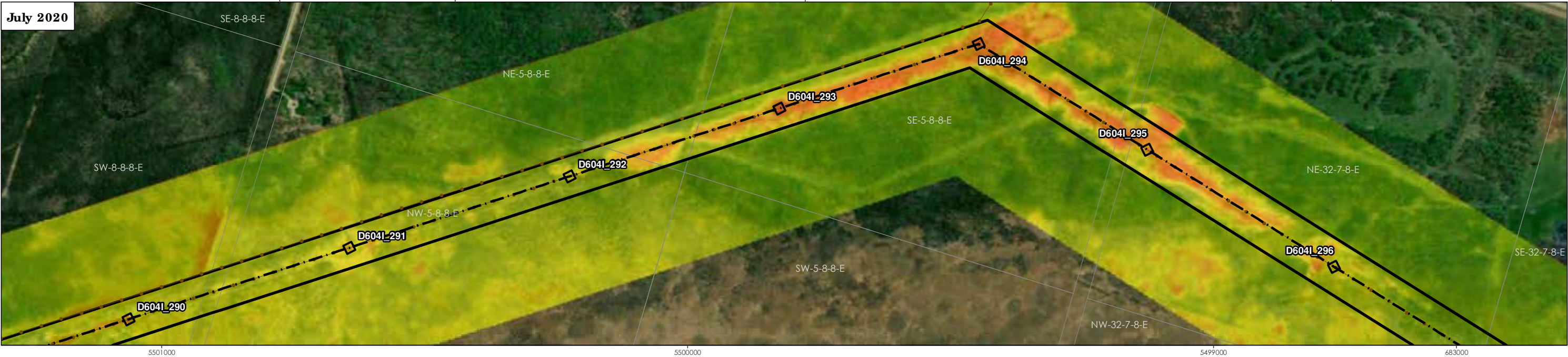
G:_GIS_Project_Folder\00_Hydro\111477020_MMTP_Soil_Crop_Security_Monitoring\Figures\2021\111477020_001_REVA_NDVI_2021_Mapbook_Infra.mxd Revised: 2022-07-25 By: ACampigotto

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July 2021



July 2020



Notes
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Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

--- Existing Transmission Lines

□ Quarter Sections

0 125 250 metres

1:8,017 (At original document size of 11x17)



Project Location

Near Winnipeg,
Manitoba

Client/Project

Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.

C.2-41

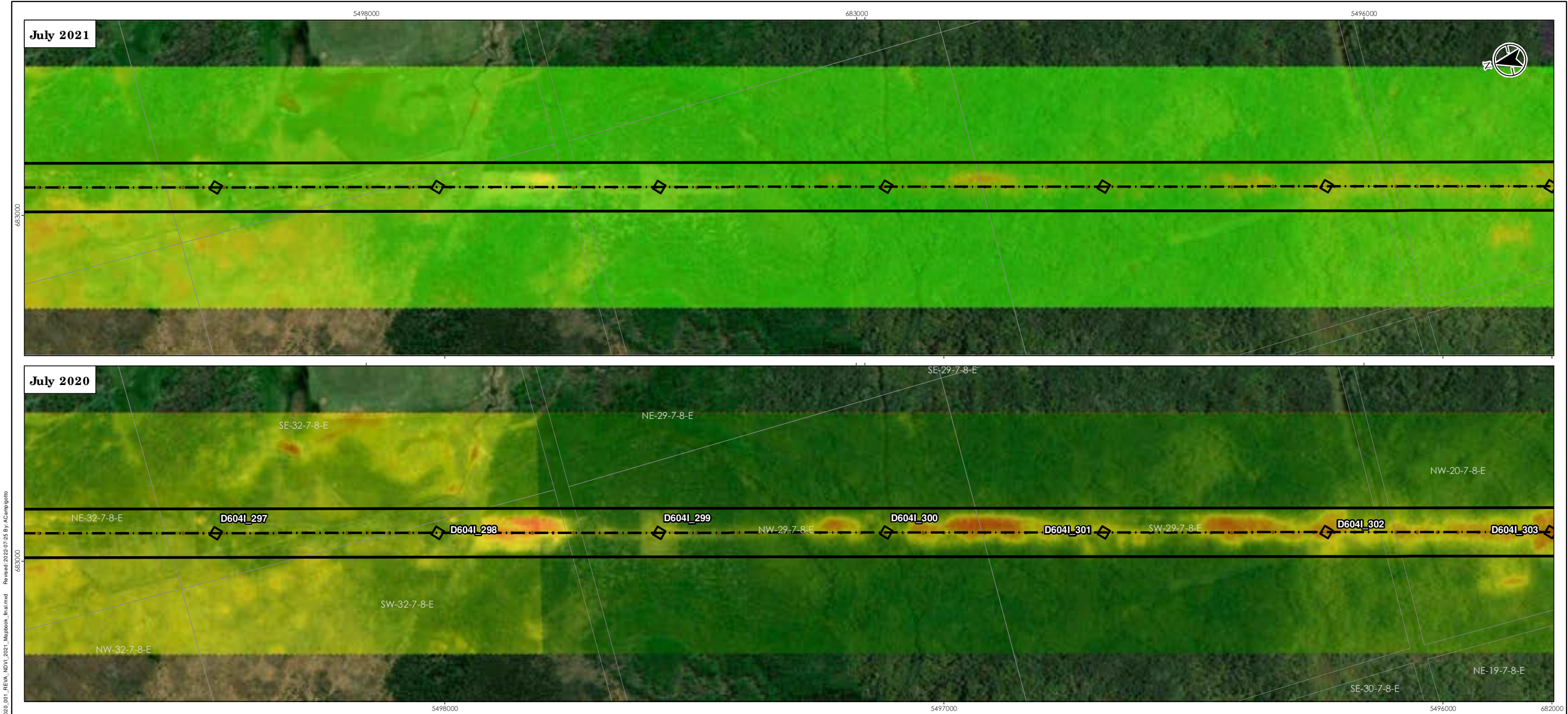
Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

111477020-001-REVA

G:_GIS_Project_Folder\00_Hydro\111477020_MMTP_Soil_Crop_BaseSecurity_Monitoring\Figures\2021\111477020_001_REVA_NDVI_2021_Mapbook_Infra.mxd Revised: 2022-07-25 By: ACampigotto

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Revised: 2022-07-25 By: ACampigotto



Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Data obtained from Government of Canada, Government of Manitoba, Manitoba Hydro, Stantec Consulting
3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

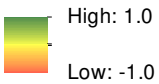
Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

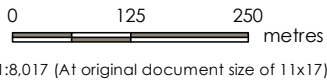


Project Related Disturbance Category

- Negative Outlier, Not Project Related
- No Disturbance
- Project-Related Disturbance Persists
- Project-Related Disturbance Persists, Trending to
- Recovered

— Existing Transmission Lines

□ Quarter Sections



Project Location

Near Winnipeg,
Manitoba

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

Client/Project

Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

111477020-001-REVA

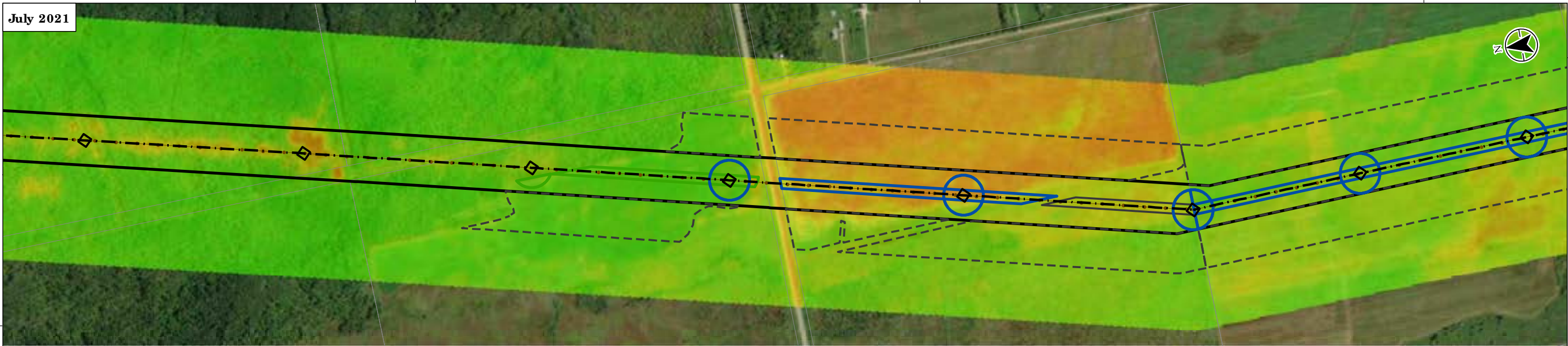
Map No.

C.2-42

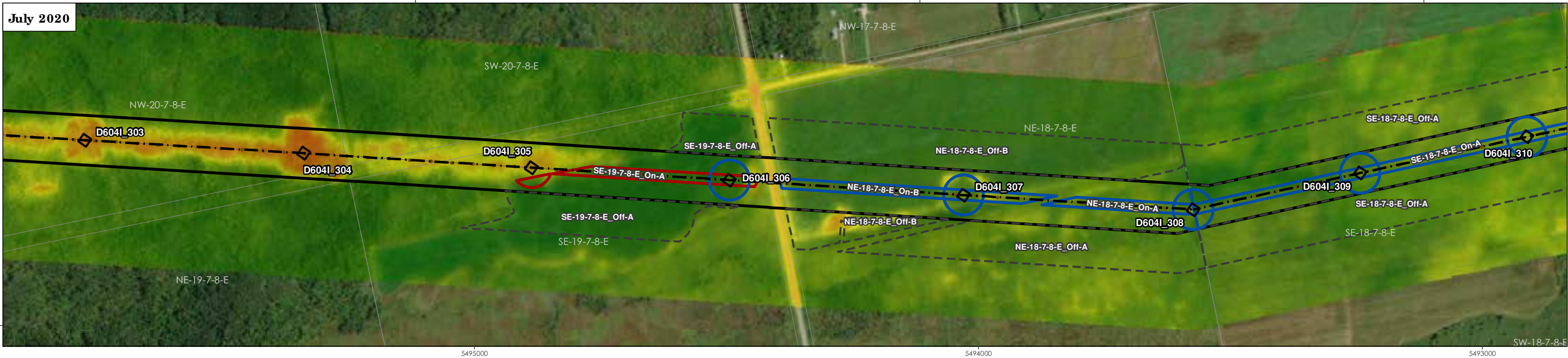
Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

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July 2021



July 2020



Notes

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Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

— Existing Transmission Lines

□ Quarter Sections

0 125 250 metres

1:8,017 (At original document size of 11x17)



Project Location

Near Winnipeg,
Manitoba

Client/Project

Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.

C.2-43

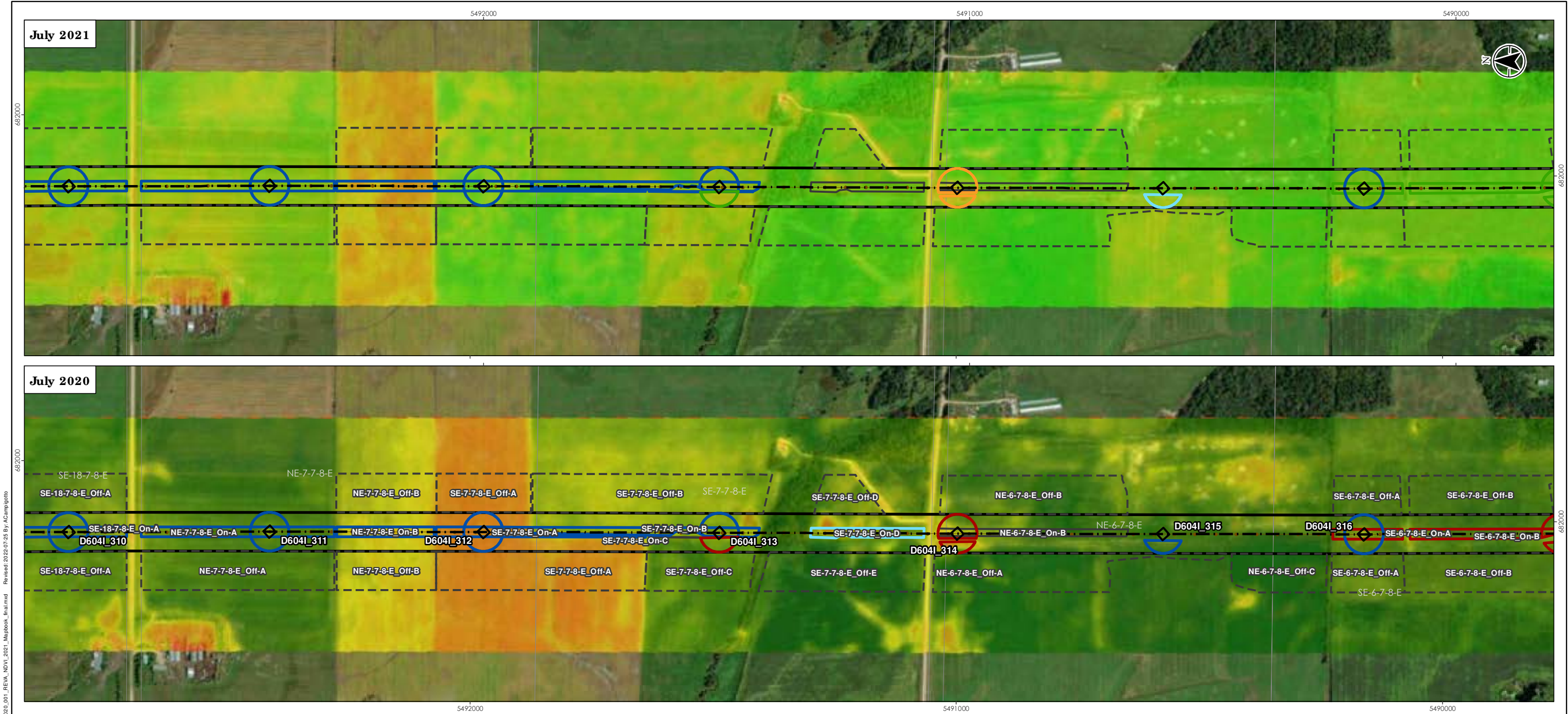
Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

111477020-001-REVA

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KEY MAP

Legend

- Manitoba-Minnesota Transmission Line
- MMTP Tower
- Right-of-Way
- On RoW Farm Management Unit (On RoW FMU)
- Tower Work Area (TWA)
- Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

- Negative Outlier, Not Project Related
- No Disturbance
- Project-Related Disturbance Persists
- Project-Related Disturbance Persists, Trending to
- Recovered

Existing Transmission Lines

Quarter Sections

Notes

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Scale

0 125 250 metres

1:8,017 (At original document size of 11x17)

