Invasive Plant Management and Restoration of Protected Areas

Project Number: COL-F20-W-3101

Prepared with financial support of the Fish and Wildlife Compensation Program on behalf of its program partners BC Hydro, the Province of BC, Fisheries and Oceans Canada, First Nations and Public Stakeholders. Additional partners include Nature Conservancy of Canada, The Nature Trust of BC, and the Ministry of Forests, Lands, Natural Resource Operations, and Rural Development.

Prepared for:
Fish and Wildlife Compensation Program
333 Dunsmuir Street, Vancouver, BC
V6B 5R3

Prepared by:
Katie Reid and Kendal Benesh
East Kootenay Invasive Species Council
1902 Theatre Road, Cranbrook, BC
V1C 7G1

22-03-2020

Contents

List of Tables

List of Figures

Executive Summary

Invasive species have numerous negative impacts on natural ecosystems: they threaten the health of British Columbia and Canada's limited native grasslands, may displace or extirpate endangered plant and animal species, negatively impact wildlife habitats, reduce productivity in forestry, agriculture and fisheries, and overall have a negative impacts on ecosystem function and health. Sensitive habitats, typically those that have been selected for protection and conservation, can be particularly vulnerable to the impacts of invasive species; they can establish quickly and spread easily across landscapes and attribute to overall ecosystem alteration and habitat change. Mitigating the impacts of invasive species requires a coordinated and landscape-level approach involving multiple stakeholders and long-term investments on the land base.

The objective of the East Kootenay Invasive Species Council's (EKISC) Invasive Plant Management and Restoration of Protected Areas (IPMRPA) Project is to contribute to the prevention and control of high priority terrestrial and aquatic invasive species on upland and riparian sites that have the potential to negatively impact high-value conservation lands, including Fish and Wildlife Compensation Program (FWCP) project investments on, or adjacent to, conservation properties and FWCP restoration sites. EKISC has been working with FWCP on the IPMRPA project since 2014, when the need to collaboratively bolster invasive plant management efforts across high value conservation lands was identified.

The IPMRPA project aligns closely with FWCP-identified habitat-based Priority Actions and intended outcomes in the Upland/Dryland and Wetland/Riparian Action Plans. In Upland/Dryland and Riparian/Wetland habitats, this project aims to protect conservation lands and FWCP investment sites against the establishment and spread of invasive species, improve understanding of invasive species distribution, and allow early detection and rapid response to new invasive plant infestations. Priority habitats include fire-maintained ecosystems, ungulate winter range, grasslands and deciduous forests existing conservation lands and surrounding areas, and FWCP investment sites within Upland/Dryland and Wetland/Riparian habitats.

In 2019, invasive plant inventories, treatments, and monitoring visits were completed on and adjacent to 12 conservation properties that were identified as high priority by project partners. A total of 130 invasive plant treatments were completed (primarily herbicide/chemical with one mechanical treatment) covering an area of 35.56 ha. Additional invasive plant surveys, treatment efficacy monitoring, and grass seeding activities took place throughout the field season to ensure completion and effectiveness of management practices and to help inform future treatment recommendations.

This work was completed directly in partnership with FWCP, Nature Conservancy of Canada, the Nature Trust of British Columbia, and the Ministry of Forests, Lands, Natural Resource Operations & Rural Development, and as such, has enabled a substantial amount of leveraged funds to be directly applied to invasive plant management on and adjacent to high value conservation lands. This program primarily aims to decrease the establishment and spread of new invasive species on high value conservation lands, and works to create benefits to the landscape such as reduction of propagule pressure from neighbouring invasive species populations, wildlife habitat conservation, and long-term cost savings through collaborative invasive species management action. EKISC is confident that continued collaborative invasive plant management planning will continue to benefit conservation lands across the East Kootenay region.

Introduction

Invasive species are widely known as a significant threat to global biodiversity (IUCN 2004, 2011), and have the potential to impose significant negative social, economic and environmental impacts on ecosystems and communities across the East Kootenay Region. Sensitive habitats, typically those that have been selected for protection and conservation, can be particularly vulnerable to the impacts of invasive species; they can establish quickly and spread easily across landscapes, displacing native wildlife and plants, and attributing to overall ecosystem alteration and habitat change (MFLNRORD 2019). The Global Invasive Species Program (GISP) recognizes invasive species "as one of the greatest threats to the ecological and economic well-being of the planet" (Mooney 1999).

The East Kootenay Invasive Species Council (EKISC) is a non-profit organization that strives to reduce the negative social, environmental and economic impacts caused by invasive species across the region (EKIPC 2013). EKISC has been delivering an efficient and effective partnership delivery program across multiple jurisdictions since the East Kootenay Invasive Plant Pilot Program began in 2005 (Liepa 2013). To do this, EKISC coordinates invasive species management on public and private lands, delivers invasive species education and outreach, and fosters expanded support of invasive species management in the region. EKISC is comprised of various stakeholders including provincial ministries, regional governments, community associations, and environmental groups with the common goal of invasive species management.

EKISC has been working in partnership with the Fish and Wildlife Compensation Program (FWCP), Nature Trust of (NTBC), Nature Conservancy of Canada (NCC), Columbia Basin Trust (CBT) and the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (MFLNRORD) on the Invasive Plant Management and Restoration of Protected Areas (IPMRPA) Project since 2014, managing invasive species on important high-value conservation lands and adjacent areas (Note: funding was not awarded by FWCP in 2017). EKISC works with these partners to identify priorities and recommendations for invasive plant treatment areas and to facilitate informed, landscape-level planning. Previous years have shown successes in program areas not only in managing and reducing the spread of existing invasive species populations, but have also allowed contractors and EKISC staff to quickly identify and respond to new high priority invasive plant populations and as assist with reducing the introduction of invasive species with targeted education and outreach through regular programming.

The 2019 field season marks the 5th year of the IPMRPA project. The following report will identify all invasive plant management efforts (surveys, treatments, monitoring, grass seeding) that were completed as a part of this collaborative project and recommendations for future programming.

Goals and Objectives

Mitigating the impacts of invasive species requires a coordinated and landscape-level approach involving multiple stakeholders (MFLNRORD 2019). The objective of the IPMRPA Project is to contribute to the prevention and control of high priority terrestrial and invasive species on upland/dryland and riparian/wetland sites that have the potential to negatively impact FWCP project investments on, or adjacent to, conservation properties and FWCP restoration sites. The IPMRPA Program aligns with Habitat-Based, Ecosystem Actions as outlined in the Dryland/Upland and Wetland/Riparian Action Plans for the Columbia Region (FWCP 2019a, FWCP 2019b).

Specifically, this program aims to achieve the following:

1. Work with project collaborators to identify and prioritize high-value wildlife sites in project areas for invasive species inventory, treatments and monitoring.
2. Reduce the size and number of invasive plant sites in the East Kootenay through an Integrated Plant Management Plan.
3. Monitor for effectiveness to ensure treatment completion and efficacy.
4. Restore sites with appropriate seed mixes to outcompete weed establishment and increase wildlife forage.

EKISC works with adjacent land managers to coordinate invasive plant treatments and provide the most efficient and effective invasive species manage possible with available funds.

Management Area

Invasive plant treatments occurred within the Regional District of East Kootenay (RDEK), which has been divided by EKISC into five primary Invasive Plant Management Areas (IPMAs), as shown in Figure 1. Each IPMA may be sub-divided into sub-IPMAs. The intent of delineating these units is to provide a more localized approach to prioritizing invasive plant species. For example, a certain species may be a Priority 1 in one sub-IPMA due to its extremely limited distribution (where the goal is to eradicate the species), whereas it may be considered a Priority 2 or 3 in another sub-IPMA if it has a much broader distribution (and it may be treated for annual control or containment purposes).

Invasive plant management sites that were visited under the IPMRPA program in 2019 are within the Columbia Region of the RDEK (as defined by the FWCP), and include: Bull River Conservation Property (Armstrong and Grassland Corridor), Bull River Red Barn, Bummer Flats Zirnhelt, Columbia Lake Eastside Wildlife Management Area, Columbia Lake Westside/Sun Lakes Conservation Property, Hoodoos Conservation Property, Kootenay River Ranch, Lower Norbury/O'Grady Conservation Property, Luxor Linkage, Middle Bummers, and Premier Ridge/3 Sons Pommier.

Methods

Project Planning

Prior to the 2019 field season, EKISC facilitated a planning meeting with all project partners to select, prioritize, and strategize invasive plant management activities on high-value lands across the Columbia Region. Priority treatment units and target species were identified by EKISC staff and project partners using information on previous invasive plant management activities, monitoring notes, site-specific management objectives, and available funding.

EKISC used this information, along with information from the Provincial Alien Plant Program (IAPP) and adjacent land manager invasive plant management efforts to develop and share a project work plan that was used to initiate management efforts for 2019. Invasive plant treatments are typically coordinated so they occur at the same time as nearby treatments to increase efficiency and better utilize a landscape-level approach.

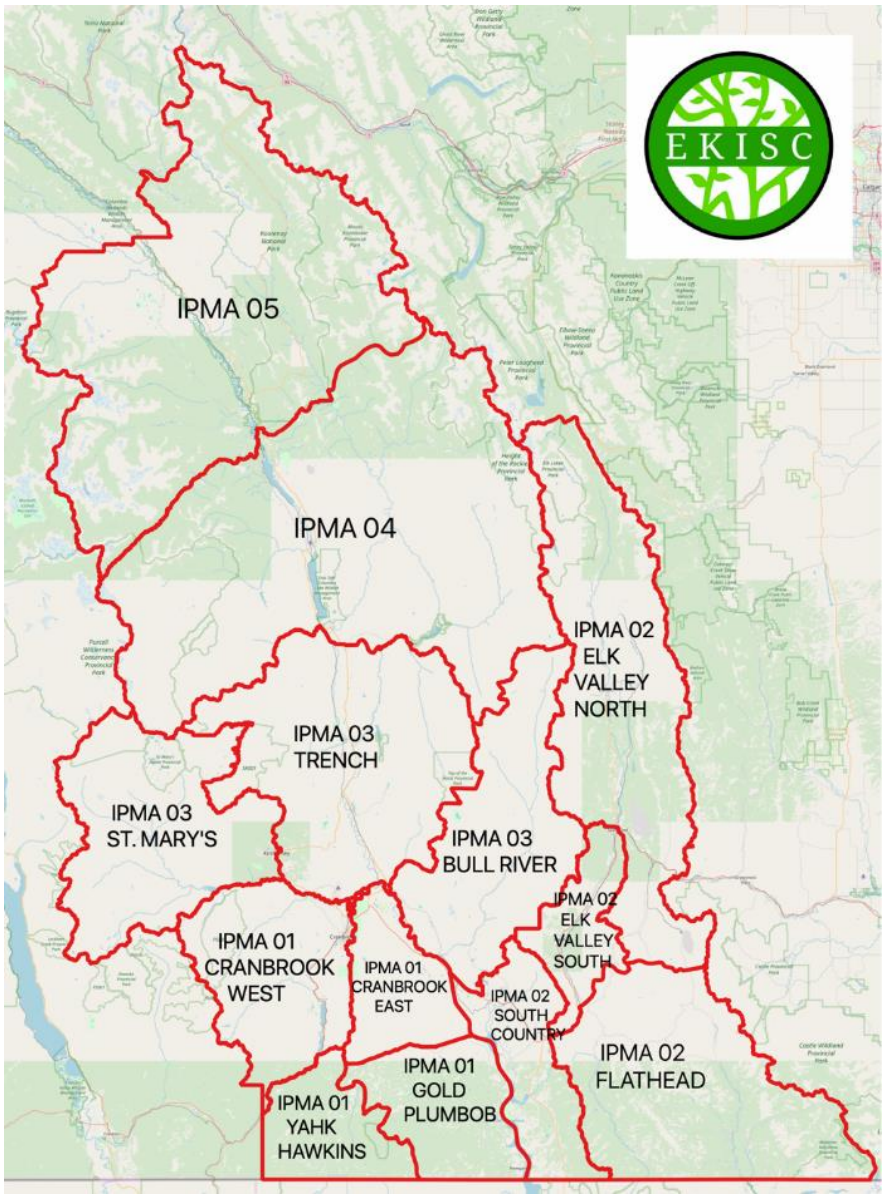

Figure 1. Invasive Plant Management Areas (IPMAs) within the Regional District of East Kootenay. Note that IPMA's 1 through 3 are further divided into sub-IPMAs.

Invasive Plant Surveys & Treatments

Invasive plant surveys and treatments at priority sites in Upland/Dryland areas and Riparian/ Wetland areas were completed between July 16th and October 17th, 2019. Survey data for invasive plant sites are collected during initial treatment visits, and include collecting data on species present, infestation size and density, and relevant site characteristics.

