McDougall Cairn Natural Area Habitat Restoration Project Report

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Table of Contents

ABSTRACT

The McDougall Cairn Natural Area Habitat Restoration Plan Report accompanies the Habitat Restoration Plan (Appendix 1) drawings. The report outlines the need for ecological restoration at the McDougall Cairn Natural Area in Calgary, Alberta. It outlines the restoration goals and methods, preliminary results, and includes a monitoring and maintenance plan for the project site.

Restoration mission statement

The overall goal of the habitat restoration project at the McDougall Cairn Natural Area is to complete a naturalization level of habitat restoration that maintains the prairie landscape character-defining elements of this Provincial Historic Resource site and its heritage value, by adding native species appropriate to a native reference habitat and aid the future succession of native species in the park.

Goals

The goals for the habitat restoration project include:

1. Increase the prairie landscape character-defining elements of the provincial historic resource, including an environment of native prairie grasses and plants appropriate to the reference habitat.
2. Native tree plantings that had previously died on site are replaced with new native trees that survive.
3. Invasive weeds on site are managed to reduce pressures on native species and as per legislated requirements.
4. Collaborate with site stewardship stakeholders.
5. Communicate the project to nearby homeowners.
6. Create an ongoing site maintenance and monitoring plan.
7. Improve site infrastructure to bring attention to historical resource and improve site function.
8. Mapping activities and planting/seeding locations for long-term monitoring.

Project duration

The project duration is expected to run from spring 2017-summer 2018. Follow-up monitoring and maintenance of the site will be needed on an ongoing basis.

1. INTRODUCTION

Calgary is a city in southern Alberta, Canada with urban green space that include municipal parks, some of which are natural area parks maintained for their biodiversity, ecological services, and enjoyment by citizens. Calgary Parks has developed policy for managing biodiversity in the city, and has established targets to address the biggest threats to biodiversity – invasive species, habitat loss, and habitat fragmentation. Calgary's natural areas are the most biodiverse areas in the city, but are also experiencing these pressures in an urbanized environment. Most species are affected by reduced landscape connectivity which reduces available habitat (Wade *et al.* 2015). Globally, habitat fragmentation and landscape modification are considered to be major threats to biodiversity (Fischer and Lindenmayer 2007).

The Naturalization program in Calgary Parks aims to restore 20% of Calgary's open space, and is guided by principles of increasing connectivity, increasing biodiversity, improving vegetation community structure, and stewarding the landscape (The City of Calgary 2018). The program focuses on building resilience to reduce maintenance costs, and improving site aesthetics while improving nature education opportunities. Within Alberta, The City of Edmonton has also developed a naturalization program that focuses on transforming maintained areas into more natural conditions using an ecological approach to adding native plants to promote healthy ecosystems (The City of Edmonton 2018).

The McDougall Cairn Habitat Restoration Project is a naturalization-level habitat restoration that contributes to the 20% habitat loss target, and improves connectivity within the community of Panorama Hills where the project site is located. A city-wide connectivity study conducted on behalf of Calgary Parks (Fiera Biological Consulting 2016) found that the community of Panorama had a low-medium connectivity relative to the city overall. Although the site is relatively small (<0.2ha), native vegetation in small areas can complement those in larger areas because loss of native vegetation at local scale reduces native species richness on a landscape scale (Fischer and Lindenmayer 2007).

2. PROJECT TEAM

The project was being designed and managed by a Parks Ecologist with Calgary Parks, whom is a student of the Restoration of Natural Systems Diploma Program at the University of Victoria's School of Environmental Studies. In addition, the Parks Ecologist that oversees Calgary Parks' operational Zones 4 and 5 (North and East Region) is managing the financial and operational implementation of the project, due to formal reporting and financial management structures within Calgary Parks. See Appendix 1. Sheet 1 – Location Plan for project manager and project sponsor contact information.

The project team consists of those individuals responsible for implementing various aspects of the project, including the project manager, project sponsor, operational staff from Calgary Parks' portfolios, and external contractors. Individuals from the portfolios of Urban Forestry, Cultural Landscapes… etc. were involved.

Stakeholders for the project include both internal and external parties that have a stake in the project site, but are not responsible for implementing the project. This includes Calgary Parks' portfolio staff that steward certain asset types in the park. External stakeholders include the Nose Creek Historical Society, Alberta Government, the Panorama Hills Community Association, and residents living in the vicinity of the project. See Appendix 2 for current project team contacts and stakeholders.

It is recommended that the project contacts and stakeholders list be reviewed on an annual basis and that contact information is updated as needed.

3. PROJECT LOCATION

3.1. Location details

The project site is the McDougall Cairn Natural Area, located at 133 Panora Way NW, on the edge of the community of Panorama Hills in Calgary, Alberta, Canada (see Appendix 1: Sheet 1 – Location Plan). The project site is a 1940 m^2 (0.194 ha) municipal natural environment park owned by The City of Calgary and stewarded by Calgary Parks, referred to internally with the park code PAN800. The park is located within Calgary Parks' operational management Zone 4 of the North and East Region. The park's location is a Calgary Historic Resource (Reid 2009) because it is a Provincial Historic Resource (see Section 4 for details).

3.2. Landscape context

The McDougall Cairn Natural Area is flanked on two opposite (NW and SE) sides by suburban private properties (see Appendix 1: Sheet 1 – Location Plan), by a residential sidewalk along the Panora Way street on the SW side, and on the NE side by the transportation utility corridor for the Stoney Trail provincial highway. This adjacent right-of-way currently consists of open green space fragmented by roadways with future development planned for a 14 Street overpass across Stoney Trail.

4. SITE HISTORY AND PRE-EXISTING DISTURBANCE

4.1. Historic Resource and heritage value

The site is a registered Provincial Historic Resource and was designated on June 15, 1976 (HeRMIS 2013a, 2013b). It is considered a Calgary Historic Resource (Reid 2009), however it is not yet designated federally (Michelle Reid, personal communication). Its heritage value stems from the site's key feature: the McDougall Cairn, a concrete obelisk erected to memorialize the location where the historical figure Reverend George McDougall had died in 1876.

The character-defining elements of the Provincial Historic Resource include (Reid 2009; CHC 2016; HeRMIS 2013a, 2013b):

- The location of the cairn, marking where George McDougall is believed to have died
- The cairn, including concrete obelisk and bronze plaque
- The environment of native prairie plantings
- The metal Nose Creek Historical Society memorial sign

A cairn (Figure 1) was constructed at the site in 1960 to commemorate the location that Reverend George McDougall (1821-1876) had died in a blizzard from a heart attack while out on a buffalo hunt. McDougall had contributed significantly to the early pioneering history of what is now Alberta, and dedicated much of his life to supporting the Cree and Stoney. He played a critical role in negotiating an agreement on behalf of Treaty 7 First Nations (Dave Chalmers, personal communication). The Calgary area is the traditional territory of the Blackfoot people and the people of Treaty 7 (CAUAC 2017). The Nose Creek Historical Society sign was unveiled in 1976 when the site was designated (Figure 1).