Stantec

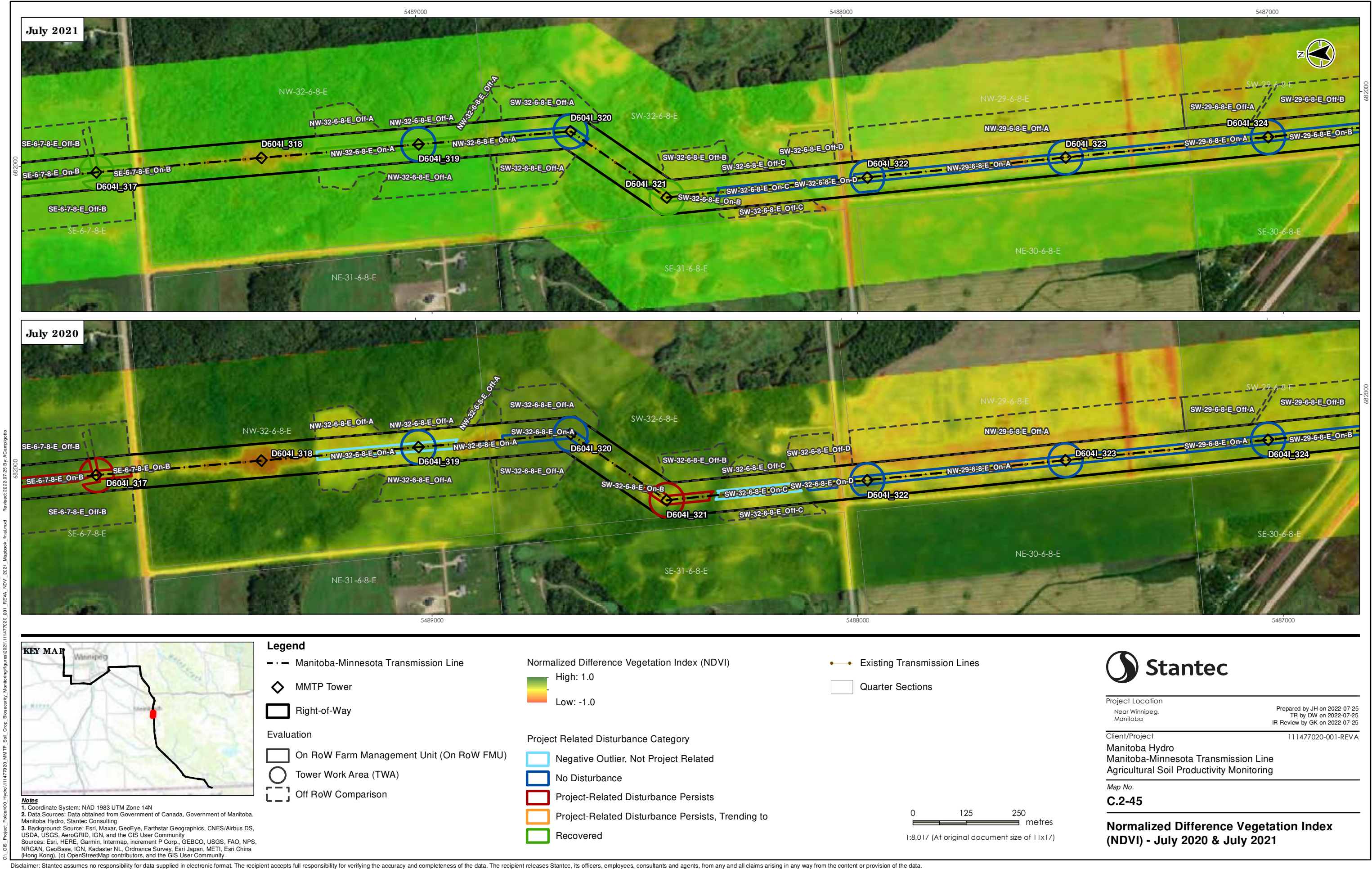
Project Location
Near Winnipeg,
Manitoba

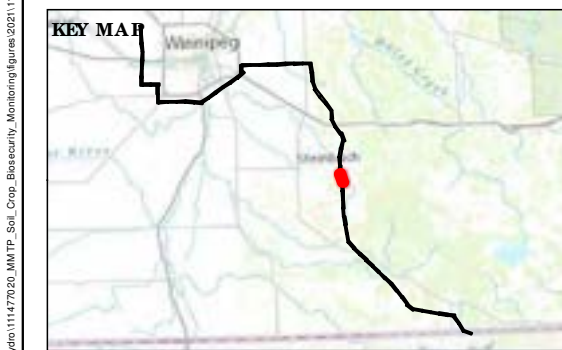
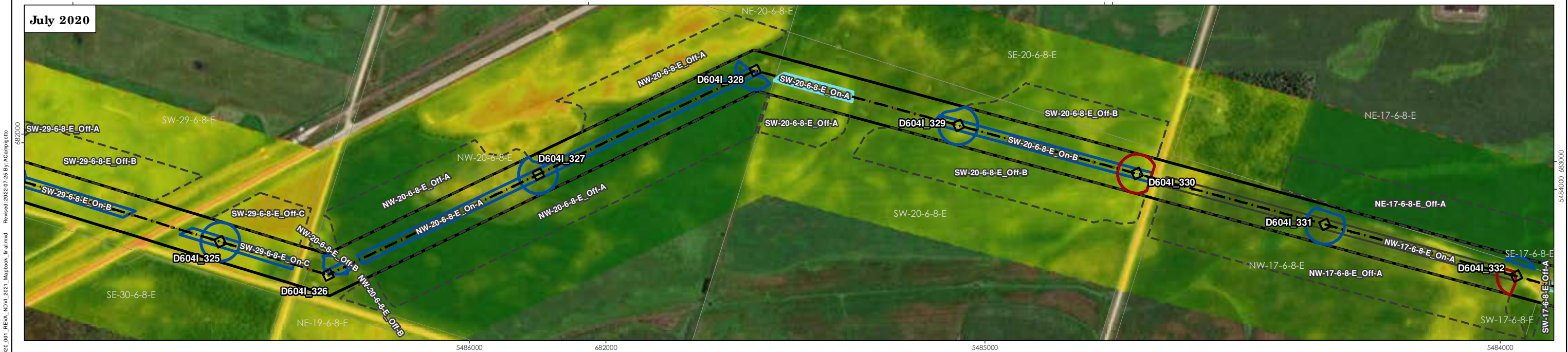
Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.
C.2-44

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021





Notes

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2. Data Sources: Data obtained from Government of Canada, Government of Manitoba, Manitoba Hydro, Stantec Consulting
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Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

— Existing Transmission Lines

□ Quarter Sections

0 125 250 metres

1:8,017 (At original document size of 11x17)



Project Location

Near Winnipeg,
Manitoba

Client/Project

Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.

C.2-46

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

111477020-001-REVA



KEY MAP

Legend

- Manitoba-Minnesota Transmission Line
- MMTP Tower
- Right-of-Way
- On RoW Farm Management Unit (On RoW FMU)
- Tower Work Area (TWA)
- Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0
Low: -1.0

Project Related Disturbance Category

- Negative Outlier, Not Project Related
- No Disturbance
- Project-Related Disturbance Persists
- Project-Related Disturbance Persists, Trending to
- Recovered

Existing Transmission Lines

Quarter Sections

Scale

0 125 250 metres

1:8,017 (At original document size of 11x17)

Stantec

Project Location
Near Winnipeg,
Manitoba

Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.
C.2-47

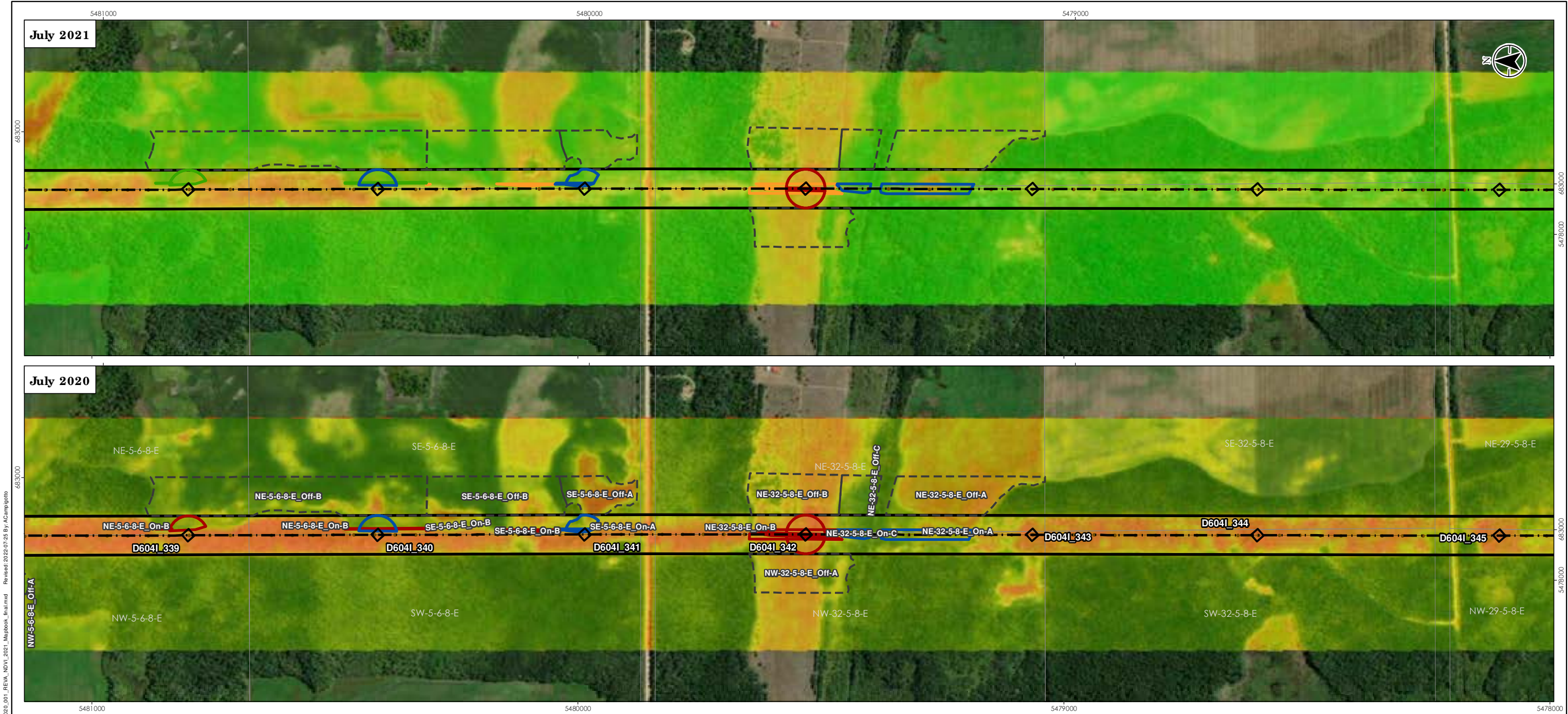
Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

111477020-001-REVA

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

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KEY MAP

Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

Existing Transmission Lines

□ Quarter Sections

0 125 250 metres

1:8,017 (At original document size of 11x17)

Stantec

Project Location
Near Winnipeg,
Manitoba

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.
C.2-48

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

Notes

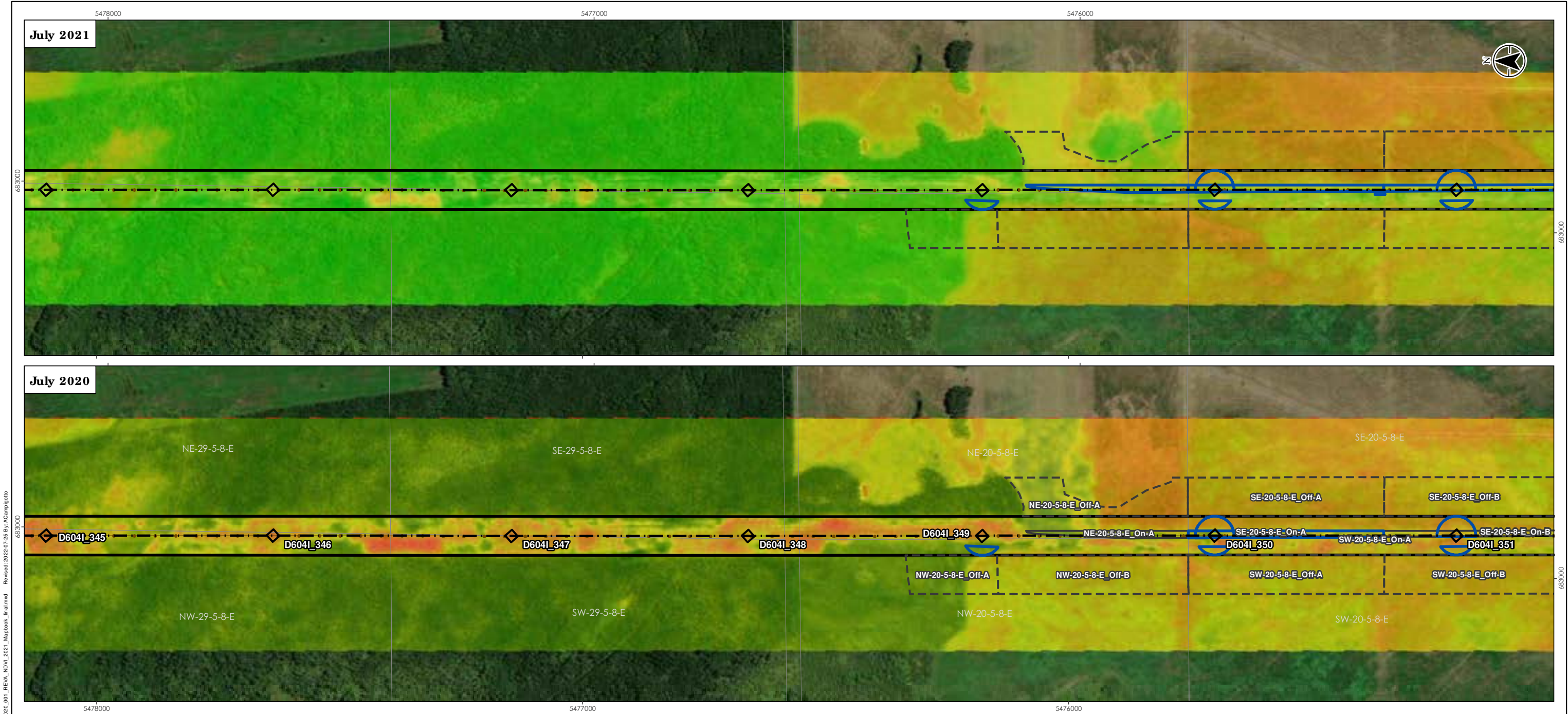
1. Coordinate System: NAD 1983 UTM Zone 14N

2. Data Sources: Data obtained from Government of Canada, Government of Manitoba, Manitoba Hydro, Stantec Consulting

3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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KEY MAP

Legend

- Manitoba-Minnesota Transmission Line
- MMTP Tower
- Right-of-Way
- On RoW Farm Management Unit (On RoW FMU)
- Tower Work Area (TWA)
- Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

- Negative Outlier, Not Project Related
- No Disturbance
- Project-Related Disturbance Persists
- Project-Related Disturbance Persists, Trending to
- Recovered

Existing Transmission Lines

Quarter Sections

Notes

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Scale

0 125 250 metres

1:8,017 (At original document size of 11x17)

