TETRA TECH

May 31, 2021

FINAL
FILE: 704-ENW.EENW03031-12

Public Services & Procurement Canada
635 - 8th Avenue SW, Suite 1650
Calgary, AB T2P 3M3

Via Email: claudia.simonato@pwgsc-tpsgc.gc.ca

Attention: Claudia Simonato, Senior Environmental Specialist

Subject: Weed Control Plan for Fort Reliance Former Weather Station

1.0 PROJECT DESCRIPTION

Tetra Tech Canada Inc. (Tetra Tech) was retained by Public Services and Procurement Canada (PSPC) on behalf of Environment and Climate Change Canada (ECCC) to identify and plan the required approach for weed control activities at the former weather station located at Fort Reliance, Northwest Territories (NT; 'the Site') located approximately 270 km east of Yellowknife on the eastern end of Great Slave Lake, within the Thaidene Nene National Park Reserve (Figure 1). The Site's Federal Contaminated Sites Inventory identification number is 00002376 and the Directory of Federal Real Property identification number is 20920. The Site is currently held by ECCC.

Following remediation of the Fort Reliance site in the summer of 2019, a site monitoring program was developed for future implementation to monitor the status of remaining contamination, geotechnical stability of the areas that were disturbed, and reclamation of the site. During the first monitoring event in the summer of 2020, six invasive weed species were identified to have taken hold in various disturbed areas: Lamb`s Quarters (*Chenopodium album*), White Sweetclover (*Melilotus albus*), Common Plantain (*Plantago major*), Common Dandelion (*Taraxacum officinale*), Horseweed (*Conyza canadensis*), and Worm-seed Wallflower (*Erysimum cheiranthoides*). The site was free of invasive species prior to remediation work. The six invasive species likely came to site through vegetative structures such as seeds or roots found on equipment and/or personnel. Construction/disturbance provided a vector for the establishment of invasive species.

Invasive alien plant species are those that have been introduced into areas beyond their natural range and are capable of causing significant harm to the environment, economy, or society (GNWT and NWT Biodiversity Team 2010). Generally, the NT has fewer documented occurrences of invasive species despite its size compared to the rest of Canada. The NT does not have legislation pertaining specifically to weed control. Invasive species are likely to cause economic and environmental damage and should be controlled and/or prevented from dispersing. Increasing development, disturbance, and climate change may promote conditions favourable for the establishment of invasive species.

Invasive plants have the ability to aggressively establish and quickly spread in new environments, altering natural habitats, displacing native species, and reducing habitat effectiveness for wildlife. Once native species are displaced, conditions become favorable for the establishment of other invasive species, further compounding the issue. Invasive species can degrade riparian areas, destabilize slopes, increase fire hazards, reduce sightlines, and damage infrastructure.

Tetra Tech Canada Inc.
14940 - 123 Avenue
Edmonton, AB T5V 1B4 CANADA
Tel 780.451.2121 Fax 780.454.5688

2.0 OBJECTIVES

The general reclamation goals of the Site are to:

- Prevent the establishment of invasive species;
- Minimize the adverse effects of the Project on the environment;
- Establish conditions that lead to acceptable long-term physical stability of the reclaimed areas;
- Establish conditions that are appropriate for the surrounding environment and identified end land uses; and
- Return the affected areas to technically viable and, where practicable, self-sustaining ecosystems that are compatible with a healthy environment and with human activities.

This Weed Control Plan (WCP) is slightly different than a typical WCP because the main objective is to eradicate invasive species brought to site. Typical WCPs are designed to prevent and limit the spread of invasive species during a disturbance event (i.e., construction). In this scenario, there are no future disturbances expected to exacerbate the issue. The objectives of the WCP are to:

- Identify best management practices for identification, control, and destruction (within reason) of current populations of invasive species and prevent the spread and degradation of the site and surrounding area.
- Manage infestation levels so that the project does not result in an increase relative to local and regional background levels.
- Consult and collaborate with the Management board of the THAÍDËNE NENE XÁ DÁ YÁŁTI (TNNPR) to determine appropriate control measures.
- Protect public health, environmental resources, and ecologically sensitive areas.
- Prevent the establishment of new invasive species that could occur during weed control events.
- Provide guidance on monitoring after control measures occur, and adaptive management strategies in case the first treatment event is not completely successful.
- Identify appropriate treatment methods for each observed species along with any permit requirements.

There are no specific guidelines for vegetation monitoring or assessment, however, the site should be on a trajectory towards reclamation with native species. Over time, bare ground that was disturbed should be infilled with native species similar to those found in adjacent vegetation communities.

3.0 BACKGROUND AND WEED LOCATIONS

Vegetation monitoring was conducted at the Site between August 10 and 14, 2020. Ten permanent vegetation plots were established in areas disturbed by remediation work (Figure 2). A total of 52 species were observed between the plots and general site. Of the 52 species, six are considered invasive plant species (Table 1), two of which are not listed in the NWT Species 2016-2020 – General Status Ranks of Wild Species in the Northwest Territories (Working Group on General Status of NWT Species 2016) although these two species have been reported through work done by Oldham and Delisle-Oldham (2017) who detected 118 invasive plant species along highways and rest stops in the NT.

In general, disturbed areas where vegetation monitoring plots were established are still relatively bare as most species had less than 1% cover.

Table 1: Invasive Plant Species Observed During 2020 Vegetation Monitoring

Scientific Name	Common Name	Plot Numbers	Status
Chenopodium album	Lamb's Quarters	All plots, general site	Exotic/Alien
Erigeron canadensis	Horseweed	V4-V10	Not Assessed
Erysimum cheiranthoides	Worm-seed Wallflower	V8, general site	Exotic/Alien
Melilotus alba	White-sweet clover	V1, general site	Not Assessed
Plantago major	Common Plantain	V3	Exotic/Alien
Taraxacum officinale	Common Dandelion	V5	Exotic/Alien

Lamb's Quarters was found across most of the site. Worm-seed Wallflower and White-sweetclover were found across the entire site. All areas assessed in 2020 except for one had Lamb's Quarters plus one or more weed species. 100% of the disturbed area had some percent cover of weed species (Figure 2). Percent cover for weeds is generally 1 or less, but this is also comparable to the native species regenerating on Site.