The wording on the cairn and Nose Creek Historical Society sign are as follows:

Nose Creek Historical Society sign	McDougall Cairn bronze plaque
IN RECOGNITION OF THE TRAGIC DEATH OF THE REV. GEO. McDOUGALL AT THIS SITE ON JAN. 24 1876 UNVEILED JAN. 25 1976 CENTENNIAL CHURCH SERVICE NOSE CREEK HISTORICAL SOCIETY	REV. GEORGE McDOUGALL 1821-1876 REV GEORGE McDOUGALL, PIONEER, METHODIST MISSIONARY DIED HERE ON JANUARY 24, 1876. HE HAD BEEN BUFFALO HUNTING, APPARENTLY LOST HIS WAY ON THE PRAIRIE AND DID NOT RETURN TO CAMP. COMING WEST IN 1860, HE HAD DEVOTED HIMSELF TO EVANGELIZING THE INDIANS. SETTLER, FUR TRADER, AND INDIAN ALIKE MOURNED HIS PASSING. ERECTED BY THE PROVINCE OF ALBERTA

Table 1 provides a timeline of important historical events at the site. See Appendix 3 for a series of historical aerial photos of the site, and section 9.6.2 for photomonitoring methods.

Figure 1. Some of the character-defining elements of the site. Top-left (September 2009): context image from Calgary Historic Resource Evaluation Form (Reid 2009), showing the fence surrounding the cairn, and memorial sign to the left of the fence. Remaining photos by Angie Arrau. Top-right (June 2016): McDougall Cairn consisting of concrete obelisk and bronze plaque. Bottom-right (June 2016): detail of cairn plaque on cairn. Bottom-left (June 2016): metal Nose Creek Historical Society memorial sign.

Table 1. Site history and contextual history of the McDougall Cairn Natural Area.

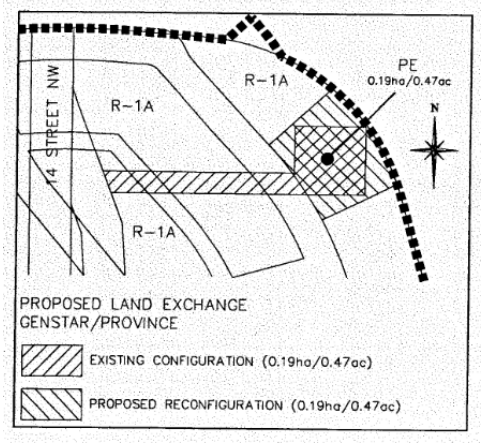
Year	Historic events and prior disturbance
Time immemorial	Niitsitapi (the Blackfoot People) traditional territory (CAUAC 2017).
1500s	Presence of Stoney Nakota Nations in the territory (CAUAC 2017).
1860	Reverend George McDougall moved west (cairn wording).
1875	North West Mounted Police establish fort at confluence of Bow and Elbow Rivers (CAUAC 2017).
1876	Reverend George McDougall died of a heart attack during a buffalo hunt at the site now marked by the commemorative cairn.
1877	Treaty 7 signed (CAUAC 2017).
1960	The McDougall Cairn concrete obelisk was constructed and unveiled (HeRMIS 2013a), 100 years after McDougall arrived in the west
1976	McDougall Cairn was designated as a Provincial Historic Resource, and the Nose Creek Historical Society sign was unveiled, 100 years after McDougall's death
Pre-2007	The Cairn was previously located in a fenced area in an agricultural field (Reid 2009), in order to keep cattle out (Michelle Reid, personal communication). The prior agricultural setting suggest a long history of soil and vegetation disturbance. Photo of cairn setting in 1997. Photo source: (Reid 2009). 

4.2 Park development history

Table 2 provides a park development history summary. When the Area Structure Plan (The City of Calgary Planning & Building Department 1999) was developed, this cairn was in an agricultural, cattle-grazed, non-native setting and so was not identified as an Environmentally Significant Area (ESA). However, the need to integrate the McDougall Cairn into community park space was recognized. At the subdivision development approval stage, the Outline Plan identified that this site was originally provincially-owned land, and was part of a land swap between the developer and the province (Genstar Development Company 2002). Because this provincial land was disturbed and relatively level without water bodies, it did not qualify at the subdivision stage as Environmental Reserve (ER) under the criteria set out in s. 664 of the Alberta Municipal Government Act (Province of Alberta 2000).

Calgary's Open Space Plan policy (The City of Calgary Parks 2003) only requires that a Biophysical Impact Assessment (BIA) is conducted for a site when an Environmentally Significant Area is identified (p. 80). A BIA was conducted, however, within Panorama for riparian sites to the southeast that became natural area parks (see Appendix 1. Habitat Restoration Plan: Sheet 1 – Location Plan). Similarly, the Open Space Plan outlines criteria for determining the appropriate development protection level (preservation, restoration, disturbed) of Environmental Reserves, including resource significance and historical criteria, but this is only applied if an ER is designated. It may not have been clear at the time that the Provincial Historic Resource required maintaining a prairie landscape, or that the park would be converted to a natural area. The City's processes for protecting these types of sites is currently being modified, so that ecological inventories are conducted earlier in the process and may include historical resources.

Table 2. Park development history timeline.

Year	Park development history
1999	Area Structure Plan (The City of Calgary Planning & Building Department 1999) recognized the need to preserve and integrate the McDougall Cairn into the community's open space system (page 13).
2002	Panorama Hills Stage 5 Outline Plan and Land Use Redesignation (Genstar Development Company 2002) proposed a land exchange with the Province of Alberta to integrate the cairn into community open space. 
2003	Historic Resources Order was registered in 2003, as per land title. Ownership was transferred from Province of Alberta to Genstar Development Company.
2007	Calgary Historic Resource Evaluation Form (Reid 2009) describes that the entire site was stripped and graded in 2007 for subdivision construction (see Appendix 3, 2007 aerial photos). The memorial cairn itself was raised 1.5m to accommodate grading.
2008	Land title indicates that parcel title ownership was transferred from Genstar Titleco Limited to the Calgary Civic Trust Society in August 2008. Landscape plan (L.A. West Inc. 2008) for the park instructed the use and application of 'native grass seed mix' as the City-approved Urban 'F' Seed Mix. It instructed the planting of non-native shrubs and varietals of native shrubs grouped in mulched beds, with a 75mm depth of mulch installed. The landscape plan also included sandstone boulders, gravel trail installation, a fence around the cairn, and installation of topsoil to a depth of 150mm.
2009	Construction Completion Certificate date in Parks Asset Reporting & Information System (Calgary Parks 2018) indicates the park was installed as per the landscape plan.
2010	Final Acceptance Certificate date in PARIS system (Calgary Parks 2018) indicates the park was turned over by the developer to The City. Park begins to be managed as a mowed turf park.
2013	Land title indicates that parcel title ownership was transferred from the Calgary Civic Trust to The City of Calgary. Calgary Parks re-classified the park as a Natural Area asset (PARIS 2018).