Stantec

Project Location
Near Winnipeg,
Manitoba

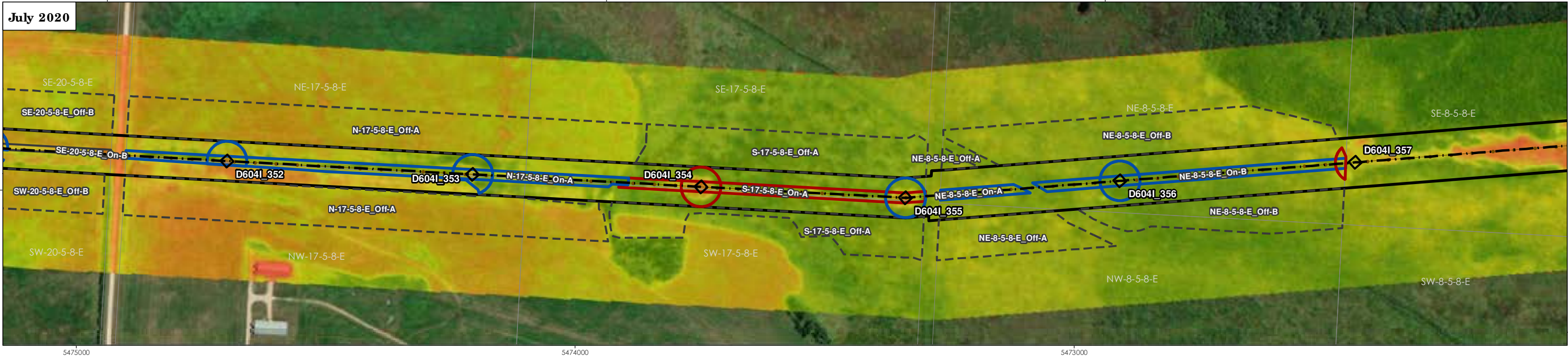
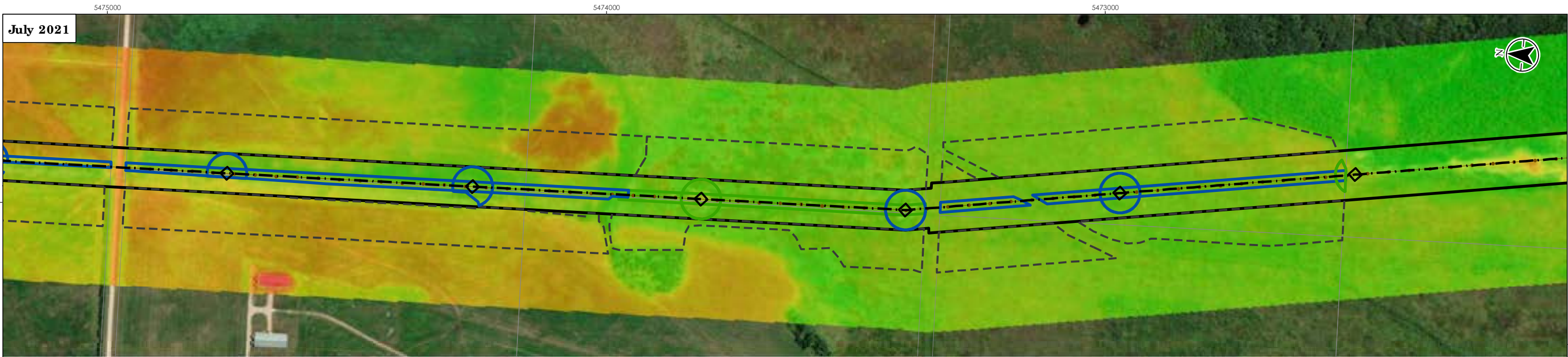
Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.
C.2-49

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

111477020-001-REVA

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021



Notes

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Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

— Existing Transmission Lines

□ Quarter Sections

0 125 250 metres

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Project Location

Near Winnipeg,
Manitoba

Client/Project

Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.

C.2-50

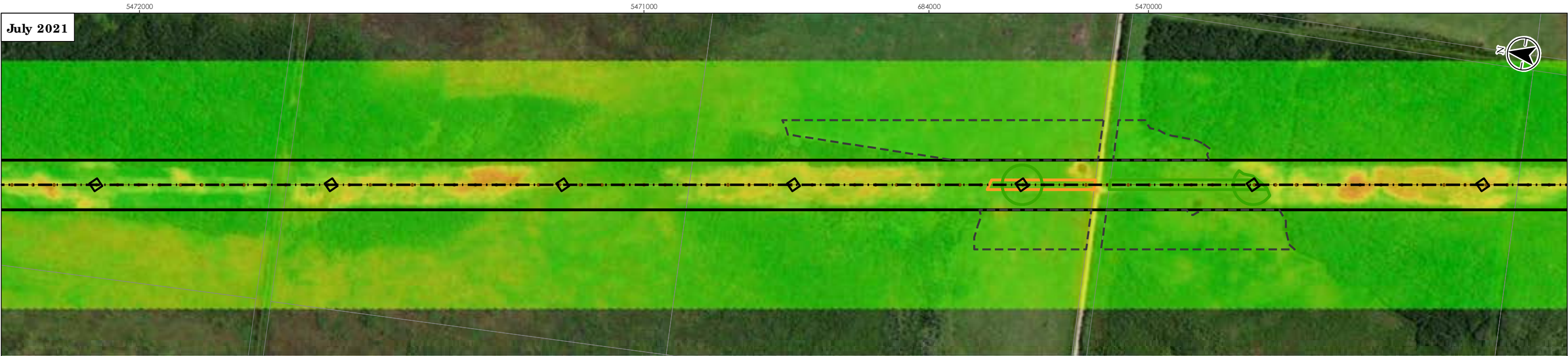
Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

111477020-001-REVA

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Legend

- Manitoba-Minnesota Transmission Line
- MMTP Tower
- Right-of-Way
- On RoW Farm Management Unit (On RoW FMU)
- Tower Work Area (TWA)
- Off RoW Comparison

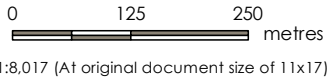
Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

- Project Related Disturbance Category
- Negative Outlier, Not Project Related
 - No Disturbance
 - Project-Related Disturbance Persists
 - Project-Related Disturbance Persists, Trending to
 - Recovered

- Existing Transmission Lines
- Quarter Sections



1:8,017 (At original document size of 11x17)



Project Location
Near Winnipeg,
Manitoba

Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.
C.2-51

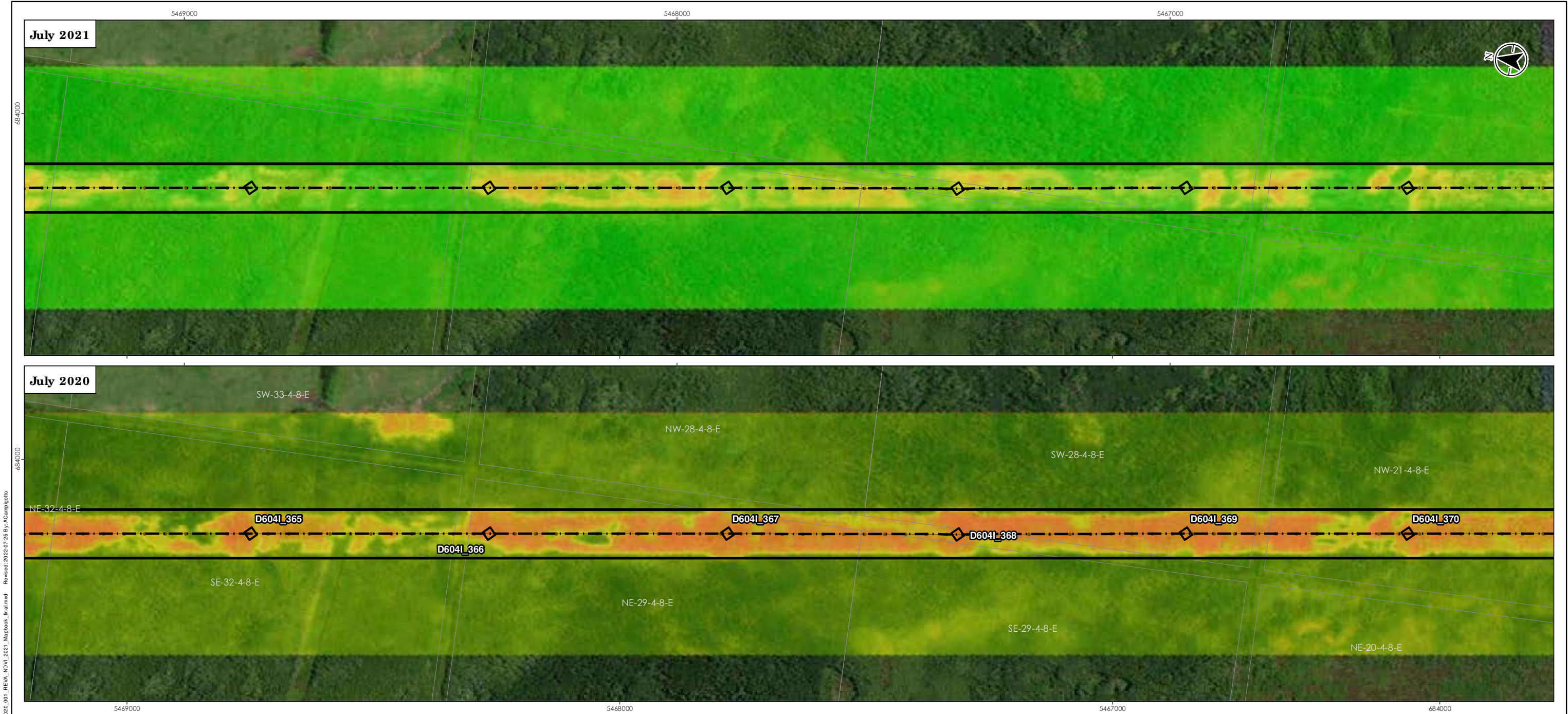
Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

111477020-001-REVA

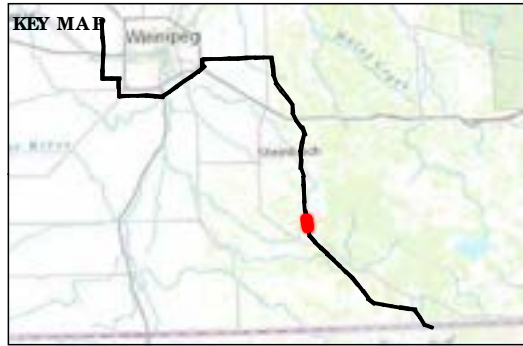
Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

G:_GIS_Project_Folder\00_Hydro\111477020_MMTP_Soil_Crop_Security_Monitoring\Figures\2021\111477020_001_REVA_NDVI_2021_Mapbook_1.mxd Revised: 2022-07-25 By: ACampitello

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Notes

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Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

Evaluation

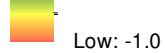
□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0



Low: -1.0

Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

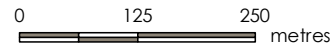
□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

— Existing Transmission Lines

□ Quarter Sections



1:8,017 (At original document size of 11x17)



Project Location

Near Winnipeg,
Manitoba

Prepared by JH on 2022-07-25

TR by DW on 2022-07-25

IR Review by GK on 2022-07-25

Client/Project

Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

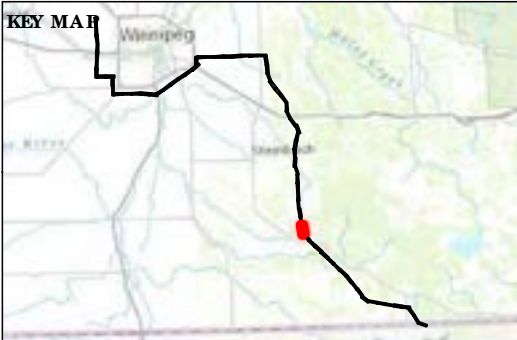
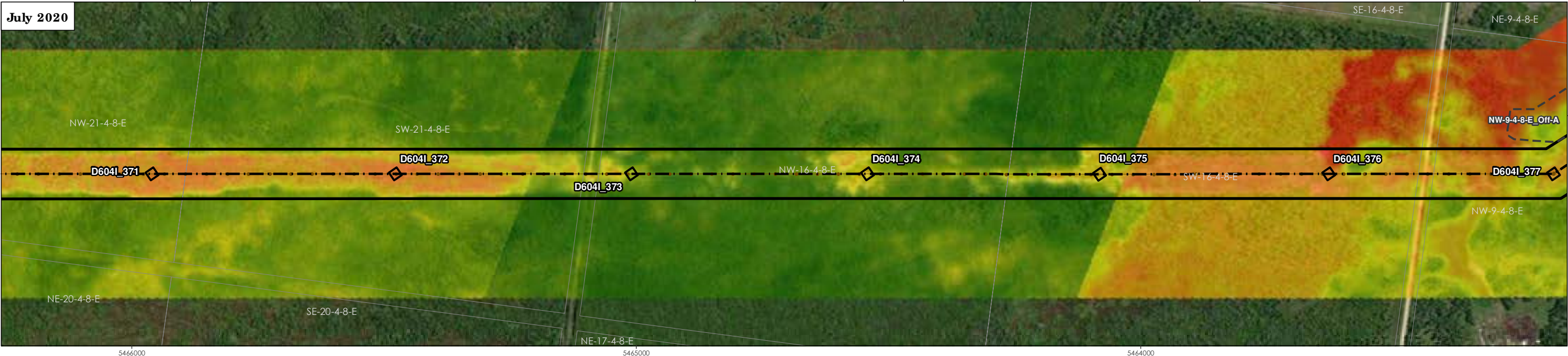
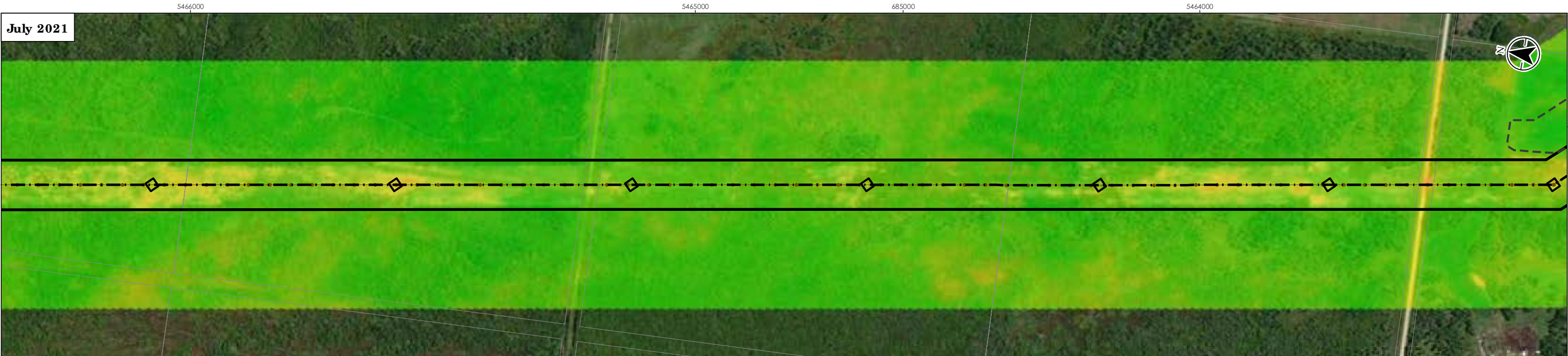
111477020-001-REVA

Map No.