Although the Northwest Territories does not have legislation pertaining to weeds, legislation from Alberta could be used as a reference (Province of Alberta 2017). Alberta categorizes two types of weeds:

- Noxious weeds – invasive species that must be controlled
- Prohibited noxious weeds – invasive species that must be destroyed

Of the six weeds observed, none are listed as Noxious or Prohibited. The Project site is revegetating with native species, consistent with what was observed during the 2018 baseline surveys, however, growth is slow, as most species are present with less than 1% cover. In some scenarios, applications of native seed and fertilizer would be considered too increase competition from native vegetation; however, this reclamation technique is not recommended at the Ft. Reliance site given that some seed mixes may contain invasive species and the TNNPR are not in favour of chemical (i.e., fertilizer) application. Given the difficult climate for vegetation establishment and the adaptive nature of invasive species, weeds should be controlled across the entire site as soon as possible to prevent further spread and degradation of the surrounding habitat.

4.0 WEED DESCRIPTIONS

Lifecycles, physical descriptions, key identification features, avenues of disbursement, favourable habitats, and applicable control measures are listed for each invasive plant species observed during the 2020 monitoring event. Certain features are more obvious in some species (e.g., seeds) than others and therefore may not be described for each species. Photos of each species can be found in Appendix A.

4.1 Lamb's Quarters (*Chenopodium album*)

Synonyms
Pigweed, Fat-hen, White Goosefoot

Life Cycle
Annual

Leaves
Alternate, stalked leaves of variable shape (often triangular) with toothed margins. The upper surface is green. The lower surface is greyish-green and often covered with white mealy particles

Stems
Erect, branched stems growing 60 cm to 250 cm tall. Stems are green and grooved, with purple or red vertical striping

Flowers
Small and inconspicuous green or blue-green flowers with no petals growing at the top of the stem and in the leaf axils

Seeds
Shiny, black, disk-shaped seeds about 1 mm in diameter, often covered in a white papery envelope

Similar Species
Lamb's Quarters is similar to several other species in the *Chenopodium* genus. Maple-Leaved Goosefoot (*C. gigantospermum*) has thinner leaves and larger seeds, Oak-leaved Goosefoot (*C. glaucum*) has smaller leaves with white undersides and is a shorter plant, and Strawberry Blite (*C. capitatum*) has fleshy red flowers and triangular leaves with wavy or toothed margins

Dispersal and Reproductive Mechanisms
Seeding

Favourable Habitat
Fields, waste places, roadsides

Control Measures
Hand-pulling may be an effective control measure for small, localized infestations. For larger infestations, tillage may be effective, as Lamb's Quarters cannot recover once uprooted. Clipping when plants are young is also an effective control method of Lamb Quarters (Bassett 1978).

Chemical control may be effective using Group 1, 2, 4, and 5 herbicides such as Glyphosate, Bromoxynil, Dicamba, or Thifensulfron (Cowbrough 2017, Government of Manitoba 2018, Parks et al. 1995). Note that Lamb's Quarters resistant to some Group 2 and 5 herbicides have been found in Ontario and in some regions of the United States (Cowbrough 2017).

4.2 White Sweetclover (*Melilotus albus*)

Synonyms
Honey Clover, White Melilot, Bokhara Clover, Sweet Clover

Life Cycle
Annual or biennial

Roots
Roots form an extensive system with a semiwoody taproot and lateral roots and produce root crown buds

Leaves
Alternate, compound leaves with three leaflets

Stems
Sweet-smelling stem, grows up to 2.5 m long

Flowers
Lots of white flowers, can be up to 350,000 flowers on one plant

Similar Species
Yellow sweetclover

Dispersal and Reproductive Mechanisms
Seeding, vegetative reproduction

Favourable Habitat
Flourishes in well-drained clay and clay loam soils as well as saline soils. Often found along roadsides, railways, grasslands, and riparian areas

Control Measures
Hand-pulling is a successful control method for small infestations if conducted when the ground is moist, to maximize the possibility of removing the entire root system (Gucker 2009). Mulching is also considered quite effective (Tu et al. 2001). Mulch may either be applied in a layer at least 10 cm thick prior to seed germination or over seedlings in a thicker layer, usually at least 15 cm or until no light may reach the plants (University of California 2017). Cutting and mowing may also be somewhat effective, though these methods primarily reduce seed generation in the plant, rather than reducing the abundance of the plants themselves (Gucker 2009).

Another potential method of control for White Sweetclover is to seed with native perennial plants, as an established cover of perennial species has been found to reduce abundance within two years (Gucker 2009).

Burning may be used as a form of control, though controlled burns must be conducted two years in a row during late spring or summer, as fall and winter burns increase the plant's abundance (Gucker 2009, Tu et al. 2001).

White Sweetclover can be controlled using most herbicides designed for broad-leaved plants (Government of Manitoba 2017a), such as 2,4,-D, Quinclorac, and Dicamba, though Conn & Seefeldt (2009) found Chlorsulfron to be the most effective chemical control.

4.3 Common Plantain (*Plantago major*)

Synonyms
Broad-leaved Plantain, Dooryard Plantain, Whiteman's Foot

Life Cycle
Simple perennial

Roots
Short but thick rootstock with many lateral root strands

Leaves
Basal rosette of dark green, ribbed, slightly hairy oval leaves that are either entire or with coarse teeth. The leaves grow on thick stalks that are usually about as long as the leaf itself. Leaves are ribbed, with three to seven main veins. No stem leaves

Stems
Stems are leafless and grow up to 60 cm tall

Flowers
Dense rods of small and inconspicuous green flowers growing from the stems

Seeds
Seeds are dark brown to black, marked with wavy ridges, and about 1 mm long. Seed pods hold 5 to 16 seeds. Seed pods are brown, ovoid, and 3 mm long

Dispersal and Reproductive Mechanisms
Seeding

Favourable Habitat
Fields, meadows, waste places, and roadsides

Control Measures
Hand-pulling can be an effective control measure for small infestations. Increased competition of other native species is the best control methods. Mowing can increase populations because of the reduction of other tall species that would normally out compete common plantain.

For larger infestations, Common Plantain can be controlled using some Group 4, 9, and 10 herbicides such as Aminopyralid, 2,4-D, Pyroxsulam, Lalauxlfen, Dicamba, and MCPA (Government of Manitoba 2017b).