4.2.1. Historically planted and seeded species

The site's construction did not explicitly require the use of native species or pure native stock because it was not identified as an Environmental Reserve, resulting in the landscape plan for the park design (L.A. West Inc. 2008) not being limited to the use of native species. As a result, the site was stripped and graded, leaving no native soils or vegetation in place (see Appendix 3, 2007 aerial photos). The landscape plan (L.A. West Inc. 2008) did not provide scientific names for all species (Table 3). In accordance with the 2008 Development Guidelines and Standard Specifications (The City of Calgary Parks 2008), the park was originally seeded with the Urban 'F' seed mix containing non-native and native grasses (Table 3). However, this was not a true native seed mix (note that scientific names were not provided in the specifications), and was described in the Specifications as "a slow growing, low maintenance mix for medium use park areas where a more natural grassland appearance is desired on a

non-irrigated site," and that it "can be used adjacent to natural areas only if a suitable barrier can be provided (such as a pathway) to prevent the Urban mix form encroaching into the native community." The park was also planted with non-native varietals of native species, as well as an invasive species (*Caragana arborescens*) that was listed on the Alberta Weed Control Act and Regulations (Province of Alberta 2010) before it was updated in 2010 (Table 3).

Table 3. Species and varietals originally planted and seeded when park was constructed (L.A. West Inc. 2008). Exotic species are bolded.

Method	Quantity/Size or Seed Mix %	Common name	Scientific name	Species Code	Nativity
Seeded	20%	**3 varieties of Kentucky blue grass**	*Poa pratensis* (likely scientific name)	POAPRAT	**Exotic**
	40%	**Creeping red fescue**	*Festuca rubra* (likely scientific name)	FESTRUB	**Exotic**
	15%	**Lowgrow perennial ryegrass**	Unknown (may be *Lolium perenne)*	(unknown)	**Exotic**
	25%	**Hard fescue**	Unknown (may be *Festuca trachyphylla*)	(unknown)	**Exotic**
Planted	10 (3.0m height)	**'Sutherland' Caragana**	*Caragana arborescens*	CARAARB	**Exotic**
Planted	6 (#5 container)	'Katherine Dykes' Potentilla	*Potentilla fruticosa*	POTEFRU	Native (varietal)
Planted	31 (#4 container)	'Blue Fox' Willow	*Salix brachycarpa* x 'Blue Fox'	SALIBRA	Native (varietal)
Planted	12 (#5 container)	Silver Buffaloberry	*Shepherdia argentea*	SHEPARG	Native

4.3. Park management history

A general timeline of the management history of the park after it was turned over to The City of Calgary is provided in Table 4.

Table 4. Park management history of the McDougall Cairn Natural Area (PAN800).

Year	Park management activities
2010-2013	Site was managed as a mowed turf park to control weeds.
2013	Site was converted to a natural area park. Invasive plants noted as existing on site included Canada thistle, goats beard, and cicer milk vetch. Caragana was removed in 2013. Plans were made to plant native trees and shrubs in 2014.
2014	Urban Forestry portfolio of Calgary Parks planted some trees on July 25, 2014: • 3 white spruce (*Picea glauca*); DBH_CM = 1 • 9 trembling aspen (*Populus tremuloides*); DBH_CM = 2 Trail re-surfacing work completed in 2014. A total of 270 individual native forb plants (19 species) were planted on August 27, 2014 in the shrub bed areas of the park (see section 4.3.3). Invasive plant mapping and control.
2015	Invasive plant mapping and control.
2016	Invasive plant mapping and control.
2016	Threats of disturbance noted: encroaching smooth brome, invasive plant species, small informal trail forming; disturbances due to unofficial off-leash use of park. Invasive plant mapping and control.

4.3.1 Park classification

The park was turned over from the developer to Calgary Parks in September 2010 but was not identified as a natural area park asset at that time (Calgary Parks 2018). Background files for the park from 2013 (Kellett 2013) identified that the site was previously mowed to control weeds, but that the park was intended to be maintained as a natural area to represent the natural landscape in which McDougall had perished. The site was formally converted into a natural area in the Calgary Parks asset database (Calgary Parks 2018) in September 2013, at which time mowing was discontinued.

4.3.2. Invasive species management

Due to the change in park status and its invasiveness, the Caragana that was planted during the park's construction was removed in 2013 (Kellett 2013). Calgary Parks is actively removing Caragana throughout the city in order to increase native trees and shrubs and biodiversity (The City of Calgary 2018), and this activity was consistent with natural areas management across the city.

Mapped invasive plant data was available beginning in 2014. Historical data from 2014 was based on CartoPac mapping software; beginning in 2015 weed mapping and control were recorded in Calgary Parks' IPM Invasive Weeds Mapping App. Table 5 is a summary of presence and control recorded through these applications. Historical mapping and treatment from previous mapping platforms were imported into an ArcGIS File Geodatabase for the project (see section 9.1.1 for details), and separated into mechanical control and chemical control polygons to align with current Weed Mapping App data viewing capabilities. These historical spatial data for invasive species often overlap park boundaries or appear outside of the park (Figure 2). The 2016 chemical control was a tank mix used to control vegetation in the shrub beds and hard surfaces, including grass, Canada thistle, dandelion, perennial sowthistle, cicer milkvetch, dandelion, perennial sowthistle, and yellow toadflax.

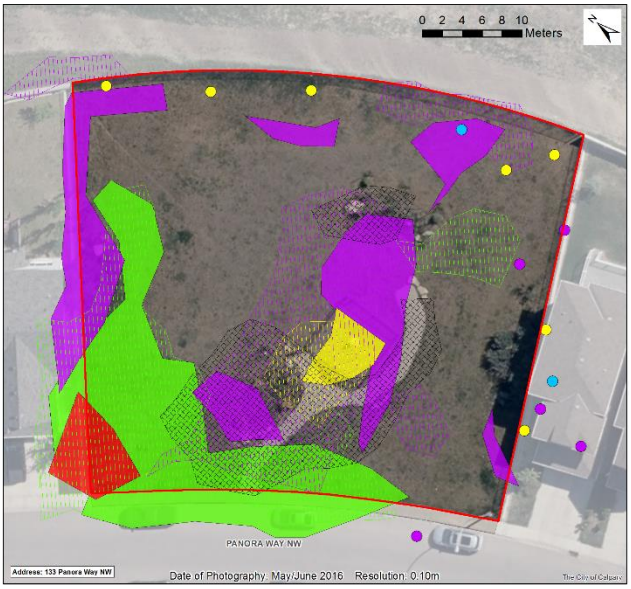
Nodding thistle was first recorded in 2015, but not recorded again after. This suggests that it was either eradicated from the site, as is required by the Weed Control Act (Province of Alberta 2010), or mis-identified as bull thistle, which was recorded in 2016. Table 5 illustrates that although certain species were not recorded in a given year, it does not imply their absence on the site. For example, Caragana was not recorded from 2014-2016, but is currently present in the park (see section 5). This is particularly true of non-regulated species, which would not have been the focus of mapping activities.