C.2-52

**Normalized Difference Vegetation Index
(NDVI) - July 2020 & July 2021**

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Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

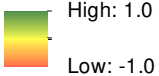
Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

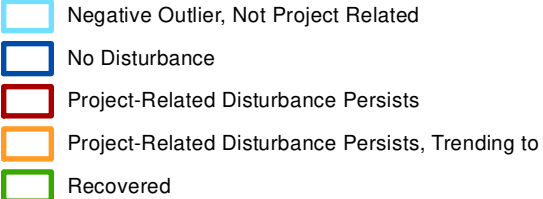
○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

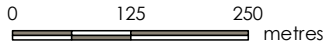


Project Related Disturbance Category



--- Existing Transmission Lines

□ Quarter Sections



1:8,017 (At original document size of 11x17)



Project Location
Near Winnipeg,
Manitoba

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

111477020-001-REVA

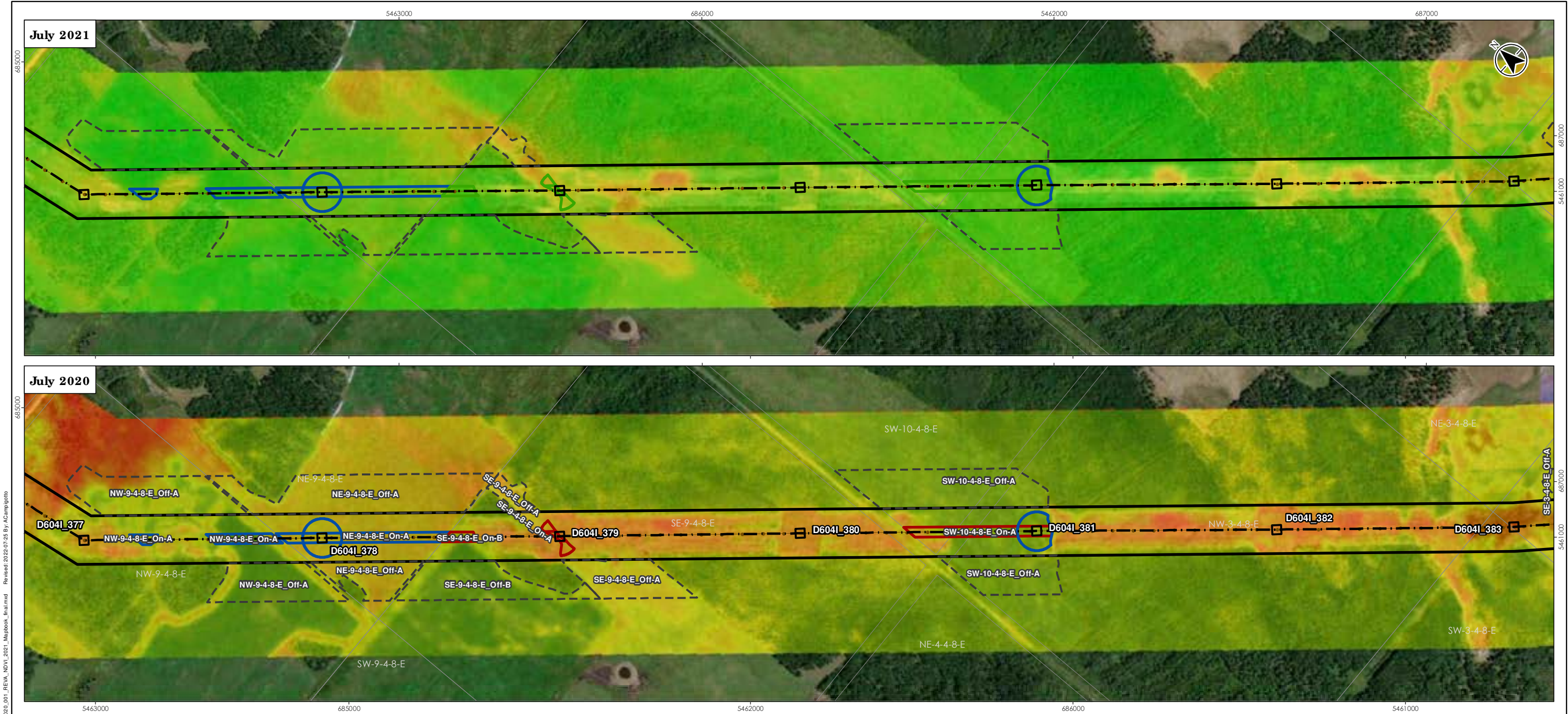
Map No.

C.2-53

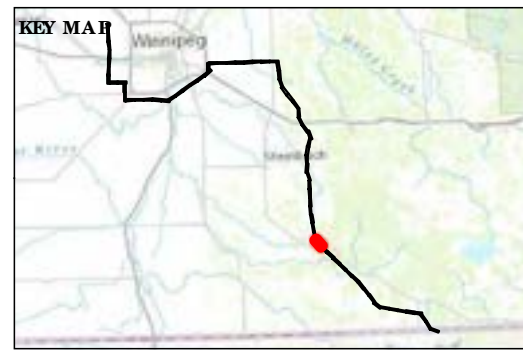
Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

G:_GIS_Project_Folder\00_Hydro\111477020_MMTP_Soil_Crop_Biosecurity_Monitoring\Figures\2021\111477020_001_REVA_NDVI_2021_Mapbook_in.a.mxd Revised: 2022-07-25 By: ACampigotto

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G:_GIS_Project_Folder\00_Hydro\111477020_MMTP_Soil_Crop_Biosecurity_Monitoring\Figures\2021\111477020_001_REVA_NDVI_2021_Mapbook_Infra.mxd
Revised: 2022-07-25 By: ACampigotto



Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Data obtained from Government of Canada, Government of Manitoba, Manitoba Hydro, Stantec Consulting
3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

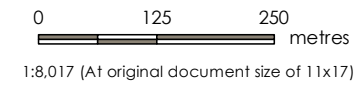
Legend

- Manitoba-Minnesota Transmission Line
- ◇ MMTP Tower
- Right-of-Way
- Evaluation
 - On RoW Farm Management Unit (On RoW FMU)
 - Tower Work Area (TWA)
 - Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)
High: 1.0
Low: -1.0

- Project Related Disturbance Category
- Negative Outlier, Not Project Related
 - No Disturbance
 - Project-Related Disturbance Persists
 - Project-Related Disturbance Persists, Trending to
 - Recovered

- Existing Transmission Lines
- Quarter Sections



Project Location
Near Winnipeg,
Manitoba

Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

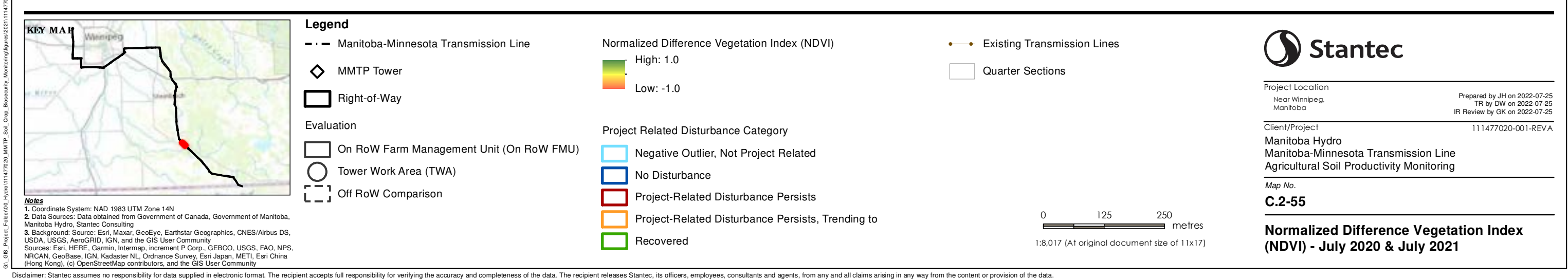
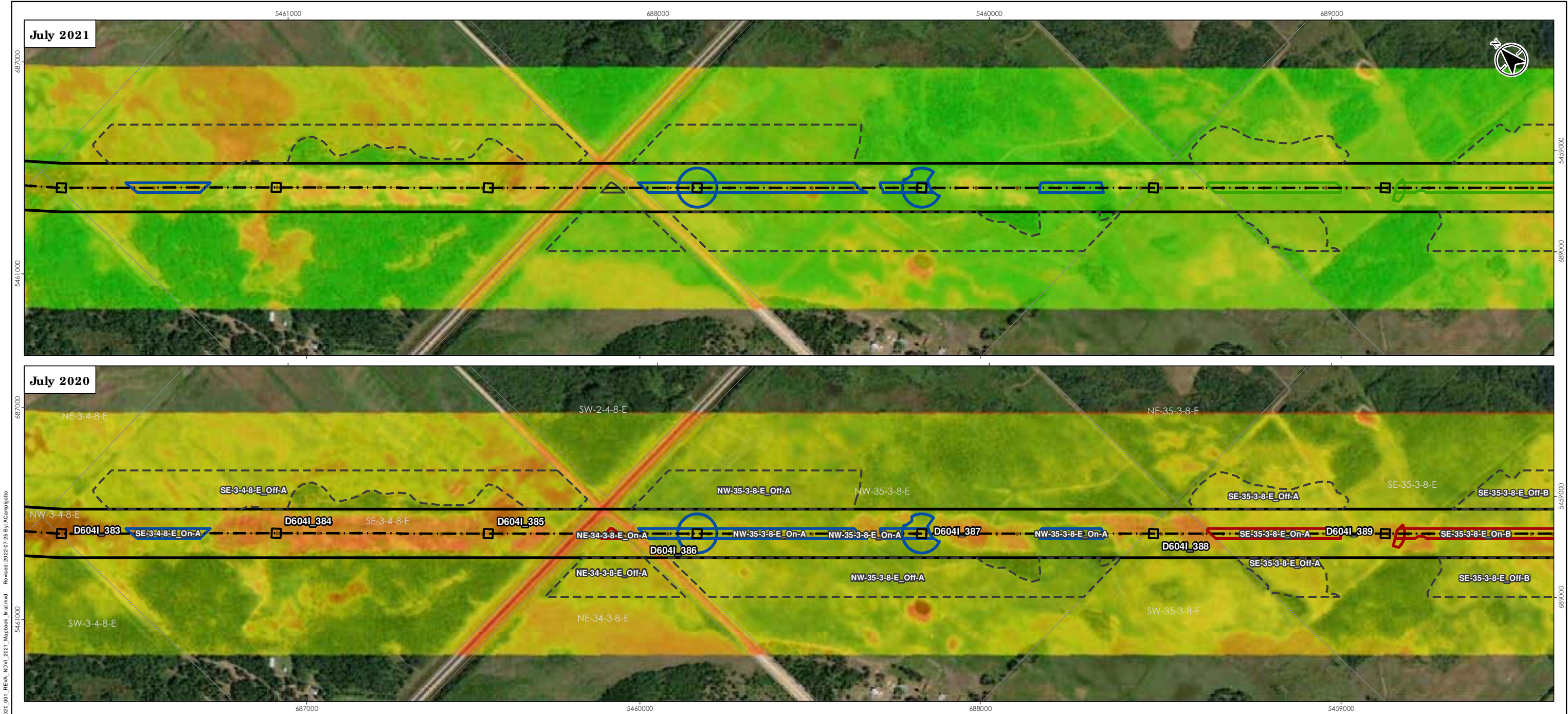
Map No.
C.2-54

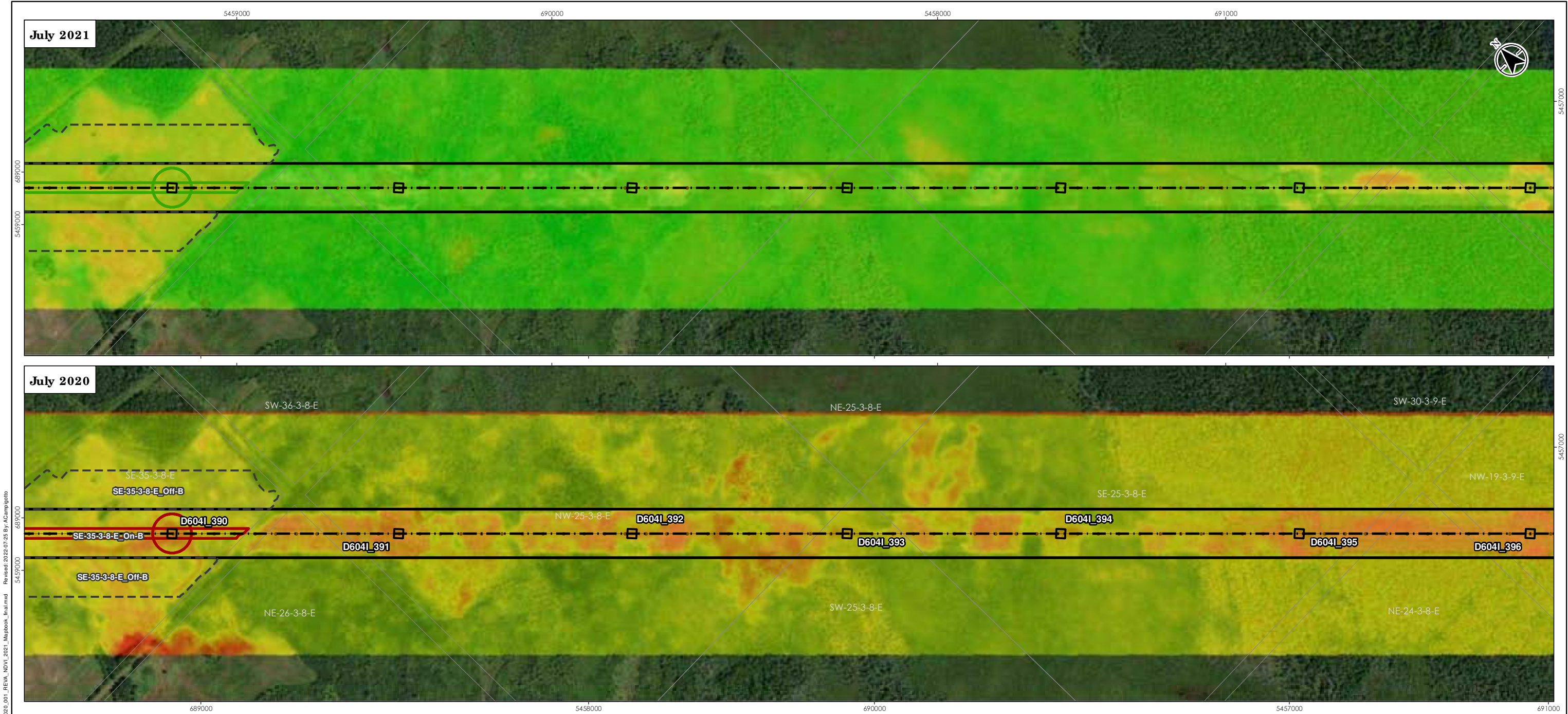
Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

111477020-001-REVA

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

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KEY MAP

Legend

- Manitoba-Minnesota Transmission Line
- MMTP Tower
- Right-of-Way
- On RoW Farm Management Unit (On RoW FMU)
- Tower Work Area (TWA)
- Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0
Low: -1.0

Project Related Disturbance Category

- Negative Outlier, Not Project Related
- No Disturbance
- Project-Related Disturbance Persists
- Project-Related Disturbance Persists, Trending to
- Recovered