The majority of invasive plant treatments were accomplished by applying an appropriate herbicide to the site using either a vehicle (e.g., an all-terrain vehicle or truck boom spray) or by hand (e.g., using a

hand nozzle or backpack sprayer) depending on the terrain and ensuring to disturb the site as little as possible. Herbicides were selected based on the target species and site characteristics such as soil type, slope, and distance to water.

All invasive plant surveys and treatments were conducted by qualified and licensed contractors or EKISC staff. Invasive plant inventory and treatment data were entered into the Provincial IAPP database by December 1, 2019.

Grass Seeding

Candidate sites for native grass seed application were prioritized by EKISC staff based on the amount of bare ground and site disturbance present. Sites that had mechanical treatments or had experienced consecutive years of herbicide application were prioritized for grass seed application in 2019 in efforts to deter new or existing invasive plants from establishing. Available funding enabled the application of grass seed to six of the treatment areas, varying from small spot treatments where existing native grasses were already reestablishing at the site, to larger applications where bare ground was a concern.

Monitoring

Over 10% of all invasive plant treatments completed under this project were monitored for treatment efficacy (how effective was the herbicide application or manual removal in controlling the target species this year?), treatment completion (were treatments considered complete at the site?), and overall treatment response. Monitoring sites visits occurred from July through September 2019, by a qualified and experienced EKISC Field Staff member. Treatments that occurred in October 2019 were not monitored, as early snowfall and frost damage to plants created poor conditions for assessing treatment efficacy and completion.

Treatment Results & Outcomes

Invasive plant surveys and treatments were completed at the following conservation lands within the Columba Region: Bull River Conservation Property (Armstrong and Grassland Corridor), Bull River Red Barn, Bummer Flats Zirnhelt, Columbia Lake Eastside Wildlife Management Area, Columbia Lake Westside/Sun Lakes, Columbia Lake, Westside Conservation Property, Hoodoos Conservation Property, Kootenay River Ranch Lower Norbury/O'Grady Conservation Property, Luxor Linkage, Middle Bummers, and Premier Ridge/3 Sons Pommier.

Within the identified treatment areas, a total of 130 invasive plant sites were treated chemically with herbicide, using 52.89 L and 0.64 kg of undiluted chemical, and covering an area of 35.56 ha. One additional site (Bummer's Flats – Zirnhelt) was treated mechanically. Tables 1 through 13 and Figures 2 through 15 summarize the treatments that occurred within each Invasive Plant Management Area.

EKISC conducted post-treatment monitoring of invasive plant control activities at 8 of the 12 properties that FWCP contributed funds to managing. Individual treatment sites were monitored for treatment efficacy and site completion and scores were multiplied together to generate an overall score. All visited treatments sites passed monitoring exams an no re-treatments by EKISC staff or contractors was required. On average, treatments had a combined efficacy and completion score of 88.5%. No Priority 1 species (as defined in EKISC Invasive Plant Priorities by IPMA 2019) were observed at project sites in 2019 during treatment or monitoring visits.

Bull River (Armstrong) Grassland Corridor (NTBC)

Invasive plant treatments were conducted on the NTBC Bull River Armstrong & Grassland Corridor Conservation Properties on August 3rd, and August 5th, 2019. Table 1 and Figure 2 provide details of the treatments that occurred. With collaborative funding from FWCP and NTBC, EKISC was able to treat all high and low priority species in along the main trails, pathways, and main open areas were treated. Target species included Blueweed, St. John's wort, Yellow hawkweed and built on previous year's treatments. Blueweed and Yellow hawkweed infestations are becoming managed throughout the property due to consistent funding and some sites were smaller in size compared to 2018 treatments (e.g., sites 309773 and 339362 treatments covered 0.55 and 3.33 ha in 2018 and 0.0232 and 2.791 ha in 2019, respectively).

Table 1. Details of the invasive plant treatments that occurred on the NTBC Bull River (Armstrong) and Grassland Corridor Property.

Site #	Invasive Plants Found	Treatment Method	Herbicide Used	Amount of Undiluted Herbicide Used (L or Kg)	Area Treated (ha)
309773	Blueweed, St. John's wort	Boomless Nozzle	Clearview	0.0054	0.0232
309778	Blueweed	Boomless Nozzle	Clearview	0.0054	0.0233
339362	Blueweed, Burdock species, Yellow hawkweed	Boomless Nozzle	Tordon 22K	12.5580	2.7906
339363	Burdock species, Sulphur cinquefoil, Yellow hawkweed	Boomless Nozzle	Clearview	0.3720	1.8604
339489	Blueweed, Dalmatian toadflax, Hound's-tongue, Sulphur cinquefoil, Yellow hawkweed	Boomless Nozzle	Clearview	1.2942	6.3953
345109	Blueweed, Hound's-tongue, Yellow hawkweed	Hand Gun	Clearview	0.0160	0.0698
			Total	14.2510	11.1626

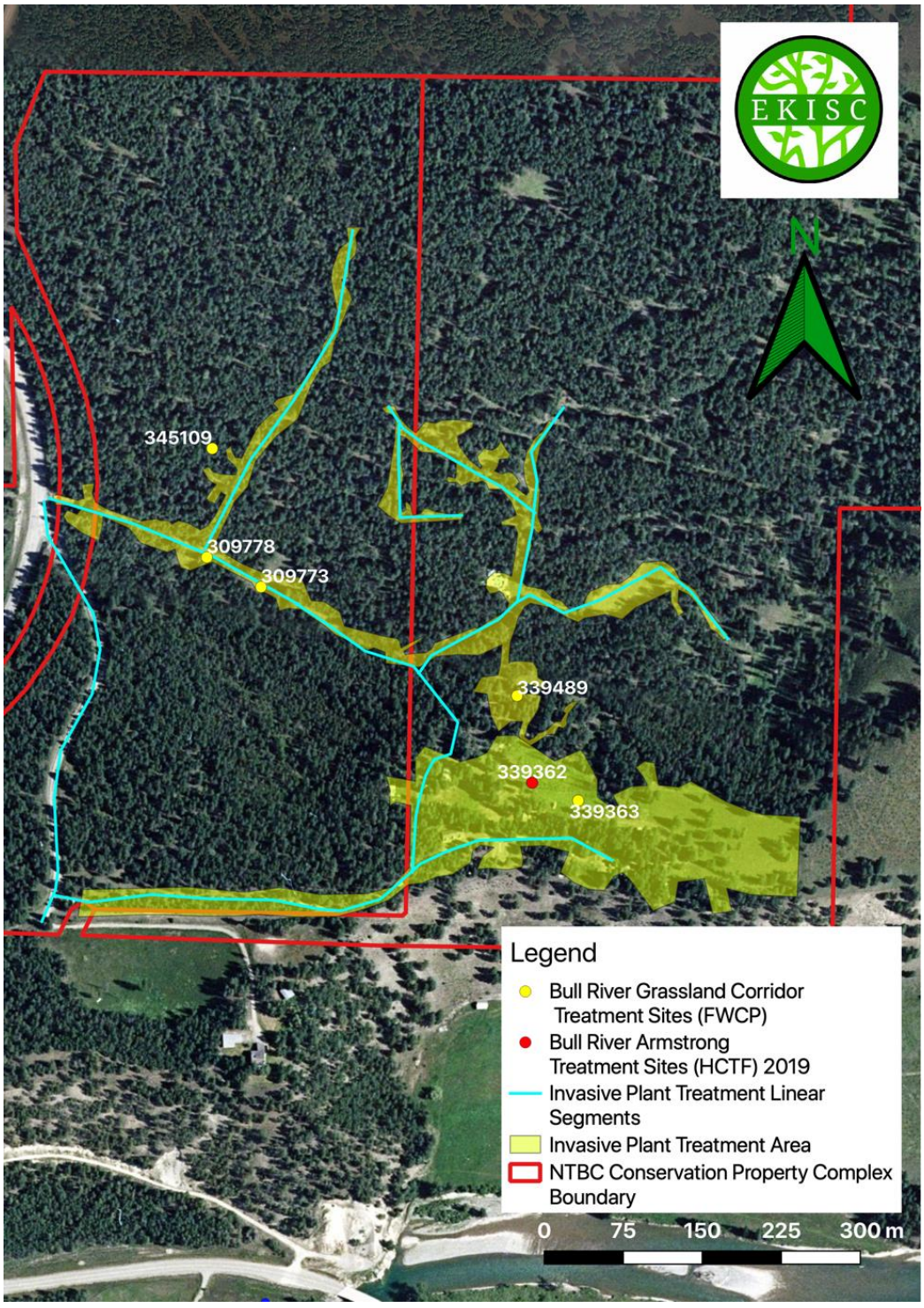

Figure 2. Map of the 2019 invasive plant treatment sites at the Bull River Armstrong and Grassland Corridor Conservation Properties.

Bull River Red Barn (MFLNRORD)

Bull River Red Barn Conservation Site invasive plant treatments were conducted on June 19th, and October 17th, 2019, in areas adjacent to the Red Barn MFLNRORD Conservation property (Figure 3 and Table 2). Treatments focused on the main trails, pathways and access areas (i.e., "vectors of spread") into the conservation area to prevent further spread of invasive plants into the property. This property received a significant amount of targeted treatments in 2018 in preparation for a MLFNRORD seeding project. The project continued in 2019, with additional grass seeding and aeration, and 2018 treatments were successful in reducing the distribution of invasive species in the project area. In 2019, EKISC leveraged funds from FWCP, NTBC and BC Hydro to enable treatment of all targeted high and low priority species. Additional grass seed was applied in the fall on treatment sites in the Red Barn parking area to deter establishment of invasive species and potential reintroduction into the MFLNRORD project site.

Table 2. Details of the invasive plant treatments that occurred adjacent to the Red Barn Conservation Property

Site #	Invasive Plants Found	Treatment Method	Herbicide Used	Amount of Undiluted Herbicide Used (L or Kg)	Area Treated (ha)
243934	Mullein, Russian thistle, Spotted knapweed	Back Pack	Milestone	0.0031	0.0063
342559	Blueweed, Spotted knapweed	Boomless Nozzle	Clearview	0.006	0.3
342534	Yellow hawkweed	Boomless Nozzle	Clearview	0.0370	0.1850
342536	Yellow hawkweed	Boomless Nozzle	Clearview	0.0450	0.2250
342537	Blueweed	Boomless Nozzle	Clearview	0.0030	0.0150
			Total	0.0941	0.7313

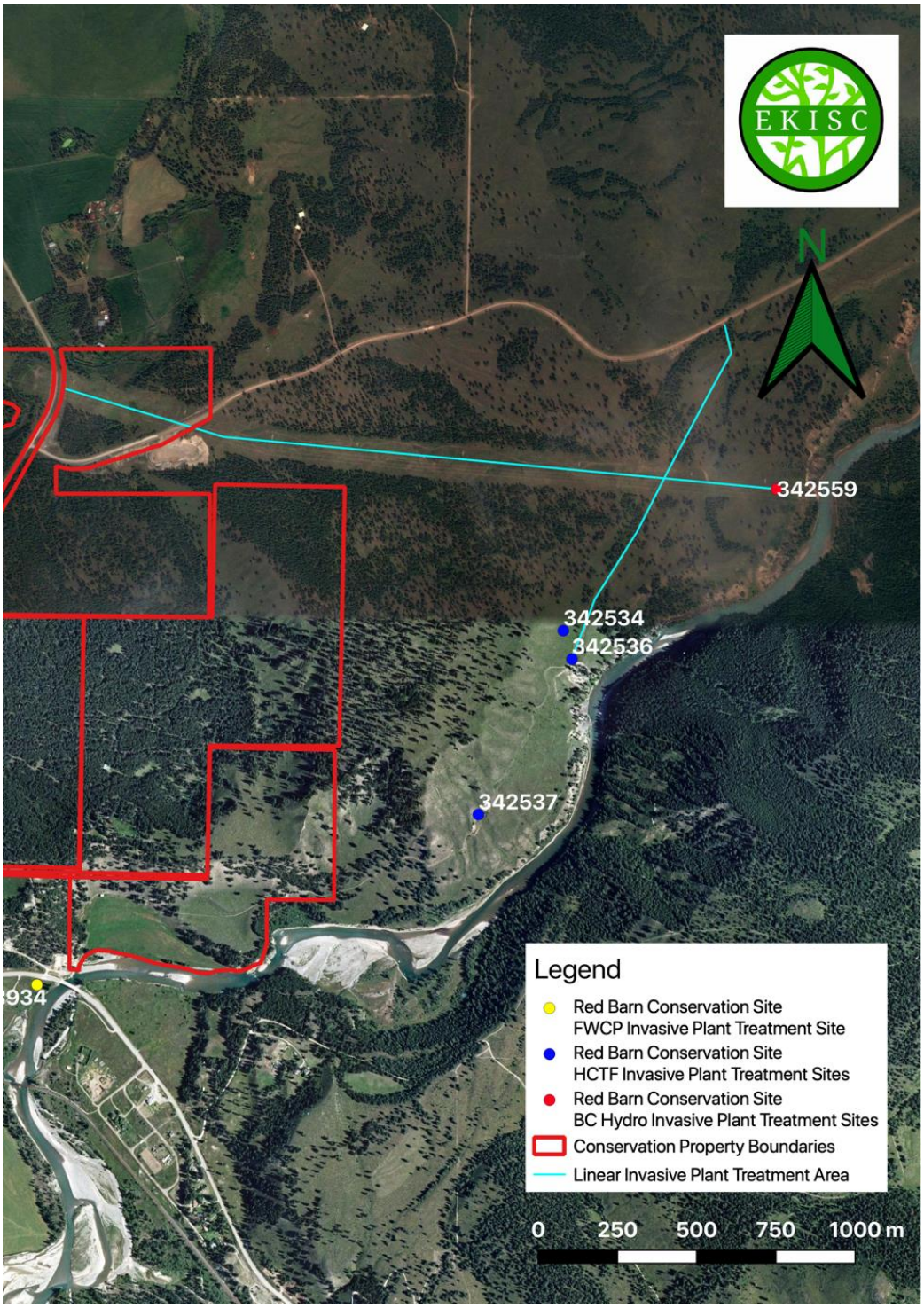

Figure 3. Map of the 2019 invasive plant treatment sites adjacent to the Red Barn Conservation Property.