Table 5. Summary of 2013-2016 invasive species records for PAN800, including presence and control. Regulatory status is based on the Alberta Weed Control Act (Province of Alberta 2010). P = Present (in recorded notes only). R = Removed (methods unknown). G = GIS-mapped (no control completed). M = Mechanical control. C = Chemical control. ~ = no data.

Common Name	Scientific Name	Regulatory Status	Nativity	Infestation and Control History			
				2013	2014	2015	2016
Canada thistle	*Cirsium arvense*	Noxious	Exotic	P	C	M	M/C
Cicer milkvetch	*Astragalus cicer*	N/A	Exotic	P	M	M	M/C
Caragana	*Caragana arborescens*	Formerly "Noxious"	Exotic	R	~	~	
Goatsbeard	*Tragopogon dubius*	N/A	Exotic	P	~	~	~
Nodding thistle	*Carduus nutans*	Noxious	Exotic	~	~	M	~
Perennial sowthistle	*Sonchus arvensis*	Noxious	Exotic	~	~	~	C
Yellow toadflax	*Linaria vulgaris*	Noxious	Exotic	~	~	~	M/C
Dandelion	*Taraxacum officinale*	N/A	Exotic	~	~	~	C
Bull thistle	*Cirsium vulgare*	N/A	Exotic	~	~	~	G

2014

2015



2016

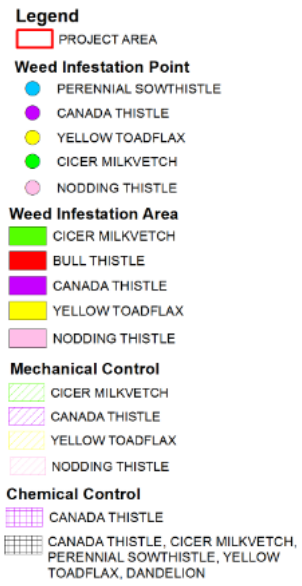


Figure 2. Invasive species mapping and control for 2014, 2015, 2016.

4.3.3. Native species planting

In July 2014, the Urban Forestry portfolio of Calgary Parks planted native deciduous and coniferous trees (Table 6). In October 2014, the Zone Parks Ecologist planted a total of 270 native forb plugs of 19 different native species (Table 6).

Table 6. Native tree and forb species planted in 2014.

Method	Quantity (Size)	Common name	Scientific name	Nativity
Planted	3 (DBH = 1cm)	White spruce	*Picea glauca*	Native
Planted	9 (DBH = 2cm)	Trembling aspen	*Populus tremuloides*	Native
Planted	10 (plug)	Yarrow	*Achillea millefolium*	Native
Planted	10 (plug)	Nodding Onion	*Allium cernuum*	Native
Planted	10 (plug)	Cut-Leaved Anemone	*Anemone multifida*	Native
Planted	15 (plug)	Rosy Pussytoes	*Antennaria rosea*	Native
Planted	15 (plug)	Meadow Arnica	*Arnica chamissonis*	Native
Planted	10 (plug)	Prairie Sagewort	*Artemisia frigida*	Native
Planted	20 (plug)	Smooth Aster	*Aster laevis*	Native
Planted	10 (plug)	Harebell	*Campanula rotundifolia*	Native
Planted	10 (plug)	Cut-Leaved Fleabane	*Erigeron compositus*	Native
Planted	15 (plug)	Smooth Fleabane	*Erigeron glabellus*	Native
Planted	20 (plug)	Brown-eyed Susan	*Gaillardia aristata*	Native
Planted	10 (plug)	Three Flowered Avens	*Geum triflorum*	Native
Planted	10 (plug)	Beautiful Sunflower	*Helianthus subrhombideus*	Native
Planted	20 (plug)	Wild Bergamot	*Monarda fistulosa*	Native
Planted	10 (plug)	Yellow Penstemon	*Penstemon confertus*	Native
Planted	15 (plug)	Smooth Blue Beardtongue	*Penstemon nitidus*	Native
Planted	20 (plug)	Black Eyed Susan	*Rudbeckia hirta*	Native
Planted	20 (plug)	Blue Eyed Grass	*Sisyrinchium montanum*	Native
Planted	20 (plug)	Canada Golden Rod	*Solidago canadensis*	Native

5. PROJECT AREA ECOLOGICAL OVERVIEW

A pre-disturbance biophysical inventory cannot be conducted or researched for this site because neither a biophysical inventory nor a biophysical impact assessment were conducted prior to park construction. The BIA conducted in a nearby location was for a riparian area and does not offer a suitable comparison.

5.1. Methods

This ecological overview is based on informal site assessments and desktop research on site conditions. A preliminary site visit was conducted on June 16, 2016 between the Project Manager and Project Sponsor prior to the project formally commencing. Results from ongoing site assessments from 2017-2018 are also presented below, as appropriate.

5.2. Natural Region and Subregion and climate conditions

The site lies within the Foothills Fescue Natural Subregion of the Grassland Natural Region (Natural Regions Committee 2006), but lies just 1km from the Central Parkland Natural Subregion and less than 3km from the Foothills Parkland Natural Subregion, both of the Parkland Natural Region (Appendix 1: Sheet 1 – Location Plan). The Natural Subregion boundaries are not well defined in this area, which is further compounded by the suburban Calgary setting.

Both the Grassland and Parkland Natural Regions are dominated by a grassland climatic regime, characterized by cold winters and short hot summers, with average annual temperatures of +3◦C (Natural Regions Committee 2006). Climate conditions allow a growing season between May-September, with precipitation highest in June and an average annual precipitation of 410mm (Natural Regions Committee 2006). The winter climate is influenced by cold northerly air masses and warmer Pacific air flows that result in warm temperatures during the winter months (Natural Regions Committee 2006).

The western edge of the Foothills Fescue Natural Subregion is characterized by mountain rough fescue, bluebunch fescue, and Parry oatgrass, as well as species that occur in the Montane or Foothills Parkland Natural Subregion (Natural Regions Committee 2006). Mean monthly temperatures in the Subregion range from -10◦C in January to about +17◦C in July.

5.5. Geology and geomorphology

Prior to stripping and grading of the subdivision, the surficial geology at the McDougall Cairn's location was the Balzac Drift stratigraphic unit: [Bbt-d]

PF

This unit is a pebble-loam till overlying sandstone non-marine bedrock of the Porcupine Hills Formation (Moran 1986). Balzac Drift originated from glacial sediment, and is typically 10-20% sand, 45-60% silt, and 20-40% clay (Moran 1986).