Existing Transmission Lines

Quarter Sections

0 125 250 metres

1:8,017 (At original document size of 11x17)

Stantec

Project Location
Near Winnipeg,
Manitoba

Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.
C.2-56

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

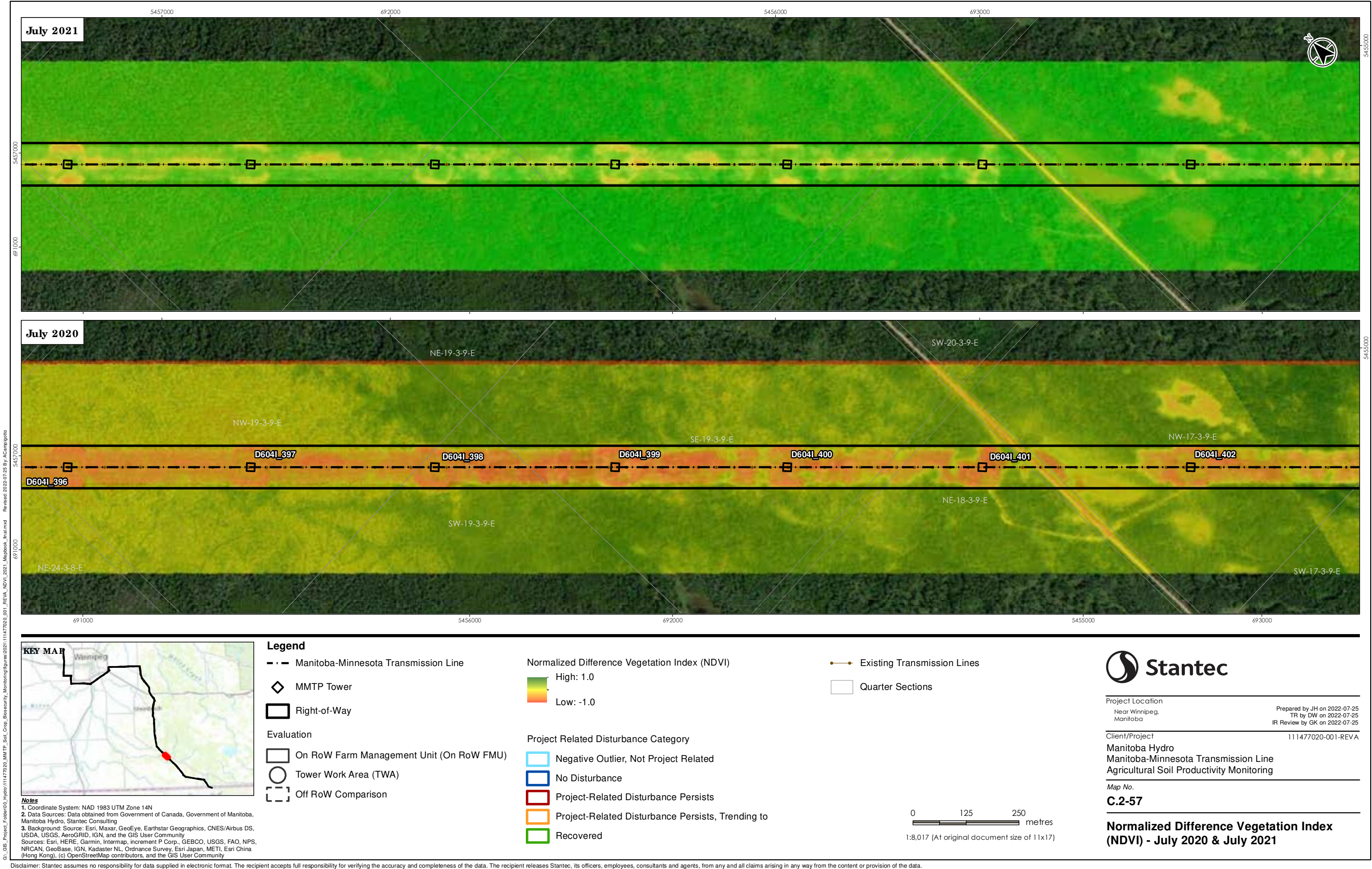
111477020-001-REVA

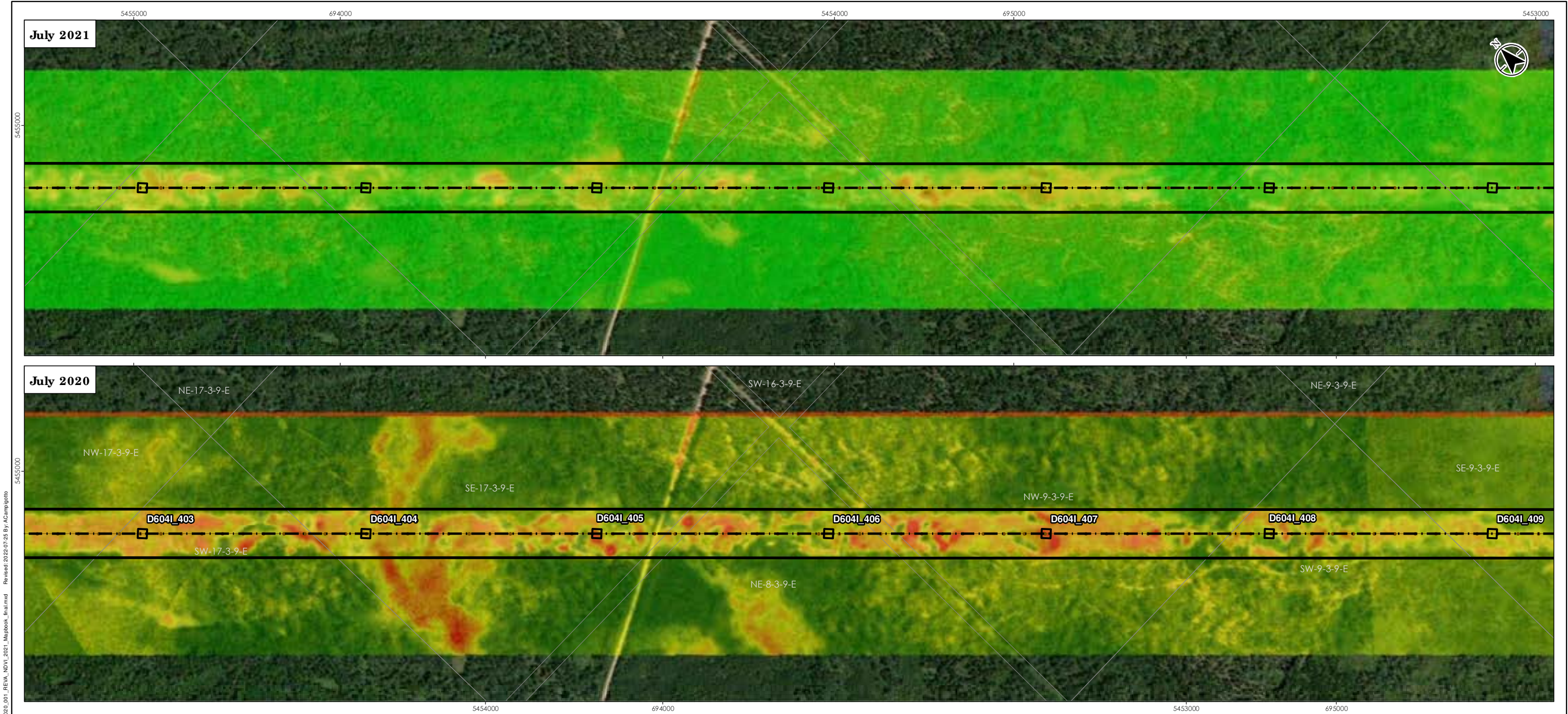
Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

Notes

- Coordinate System: NAD 1983 UTM Zone 14N
- Data Sources: Data obtained from Government of Canada, Government of Manitoba, Manitoba Hydro, Stantec Consulting
- Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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KEY MAP

Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

Existing Transmission Lines

Quarter Sections

0 125 250 metres

1:8,017 (At original document size of 11x17)

Stantec

Project Location
Near Winnipeg,
Manitoba

Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.
C.2-58

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

111477020-001-REVA

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

Notes

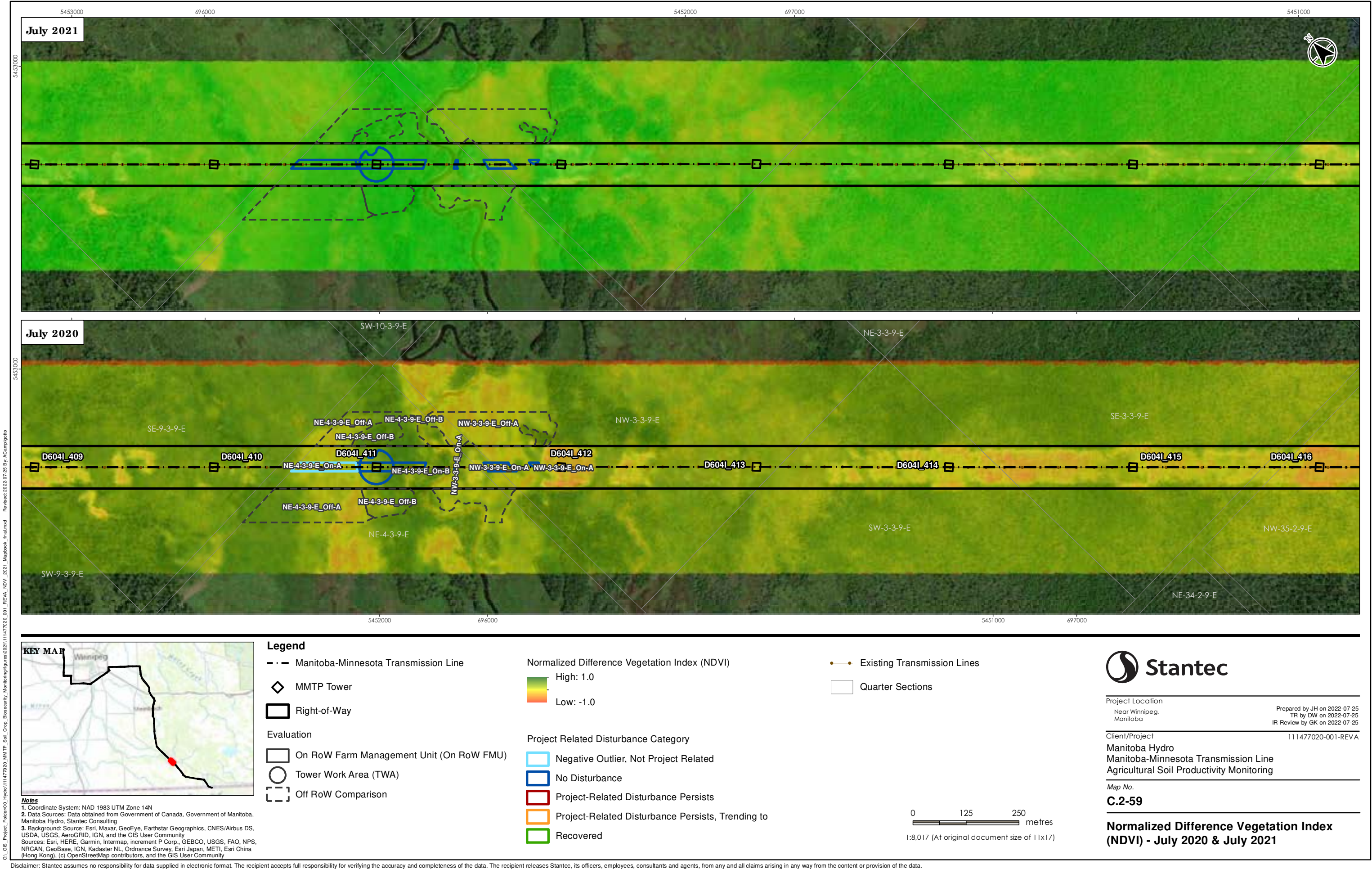
1. Coordinate System: NAD 1983 UTM Zone 14N

2. Data Sources: Data obtained from Government of Canada, Government of Manitoba, Manitoba Hydro, Stantec Consulting

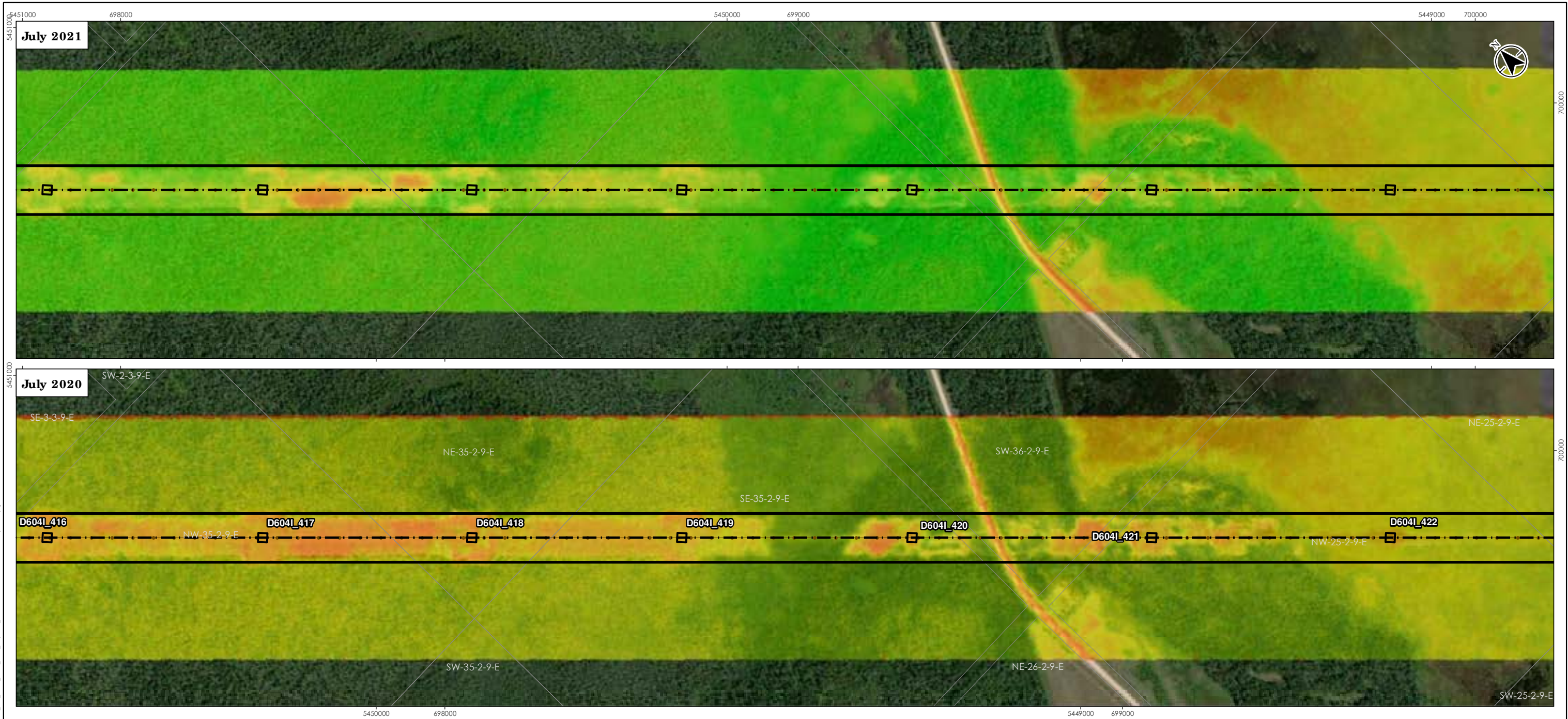
3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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Revised: 2022-07-25 By: ACampigotto