4.4 Common Dandelion (*Taraxacum officinale*)

Synonyms
Lion's Tooth, Blowball

Life Cycle
Simple perennial

Roots
Thick overwintering taproot growing up to 15 cm long

Leaves
A basal rosette of lobed or toothed leaves. No stem leaves

Stems
One to ten stems typically grow from the taproot. Stems may be upright or lax and are typically green but may be tinged with purple. Stems are hollow and usually glabrous, though sometimes sparsely hairy. Stems contain sticky, white latex

Flowers
Bright yellow flower head with 100 to 300 ligulate ray florets. Involucral bracts around each flower head are green and in two whorls, with the outer whorl having shorter bracts that are bent backward

Seeds
Achene seeds topped with a parachute of bristly pappus to aid windborne dissemination

Similar Species
Young Common Dandelion may resemble some Sow-thistles but can be distinguished by a lack of prickles on the leaf margins

Dispersal and Reproductive Mechanisms
Seeding, vegetative reproduction

Favourable Habitat
Waste areas, roadsides, railroad ROW, lawns, fields, shorelines, and disturbed areas such as avalanche chutes, burned forests, and overgrazed areas

Control Measures
Hand-pulling can be an effective control measure for small infestations. An effective method to control larger infestations of Common Dandelion is tilling to a depth of 10 cm. The Government of Alberta (2009) suggests tilling before seed set occurs, which will sever taproots and kill seedlings, while the Government of Manitoba (2017c) recommends tilling in the fall (Government of Alberta 2009a). A mouldboard plough is the most effective tillage tool for reducing dandelion populations, followed by the tandem disc (Cowbrough 2017). Use of a chisel plough is not effective as it tends to sever the tap roots instead of completely uprooting the plant (Cowbrough 2017).

Common Dandelion may also be controlled using systemic herbicides such as Glyphosate, PrePass, 2,4-D, and MCPA (Esser 1993, Government of Alberta 2009b). The most effective time of year to apply herbicides for Common Dandelion is in the fall, when both perennial plants and new seedlings can be affected by the herbicide (Cowbrough 2017, Government of Alberta 2009b; Government of Manitoba 2017d). The Government of Manitoba (2017d) recommends 1.5 L/acre of Glyphosate or Amitrol, while Cowbrough (2017) recommends Infinity.

4.5 Horseweed (*Conyza canadensis*)

Synonyms
Canadian Horseweed, Horseweed, Mares tail

Life Cycle
Winter Annual. Rosettes overwinter allowing Horseweed to emerge in the early spring giving is a competitive advantage.

Roots
Short taproot

Leaves
Seedlings form a basal rosette of dark green, sparsely hairy leaves and coarsely toothed margins. Mature leaves alternate, numerous and crowded often appearing opposite or whorled. Leaves lanceolate to linear, with almost entire margins; upper stem leaves only 5mm wide

Stems
Erect 10-180 cm high, hairy, with small flowering branches in the upper portions

Flowers
Flower heads small 3mm to 5mm in diameter and numerous on short branches near top of main stem. Pistillate ray florets are white, ligulate and very short, often concealed by involucre bracts around each head. Perfect disk florets are yellowish-green and very fluffy at maturity.

Seeds
Achenes averaging 60 to 70 per capitulum, small, transparent and have an attached pappus

Similar Species
The Genera Conyza is differentiated from the genera Erigeron by the absence of ligules or their lengths, and the relative number if pistillate versus perfect flowers.

Dispersal and Reproductive Mechanisms
Seeds are dispersed by wind by the attached pappus that is twice as long as the seeds. The tall wand like stem positions the seeds above the ground for better wind dispersal.

Favourable Habitat
Well suited to a broad range of conditions and habitat types. Mainly found on course, well drained soils and areas of disturbance.

Control Measures
Hand pulling can be an effective control measure when conducted in the spring and fall before plants are able to mature past the rosette stage and set seed.

Rosettes can be controlled with herbicides containing glyphosate applied in the fall when early spring when rosettes are small and actively growing before stem elongation (Weaver 2001).

Horseweed emerges in the early fall and spring and can be controlled with mechanical controls such as tilling or hand pulling during its emergence before stem elongation (Weaver 2001).

4.6 Worm-seed Wallflower (*Erysimum cheiranthoides*)

Synonyms
Wormseed mustard, Treacle mustard

Life Cycle
Winter Annual reproducing by seed

Roots
Shallow taproot

Leaves
Spreading to ascending, alternate, narrowly lance-elliptic, toothless or with few small teeth, tapering to a point or blunt tip

Stems
Stems 15cm to 100cm, erect, usually branched, firm, appearing hairless but slightly rough due to tiny, flat-lying, 2-branched hairs.

Flowers
Inflorescence racemose in round, pale-yellow, clusters, at tip of stems arising from leaf axis. Flowing top extends as plant matures with pods developing underneath.

Seeds
Pods, linear, greater than or equal to 3 times as long as wide. Densely hairy on inside, 4-sided, and spreading or ascending from stalk nearly erect.

Similar Species
Flowers are mustard like and could be confused with other members of the Brassicaceae family

Dispersal and Reproductive Mechanisms
Seeding

Favourable Habitat
Stream beds, moist areas, waste ground, fields, pastures, disturbed ground

Control Measures

Mechanical control can be an effective form of control on small infestations when rosettes are removed prior to seed set.

Annual weeds are often not a concern in conventional crops due to spring and fall tillage, however they have been found to increase under Zero tillage or reduced tillage cropping systems in Canada (Ramesh 2015).

5.0 TREATMENT METHODOLOGY

5.1 Pre-Treatment

Prior to implementing weed treatment methods, the entire Site should be resurveyed by a qualified biologist and photographed to formally document species density and extent as this has likely changed since 2020. This provides up-to-date baseline conditions for comparison purposes after treatments have been applied. The surrounding environment should be swept for sensitive features such as bird nests, dens, and mineral licks. Surveys will be conducted in areas with known infestations, or areas with higher risk of infestation. When an invasive species is first detected, the following information will be recorded:

- Geographic location
- Percent cover
- Other species present amongst the infestation
- Extent of infestation

5.2 Treatment Options

The most critical component of the WCP is that all equipment and personnel should arrive on-site thoroughly cleaned of soils, seeds, and debris to avoid further spreading invasive species. For treatment, a combined approach between mechanical (i.e. pulling), chemical, and increased competition from native vegetation often works best depending on the target species and adjacent landscape features. **For chemical control, only spot spraying of herbicides containing 2,4-D as the active ingredient would be permitted**. Chemical control should be limited near environmentally sensitive areas (i.e., near the lake shore); a 100 m set-back is recommended as run-off from 2,4-D herbicides could impact adjacent aquatic vegetation. After consultation with the TNNPR, it was determined that chemical control would not be used as a treatment method during the 2021 weed control event, however, these methods will remain in the WCP in case this option is considered in the future.

Treatments should be initiated prior to flowering and definitely prior to seed set. The selection of treatment will depend on:

- Timing and species;
- Site characteristic including land use, proximity to water, soil type, and other environmental features;
- Land management being carried out on adjacent land. (e.g. proximity to undisturbed native land);
- Safety, security, economic impacts, and site accessibility; and
- The consequences of not treating.