Bummer Flats (Zirnhelt - MFLNRORD)

Mechanical invasive plant treatments were conducted at the Bummer Flats Zirnhelt property on July 17th, 2019 (Figure 4 and Table 3). The goal at this project location is to contain the high priority invasive species Purple loosestrife – currently the only known occurrence on Crown land within the RDEK. Treatments occurred throughout the southern section of the Bummer Flats wetlands and covered many satellite infestations, utilizing canoes for transport. Plants were hand pulled on floating mats of vegetation found throughout the wetland. 2019 was the 4th year that mechanical invasive plant treatment has occurred on Purple loosestrife in Bummer Flats. Though some satellite infestations appear to have increased in density, the overall infestations remains contained to the Bummers Flats area and has not spread.

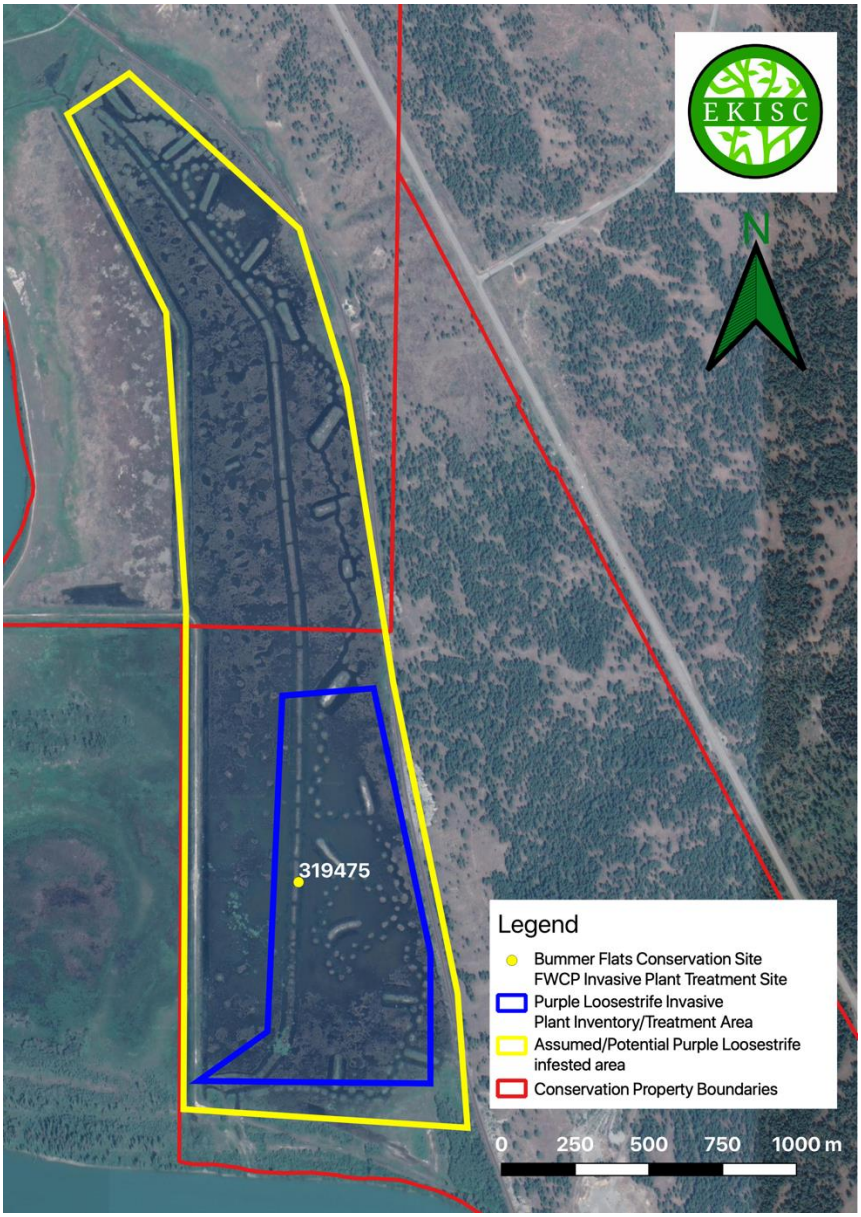

Figure 4. Map of the 2019 invasive plant mechanical treatment at Bummer Flats.

Table 3. Details of the mechanical invasive plant treatments that occurred at Bummer Flats.

Site #	Invasive Plants Found	Treatment Method	Area Treated (ha)
319475	Purple loosestrife	Hand pulling	1.0

Columbia Lake Eastside Wildlife Management Area (MFLNRORD)

Invasive plant treatments were conducted on June 26th, and July 19th, 2019 – the fourth consecutive year that treatments were conducted at this project area. Figure 5 and Table 4 provide details of the treatments that occurred. The Spotted knapweed infestation along the road from Canal Flats to the radio tower, and at the radio tower, has significantly reduced in density and distribution; in 2017, 1.42 ha of Spotted knapweed was treated in this area, compared to 0.37 ha in 2019. Yellow hawkweed is still being maintained and infestations are minimal in areas that were treated in 2017 and 2018.

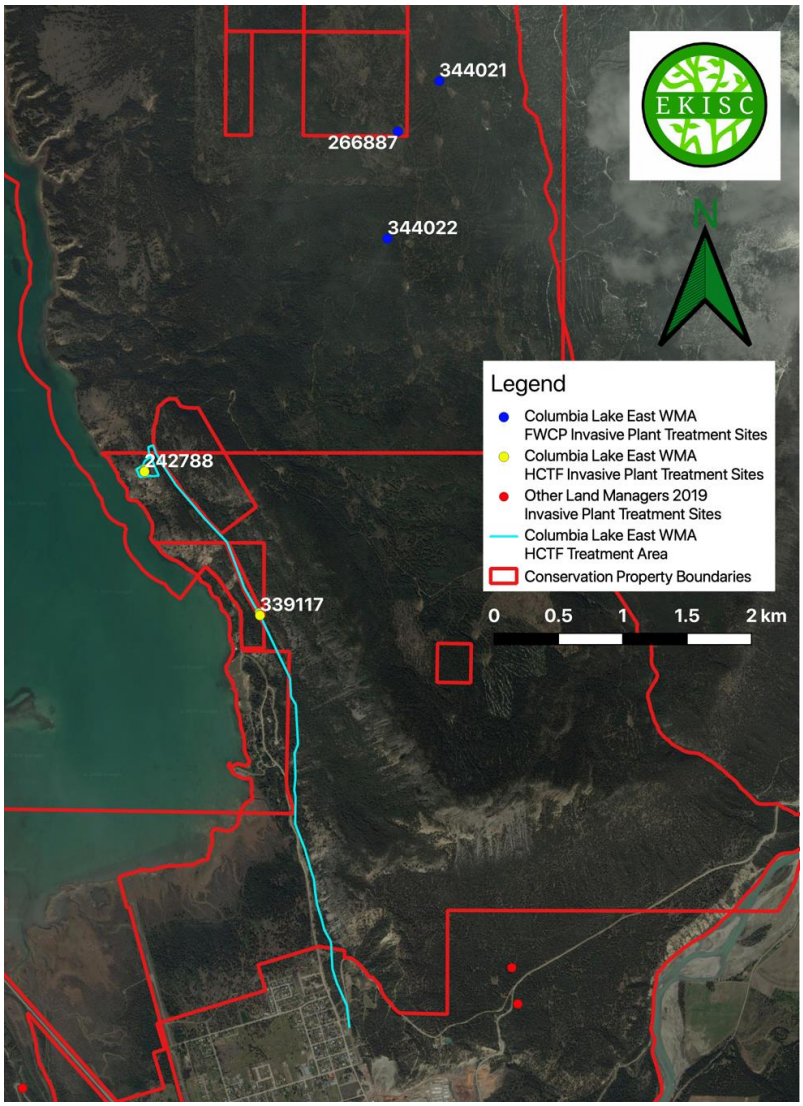

Figure 5. Map of the 2019 invasive plant treatment at Columbia Lake East WMA.

Table 4. Details of the invasive plant treatments that occurred adjacent to the Columbia Lake East WMA that was funded by FWCP.

Site #	Invasive Plants Found	Treatment Method	Herbicide Used	Amount of Undiluted Herbicide Used (L or Kg)	Area Treated (ha)
266887	Canada thistle, Spotted knapweed	Back Pack	Tordon 22K	0.0201	0.0044
344022	Yellow hawkweed	Back Pack	Tordon 22K	0.0013	0.0003
344021	Yellow hawkweed	Back Pack	Tordon 22K	0.0013	0.0003
339117	Spotted knapweed	Boomless Nozzle	Lontrel XC	0.2975	0.4250
242788	Spotted knapweed	Hand Gun	Lontrel XC	0.0525	0.0750
			Total	0.4227	0.5005

Columbia Lake Westside (Sun Lakes – MFLNRORD)

Columbia Lake Westside Sun Lakes invasive plant treatments were conducted on July 23rd, 2019. Figure 6 and Table 5 provide details of the treatments that occurred. Treatments focused on existing Spotted knapweed infestations, most of which are experiencing a reduction in size due to successful previous year's treatments (e.g., sites 211088, 211089, 339121, 339163).

Table 5. Details of the invasive plant treatments that occurred at Columbia Lake West Sun Lakes area.

Site #	Invasive Plants Found	Treatment Method	Herbicide Used	Amount of Undiluted Herbicide Used (L or Kg)	Area Treated (ha)
211088	Spotted knapweed	Boomless Nozzle	Lontrel XC	0.0105	0.0150
211089	Spotted knapweed	Boomless Nozzle	Lontrel XC	0.0280	0.0400
243651	Spotted knapweed	Boomless Nozzle	Lontrel XC	0.0035	0.0050
243652	Spotted knapweed	Boomless Nozzle	Lontrel XC	0.0070	0.0100
251015	Spotted knapweed	Hand Gun	Lontrel XC	0.0210	0.0300
263590	Spotted knapweed	Boomless Nozzle	Lontrel XC	0.0350	0.0500
278363	Spotted knapweed	Boomless Nozzle	Lontrel XC	0.0105	0.0150
339112	Yellow hawkweed	Boomless Nozzle	Lontrel XC	0.0175	0.0250
339120	Yellow hawkweed	Boomless Nozzle	Lontrel XC	0.8785	1.2550
339121	Spotted knapweed	Boomless Nozzle	Lontrel XC	0.0140	0.0200
339123	Yellow hawkweed	Boomless Nozzle	Lontrel XC	0.0210	0.0300
339163	Spotted knapweed	Boomless Nozzle	Lontrel XC	0.0035	0.0050
344041	Spotted knapweed	Hand Gun	Lontrel XC	0.0175	0.0250
			Total	1.0675	1.5250