5.6. Soils

The Foothills Fescue Natural Subregion is dominated by Black Chernozem soils (Natural Regions Committee 2006). According to geospatial data derived from the Soil Survey of the Calgary Urban Perimeter report (MacMillan 1987), the McDougall Cairn was historically located on Lloyd Lake soils, which are well-drained black grassland soils that formed atop glaciolacustrine sediments, with a depth

of between 1m-20m. Specifically, Lloyd Lake 3 soils were typically only of 1-2m depth overlying till (MacMillan 1987).

However, because the entire site was stripped and graded in 2007 to accommodate subdivision grading, and the cairn itself was raised 1.5m from its original location (Reid 2009), it is unlikely that any native black chernozem soil remains on site. With the 1.5m depth of fill added to the site, in addition to 150mm of topsoil installed prior to seeding the grass seed mix (L.A. West Inc. 2008), this level of soil disturbance suggests that the native Lloyd Lake 3 soils are no longer present.

A biological soil test conducted by the Living Soil Solutions contractor in April and June 2017 (Mike Dorion, personal communication) indicated the soil contained all bacteria, and little diversity with no fungal mycorrhizae or predator species, resulting in bacteria competing with plants for soil nutrients. This test also showed high amounts of clay and poor conditions for soil microbiota, and therefore poor soil structure. Soil pits were not dug to assess soil profiles for this project due to the amount of disturbance that it would cause in the small park, as well as for public safety reasons.

5.7. Topography and exposure

The site has a gently convex surface shape, its upper plateau is relatively level, with a gentle downward slope and change of elevation of only 1m (ranging from 1115.5m to 1114.5m). Some micro (<0.3m) depressions exist within the shrub planting beds. The site has a south-southwest aspect, and exposure to sun and wind. The park is located on the crest of the slope relative to the adjacent residential and right-of-way properties.

5.8. Hydrology

The project site is located within the Nose Creek watershed (see Appendix 1: Sheet 1 – Location Plan). Drainage from the site is directed toward concrete swales between the park edges and adjacent private properties, which drain toward the Panora Way street. No hydrological features are present within the park, however three large storm ponds are located nearby:

- ~2.95 ha storm pond located ~200m to the northeast (across 14 St NW),
- ~2.63 ha storm pond located ~675m to the northwest (across Stoney Trail NW), and
- ~2.99 ha storm pond located ~660m to the southeast.

5.9. Vegetation

5.9.1. Vegetation communities

The park is dominated by modified grassland which covers 87% of park (Table 7, Figure 3). It includes four anthropogenic planting beds containing trees and shrubs (8% of park), as well as gravel trail areas (4.7% of the park). For ease of reference, restoration zone names have been assigned to each area. A Calgary Parks field-based Habitat Condition Rating Assessment form was completed on August 18, 2016. This assessment determined that the canopy aerial cover comprised of native species of trees, forbs, and grasses was between 0-5% each, and native shrubs comprised 6-25% of the canopy aerial cover of the park. This assessment found that the canopy aerial cover of non-native grass species was 6-25% smooth brome (*Bromus inermis*), and 51-75% Kentucky bluegrass (51-75%). The HCR assessment found none of the native grass species that are specifically searched for because they are indicators of less-disturbed grasslands: *Festuca hallii*, *F. campestris*, other *Festuca* species, *Danthonia* spp., *Stipa* spp., or

Koeleria macrantha. The combined native and non-native canopy aerial cover was found to be 6-25% shrubs, 26-50% forbs, 0-5% lichens and moss, and 6-25% bare ground.

Table 7. Area of each restoration zone and vegetation community.

Restoration Zone	Area (m^2)	% of Total Area	Vegetation Community	Area (m^2)	% of Total Area
Outer Prairie	1602.0	82.6%	Modified Grassland		
Cairn Prairie	90.3	4.7%		1692.3	87.3%
Entry Shrub Bed	55.0	2.8%	Anthropogenic Shrubland		
Rear Shrub Bed	41.9	2.2%			
Left Shrub Bed	31.3	1.6%			
Right Shrub Bed	27.4	1.4%		155.7	8.0%
Existing Trail	63.6	3.3%	Hard Surface Areas		
New Trail	27.6	1.4%		91.2	4.7%
TOTAL	**1939.2**	**100.0%**	**TOTAL**	**1939.2**	**100.0%**

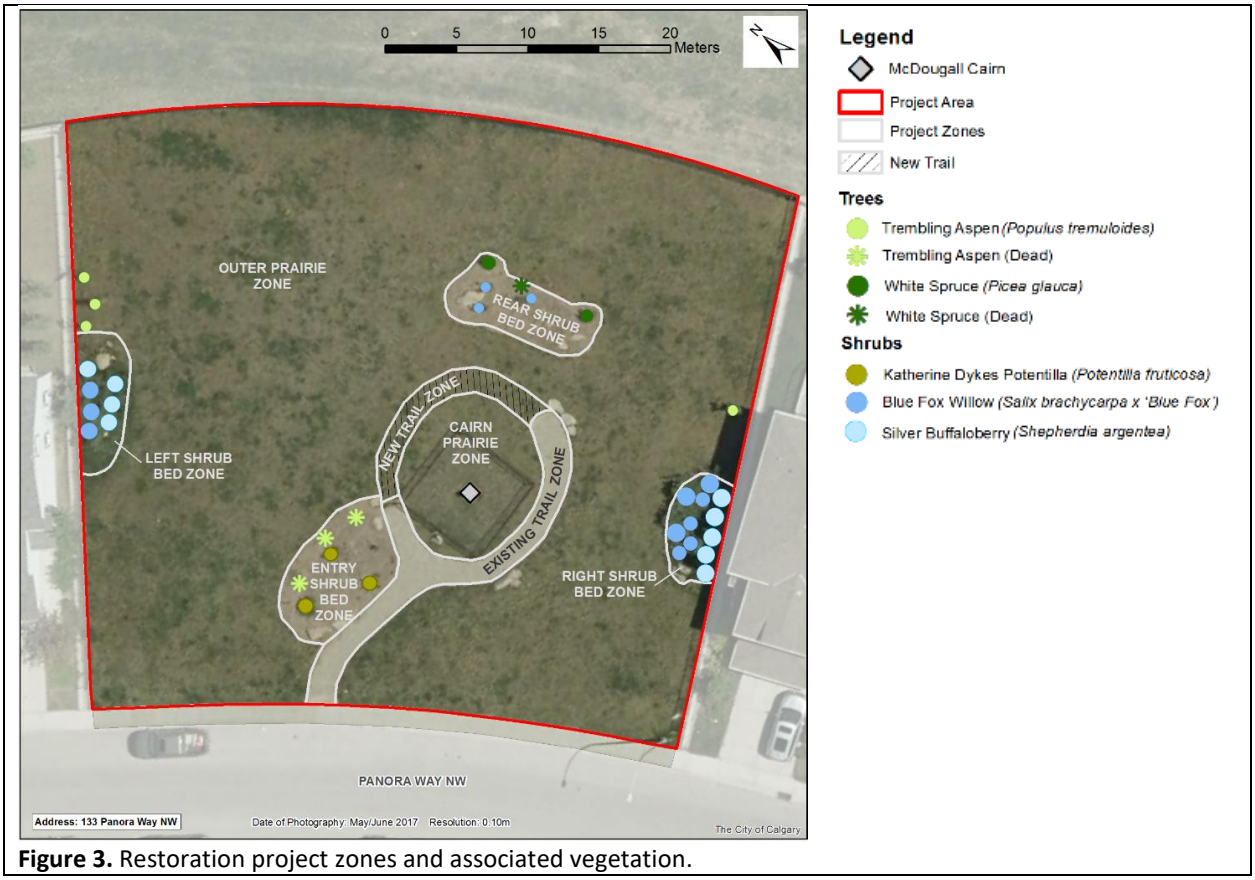


Figure 3. Restoration project zones and associated vegetation.