Treatment methods specific to the six weed species identified during the 2020 monitoring event are found below in Table 2.

Table 2: Treatment Methods for Invasive Species at the Fort Reliance Former Weather Station

Species	Occurrence within the Site	Proposed Treatment Method		
		Mechanical	Chemical	Comments
Lamb`s Quarters	Found In all assessment plots during monitoring and found throughout the Site	✓		Mechanical Control (hand pulling) is the preferred method for control. Lamb`s Quarters cannot recover once uprooted.
White Sweetclover	Found across the Site	✓		Mechanical Control (hand pulling) is the preferred method of control. Moist ground can assist in the removal of the entire root system.
Common Plantain	Found across the Site	✓	Chemical control effective but will not be used during the 2021 weed control event	Mechanical Control (hand pulling) can be an effective control measure, however; the lack of other tall native species to out-compete (shade) makes the effectiveness of control difficult. A combined treatment of mechanical treatment in sensitive areas and chemical treatment with 2,4-D where possible is recommended.
Common Dandelion	Found across the Site	✓	Chemical control effective but will not be used during the 2021 weed control event	Mechanical control (hand pulling) is of limited use as the entire taproot needs to be removed, even small pieces can propagate new plants. A combined treatment of mechanical treatment in sensitive areas and chemical treatment with 2,4-D where possible is recommended.
Horseweed	Found across the Site	✓		Mechanical control (hand pulling) is the preferred method of control. Rosettes of Horseweed emerge in the early spring and autumn. Rosettes should be pulled before they can set seed. Moist ground can assist in the removal of the entire root system.
Worm-Seed Wallflower	Found across the Site	✓		Mechanical Control (hand pulling) is the preferred method of control. Moist ground can assist in the removal of the entire root system.

If chemical control is deemed necessary in the future, prior to application, the herbicide contractor will supply a safety plan for handling, transport and storage of any chemicals or other equipment as well as a spill response plan. Potential techniques proposed for the management of weeds on the site are summarized in Table 3.

Table 3: Proposed Weed Management Techniques

Method	Details	Types of Methods and Cautions
Manual and Mechanical Methods	Mechanical control will be the main method of control for Lamb`s Quarters, White Sweetclover, Horseweed, and Worm-seed Wallflower. ▪ Care should be taken to try and remove as much of the root structure as possible during mechanical removal. ▪ Mechanical control will involve the removal of individual plants or small, localized infestations by hand. Some species can be stimulated by mechanical controls, so oftentimes treatments will require a combination of mechanical and chemical control. ▪ Gloves, simple garden tools (e.g., shovel, fork, hoe), and some form of containment (garbage bags, large buckets) will be used for hand pulling. ▪ Mechanical controls are also often executed in sensitive areas such as riparian zones, where chemical control might be restricted. ▪ Any biological material left from the mechanical control should be burned on site and not transported any significant distance from the areas of treatment.	▪ Hand pulling ▪ Digging
Natural Control	The establishment of native species helps to prevent and slow down the establishment of invasive, non-desirable weedy species. Weeds will typically invade disturbed sites, and the removal of native vegetation creates an area for weeds to establish. Care should be taken to prevent the destruction of desirable species on the site when implementing weed control measures.	▪ Prevention of damage to native species ▪ Proper identification of native vs. non-native ▪ Prevention of over spraying of chemicals ▪ Avoiding chemical control on disturbance boundaries
Chemical Methods	Chemical control is the least preferred option for the management of weeds and will not be used following consultation with the TNNPR during the 2021 weed control event, however; herbicides can provide an effective and time efficient method of control. Chemical control will be used on Common Plantain and Common Dandelion. Care should be taken to avoid overspray onto other native species. ▪ Careful planning is essential when considering herbicide applications. All operations should comply with applicable *Acts* and Regulations for herbicide handling, application, and disposal. ▪ A Pesticide Permit must be received from Environment and Natural Resources to apply chemicals: ▪ Ensure a spill response plan and procedures for handling herbicide spills is available prior to commencing chemical application activities. ▪ Ensure spill treatment equipment is present or near storage, mixing and loading sites. Spill response equipment includes personal protective equipment, absorbent material, neutralizing material, a long-handled broom, shovel and waste container with a sealed lid.	▪ Spot Spray – When spraying has been completed, equipment must be washed out in an identified wash down area to avoid contamination. This should be done off site if possible. ▪ All chemicals must be appropriately stored as follows: – Store in accordance with the Material Safety Data Sheet (MSDS) for the chemical. – Store away from foodstuffs, seeds, or fertilizers. – Keep herbicides in their original labelled containers; and – Seal containers adequately and store in relatively cool conditions. – All chemicals will be removed from site once the program has been executed. ▪ Stop herbicide application if:

Table 3: Proposed Weed Management Techniques

Method	Details	Types of Methods and Cautions
Chemical Methods	▪ Ensure a copy of the Spill Response Plan is always available on site. This is to be completed by the herbicide contractor and approved by the Consultant. ▪ Weed spraying is only to be undertaken by appropriately qualified and certified persons. ▪ Always follow the manufacturer's guidelines for application methods and concentration. ▪ Always conduct the application of herbicide from downwind to upwind of weeds. ▪ Spray as evenly as possible. ▪ Do not apply a higher volume than necessary. ▪ Do not apply at a higher pressure than needed to obtain good coverage. ▪ Spray weeds at the correct size or stage of growth; and ▪ Spray weeds when they are actively growing (weeds should not be sprayed when they are under stress). ▪ Spraying should not occur within 100 m of the lake shore. ▪ Be aware of and maintain appropriate protective buffer zones around inhabited nests, wildlife trees and mineral licks during weed management activities. ▪ Temperature, precipitation, frost, and dew conditions should be recorded for all spot spray applications.	– The maximum/minimum temperature range is exceeded for the chemical; – If wind speed/direction results in drift which may miss the target vegetation; – Ground velocity wind is over 8 km/h; – Precipitation occurs at a steady rate; – Increasing the risk of leaching or runoff, or – If there is ice or frost on foliage.

When 2021 Site work has been completed, a report should be prepared detailing results of the baseline survey and treatment methods and results.

5.3 Disposal of Invasive Species

All weeds mechanically removed from the ground should be bagged to prevent seed dispersal before being moved to small piles no more than one cubic meter to be burned on site. A **burn permit** from the Government of the Northwest Territories' Environment and Natural Resources division will be required. Burning should occur in a manner that does not release additional contaminants into the environment. Burn areas should be in open spaces at least 25 m away from standing timber or brush in a sheltered area (Government of Alberta 2019), although specific conditions to be met will be specified in the permit.