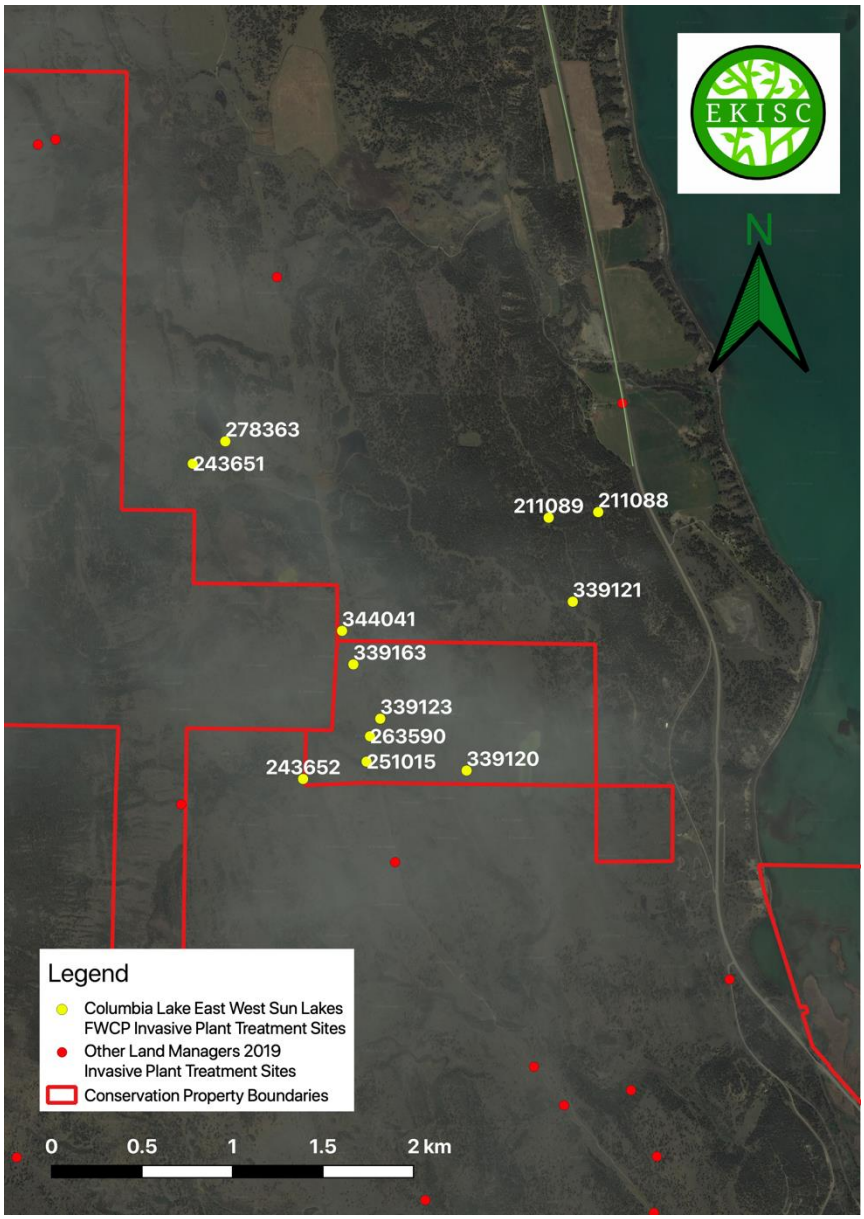

Figure 6. Map of the 2019 invasive plant mechanical treatment at Columbia Lake West Sun Lakes area.

Columbia Lake Westside Conservation Property (NTBC)

Invasive plant treatments on the NTBC Columbia Lake Westside Conservation Property were completed on July 31st, August 1st, August 6th and August 7th, 2019, and were funded by NTBC and FWCP. Figure 7 and Tables 6 and 7 provide details of the treatments that occurred. Funding allocated for this area was adequate to survey the entire property and subsequently treat all high and medium priority plant infestations. Lower priority plants, such as Yellow hawkweed, were also treated, but found in too great of distribution and densities to treat all infestations. One Scentless chamomile site was treated; however, many Scentless chamomile sites are found along the Crown Forest Service Road (which leads into the conservation property) and threatens further invasion. Common tansy continues to be a priority at this site, and The Orange hawkweed site that was treated in 2017 and monitored in 2018 continues to

be “No Weed Found,” and the majority of treatments were targeted for existing Spotted knapweed infestations.

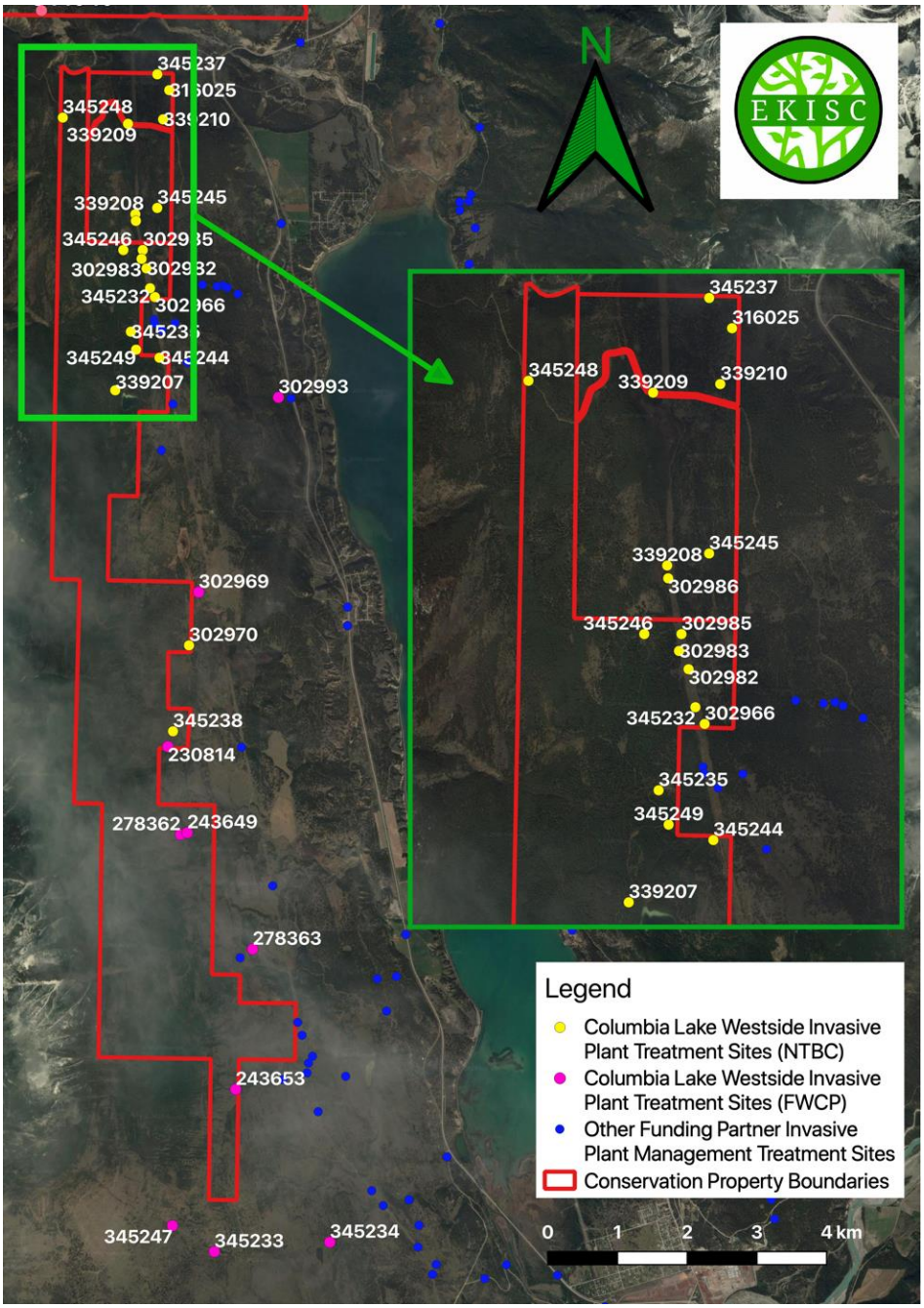

Figure 7. Map of the 2019 invasive plant treatment sites at the Columbia Lake Westside Conservation Property.

Table 6. Details of the invasive plant treatments that occurred on the Columbia Lake Westside Conservation Property.

Site #	Invasive Plants Found	Treatment Method	Herbicide Used	Amount of Undiluted Herbicide Used (L or Kg)	Area Treated (ha)
230814	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0070	0.0100
243649	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0035	0.0050
243653	Spotted knapweed	Chemical - Hand Gun	Lontrel XC	0.1925	0.2750
278362	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0175	0.0250
278363	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0245	0.0350
302969	Spotted knapweed	Chemical - Hand Gun	Lontrel XC	0.0035	0.0050
302993	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0035	0.0050
345233	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0280	0.0400
345234	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0070	0.0100
345247	Spotted knapweed, St. John's wort	Chemical - Back Pack	Clearview	0.0009	0.0050
302966	Common tansy	Chemical - Back Pack	Clearview	0.0009	0.0050
302970	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel 360	0.0140	0.0200
302982	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel 360	0.0035	0.0050
302983	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel 360	0.0420	0.0600
302985	Common tansy	Chemical - Back Pack	Clearview	0.0009	0.0050
302986	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel 360	0.0140	0.0200
316025	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel 360	0.0210	0.0300
339207	Common tansy	Chemical - Back Pack	Clearview	0.0009	0.0050
339208	Dalmatian toadflax	Chemical - Back Pack	Clearview	0.0009	0.0050
339209	Common tansy	Chemical - Back Pack	Clearview	0.0009	0.0050
339210	Yellow hawkweed	Chemical - Boomless Nozzle	Lontrel 360	0.0700	0.1000
345232	Spotted knapweed	Chemical - Hand Gun	Lontrel 360	0.0028	0.0040
345232	Yellow hawkweed	Chemical - Hand Gun	Lontrel 360	0.0252	0.0360
345235	Spotted knapweed	Chemical - Hand Gun	Lontrel 360	0.0035	0.0050
345237	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel 360	0.0070	0.0100
345238	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel 360	0.0035	0.0050
345244	Yellow hawkweed	Chemical - Boomless Nozzle	Lontrel 360	0.0280	0.0400
345245	Yellow hawkweed	Chemical - Boomless Nozzle	Lontrel 360	0.0700	0.1000
345246	Yellow hawkweed	Chemical - Boomless Nozzle	Lontrel 360	0.1400	0.2000
345248	Scentless chamomile	Chemical - Boomless Nozzle	Lontrel 360	0.0105	0.0150
345249	Common tansy	Chemical - Back Pack	Clearview	0.0026	0.0151
			Total	0.7472	1.1051

Table 7. Details of the invasive plant treatments that occurred on the Columbia Lake Westside Conservation Property continued.

Site #	Invasive Plants Found	Treatment Method	Herbicide Used	Amount of Undiluted Herbicide Used (L or Kg)	Area Treated (ha)
302966	Common tansy	Chemical - Back Pack	Clearview	0.0009	0.0050
302970	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel 360	0.0140	0.0200
302982	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel 360	0.0035	0.0050
302983	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel 360	0.0420	0.0600
302985	Common tansy	Chemical - Back Pack	Clearview	0.0009	0.0050
302986	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel 360	0.0140	0.0200
316025	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel 360	0.0210	0.0300
339207	Common tansy	Chemical - Back Pack	Clearview	0.0009	0.0050
339208	Dalmatian toadflax	Chemical - Back Pack	Clearview	0.0009	0.0050
339209	Common tansy	Chemical - Back Pack	Clearview	0.0009	0.0050
339210	Yellow hawkweed	Chemical - Boomless Nozzle	Lontrel 360	0.0700	0.1000
345232	Spotted knapweed	Chemical - Hand Gun	Lontrel 360	0.0028	0.0040
345232	Yellow hawkweed	Chemical - Hand Gun	Lontrel 360	0.0252	0.0360
345235	Spotted knapweed	Chemical - Hand Gun	Lontrel 360	0.0035	0.0050
345237	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel 360	0.0070	0.0100
345238	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel 360	0.0035	0.0050
345244	Yellow hawkweed	Chemical - Boomless Nozzle	Lontrel 360	0.0280	0.0400
345245	Yellow hawkweed	Chemical - Boomless Nozzle	Lontrel 360	0.0700	0.1000
345246	Yellow hawkweed	Chemical - Boomless Nozzle	Lontrel 360	0.1400	0.2000
345248	Scentless chamomile	Chemical - Boomless Nozzle	Lontrel 360	0.0105	0.0150
345249	Common tansy	Chemical - Back Pack	Clearview	0.0026	0.0151
			Total	0.4593	0.6901

Hoodoos Conservation Property (NTBC)

Invasive Plant treatments on the Hoodoos Conservation Property were completed on July 29th, and July 30th, 2019 and were funded by FWCP and BC Hydro. Figure 8 and Table 8 provide details of the treatments that occurred. Funding levels in 2018 enabled the property to be thoroughly surveyed and chemically treated. In 2019 however, due to decreased funding levels, the focus of invasive plant treatments was along the access roads and vectors of spread. Prioritized treatments included the various Spotted knapweed sites that exist throughout the property, and a large Diffuse knapweed site (243929) that was treated extensively in 2018. Previous treatments have reduced the density and size of some infestations; for example, site 243929 treatments in 2018 covered 0.266 ha, compared to 0.005 ha in 2019. Grass seed was applied at some of the treatment locations as spot-treatments.