Modified grassland

Using the Foothills Fescue Range Plant Community Guide (Adams *et al.* 2003), the vegetation community most closely keys out to the Kentucky Bluegrass – Awnless Brome – Northern and Western Wheatgrass FFB4 community type (Table 8). The steps followed in the community key were as follows:

- Plant Community Categories
  1. Plant communities are modified to non-native species or are shrub communities → 2
  2. Plant communities dominated by non-native species like Kentucky blue grass, awnless brome and Timothy and/or weedy disturbance species → Modified Grassland Key
- Modified Grassland Key
  1. Modified grassland community is dominated by Kentucky bluegrass → 2
  2. Modified grassland community is dominated by Kentucky bluegrass with awnless brome and native wheatgrasses as a subdominant species → Kentucky Bluegrass – Awnless Brome – Northern and Western Wheatgrass FFB4

Table 8. The Kentucky Bluegrass - Smooth Brome - Northern and Western Wheatgrass (FFBR) vegetation community. Source: Foothills Fescue Range Plant Community Guide (Adams *et al.* 2003)

Growth Form	Common Name	Scientific Name	Canopy Cover [mean(range)]	Status
Shrubs	Buckbrush	*Symphoricarpos occidentalis*	7% (0-18%)	Native
	Prairie rose	*Rosa arkansana*	3% (0-13%)	Native
	Saskatoon	*Amelanchier alnifolia*	2% (0-5%)	Native
Forbs	Alfalfa	*Medicago sativa*	3% (0-15%)	Exotic
	Canada thistle	*Cirsium arvense*	2% (0-11%)	Exotic
	Prairie sagewort	*Artemisia ludoviciana*	1% (0-3%)	Native
	Common dandelion	*Taraxacum officinale*	1% (0-4%)	Exotic
Grasses	Kentucky bluegrass	*Poa pratensis*	32% (18-53%)	Exotic
	Awnless brome	*Bromus inermis*	28% (15-40%)	Exotic
	Undifferentiated wheatgrass	*Agropyron sp.*	7% (2-19%)	~
	Canada bluegrass	*Poa compressa*	2% (0-11%)	Native
	Quack grass	*Agropyron repens*	2% (0-5%)	~
Moss/Lichen Cover			4% (0-7%)	
Soil Exposure			14% (5-33%)	
Total Vegetation			89% (69-98%)	

Anthropogenic shrubland

The shrub bed restoration zones are dominated by shrubs, these areas do not fit the typical shrub communities of the Foothills Fescue Natural Subregion as they were originally planted with non-native varietals not typical of the Subregion (Table 3). For this reason, these areas were not keyed out using a classification key.

In 2016, the anthropogenic shrub beds included shrub species planted in 2009 as well as standing dead trembling aspen and white spruce trees from failed plantings that occurred in 2014. The beds on the left and right side of the park have a dense tall shrub canopy of 'Blue Fox' Willow (*Salix brachycarpa* 'Blue Fox') and silver buffaloberry (*Shepherdia argentea*). The two beds in the centre of the park had very little shrub canopy, with only 'Katherine Dykes' Potentilla (*Potentilla fruticosa*) present in the entry bed, and only 'Blue Fox' Willow in the bed toward the back of the park.

5.9.2. Site assessment vegetation results

Site assessments conducted prior to restoration activities beginning determined what vegetation species are present on site. Appendix 4 provides a list of the trees, shrub, forbs, grasses, and non-vascular plants known to exist in the park prior to restoration activities within the scope of this project beginning. These included species from 17 different Families, and 55 species (39 forb species, 9 grass species, 4 shrub species, and 2 tree species, and 1 unidentified moss species). Of the 55 species, 30 species (54.5%) are native to Alberta, 21 species (38.2%) are exotic, and 3 species are of unknown status.

Appendix 4 includes the S (Subnational Status) Rank, N (National Status) Rank, G (Global Status) Rank and Origin of each species according to Alberta Conservation Information Management System (ACIMS 2018) element occurrence data. ACIMS uses the Nature Serve methodology (Alberta Parks 2016) to assign ranks; S Ranks are Alberta-specific and N Ranks are Canada-specific. The origin describes whether the species is native or exotic to Alberta.

Appendix 4 also provides the life span and grazing response for each species, where information was available through the Alberta Agriculture and Forestry (2018). Life span (Alberta Agriculture and Forestry 2018) describes whether the species lives only for one growing season (annuals), for two years (biennials), or for more than two years from the same root system (perennials). Grazing response describes how the species reacts to continuous defoliation (Alberta Agriculture and Forestry 2018): decreasers reduce relative amounts in an area in response to continuous defoliation, increasers reacting by increasing relative amounts, and invaders move into a community when desirable species have been overgrazed.

Native plant status ranks

Two of the shrub species planted in the park in 2008 are subnationally-ranked S3 species, though one is a native varietal and not pure native stock:

- Silver Buffaloberry (*Shepherdia argentea)*
- 'Blue Fox' Willow (*Salix brachycarpa* 'Blue Fox')

An S3 rank is defined by the Alberta Conservation Information Management System (Alberta Parks 2016) as somewhat vulnerable (known from 100 or fewer occurrences, or somewhat vulnerable due to other factors, such as restricted range, relatively small population sizes, or other factors). Both S3 species are perennials that increase in response to grazing (Appendix 4). All other native plant species are ranked as S5 (Secure: taxon is common, widespread, and abundant).

Native plantings from 2014 that survived in park

Only 2 of the 3 white spruce trees planted in 2014 were alive in 2016, and all trembling aspen trees planted in the shrub beds had died, though some survived where they were planted in the outer prairie zone along the left and right sides of the park. Tree deaths may be attributed to insufficient watering, or application of non-selective herbicide the following year, however further investigation is required to determine this. Of the 19 native forb species planted in 2014, the following 6 were directly observed in the park in 2016:

- cut-leaved anemone (*Anemone multifida*)
- wild bergamot (*Monarda fistulosa*)
- common yarrow (*Achillea millefolium*)
- Rosy pussytoes (*Antennaria rosea*)
- smooth blue beardtongue (*Penstemon nitidus*)
- yellow penstemon (*Penstemon confertus*)

Regulated exotic plants

Three of the 21 exotic species are designated as noxious under the *Alberta Weed Control Act* (Province of Alberta 2010) and therefore there is a legal requirement to control their spread on all land in Alberta:

- Canada thistle (*Cirsium arvense*)
- perennial sowthistle (*Sonchus arvensis*)
- houndstongue (*Cynoglossum officinale*)

None of the exotic species found on site are designated as prohibited noxious. The majority of exotic plants found in the park are perennial species (Appendix 4).