6.0 REGULATORY REQUIREMENTS

If chemical control is used in the future, measures within the Government of the Northwest Territories' *Pesticide Act* (1988) and Pesticide Regulations (2009) must be adhered to as well as the Government of Canada's *Pest Control Products Act* (2002) and the Pest Control Products Regulation (2006). The following permits and licenses are required:

- A Pesticide Application Permit from NT's Environment and Natural Resources division
- A Burn Permit from NT's Environment and Natural Resources division
- The herbicide applicator must be appropriately trained and licensed

Pesticide Application Permit Applications are subject to the preliminary screening process under the *Mackenzie Valley Resource Management Act* (1998) for all first time applications.

For the 2021 weed control event, the Burn Permit is the only required permit.

Once the WCP has been implemented, the MVLWB should be provided with an update on site activity as directed in the Land Use Permit.

According to the National Parks of Canada Businesses Regulations SOR/98-455 as part of the Canada National Parks Act, anyone wishing to operate a business within a national park in Canada is required to apply to Parks Canada for a Business Licence. The process of applying for a business license within the Thiadene Nene National Park Reserve includes a review by the Management Board (members include Lutsel' Ke First Nation, NWT Metis, etc.) to ensure impacts by this issuance of a business license does not impact the natural state of the Park or the interests of the local populations. ECCC will apply for this business licence; the licence should be in place prior to any work conducted on site.

7.0 SCHEDULE

Weed control treatments should take place during the growing season before invasive plants are able to set seed if possible. Given the remote location and difficult access, site access is weather dependent but proposed for mid-July in 2021 when the ice is off the lake and the Trophy Lodge is open. If control measures are implemented mid-summer of 2021, follow-up monitoring should occur mid to late August 2021.

The TNNPR should be engaged and consulted as soon as possible to finalize acceptable weed treatment and management techniques before field work is conducted.

8.0 MONITORING AND TREATMENT THRESHOLDS

Monitoring provides the means to gather information to evaluate the success of prevention, detection, and control measures. Once control measures have been implemented, regular monitoring and follow-up reporting will occur to verify whether the eradication goal has been met and the site has been sufficiently restored to target conditions (e.g., pre-infestation conditions). Once an area has been treated, a biologist will assess the effectiveness for all species treated, percent cover before and after treatment (of invasive and native species), and the overall condition of the treated area. If eradication goals are not met, further treatments and/or alternative control measures may need to be deployed.

The procedure for post-remediation monitoring following the 2019 Site-wide remediation and decommissioning work is outlined in the *Final Project Monitoring Plan, Fort Reliance Weather Station Remediation Project, NT* issued January 31, 2020 (2020 PMP; Tetra Tech 2020). The 2020 PMP was approved by the Mackenzie Valley Land and Water Board.

Vegetation monitoring in areas backfilled and/or disturbed during the 2019 remediation and decommissioning work is scheduled to be completed in years 1, 3, 5, 7 and 10 post-remediation. 2020 was year 1, 2021 will be year 2; year 3 will provide further documentation on invasive species control success. If control was successful, monitoring can continue every other year. The ultimate focus is to maintain native vegetation communities and repopulate disturbed areas with native species through natural succession. If invasive species continue to be detected after control measures, additional techniques may warrant consideration to encourage native plant encroachment and limit pathways for the establishment of invasive species.

If control measures are not successful, adaptive management will occur and monitoring length and frequency may need to be reset. Monitoring is completed to assess whether disturbed areas are revegetating with native species and are free from invasive vegetation. For the **treatment threshold**, monitoring should show a progressive decrease in invasive species and increase in native species which should ultimately out-compete any remaining weeds. So long as this is occurring, further control measures may not be required.

Vegetation monitoring plots established in 2020 should be reassessed each monitoring year within the growing season to document naturalization progression. Vegetation monitoring plots measure 20 m x 20 m and were established in the main areas of disturbance/remediation. At plot centre, geographic location should be confirmed (a metal rod was installed to mark plot centre for future monitoring). Species and their respective percent cover should be recorded. Common species observed throughout the site should also be recorded. A report with results of each monitoring event should be prepared and provided to ECCC.

8.1 Adaptive Management

Adaptive management will be used to evaluate the effectiveness of the WCP; the WCP is effective if the goals are being met. The WCP is a living document. As part of the adaptive management approach, this document will require revisions if and when new species are detected/introduced, control methods are added or removed (based on effectiveness), new vectors for spread/propagation are introduced (e.g., natural disturbances such as fire or flood), and/or invasive species legislation changes.Adaptive Management is a systematic, rigorous approach designed to link environmental monitoring to management actions. Adaptive management will help to evaluate the success of reclamation and revegetation programs and confirm that disturbed areas have stabilized and are performing as expected. The determination will include assessment of both the reclamation works and the downstream receiving environment.

Once the initial weed control event occurs in 2021, monitoring will be conducted to determine effectiveness of the mechanical control measures. If further weed control is required, adaptive management would play an important role to determine future weed control measures such as chemical means.

9.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of PSPC, ECCC and their agents. Tetra Tech Canada Inc. (operating as Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than PSPC and ECCC, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on the Use of this Document attached in Appendix B or Contractual Terms and Conditions executed by both parties.

10.0 CLOSURE

We trust this document meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.

Prepared by:
Patrick Lynch, ATT.
Technologist
Environment & Water Practice
Direct Line: 403.710.5456
Patrick.Lynch@tetratech.com

Reviewed by:
Amy McLenaghan, B.Sc., P.Biol., L.A.T.
Biologist
Environment & Water Practice
Direct Line: 780.977.2029
Amy.McLenaghan@tetratech.com

/cee

REFRENCES

Bassett, I. J., & C.W. Crompton. 1978. THE BIOLOGY OF CANADIAN WEEDS.: 32 Chenopodium album L. Canadian Journal of Plant Science, 58(4), 1061-1072.

Bubar, C.J., S.J., McColl, and L.M. Hall. 2000. Weeds of the Prairies. Alberta Agricultural and Rural Development. Edmonton, AB: Queen's Printer for Alberta.

Cowbrough, M. 2017. Problem Weed Guide for Ontario Crops – Volume 1. Ontario Ministry of Agriculture, Food, and Rural Affairs. Guelph, ON: Queen's Printer for Ontario.

Esser, L. L. 1993. *Taraxacum officinale*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available at: https://www.fs.fed.us/database/feis/plants/forb/taroff/all.html. [Accessed Nov 20, 2018].