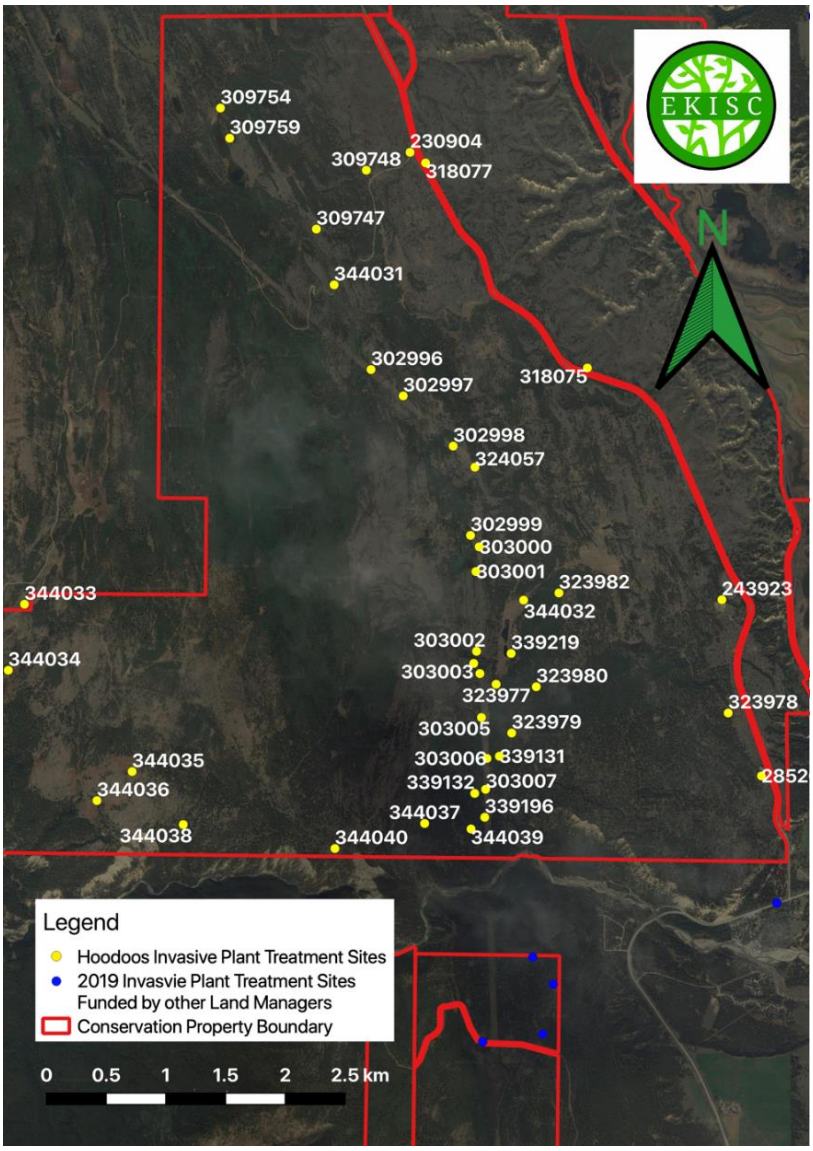

Figure 8. Map of the 2019 FWCP invasive plant treatment sites at the NTBC Hoodoos Conservation Property.

Table 8. Details of the invasive plant treatments that occurred on the NTBC Hoodoos Conservation Property.

Site #	Invasive Plants Found	Treatment Method	Herbicide Used	Amount of Undiluted Herbicide Used (L or Kg)	Area Treated (ha)
230904	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0140	0.0200
243923	Diffuse knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0035	0.0050

285261	Diffuse knapweed, Spotted knapweed	Chemical - Hand Gun	Lontrel XC	0.0210	0.0300
302996	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0035	0.0050
302997	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0280	0.0400
302998	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0105	0.0150
302999	Spotted knapweed	Chemical - Hand Gun	Lontrel XC	0.0035	0.0050
303000	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0105	0.0150
303001	Spotted knapweed	Chemical - Hand Gun	Lontrel XC	0.0105	0.0150
303002	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0140	0.0200
303003	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0105	0.0150
303004	Spotted knapweed	Chemical - Hand Gun	Lontrel XC	0.0140	0.0200
303005	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0245	0.0350
303006	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0210	0.0300
303007	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0175	0.0250
309747	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0420	0.0600
309748	Spotted knapweed	Chemical - Hand Gun	Lontrel XC	0.0035	0.0050
309754	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0140	0.0200
309759	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0035	0.0050
318075	Diffuse knapweed, Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0280	0.0400
318077	Spotted knapweed	Chemical - Hand Gun	Lontrel XC	0.0105	0.0150
323977	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0070	0.0100
323978	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0070	0.0100
323979	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0210	0.0300
323980	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0035	0.0050
323982	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0175	0.0250
324042	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0105	0.0150
324057	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0070	0.0100
339131	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0035	0.0050
339132	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0105	0.0150
339196	St. John's wort	Chemcial - Back Pack	Aspect	0.0450	0.0100
339219	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0070	0.0100
344031	Spotted knapweed	Chemical - Hand Gun	Lontrel XC	0.0035	0.0050
344032	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0070	0.0100
344033	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0140	0.0200
344034	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.1155	0.1650
344035	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0035	0.0050
344036	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0175	0.0250
344037	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0700	0.1000
344038	Diffuse knapweed, Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0315	0.0450
344039	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0700	0.1000
344040	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0140	0.0200
			Total	0.7940	1.0800

Kootenay River Ranch (NCC)

Invasive plant treatments on the NCC Kootenay River Ranch were completed on July 13th, July 21st, July 22nd, and July 30th, 2019 and was a joint effort from NCC, FWCP, MFLNRORD "Wildfire Funding" and Ministry of Transportation and Infrastructure (MOTI). With this leveraged funding, EKISC was able to chemically treat higher priority Diffuse and Spotted knapweed sites, many of which were treated in 2018, as many of the skid trails are still experiencing an increase in knapweed spread. Yellow hawkweed infestations are continuing to spread into the property from Crown land and are reaching distributions that may become too large to manage. Funding in 2019 was not adequate to properly address this. Though active grazing in the area is still a concern for the spread of invasive species, like Spotted and Diffuse knapweed, it does appear to be better managed than it was in the past. Grass seed was applied to various areas throughout the property, and native grasses and forbs have continued to increase in particular in the wildfire affected areas. Figure 9 and Table 9 provide details of the treatments that occurred.

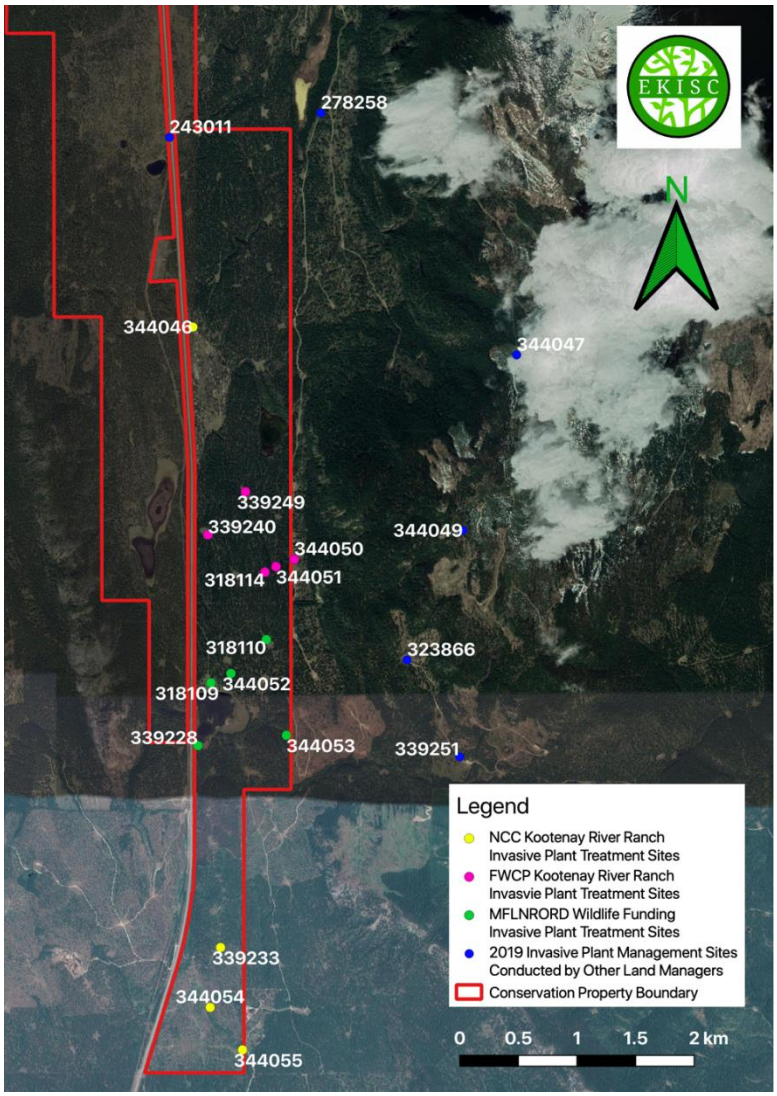

Figure 9. Map of 2019 invasive plant treatment sites at the NCC Kootenay River Ranch Property.

Table 9. Details of the invasive plant treatments that occurred on NCC Kootenay River Ranch property funded by FWCP.

Site #	Invasive Plants Found	Treatment Method	Herbicide Used	Amount of Undiluted Herbicide Used (L)	Area Treated (ha)
318114	Spotted knapweed	Chemical - Boomless Nozzle	Milestone	0.0600	0.1500
339249	Spotted knapweed	Chemical - Boomless Nozzle	Milestone	0.2300	0.5750
344050	Spotted knapweed, St. John's wort, Yellow hawkweed	Chemical - Boomless Nozzle	Milestone	0.2500	0.6251
344051	Spotted knapweed	Chemical - Boomless Nozzle	Milestone	0.0600	0.1500
339240	Spotted knapweed, Yellow hawkweed	Chemical - Boomless Nozzle	Milestone	0.5200	1.3000
339233	Spotted knapweed	Chemical - Boomless Nozzle	Milestone	0.1420	0.3550
344046	Spotted knapweed, Yellow hawkweed	Chemical - Boomless Nozzle	Milestone	0.3100	0.7751
344054	Spotted knapweed	Chemical - Boomless Nozzle	Milestone	0.0340	0.0850
344055	Spotted knapweed	Chemical - Boomless Nozzle	Milestone	0.0140	0.0350
318109	Diffuse knapweed	Chemical - Boomless Nozzle	Clearview	0.02	0.1
318110	Spotted knapweed	Chemical - Boomless Nozzle	Clearview	0.03	0.15
339228	Diffuse knapweed, Spotted knapweed	Chemical - Boomless Nozzle	Clearview	0.02	0.1
344052	Diffuse knapweed	Chemical - Boomless Nozzle	Clearview	0.1	0.5
344053	Spotted knapweed	Chemical - Boomless Nozzle	Clearview	0.03	0.15
			Total	1.82	5.0502

Lower Norbury/O'Grady Conservation Property (NTBC)

Invasive plant treatments on the NTBC Lower Norbury/O'Grady property was completed on July 16th, and August 20th, 2019 and were solely funded by FWCP. Figure 10 and Table 10 provide details of the treatments that occurred. The Blueweed infestation at the Lower Norbury/O'Grady property continues to be the primary concern, with high distribution and density throughout the property and a well-established seed bank. In 2018, extensive treatments were focused on Blueweed, patches of Yellow hawkweed and Sulphur cinquefoil on all roads and trails, and behind the barn. In 2019, treatments focused on the large field at the south entrance of the property and continued to the homestead. Although broadcast spraying is helping to reduce the Blueweed infestation, it has resulted in areas of bare ground that may be vulnerable to establishment of new invasive species or continued germination from the Blueweed seed

bank. Though we expect the herbicide residual to deter seed germination for 1-2 years, it is recommended to continue with grass seed, spot treatments, and monitoring for subsequent years. Over 12 kg of grass seed was spread on approximately half of site # 303102 in the fall of 2019. Unfortunately, there was not enough grass seed to cover the entire treatment area of approximately 11.6 ha.