Notes

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2. Data Sources: Data obtained from Government of Canada, Government of Manitoba, Manitoba Hydro, Stantec Consulting

3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

— Existing Transmission Lines

□ Quarter Sections

0 125 250 metres

1:8,017 (At original document size of 11x17)



Project Location

Near Winnipeg,
Manitoba

Prepared by JH on 2022-07-25

TR by DW on 2022-07-25

IR Review by GK on 2022-07-25

Client/Project

Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

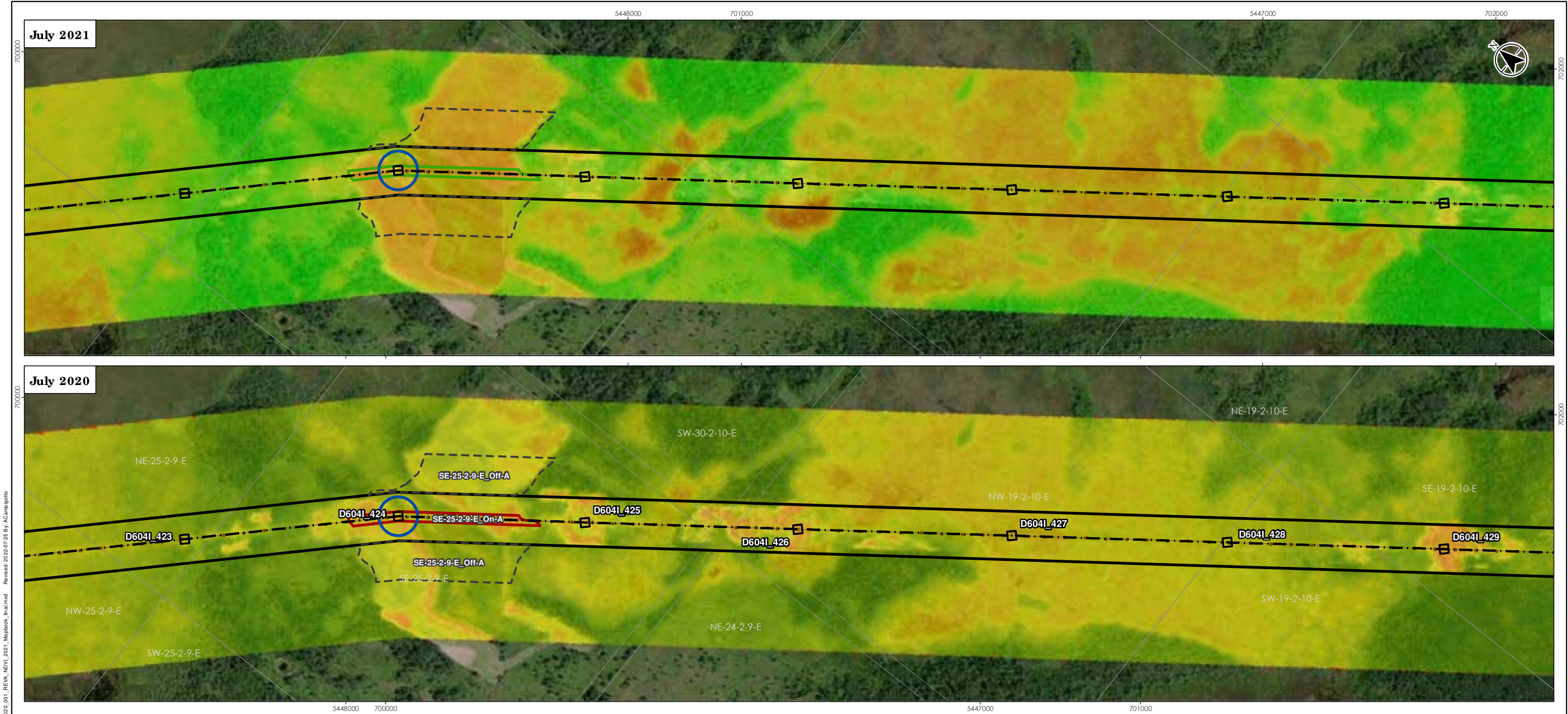
111477020-001-REVA

Map No.

C.2-60

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

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KEY MAP

Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

Existing Transmission Lines

□ Quarter Sections

0 125 250 metres

1:8,017 (At original document size of 11x17)

Stantec

Project Location
Near Winnipeg,
Manitoba

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.
C.2-61

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

Notes

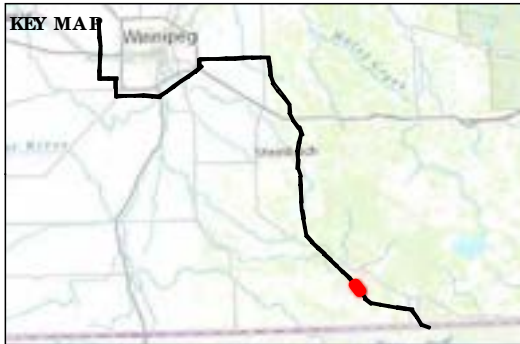
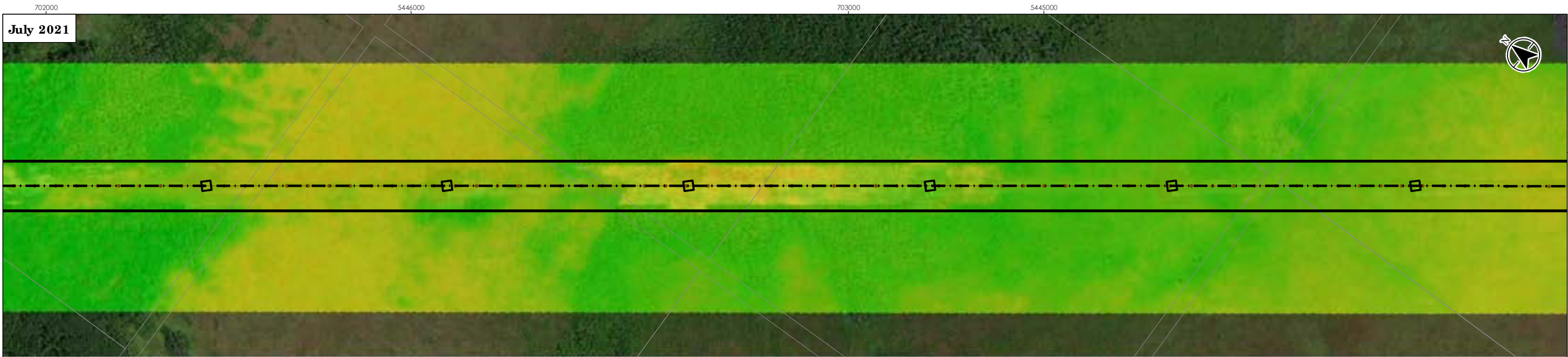
1. Coordinate System: NAD 1983 UTM Zone 14N

2. Data Sources: Data obtained from Government of Canada, Government of Manitoba, Manitoba Hydro, Stantec Consulting

3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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Notes

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Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

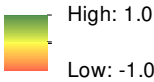
Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)



Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

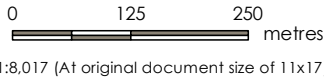
□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

— Existing Transmission Lines

□ Quarter Sections



Project Location

Near Winnipeg,
Manitoba

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

Client/Project

Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

111477020-001-REVA

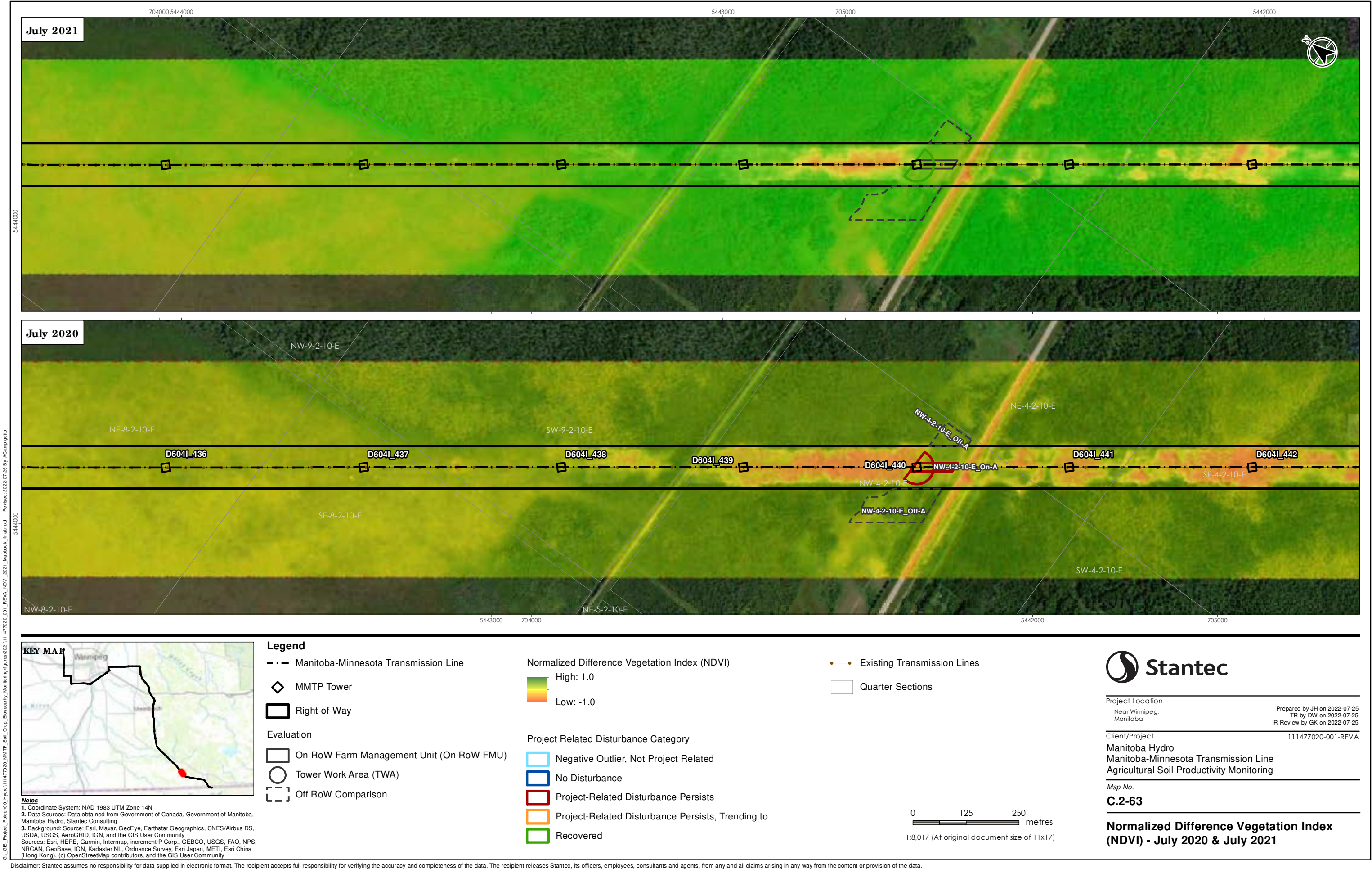
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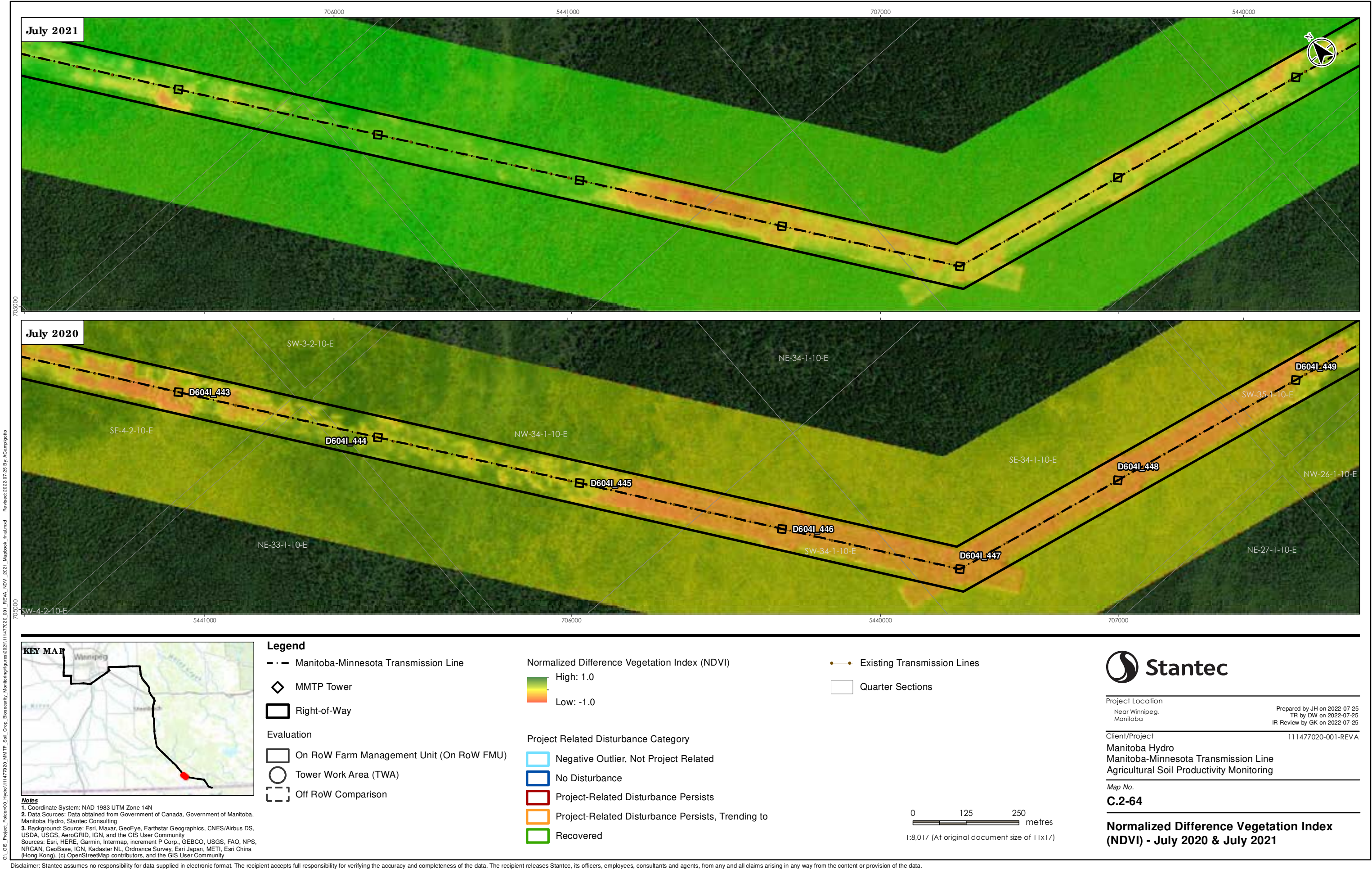
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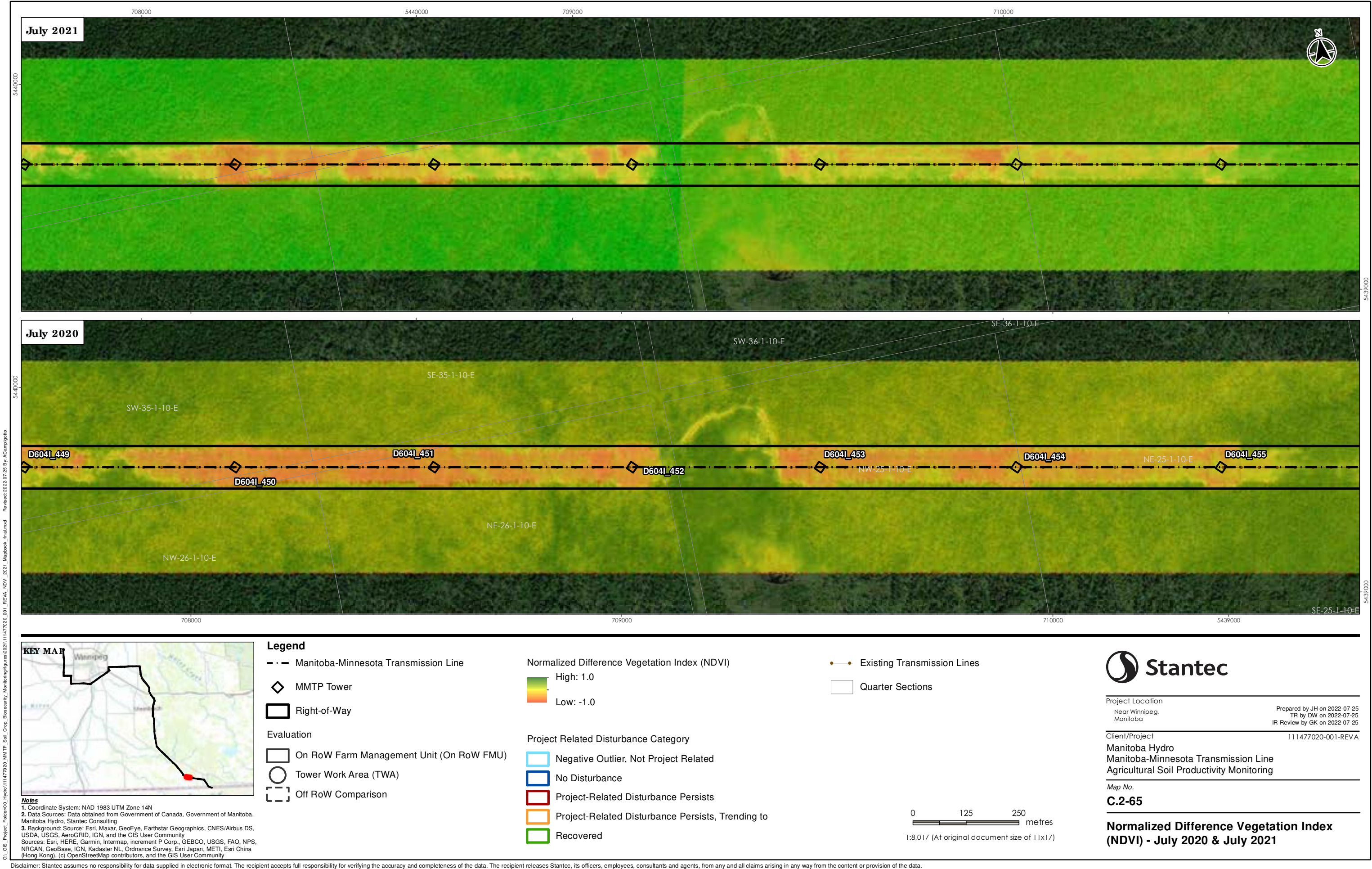
**Normalized Difference Vegetation Index
(NDVI) - July 2020 & July 2021**