Government of Alberta. 2009. Dandelion. Government of Alberta Department of Agriculture and Forestry, Edmonton, AB. Available at: http://www.agric.gov.ab.ca/app107/loadPest?action=display&id=122. [Accessed Nov 16, 2018].

Alberta Agriculture and Forestry. 2019. Brush piles & windrows: safe burning practices.

Government of Manitoba. 2018. Guide to Field Crop Protection 2018. Government of Manitoba Department of Agriculture, Food and Rural Initiatives, Winnipeg, MB.

Government of Manitoba. 2017a. Sweet Clover Seed Production. Government of Manitoba Department of Agriculture, Food and Rural Initiatives, Winnipeg, MB. Available at: https://www.gov.mb.ca/agriculture/crops/crop-management/forages/sweet-clover-seed-production.html. [Accessed Nov 16, 2018].

Government of Manitoba. 2017b. Broad-leaved Plantain. Government of Manitoba Department of Agriculture, Food and Rural Initiatives, Winnipeg, MB. Available at: https://www.gov.mb.ca/agriculture/crops/weeds/hemp-nettle.html. [Accessed Nov 16, 2018].

Government of Manitoba. 2017c. Controlling Dandelion in the Fall. Government of Manitoba Department of Agriculture, Food and Rural Initiatives, Winnipeg, MB. Available at: https://www.gov.mb.ca/agriculture/crops/weeds/controlling-dandelion-in-the-fall.html. [Accessed Nov 16, 2018]

Government of the Northwest Territories and NWT Biodiversity Team. 2010. Northwest Territories State of the Environment - 2010 Biodiversity Special Edition. Department of Environment and Natural Resources, Government of the Northwest Territories, Yellowknife. NT. Canada. 36 p.

Gucker, C. L. 2009. *Melilotus alba, M. officinalis*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available at: https://www.fs.fed.us/database/feis/plants/forb/melspp/all.html

Oldham, M.J. and M. Delisle-Oldham. 2017. Report on the 2016 Survey of Exotic Plants along the Northwest Territories Highways. Available online at: https://www.enr.gov.nt.ca/sites/enr/files/resources/report_on_the_2016_survey_of_exotic_plants_along_northwest_territories_h.pdf

Parks, R.J., W.S., Curran, G.W., Roth, N.L., Hartwig, and D.D. Calvin. 1995. Common Lambsquarters (*Chenopodium album*) control in corn (*Zea mays*) with postemergence herbicides and cultivation. Weed Technology 9(4): 728-735.

Chayka, K. 2012. Minnesota Wildflowers: a field guide to the flora of Minnesota. Available at https://www.minnesotawildflowers.info/flower/wormseed-wallflower. [Accessed May 3, 2021].

Jander, G. 2016. Erysimum cheiranthoides variety Elbtalaue growing under fluorescent lights in a Conviron growth chamber at the Boyce Thompson Institute in Ithaca, New York, USA. Distributed under Creative Commons Attribution-Share Alike 4.0 International License. Available at https://en.wikipedia.org/wiki/File:Erysimum_cheiranthoides_variety_Elbtalaue.jpg [Accessed May 3, 2021].

Licher, M. SEINet Portal Network, 2021. Distributed under Creative Commons Attribution-ShareAlike license. Available at https://swbiodiversity.org/seinet/taxa/index.php?taxon=3603&clid=97#. [Accessed May 3, 2021].

Peter M. Dziuk, 2003 Minnesota Wildflowers: a field guide to the flora of Minnesota. Available at https://www.minnesotawildflowers.info/flower/wormseed-wallflower. [Accessed May 3, 2021].

Ramesh, K. (2015). Weed problems, ecology, and management options in conservation agriculture: issues and perspectives. Advances in Agronomy, 131, 251-303.

Tetra Tech Canada Inc. (Tetra Tech), 2020. Final Project Monitoring Plan, Former Weather Station at Fort Reliance, NT. Report submitted to Environment and Climate Change Canada and Public Service and Procurement Canada, January 21, 2020. Tetra Tech file no.: ENW-EENW03031-11.

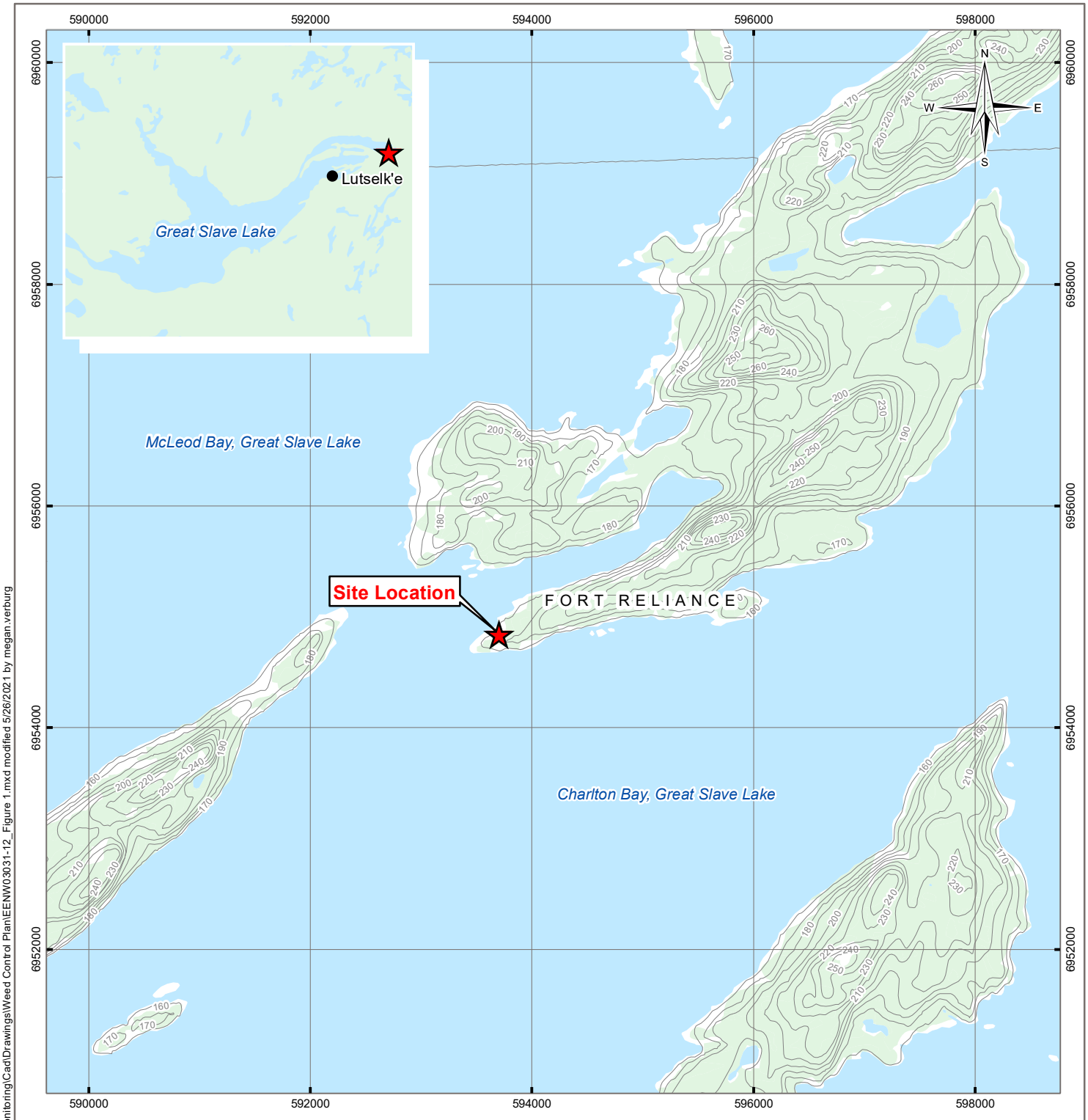
Tu, M., C., Hurd, and J.M. Randall. 2001. Weed control methods handbook. The Nature Conservancy. Available at: http://tncweeds.ucdavis.edu. [Accessed Nov 28, 2018].