5.10. Fauna

5.10.1. FWMIS

The Fish and Wildlife Internet Mapping Tool (Alberta Environment and Parks 2018) was used to query the Fish and Wildlife Management Information System (FWMIS) for fish and wildlife reports within a 1km radius of the project site. However, no fish or wildlife inventory records were found within the search extent.

5.10.2. Wildlife species and habitat

The wildlife species assessment is based on incidental observations recorded in the park during the project's duration (July 2017 – July 2018), as well as from earlier observations made by the Zone Parks Ecologist and Project Manager. In addition to wildlife, domestic dogs (*Canis lupus familiaris*) have been observed using the park on-leash, with previous reports of off-leash dog use (Sarah Kellett, personal communication).

Vertebrate wildlife

Table 9 provides a list of the vertebrate species observed (by sight, sound, or sign) within the park, adjacent to the park, or flying over the park (for some birds) from 2016-2018. Vertebrate diversity included 9 bird species, 4 mammal species, 1 reptile species, and 1 amphibian species near the site.

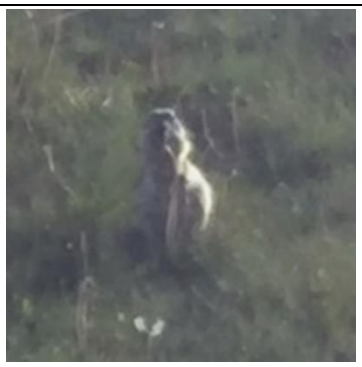
Table 9. List of vertebrate wildlife observed within, adjacent to, or flying over the McDougall Cairn Natural Area. S Rank, N Rank, G Rank and Origin are based on data from the Alberta Conservation Information Management System element occurrence data (ACIMS 2017). Exotic species are bolded.

Family	Common Name	Species Name	Observation Type	S Rank	N Rank	G Rank	Origin
Amphibians and Reptiles							
Hylidae	Boreal chorus frog	*Pseudacris maculata*	Heard	S5	N5	G5	Native
Colubridae	Snake (unknown sp.)	Unknown	Sighting (by citizen)	N/A	N/A	N/A	N/A
Birds							
Accipitridae	Swainson's hawk	*Buteo swainsoni*	Sighting	S4B	N4B	G5	Native
Accipitridae	Red-tailed hawk	*Buteo jamaicensis*	Sighting, heard	S5B	N5B	G5	Native
Corvidae	American crow	*Corvus brachyrhynchos*	Sighting	S5B	N5B, N5N	G5	Native
Turdidae	American robin	*Turdus migratorius*	Sighting, heard	S5B	N5B, N5N	G5	Native
Emberizidae	Sparrow (unknown sp).	Unknown	Sighting	N/A	N/A	N/A	N/A
Emberizidae	Savannah sparrow	*Passerculus sandwichensis*	Sighting, heard	S5B	N5B	G5	Native
Passeridae	**House sparrow**	*Passer domesticus*	Sighting	N/A	N/A	N/A	**Exotic**
Anatidae	Duck species	Unknown	Sighting	N/A	N/A	N/A	N/A
Icteridae	Red-winged blackbird	*Agelaius phoeniceus*	Heard	S5B	N5B, N5N	G5	Native
Mammals							
Sciuridae	Richardson's ground squirrel	*Urocitellus richardsonii*	Sighting, dens	S4	N5	G5	Native
Leporidae	White-tailed jack rabbit	*Lepus townsendii*	Sighting, scat, browse, shed fur	S5	N5	G5	Native
Canidae	Coyote	*Canis latrans*	Sighting, scat	S5	N5	G5	Native
Mustelidae	Long-tailed weasel	*Mustela frenata*	Scat	S3S4	N5	G5	Native

Richardson's ground squirrels are considered to be a key species in the Foothills Fescue Natural Subregion (Natural Regions Committee 2006), however their abundance has decreased across the grasslands. Richardson's ground squirrels were observed using sandstone boulders and shrubs to create burrows that protect from predatory birds, and were observed eating common dandelion in the park (Figure 4). White-tailed jack rabbits were observed eating herbaceous plants in the park, including common dandelion, and their feces were always present on site.

All vertebrate species observed are native, with the exception of the House sparrow, which was introduced from Europe. The snake was observed by a neighbouring citizen in 2016, and was likely a Garter snake in the Family Colubridae. The Natural Subregion is also habitat for the Wandering garter snake and Plains garter snake, and where wetlands are available, provides habitat for Red-winged blackbirds and Chorus frogs (Natural Regions Committee 2006). A Boreal chorus frog was heard from the direction of the stormwater pond to the north of the site (see Appendix 1: Sheet 1 – Location Plan). All other species were observed within or immediately adjacent to the site, with direct use of the site as habitat.

The back fence was used as a perch by a Swainson's hawk and American robins. A Savannah sparrow was observed singing while perched on this fence. The left and right shrub beds have a dense tall shrub canopy, and were often used by birds as habitat. Sparrows were observed consuming ripe buffaloberry berries in the left and right shrub beds in the month of July (Figure 5).

Richardsons' ground squirrel burrow entrance below shrub (above left); eating dandelion (above right).

Swainson's hawk being pestered by American robins and unknown sparrow species.


Possible long-tailed weasel (*Mustela frenata*) scat (above left). White-tailed jack rabbit in outer prairie zone (above right).

Figure 4. Vertebrate wildlife observations in the park. Photos by Angie Arrau.


Figure 5. Wildlife habitat use of the park. Buffaloberry berries ripened (left) from left shrub bed (right). Photos by Angie Arrau.

Invertebrate wildlife

Table 10 provides a list of invertebrates observed within the park from 2016-2018. The S Rank, N Rank, G Rank and Origin are based on the separate ACIMS element occurrence data for butterflies and moths (ACIMS 2017), beetles (ACIMS 2017), other insects (ACIMS 2017), when it was possible to identify to species. Invertebrate diversity included 7 orders, which included 2 native bumblebees and 5 native butterflies, some of which are shown in Figure 6.




Native butterflies included the Silvery blue butterfly (*Glaucopsyche lygdamus*) (above left), Common ringlet (*Coenonympha tullia*) (2nd from left), Clouded sulphur (*Colias philodice*) (2nd from right), and Garita skipperling (*Oarisma garita*) (above right). Native bumblebees included the Hunts bumble bee (*Bombus huntii*) (bottom left) and Nevada bumblebee (*Bombus nevadensis*) (bottom right), both observed pollinating cicer milk vetch.