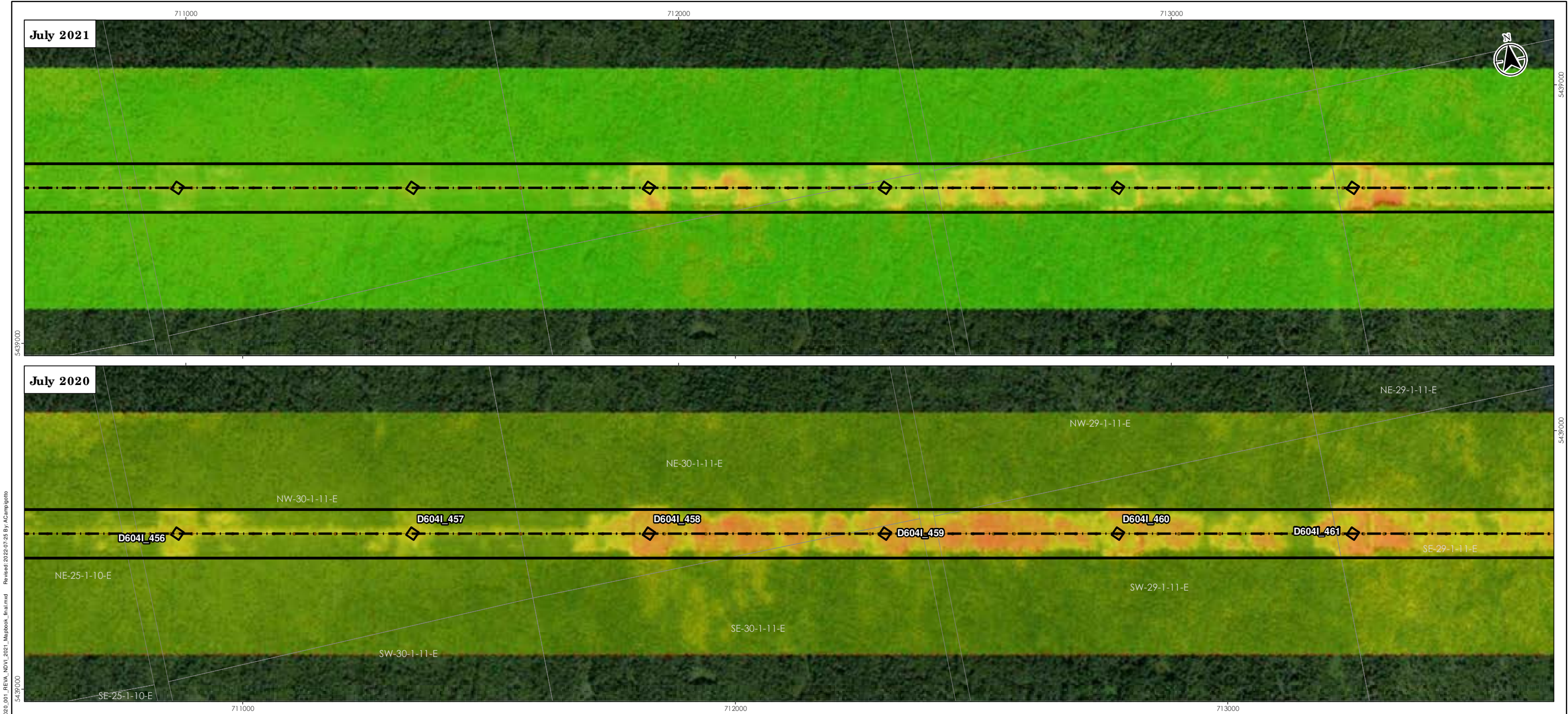
G:_GIS_Project_Folder\00_Hydro\111477020_MMTP_Soil_Crop_Biosecurity_Monitoring\Figures\2021\111477020_001_REVA_NDVI_2021_Mapbook_Infra.mxd Revised: 2022-07-25 By: ACampigotto

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KEY MAP

Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

Existing Transmission Lines

Quarter Sections

0 125 250 metres

1:8,017 (At original document size of 11x17)

Stantec

Project Location
Near Winnipeg,
Manitoba

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.
C.2-66

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

Notes

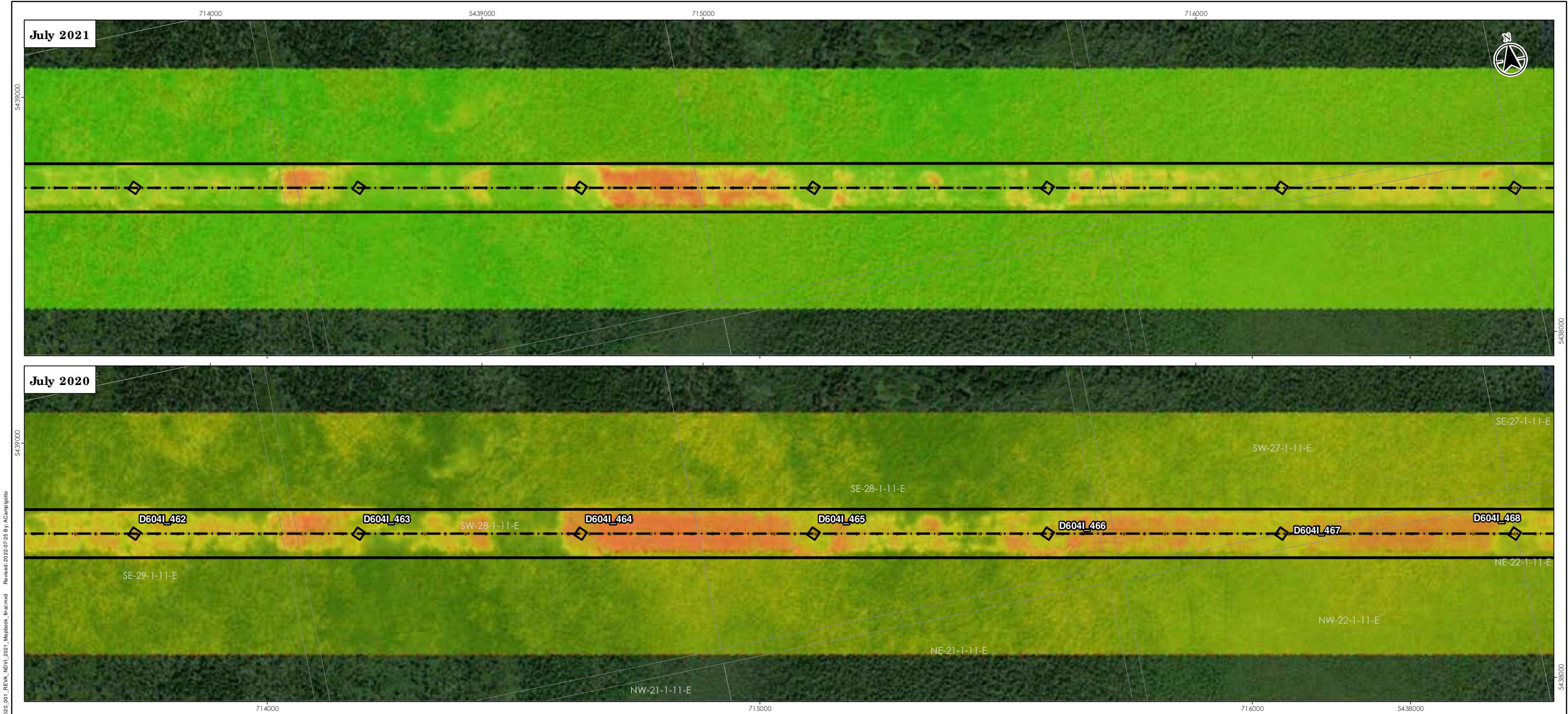
1. Coordinate System: NAD 1983 UTM Zone 14N

2. Data Sources: Data obtained from Government of Canada, Government of Manitoba, Manitoba Hydro, Stantec Consulting

3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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KEY MAP

Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

Stantec

Project Location
Near Winnipeg,
Manitoba

Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.
C.2-67

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

111477020-001-REVA

Notes

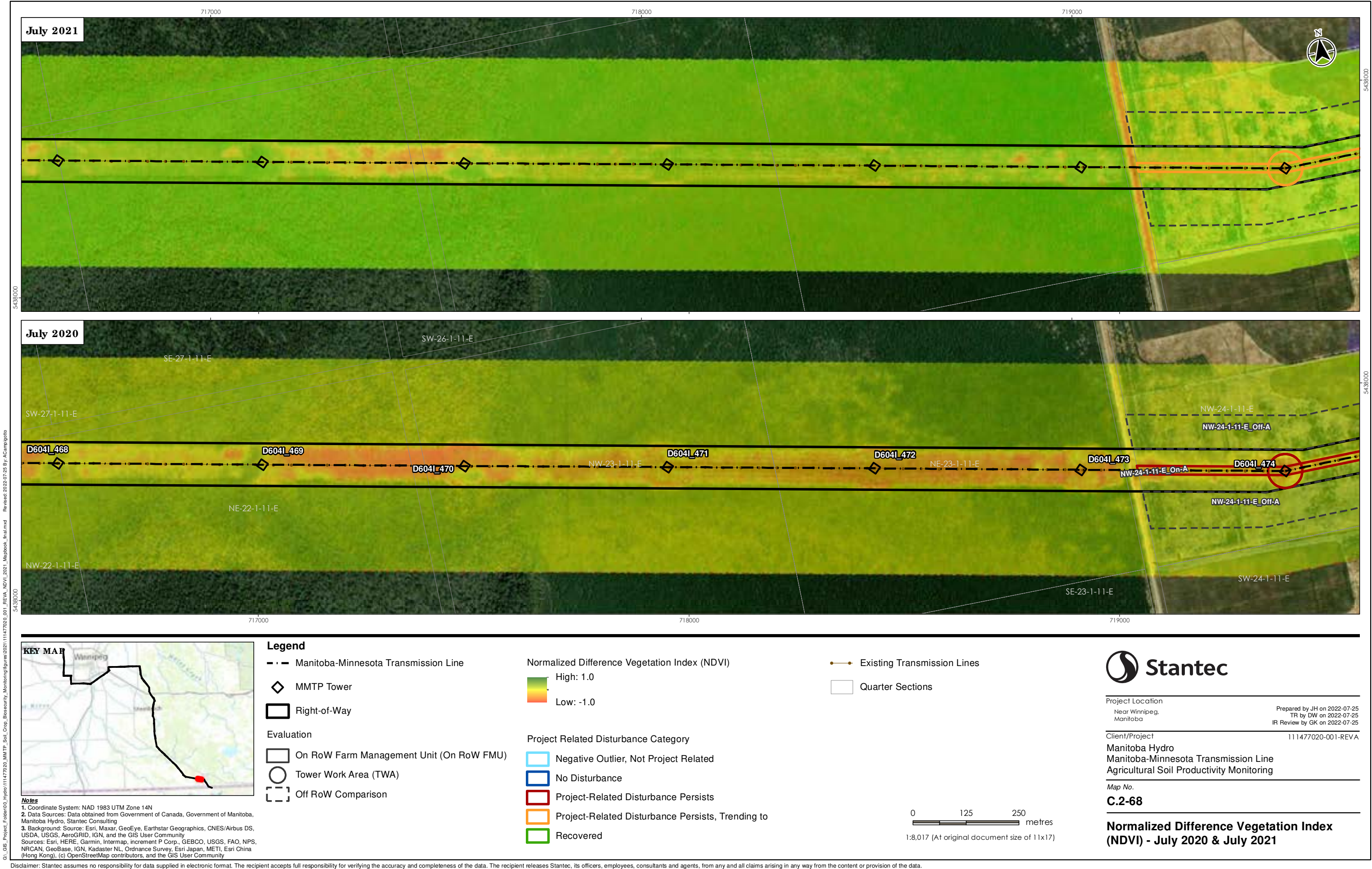
1. Coordinate System: NAD 1983 UTM Zone 14N