University of California. 2017. Clovers. University of California Division of Agriculture and Natural Resources, Davis, CA. Available at: http://ipm.ucanr.edu/PMG/PESTNOTES/pn7490.html. [Accessed Nov 21, 2018].

Weaver, S. E. 2001. The biology of Canadian weeds. 115. Conyza canadensis. Canadian Journal of Plant Science, 81(4), 867-875.

Working Group on General Status of NWT Species. 2016. NWT Species 2016-2020 – General Status Ranks of Wild Species in the Northwest Territories, Department of Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT. 304 pp.

FIGURES



Q:\Edmonton\Environmental\ENW\ENW.EENW03031-12 Ft. Reliance Monitoring\Cad\Drawings\Weed Control Plan\EENW03031-12_Figure 1.mxd modified 5/26/2021 by megan.verburg

LEGEND

- Contour (10 m)
- Waterbody
- Wooded Area

NOTES
Base data source: CanVec 1:50,000.

WEED CONTROL PLAN
FORT RELIANCE WEATHER STATION, NT

Site Location Plan

PROJECTION	DATUM	CLIENT
UTM Zone 12N	NAD83	Public Services and Procurement Canada

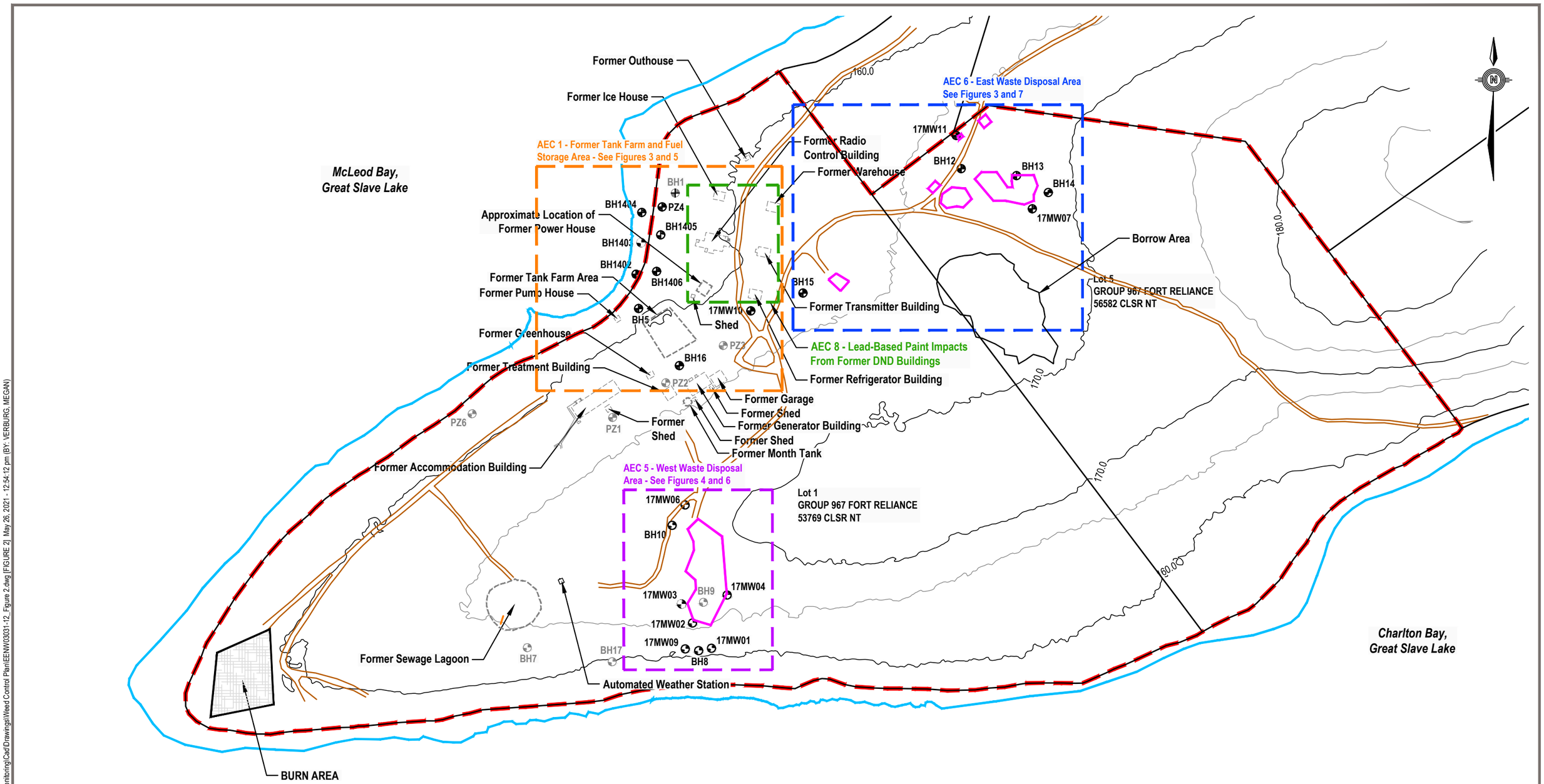
Scale: 1:50,000
1 0.5 0 1
Kilometres

TETRA TECH

FILE NO.				
EENW03031-12_Figure 1.mxd				
OFFICE	**DWN**	**CKD**	**APVD**	**REV**
Tt-EDM	MRV	BB	BB	0
DATE	**PROJECT NO.**			
September 2020	ENW.EENW03031-12			