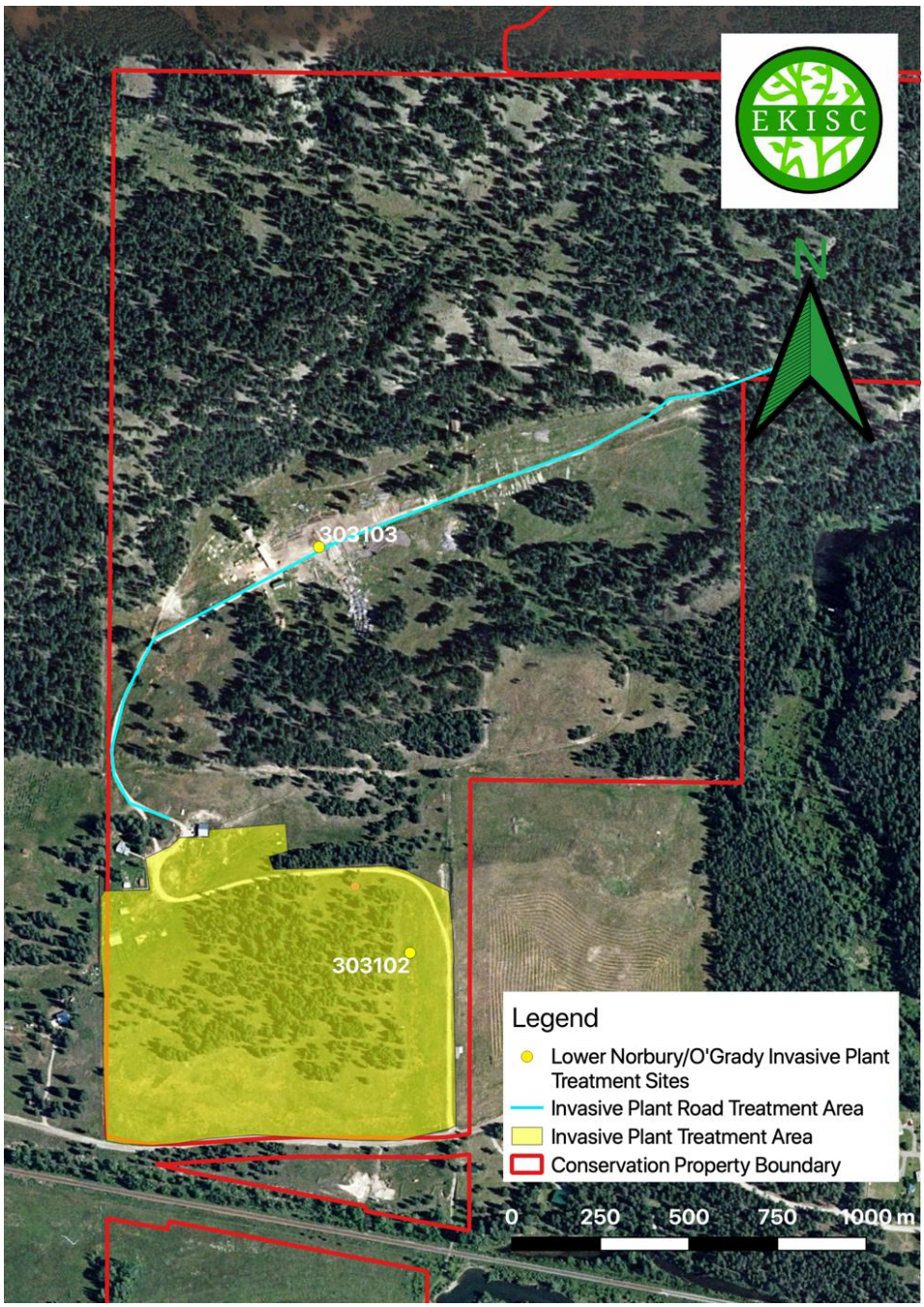

Figure 10. Map of the 2019 invasive plant treatment sites at the NTBC Lower Norbury/O'Grady Conservation Property.

Table 10. Details of the invasive plant treatments that occurred on NTBC Lower Norbury/O'Grady Conservation Property.

Site #	Invasive Plants Found	Treatment Method	Herbicide Used	Amount of Undiluted Herbicide Used (L or Kg)	Area Treated (ha)
303102	Blueweed, St. John's wort, Sulphur cinquefoil, Yellow hawkweed	Chemical - Boomless Nozzle	Tordon 22K	46.0460	10.2325
303103	Blueweed, Mullein	Chemical - Boomless Nozzle	Clearview	0.3050	1.3256
			Total	46.3510	11.5581

Luxor Linkage (NCC)

Invasive plant treatments on the NCC Luxor Linkage property was completed on August 8th and 9th, 2019 with funds from both NCC and FWCP. Figure 11 and Table 11 provide details of the treatments that occurred.

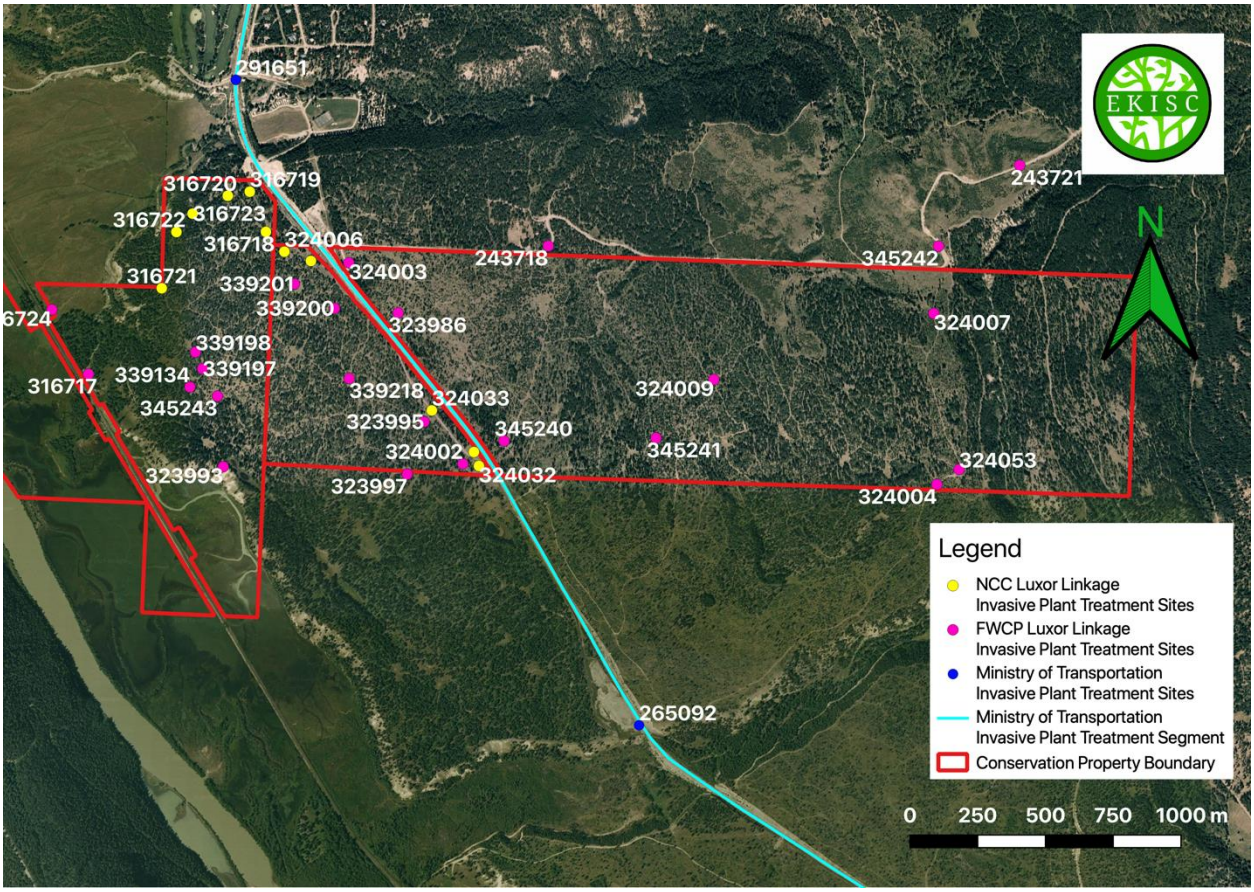

Figure 11. Map of the 2019 invasive plant treatment sites at the NCC Luxor Linkage Property.

Table 11. Details of the invasive plant treatments that occurred on NCC Luxor Linkage property.

Site #	Invasive Plants Found	Treatment Method	Herbicide Used	Amount of Undiluted Herbicide Used (L)	Area Treated (ha)
243718	Burdock species	Chemical - Hand Gun	Aspect	0.0225	0.0050
243721	Diffuse knapweed	Chemical - Boomless Nozzle	Aspect	0.0225	0.0050
316717	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0560	0.0800
316724	Spotted knapweed	Chemical - Hand Gun	Lontrel XC	0.1050	0.1500
323986	Leafy spurge	Chemical - Boomless Nozzle	Aspect	0.4725	0.1050
323993	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0035	0.0050
323995	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0105	0.0150
323997	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0035	0.0050
324002	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0105	0.0150
324003	Spotted knapweed	Chemical - Boomless Nozzle	Aspect	0.0675	0.0150
324004	Spotted knapweed	Chemical - Boomless Nozzle	Aspect	0.1800	0.0400
324007	Yellow hawkweed	Chemical - Boomless Nozzle	Aspect	0.1125	0.0250
324009	Spotted knapweed	Chemical - Boomless Nozzle	Aspect	0.0450	0.0100
324053	Spotted knapweed	Chemical - Boomless Nozzle	Aspect	0.0675	0.0150
339119	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0070	0.0100
339134	Leafy spurge	Chemical - Hand Gun	Aspect	0.4950	0.1100
339197	Leafy spurge	Chemical - Boomless Nozzle	Aspect	0.2025	0.0450
339198	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0070	0.0100
339200	Leafy spurge	Chemical - Hand Gun	Aspect	0.1125	0.0250
339201	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0035	0.0050
339218	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0175	0.0250
345240	Spotted knapweed	Chemical - Boomless Nozzle	Aspect	0.0675	0.0150
345241	Spotted knapweed	Chemical - Boomless Nozzle	Aspect	0.0450	0.0100
345242	Spotted knapweed	Chemical - Boomless Nozzle	Aspect	0.1125	0.0250
345243	Leafy spurge	Chemical - Hand Gun	Aspect	0.6683	0.1485
345243	Spotted knapweed	Chemical - Hand Gun	Aspect	0.0743	0.0165
316718	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0175	0.0250
316719	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0420	0.0600
316720	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0140	0.0200
316721	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0070	0.0100
316722	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0070	0.0100
316723	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0105	0.0150
324006	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0245	0.0350
324031	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.1330	0.1900
324032	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0210	0.0300
324033	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.2800	0.4000
324041	Spotted knapweed	Chemical - Boomless Nozzle	Lontrel XC	0.0910	0.1300
			Total	3.639	1.8600

Invasive plant treatments at both the west and east side of the Luxor Linkage property were successful. Though many Spotted knapweed sites were targeted for treatment in 2019, Leafy spurge (first identified here by EKISC staff in 2017) is the priority on this property. Leafy spurge treatments occurred at four sites

and covered an area of 0.4335 ha, up from 0.3750 ha in 2018. Infestations are expected to increase in size the first year following treatments, as plants will deploy resources to survive. We expect to see observable control in 2020. In addition, some plants connected to existing Leafy spurge infestations are under the 'dripline' of trees, and with the herbicide that is used to effectively treat Leafy spurge (Aspect), it is expected to see some degree of herbicide damage to a few of the trees on the property.

Figure 12. Photo of successful Leafy spurge treatment leaving behind healthy grass cover to provide competition to any new germinating invasive plants.

Figure 13. Photo of successful Leafy spurge treatments encroaching under the dripline of surrounding trees.

The old highway through the property is the main infestation location of Spotted knapweed, and the primary source for spread into the property (presumably by wildlife walking and grazing through the infestation and onto the property transporting seeds). This site has been the target for treatment in the past, and very few 'old' plants were observed; only an abundance of young rosettes was present which indicates past treatments have been successful.

Middle Bummers

Invasive plant treatments at Middle Bummers were completed on September 19th, 2019. Figure 14 and Table 12 provide details of the treatments that occurred. FWCP funding was prioritized for treating existing Spotted knapweed infestations located outside of the Pesticide Free Zone. Treatments locations had a positive response to herbicide application, and grass seed was applied to observed bare ground areas near treatment locations.