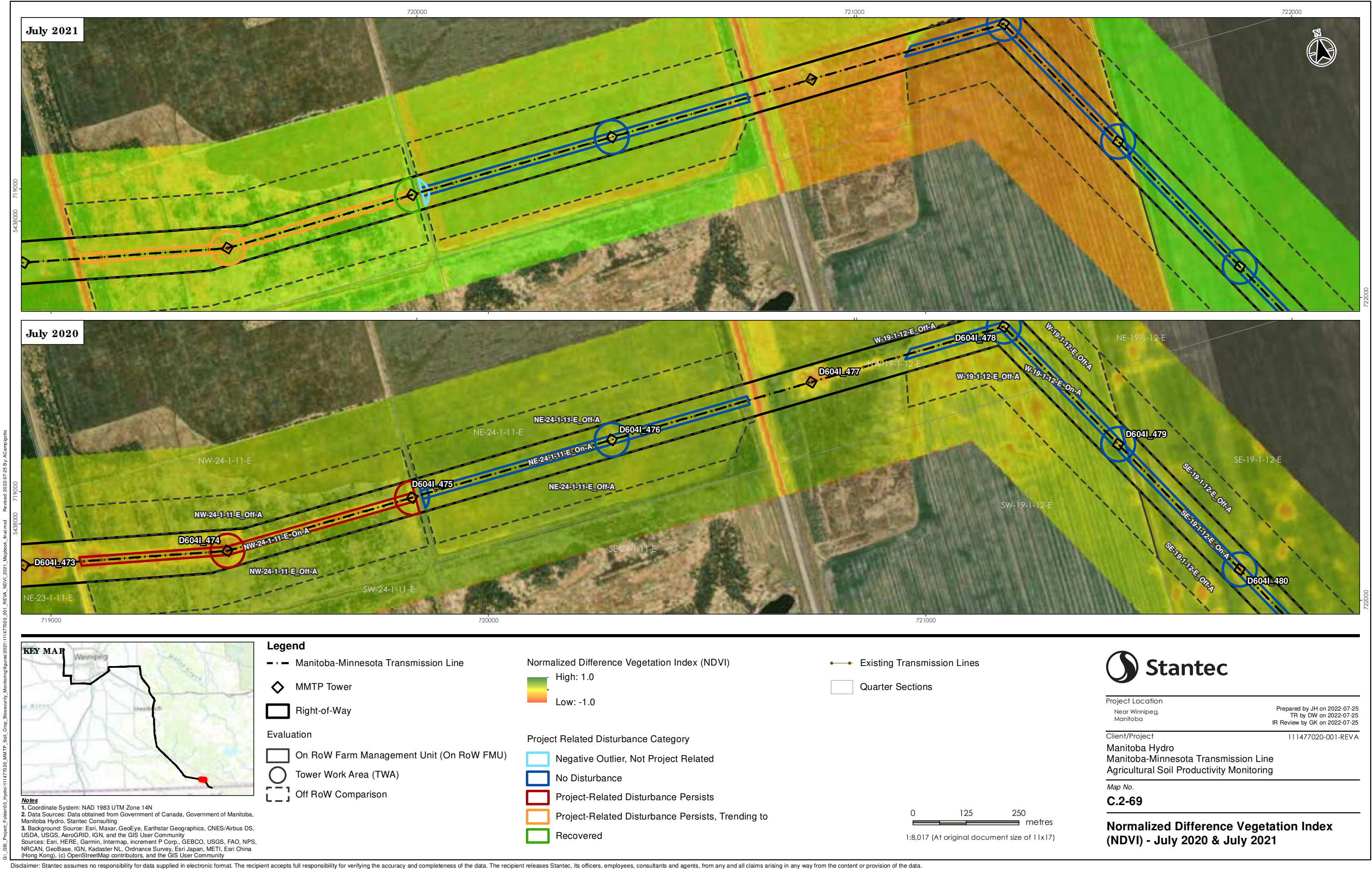
2. Data Sources: Data obtained from Government of Canada, Government of Manitoba, Manitoba Hydro, Stantec Consulting

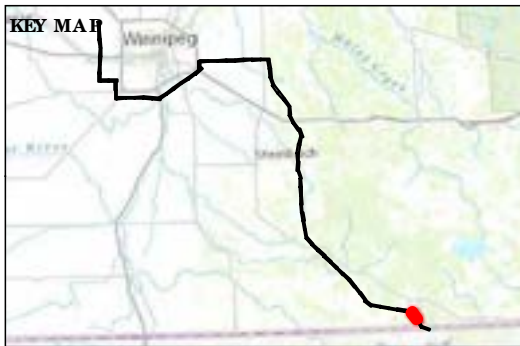
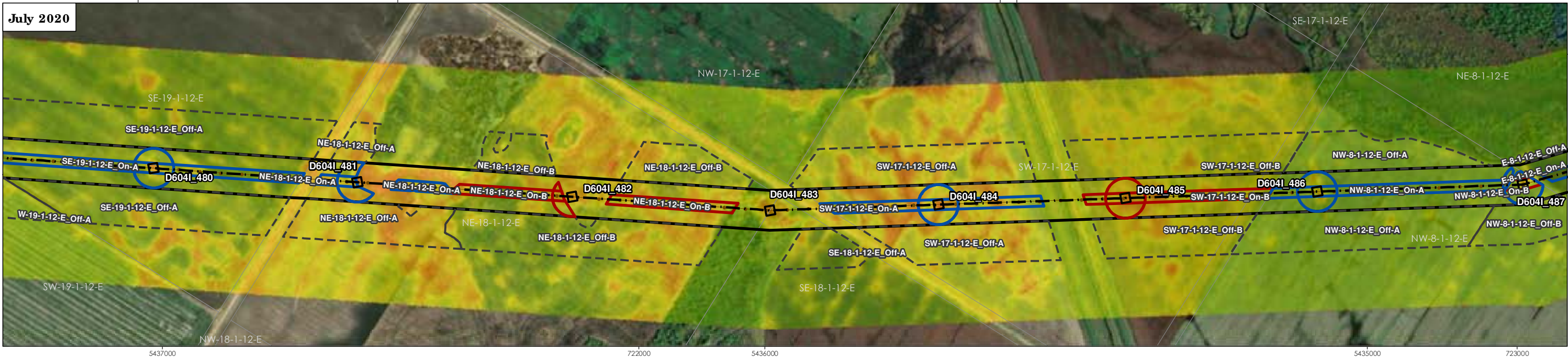
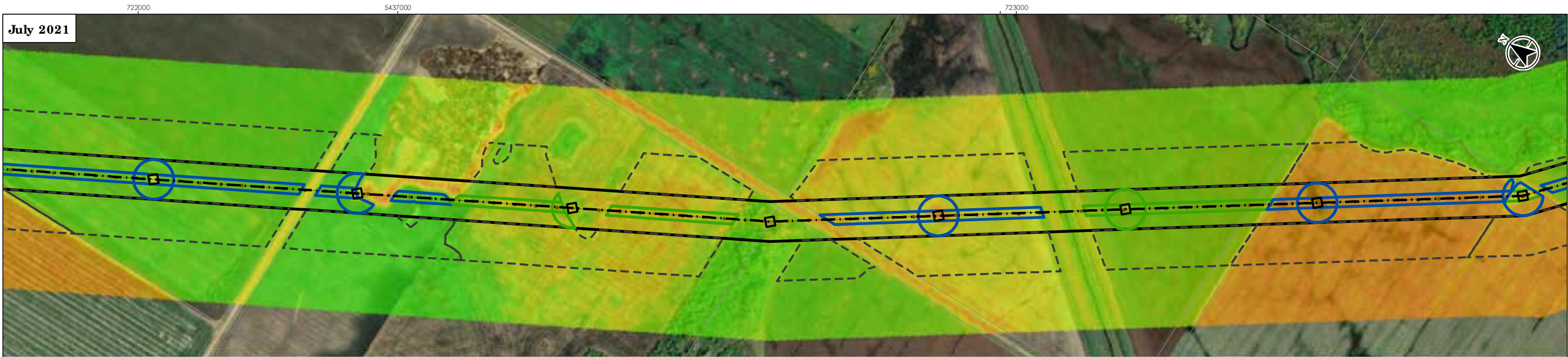
3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Notes

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3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

— Existing Transmission Lines

□ Quarter Sections

0 125 250 metres

1:8,017 (At original document size of 11x17)



Project Location

Near Winnipeg,
Manitoba

Client/Project

Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

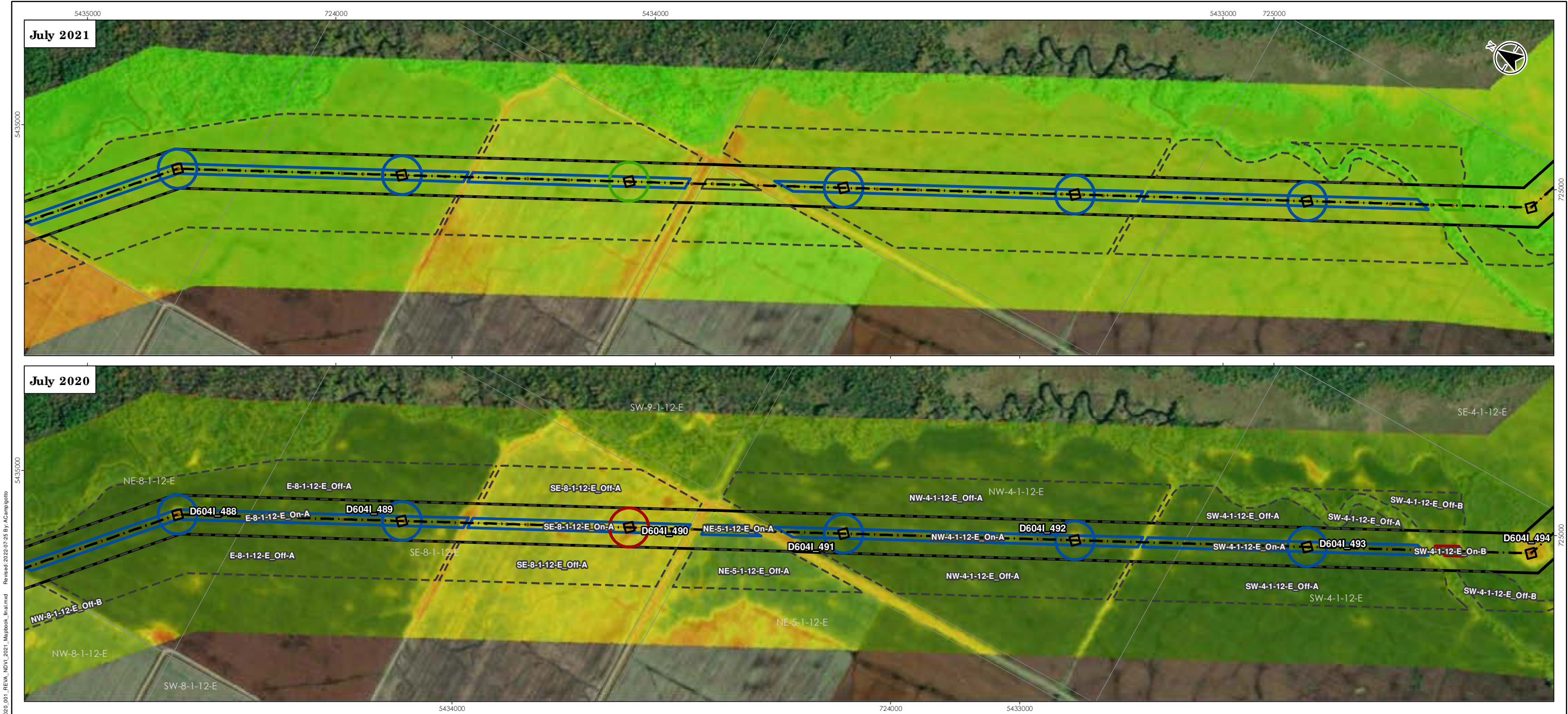
Map No.

C.2-70

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

111477020-001-REVA



KEY MAP

Legend

--- Manitoba-Minnesota Transmission Line

◇ MMTP Tower

□ Right-of-Way

Evaluation

□ On RoW Farm Management Unit (On RoW FMU)

○ Tower Work Area (TWA)

□ Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

High: 1.0

Low: -1.0

Project Related Disturbance Category

□ Negative Outlier, Not Project Related

□ No Disturbance

□ Project-Related Disturbance Persists

□ Project-Related Disturbance Persists, Trending to

□ Recovered

Existing Transmission Lines

Quarter Sections

0 125 250 metres

1:8,017 (At original document size of 11x17)

Stantec

Project Location
Near Winnipeg,
Manitoba

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

Client/Project
Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.
C.2-71

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N

2. Data Sources: Data obtained from Government of Canada, Government of Manitoba, Manitoba Hydro, Stantec Consulting

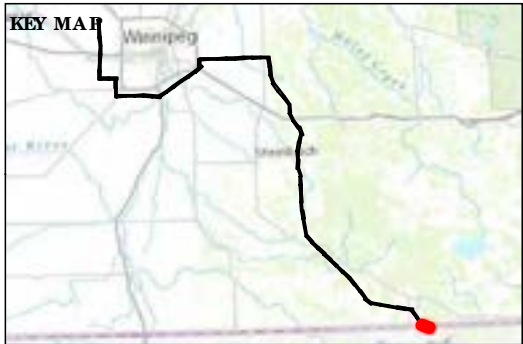
3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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G:_GIS_Project_Folder\00_Hydro\111477020_MMTP_Soil_Crop_Biosecurity_Monitoring\Figures\2021\111477020_001_REVA_NDVI_2021_Mapbook_Infra.mxd Revised: 2022-07-25 By: ACampigotto

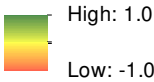


Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources: Data obtained from Government of Canada, Government of Manitoba, Manitoba Hydro, Stantec Consulting
3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Legend

- Manitoba-Minnesota Transmission Line
- MMTP Tower
- Right-of-Way
- On RoW Farm Management Unit (On RoW FMU)
- Tower Work Area (TWA)
- Off RoW Comparison

Normalized Difference Vegetation Index (NDVI)

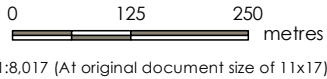


Project Related Disturbance Category

- Negative Outlier, Not Project Related
- No Disturbance
- Project-Related Disturbance Persists
- Project-Related Disturbance Persists, Trending to
- Recovered

Existing Transmission Lines

- Quarter Sections



Project Location
Near Winnipeg,
Manitoba

Prepared by JH on 2022-07-25
TR by DW on 2022-07-25
IR Review by GK on 2022-07-25

Client/Project 111477020-001-REVA

Manitoba Hydro
Manitoba-Minnesota Transmission Line
Agricultural Soil Productivity Monitoring

Map No.

C.2-72

Normalized Difference Vegetation Index (NDVI) - July 2020 & July 2021

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