STATUS
FINAL

Figure 1



LEGEND:

- ACCESS ROAD
- 170.0 - MAJOR CONTOUR
- MINOR CONTOUR
- LOT BOUNDARY
- SITE BOUNDARY
- FORMER BUILDING / SITE FEATURE
- WASTE DISPOSAL AREA REMEDIAL EXCAVATION EXTENTS (SUMMER 2019)
- SHORELINE
- MONITORING WELL LOCATION
- DECOMMISSIONED / REMOVED / NOT MONITORED MONITORING WELL LOCATION

STATUS: DRAFT

0 100 m

Scale: 1: 2 000

CLIENT: Public Services and Procurement Canada

WEED CONTROL PLAN
FORT RELIANCE WEATHER STATION, NT

Site Overview

TETRA TECH

PROJECT NO.	DWN	CKD	REV
ENW.EENW03031-12	DBD	BB	0

OFFICE: EDM

DATE: September 2020

Figure 2

APPENDIX A
PHOTOS OF EACH SPECIES

Lamb's Quarters
Chenopodium album

Mature Plant

Bubar et al. 2000

Flowers

Bubar et al. 2000

Striped Stem

Bubar et al. 2000

White Sweetclover
Melilotus albus

Mature Plant

Flowers

Leaves

Common Plantain
Plantago major

Mature Plant

Bubar et al. 2000

Flowering Spike

Bubar et al. 2000

Seedling

Bubar et al. 2000

Common Dandelion
Taraxacum officinale

Mature Plant

Bubar et al. 2000

Seed Heads

Bubar et al. 2000

Juvenile Plant

Bubar et al. 2000

Horseweed
Conyza canadensis

Mature plant with leaves

Max Licher

Inflorescence

Max Licher

Basel rosette

Tetra Tech Canada Inc. 2020

Worm-Seed Wallflower
Erysimum cheiranthoides

Erect seed pods

K. Chayka 2012

Inflorescence

P.M. Dziuk 2003

Mature plant with leaves

G. Jander 2016

APPENDIX B

TETRA TECH'S LIMITATIONS ON THE USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

NATURAL SCIENCES

1.1 USE OF DOCUMENT AND OWNERSHIP

This document pertains to a specific site, a specific development, and a specific scope of work. The document may include plans, drawings, profiles and other supporting documents that collectively constitute the document (the "Professional Document").

The Professional Document is intended for the sole use of TETRA TECH's Client (the "Client") as specifically identified in the TETRA TECH Services Agreement or other Contractual Agreement entered into with the Client (either of which is termed the "Contract" herein). TETRA TECH does not accept any responsibility for the accuracy of any of the data, analyses, recommendations or other contents of the Professional Document when it is used or relied upon by any party other than the Client, unless authorized in writing by TETRA TECH.

Any unauthorized use of the Professional Document is at the sole risk of the user. TETRA TECH accepts no responsibility whatsoever for any loss or damage where such loss or damage is alleged to be or, is in fact, caused by the unauthorized use of the Professional Document.

Where TETRA TECH has expressly authorized the use of the Professional Document by a third party (an "Authorized Party"), consideration for such authorization is the Authorized Party's acceptance of these Limitations on Use of this Document as well as any limitations on liability contained in the Contract with the Client (all of which is collectively termed the "Limitations on Liability"). The Authorized Party should carefully review both these Limitations on Use of this Document and the Contract prior to making any use of the Professional Document. Any use made of the Professional Document by an Authorized Party constitutes the Authorized Party's express acceptance of, and agreement to, the Limitations on Liability.

The Professional Document and any other form or type of data or documents generated by TETRA TECH during the performance of the work are TETRA TECH's professional work product and shall remain the copyright property of TETRA TECH.

The Professional Document is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of TETRA TECH. Additional copies of the Document, if required, may be obtained upon request.

1.2 ALTERNATIVE DOCUMENT FORMAT

Where TETRA TECH submits electronic file and/or hard copy versions of the Professional Document or any drawings or other project-related documents and deliverables (collectively termed TETRA TECH's "Instruments of Professional Service"), only the signed and/or sealed versions shall be considered final. The original signed and/or sealed electronic file and/or hard copy version archived by TETRA TECH shall be deemed to be the original. TETRA TECH will archive a protected digital copy of the original signed and/or sealed version for a period of 10 years.

Both electronic file and/or hard copy versions of TETRA TECH's Instruments of Professional Service shall not, under any circumstances, be altered by any party except TETRA TECH. TETRA TECH's Instruments of Professional Service will be used only and exactly as submitted by TETRA TECH.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems. TETRA TECH makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

1.3 STANDARD OF CARE

Services performed by TETRA TECH for the Professional Document have been conducted in accordance with the Contract, in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Professional judgment has been applied in developing the conclusions and/or recommendations provided in this Professional Document. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of the Professional Document.

If any error or omission is detected by the Client or an Authorized Party, the error or omission must be immediately brought to the attention of TETRA TECH.

1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for TETRA TECH to properly provide the services contracted for in the Contract, TETRA TECH has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by persons other than the Client.

While TETRA TECH endeavours to verify the accuracy of such information, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

1.6 GENERAL LIMITATIONS OF DOCUMENT

This Professional Document is based solely on the conditions presented and the data available to TETRA TECH at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present or variation in assumed conditions which might form the basis of design or recommendations as outlined in this report, at or on the development proposed as of the date of the Professional Document requires a supplementary investigation and assessment.

TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

1.7 ENVIRONMENTAL ISSUES

The ability to rely upon and generalize from environmental baseline data is dependent on data collection activities occurring within biologically relevant survey windows.

It is incumbent upon the Client and any Authorized Party, to be knowledgeable of the level of risk that has been incorporated into the project design or scope, in consideration of the level of the environmental baseline information that was reasonably acquired to facilitate completion of the scope.

1.8 NOTIFICATION OF AUTHORITIES

TETRA TECH professionals are bound by their ethical commitments to act within the bounds of all pertinent regulations. In certain instances, observations by TETRA TECH of regulatory contravention may require that regulatory agencies and other persons be informed. The client agrees that notification to such bodies or persons as required may be done by TETRA TECH in its reasonably exercised discretion.