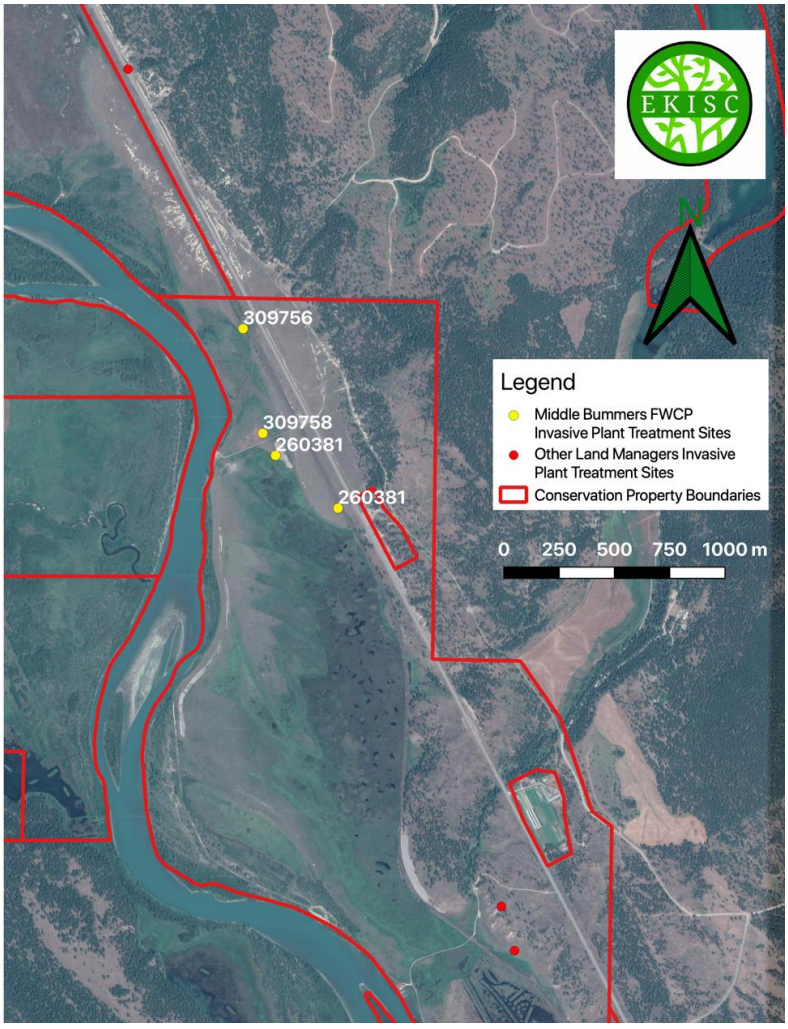

Figure 14. Map of the 2019 invasive plant treatment sites at the Middle Bummers.

Table 12. Details of the invasive plant treatments that occurred at Middle Bummers.

Site #	Invasive Plants Found	Treatment Method	Herbicide Used	Amount of Undiluted Herbicide Used (L)	Area Treated (ha)
260381	Spotted knapweed	Boomless Nozzle	Milestone	0.2900	0.7300
309756	Spotted knapweed	Boomless Nozzle	Milestone	0.1900	0.4750
309758	Spotted knapweed	Boomless Nozzle	Milestone	0.0800	0.2000
			Total	0.5600	1.4050

Premier Ridge, 3 Sons Pommier

Invasive plant treatments on the Premier Ridge, 3 Sons Pommier area were completed on September 19th, 2019 and were focused on existing Spotted knapweed infestations occurring throughout the property. Figure 15 and Table 13 provide details of the treatments that occurred. 2019 was the first year that treatment occurred at this project area.

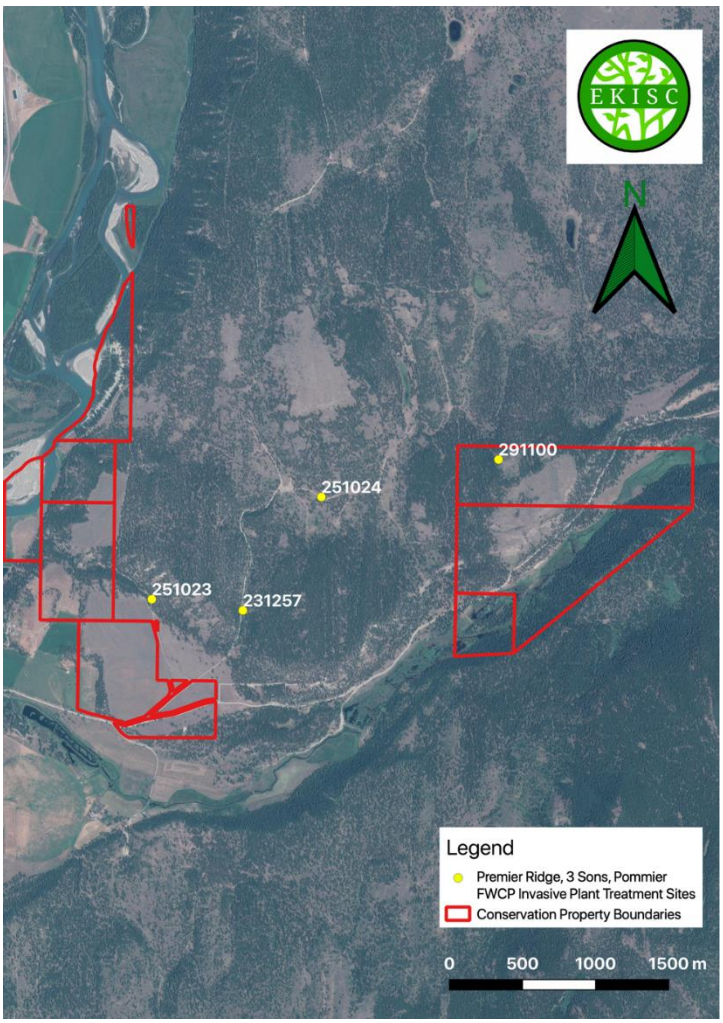

Figure 15. Map of the 2019 invasive plant treatment sites at the Premier Ridge, 3 Sons Pommier area.

Table 13. Details of the invasive plant treatments that occurred on the Premier Ridge, 3 Sons Pommier area.

Site #	Invasive Plants Found	Treatment Method	Herbicide Used	Amount of Undiluted Herbicide Used (kg)	Area Treated (ha)
231257	Spotted knapweed	Boomless Nozzle	Clearview	0.0050	0.0250
250125	Spotted knapweed	Boomless Nozzle	Clearview	0.0250	0.1250
251023	Spotted knapweed	Boomless Nozzle	Clearview	0.0150	0.0750
251024	Spotted knapweed	Boomless Nozzle	Clearview	0.0050	0.0250
291100	Spotted knapweed	Boomless Nozzle	Clearview	0.0050	0.0250
			Total	0.0550	0.2750

Additional Treatment and Survey Locations

EKISC conducted additional invasive management activities on the following areas that are aligned with the IPMRPA Project, but did not use specifically use IPMRPA project funds:

- Field scabious control and site restoration in Radium. This event involved 7 volunteers, 6 EKISC staff members, and 30 + appreciative trail users. Five bags of the high priority species Field scabious were removed from the site, 145 native trees, shrubs, grass, and sedge plugs were planted with new soil, compost, and mulch, and a new boot brush sign was installed. We also engaged our membership and others through our social media platforms and newsletter by providing posts and articles regarding this project.
- Blueweed sites in the Columbia Valley were prioritized for treatment, and a Blueweed mechanical treatment was completed by EKISC staff in an additional riparian area in the Elk Valley.
- The Columbia Wetlands Wildlife Management Area (CWWMA) was prioritize for Leafy spurge treatments, and then Canadian Wildlife Service (CWS) Wilmer Subunit was treated for Leafy spurge and other high priority species.
- Annual survey and treatment of the high priority Japanese knotweed site in the Elk Valley.
- The high priority species Water parsnip was surveyed and discussed with relevant land managers; EKISC plans on continuing treatments in 2020 and work with adjacent land managers/jurisdictions on strategy.
- Additional invasive plant inventory and treatments were completed in Upland/Dryland areas such as Columbia Lake East Conservation Properties Big Horn Sheep winter range, Wigwam Flats area Big Horn Sheep winter range, and Bull River Ungulate Winter Range.

Funding

FWCP funds were utilized for survey, treatment and monitoring at all project areas discussed within this report. Additional dollars, as outlined within the 2019 Statement of Account, were used for purchasing grass seed and field expenses, and for project administration. In addition to funds provided by FWCP for invasive plant management activities at the 12 project sites, NTBC contributed funds to two properties (Bull River Conservation Property, Columbia Lake Westside Conservation Property), NCC contributed funds to two properties (Kootenay River Ranch, Luxor Linkage), MFLNRORD contributed funds to three properties (Bull River Red Barn, Columbia Lake Eastside, Kootenay River Ranch) and BC Hydro contributed funds to two properties (Bull River Red Barn, Hoodoos Conservation Property).

Discussion and Program Recommendations

EKISC worked with project partners to identify and prioritize high-value conservation lands for invasive species surveys, treatments and monitoring during the 2019 field season, marking year 5 of 8 of the IPMRPA Project. Twelve conservation lands were identified for treatments to take place and treatments were coordinated so they occurred at the same time as nearby properties to maximize funding dollars and better utilize a landscape-level approach. Additional management activities occurred on NTBC, NCC, MFLNRORD and BC Parks managed properties but were not included in this report.

Invasive plant surveys and treatments occurred between July 26th and October 17th and were prioritized for summer herbicide application when plants were in flower or fully "greened-out." Additional treatments were completed later in the fall, as some plants still respond favorably to later herbicide applications. Across the 12 project areas, 130 invasive plant treatments were completed by contractors and EKISC staff, covering an area of 35.56 hectares. To assess success of invasive species management at project sites, EKISC looks at: 1) short term success of invasive plant treatments through seasonal efficacy and completion monitoring of project sites; 2) long term success of invasive plant treatments through permanent plot monitoring (EKISC has permanent sample plots located throughout the Regional District of East Kootenay linked to other projects which are monitored for change in invasive species presence and density over time; 3) prevention of new invasive species introductions through education and outreach and promoting best management practices; and 4) stakeholder engagement and participation.

At treatment locations, post treatment efficacy and completion monitoring by EKISC staff indicate that where herbicide application is taking place, treatments are complete and invasive species are responding favorably. On average, treatments had a combined efficacy and completion score of 88.5%, illustrating that contractors and EKISC staff are efficiently treating targeted invasive plant locations, and selected herbicides and applications are effective in plant management. In 2019, no Priority 1 species were observed by contractors or EKISC staff in IPMRPA project areas. Though we did not visit all previous project areas, we can still see this as a positive result of the overall invasive plant management for the IPMRPA project and adjacent areas, as we are not seeing new introductions of high priority invasive species. Most treatment locations are managing existing infestations.

At some project treatment locations, we have observed a reduction in both the amount of herbicide applied and the overall treatment area. However, some treatment locations increased in 2019 compared to 2018. This may be due to the invasive species response (e.g., Leafy spurge infestations often increase in size after the first treatment in an attempt to "outgrow" the stress), because previous allocated funding did not enable treatment of the entire area, or the site increased in size due to favorable conditions for release of the species seed bank. In addition, because funding varies from year to year, and priorities for invasive species management across the landscape can change based on land manager site-specific objectives, we often do not have resources to inventory, treat and monitor the same treatment sites year after year. Therefore, we apply a rotating and/or triage approach to many of our treatment locations.

In 2019, EKISC also completed the third round of data collection at permanent research trial sample locations during the 2019 field season. This research trial was established in 2017 with support from the Columbia Basin Trust and Grassland Rangeland Enhancement Program to help EKISC understand how effective current herbicide application techniques are for managing invasive plants in the East Kootenay

(i.e., “is what we are doing working?”). Appendix A summarizes site establishment, methods, and observations to date for this trial.

Based on 2019 treatment monitoring visits conducted by EKISC staff, there are various site-specific recommendations for subsequent IPMRPA project years:

- Bull River Armstrong and Grassland Corridor Conservation Properties: This project site has received consistent funding for the last several years, resulting in the Yellow hawkweed infestations being at a stage where contractors and EKISC staff believe reduction and/or eradication is possible and the existing Blueweed infestations are under control. We recommend continuing to prioritize this project site for invasive plant management activities.
- Bummer Flats Zirnhelt property: As the Bummer Flats wetland is currently the only known occurrence of Purple loosestrife on Crown land in the East Kootenay region, it is recommended that treatments continue in subsequent years. EKISC is working on finding additional partners to work on this initiative to reduce site size and enable additional inventory of the area and has requested a biocontrol agent for release from the MFLNRORD Invasive Plant Specialist. Though mechanical treatment is not ideal, as Purple loosestrife is difficult to completely remove and can reproduce through fragmentation, chemical control is not an option due to its riparian/wetland habitat.
- Columbia Lake East WMA: EKISC recommends continuing to prioritize treatments for this conservation property, in particular, to keep moment going on the large Spotted Knapweed infestation at and adjacent to the radio tower. Though the infestation has decreased in size from successful consecutive treatments, we anticipate a large seed bank being present that will need continued management. In areas beyond the radio tower, Yellow Hawkweed is starting to become established in open areas and roadsides. A thorough invasive plant inventory past the radio tower is needed to determine the extent of the Yellow Hawkweed infestation, likely with additional chemical treatments to deter its expansion into the WMA.
- Columbia Lake Westside Conservation Property: It is recommended to continue annual invasive plant treatments at the Columbia Lake Westside property to manage the higher priority infestations like Common Tansy, Dalmatian Toadflax, Scentless Chamomile and Spotted Knapweed.
- Hoodoos Conservation Property: It is recommended to prioritize this area for funding (i.e., increase funding allocation for 2020). The Hoodoos Conservation Property was last treated extensively in 2018, and EKISC expects herbicide residuals to be inactive by the 2020 field season, causing a potential influx of Spotted Knapweed from the seedbank.
- Kootenay River Ranch Property: Although treatments occurred in 2019 in collaboration with NCC, FWCP, MFLNRORD Wildfire, and MOTI, funding was still not adequate to treat the extent of Spotted Knapweed occurring on trails and disturbed areas. EKISC recommends increasing funding at this location in 2020, if possible, to target all trails and disturbed areas for treatment. The distribution of Yellow Hawkweed at this site is likely too large to manage at this time.
- Lower Norbury/O’Grady Conservation Property: The existing herbicide residual is expected to deter Blueweed seed germination for 1-2 years. Although grass seed was applied to part of this conservation property in the fall of 2019, it is recommended to return here for monitoring and additional grass seed application in 2020 to ensure that bare ground is covered and competition to germinating Blueweed seeds is provided (the site is large and additional funds would need to be allocated to seed). Chemical invasive plant treatments in 2020 should focus on areas

surrounding the mill site, as logging in this area is planned for the near future. It is anticipated this area would require 3 days of chemical treatment to complete.

- Luxor Linkage Conservation Property: Continued treatment of this area is necessary to eradicate germinating plants from the seed bank and prevent new seeds from setting, and Leafy spurge treatments should continue to be prioritized. It is also recommended to seed the areas of dense Spotted knapweed infestations after herbicide treatment to provide competition to invasive species. EKISC also recommends that land managers meet with the Recreation and Control Services Officer ("Weed Officer") of the East Kootenay Regional District to discuss invasive plant management enforcement on the surrounding private properties. There are many private properties that are directly adjacent to the Luxor Linkage property that have invasive plant infestations which are spreading onto the Luxor Linkage property or have high potential to spread onto the conservation property. It is necessary these infestations are addressed for the long-term ecosystem health of this project site.

EKISC also recommends continuing to prioritize areas for grass seed application, and to allocate more project funds toward this project component. In 2019, grass seed was applied to six of the project areas, in locations where bare ground exists and native grasses and forbs are not readily reestablishing treatment sites. In some of these locations, such as Kootenay River Ranch, grass seed is assisting with native cover establishment. In others, however, such as Lower Norbury/O'Grady, a substantial increase in grass seeding effort will be needed to properly cover the extent of exposed soil. This site should be monitored again in 2020 to observe site response to the 2019 grass seed application.

Challenges and Lessons Learned

There are many challenges of a long term, invasive species management program. The primary challenge of this program has been to quantify successes in invasive species management across a large landscape, and die to the nature of invasive species, it can be difficult to measure effectiveness of treatments. Invasive plants can spread quickly and be introduced to new areas easily – so while we are working hard to reduce the distribution and density of existing invasive species populations, we are also seeing the introduction and spread of new infestations in many areas across the East Kootenay. This makes it difficult to illustrate a reduction in both the number of invasive plant populations, the size of infestations, and the amount of herbicide or mechanical effort used on the ground. We do our best annually to quantify successes by conducting thorough monitoring visits to sites, completing sites treatment and inventory records, and communicating with area contractors and EKISC staff to measure project outcomes.

In addition, although we believe this project is not only managing and reducing the spread of existing invasive species populations and allowing contractors and EKISC staff to quickly identify and respond to new high priority invasive plant populations, we know that each year there are areas that we do not have funding to visit or treat on an annual basis. EKISC connects with regional land managers and stakeholders throughout the year to foster increased support for invasive species management and secure suitable, durable funding for projects such as IPMRPA.

In the fall of 2019, EKISC held contractor and project partner debrief sessions, where we were able to discuss the successes of the 2019 field season, and capture recommendations for invasive plant management moving forward. We found this to be valuable not only in connecting with project

partners, but also in providing information to them so they could report out on activities earlier and inform subsequent grant and funding applications. We will continue to do this moving forward.

Additional Project Recommendations

In addition to site-specific recommendations for invasive plant management activities, it is recommended that EKISC continue to develop monitoring activities as to better communicate successes of invasive plant management on the various areas associated with this project. EKISC should also complete more comprehensive monitoring visits for grass seed application sites in order to quantify seed establishment and better evaluate if grass seeding efforts are leading to establishment of favorable forage species.

Finally, although EKISC has successfully grown and maintained a level of stakeholder participation throughout the duration of this project, it is important that we actively seek new participants and collaborators, and work to better engage First Nations in the IPMRPA project.

Acknowledgements

EKISC would like to knowledge the generous support of the Fish and Wildlife Compensation Program, without whom it would not be possible to support the ongoing invasive species management at many conservation properties and areas on and adjacent to existing FWCP investment sites. This project is also possible due to support from the Nature Trust of British Columbia, Nature Conservancy of Canada, and Ministry of Forests, Land, Natural Resource Operations and Rural Development. The Ministry of Environment (BC Parks) and the Rocky Mountain Trench Natural Resource Society also works with EKISC to coordinate invasive species management that compliments the treatments related to this project.

References

East Kootenay Invasive Species Council. 2013. 2013-2018 Regional Strategic Plan. Available at: https://www.ekisc.com/ekisc-publications

East Kootenay Invasive Species Council. 2019. Priority Invasive Species by IPMA. Available at: https://www.ekisc.com/ekisc-publications

Fish and Wildlife Compensation Program. 2019a. Columbia Region: Upland and Dryland Action Plan. Available at: http://fwcp.ca/app/uploads/2019/08/Action-Plan-Columbia-Region-Upland-Dryland-Aug-21-2019.pdf

Fish and Wildlife Compensation Program. 2019b. Columbia Region: Wetlands and Riparian Areas Action Plan. Available at: http://fwcp.ca/app/uploads/2019/08/Action-Plan-Columbia-Region-Wetlands-Riparian-Areas-Aug-21-2019.pdf

International Union for Conservation of Nature. 2004 IUCN Red List of Invasive Species: a global species assessment. Available at: https://portals.iucn.org/library/node/9830

International Union for Conservation of Nature. 2011. Invasive Specues: A major conservation threat. Available at: https://science.sciencemag.org/content/sci/333/6041/404.2.full.pdf

Liepa, I. 2013. East Kootenay Invasive Plant Council, Strategic Planning Report. The Connecting Link Consulting Services.

Ministry of Forests, Lands, Natural Resource Operations and Rural Development. 2019. Invasive Plant Pest Management Plan for Provincial Crown Lands within the Southern Interior (PMP #402-0678-19-24). Available at: https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/invasive-species/pest-management/flnrord_southern_interior_pmp_402-0678-1924_2019_to_2024.pdf

Mooney, H. A. 1999. The global invasive species program (GISP). Biological Invasions, 1(1), 97-98.

Appendix A: Efficacy Monitoring Trial

EKISC completed the third round of data collection at permanent research trial sample locations during the 2019 field season. This research trial was established in 2017 to help EKISC understand how effective current herbicide application techniques are for managing invasive plants in the East Kootenay (i.e., "is what we are doing working?"). The below information summarizes site establishment, methods, and observations to date for the Treatment Efficacy and Roadside Transect Trials.

Site Selection and Establishment

52 permanent survey plots in four IPMAs across the RDEK were selected in 2017. EKISC followed a semi-random site selection procedure using existing knowledge of infestations found in the Invasive Alien Plant Program database (IAPP). Considerations such as frequency of treatment, site access, and staff availability also influenced survey plot selection, and style of data collection. IPMAs and locations included in this research project are illustrated in Appendix D and as follows:

- 01 Cranbrook East (14): Cranbrook Community Forest, Company, Mayook and Interchange
- 02 South Country (24): Sheep
- 03 Bull River (8): Red Barn and Armstrong
- 03 Trench (4): including CPR
- 04 (2): including Hawke

A large number of plots were established in South Country due to known, dense invasive plant infestations impacting forage quality. Survey plot locations (latitude, longitude) were recorded on GIS Pro and were marked using a wooden stake labelled with the location, date, and plot number. Each stake marks the center of the circular plot, with the survey area covering a 2-meter radius.

Figure A1a and b. Examples of research plots located in IPMA 2: South Country.

Methods

Plots are visited annually for data collection when plants are in flower and most easily identifiable (see Figure A1 for example of plot marking). Data collected at each sample location is illustrated in Figure A2, and includes:

- Site ID
- Collection date
- Percent cover of each invasive plant species present
- Percent cover of grasses, forbs, shrubs, and other (this may include dirt, moss, bare ground etc.)
- Four photographs (North, South, East, and West facing directions)
- Comments (anything that may have changed since previous year or may affect seasonal growth, including new site disturbances, seasonal events, etc.)

Plot #	Invasive (spp.)	Invasive (%)	Grass (%)	Forbes (%)	Shrubs (%)	Other (%)	Date
Company 3	0	0	95	0	0	5	30-July-2019
Company 2	0	0	85	0	0	15	30-July-2019
Company 4	0	0	75	0	5	20	30-July-2019
Company 1	0	0	80	0	0	20	30-July-2019
Ccf 1	SJ	20	65	3	0	12	30-July-2019
Ccf 4	0	0	89	1	0	10	30-July-2019
Ccf 2	SC	8	60	2	0	25	30-July-2019

Figure A2. Example of raw data collected for circular plots during 2019 field season.

Observations

The treatment efficacy trial is still young, with data collected for the past three years (2017, 2018, 2019). Areas may have only been treated once within this period due to the expanse of invasive species treated across the RDEK and limited funding; retreatment may occur in 2020 or 2021. Therefore, although over 150 samples have been collected over a three-year period, analysis and interpretation of the results may not demonstrate accurate trends. However, in a broad evaluation of the areas that have received treatment in 2017 or 2018, grass coverage is improving, and invasive species densities are declining. A brief analysis of each IPMA location has been described below.

01 Cranbrook East (14 sample sites)

Observed invasive species at the *Cranbrook Community Forest* (CCF) sites include Sulphur Cinquefoil (SC), Norway Cinquefoil (NC), and St. John's Wort (SJ). Overall, invasive species cover has declined at all sites, with only the percent cover of SJ increasing by 4% at one site. Within the CCF it is difficult to determine how effective treatment has been due to grass cover maintaining similar over the three years, and the 'other' category, which includes bare ground (thus easily allowing invasive species to grow), increased in 2018, but decreased in 2019.

At *Company* sample sites 1 through 4, invasive species were observed in 2017 (Spotted Knapweed (SK) and Goats Beard (GB)), followed by a significant increase in grass cover in 2018 and 2019. These observations may indicate that herbicide treatments are effectively decreasing invasive species at these locations.

At the *Interchange* sample sites, effect treatment has been observed. SK and Common Mullein (CM) have been recorded since 2017, with SK cover decreasing up to 19% at some sites by 2019, leaving SK cover at 1% in 2019. Additionally, MU was not recorded in 2018 and 2019, with no new species being observed.

Mayook's observed invasive species include SK and Dalmatian Toadflax (DT) in 2017. The two years following this, SK populations have decreased significantly (up to 22% at one site), however Yellow Hawkweed (YH) has been introduced to the area. All sites demonstrate an increase in grass, forb, and shrub cover over the three-year period, indicating positive effects of herbicide treatment.

02 South Country (24 sample sites)

At the *South Country* sample sites, observations highlight a variety of responses to herbicide treatment. Species with a higher density at a large number of sites include SC, NC, and SJ over the three years of data collection. Less frequently observed species, yet well-known in the area, include CM, SK, Blueweed (BW), Oxeye Daisy (OD), and Diffuse Knapweed (DK). Overall, observations recorded highlight all species have declined in populations across the 24 sites since 2017. However, in 2019 several new species were recorded at variety of densities (2-30%). Newly introduced species include YH, Hounds Tongue (HT), and the unlisted, yet highly invasive species Silver Cinquefoil (PA).

03 Bull River (8 sample sites)

The *Red Barn* property sample sites are all very clean with a high percent cover of grass (up to 90%). Recorded invasive plants include SC and Cheatgrass/Downy Brome (DB). SC has not been observed at the sites since 2017, and a 30% reduction of DB at one site shows positive treatment efficacy at these locations.

SC and NC are found at various *Armstrong* sample sites. Although the percent cover of all invasive plants has decreased, with no invasive plants found in 2018 and 2019, the percent cover of grass has also decreased by up to 25% from 2017 to 2019 at some sites. This has caused in increase in 'other' (i.e., bare ground) at all sites at the Armstrong location. With more bare ground at the sites there is concern that invasive plants may either grow from potential seedbank or promote new introductions to the area.

03 Trench (4 sample sites)

CPR sample sites have increased invasive plant cover at three of the four sites over the three years. SC and SK have both decreased in percent cover, however, DB was introduced in 2018 at all sites and has continued to spread over the 2019 season. The increase in DB cover has resulted in a large decrease (up to 70% at individual sites) of grass, shrub, and forb cover at all sites found in the CPR location.

04 (2 sample sites)

The two sites located in IPMA 04 highlight a progressive, significant increase of SK cover (the only invasive plant found at this location) from 2017 to 2019. Due to the large increase in SK, grass and shrub cover has decreased, and the category 'other' has increased. Due to the density of SK known in the area, the bare ground has a high possibility of becoming infested without treatment.