Figure 6. Native butterflies and bumblebees. Photos by Angie Arrau.

Table 10. List of invertebrate species and insect Orders observed within the McDougall Cairn Natural Area. S Rank, N Rank, G Rank and Origin are based on data from the Alberta Conservation Information Management System element occurrence data (ACIMS 2017). ACIMS data are recorded as N/A or not applicable when identification specificity did not allow for a check against ACIMS data. Exotic species are bolded.

Family (Order)	Common Name	Species Name	S Rank	N Rank	G Rank	Origin
Order Araneae (Spiders)						
(Order Araneae)	Spider (unknown sp.)	Unknown	N/A	N/A	N/A	N/A
Order Hymenoptera (Bees, Wasps, and Ants)						
Apidae	Nevada bumblebee	*Bombus nevadensis*	S5	N5	G4G5	Native
Apidae	Hunts bumblebee	*Bombus huntii*	S5	N5	G5	Native
(Order Hymenoptera) Vespidae	Wasp	Unknown	N/A	N/A	N/A	N/A
Formicidae	Ant (unknown spp.)	Unknown	N/A	N/A	N/A	N/A
Order Odonata						
(Suborder Zygoptera)	Damselfly (blue)	Unknown	N/A	N/A	N/A	N/A
(Infraorder Anisoptera)	Dragonfly (orange)	Unknown	N/A	N/A	N/A	N/A
Order Coleoptera						
(Order Coleoptera)	Beetles	Unknown	N/A	N/A	N/A	N/A
(Order Coleoptera)	Large beetle	Unknown	N/A	N/A	N/A	N/A
Coccinellidae	Seven-spot lady beetle	*Coccinella septempunctata*	SNA	NNA	GNR	Exotic
Nitidulidae	(toadflax biocontrol beetle)	*Brachypterolus pulicarius*	N/A	N/A	N/A	**Exotic**
Order Lepidoptera (Butterflies and Moths)						
Lycaenidae	Copper butterfly	*Lycaena* sp.	N/A	N/A	N/A	N/A
Lycaenidae	Silvery blue butterfly	*Glaucopsyche lygdamus*	S5	N5	G5	Native
Pieridae	Clouded Sulphur	*Colias philodice*	S5	N5	G5	Native
Nymphalidae	Common ringlet butterfly	*Coenonympha tullia*	S5	N5	G5	Native
Pieridae	**cabbage white butterfly**	Pieris rapae	SNA	NNA	G5	**Exotic**
Hesperiidae	Garita skipperling	*Oarisma garita*	S4	N5	G5	Native
(Order Lepidoptera)	**(toadflax biocontrol caterpillar)**	*Calophasia lanula*	N/A	N/A	N/A	**Exotic**
Order Orthoptera (Grasshoppers, Crickets, Locusts)						
Acrididae	two-striped grasshopper (likely)	*Melanoplus bivittatus*	N/A	N/A	N/A	N/A
Acrididae	Dawson's grasshopper	*Melanoplus dawsoni*	N/A	N/A	N/A	N/A
Order Hemiptera (True Bugs)						
Pentatomidae	Stinkbug	*Cosmopepla lintneriana*	N/A	N/A	N/A	N/A
Cicadellidae	leafhopper (unknown sp.)	Unknown	N/A	N/A	N/A	N/A

Both the modified grassland and anthropogenic shrubland areas were used by most species (Figure 7), although ants were only observed in the shrub beds. Two species of native bumblebee were observed pollinating cicer milk vetch in the modified grassland areas. However, the lack of formal entomological surveys cannot exclude species from using any given area of the park.




Above left: Stinkbugs (*Cosmopepla lintneriana*) mating on toadflax. Above centre: Two-striped grasshopper (*Melanoplus bivittatus*) on dandelion leaf. Top-right: ant on Canada goldenrod. Bottom-right: Seven-spot lady-beetle (*Coccinella septempunctata*).


Above: Dawson's grasshopper (*Melanoplus dawsoni*). Right: Dragonfly on park fence.

Figure 7. Other insects observed within the park. Photos by Angie Arrau.

Three exotic invertebrate species were observed on site, including two that have been previously released in North America as biocontrols (Figure 8) for yellow toadflax (McClay 1992, McClay and Hughes 1995): *Brachypterolus pulicarius*, and *Calophasia lanula*.

Figure 8. Biocontrol species of yellow toadflax found in the park. *Brachypterolus pulicarius* beetles feeding on flower heads (left). *Calophasia lanula* larvae feeding on leaves (right). Photos by Angie Arrau.

5.11. Cultural Resources

The most significant cultural resources on the site are the collection of features related to the character defining elements of the Provincial Historic Resource registration, including (Reid 2009; CHC 2016; HeRMIS 2013a, 2013b):

- The location of the cairn, marking where George McDougall is believed to have died
- The cairn, including concrete obelisk and bronze plaque
- The environment of native prairie plantings
- The metal Nose Creek Historical Society memorial sign

The site also includes contemporary cultural landscape features that contribute to this cultural landscape. This includes a gravel trail that allows park visitors to get closer to the cairn, which wraps half-way around the fenced area that the cairn is located in. However, an access gate to the cairn at the backside of the fence is not adjacent to the trail.

5.12. Aesthetic

The park received complaints regarding aesthetics in 2016 (Sarah Kellett, personal communication), and was visually very unappealing due to dead trees with metal stakes attached to them, and weedy conditions. For citizens living across the street on Panora Way, it offers a green space in front of their home, however from within the park, the view is toward the highway right-of-way with weedy conditions. The park included little diversity in flowering colours of the plants on site at the time.

5.13. Environmentally Significant Areas

The site was not determined to be an Environmentally Significant Area during the development process for the community of Panorama Hills (The City of Calgary Planning & Building Department 1999).

5.14. Other features

There are small gaps between the back fence that separates the park from the Stoney Trail highway R.O.W. and the adjacent residential backyard fences. As a result, there are lightly disturbed desire line trails running from the back corners of the park toward the center in several directions, which have not yet resulted in bare ground dirt trails. Packing of snow and associated tracks along these desire lines (Figure 9) indicated they are being used by both wildlife and people with dogs.

Figure 9. March 2018 snow tracks (people, dogs, white-tailed jacket rabbits) along desire lines from gaps in the fence. Left: view from back-right gap. Right: photo from back-left gap. Photos by Angie Arrau.

A geocache is located in one of the planting beds in the park (park visitor, personal communication, spring 2018), which attracts park visitors from outside of the local area to the site. Calgary Parks does not have an official position on the placement of geocaches in parks, but discourages any off-trail activities in natural areas. In addition, park visitors arrive at the site in large numbers on a monthly basis in order to visit a theoretical digital gym in the Pokèmon GO! game (park visitors, personal communication, summer 2018), an “augmented reality game [that] uses the mobile device GPS to locate, capture, battle, and train virtual creatures [that] appear in the player’s real-world location.” Park users informed that not all players stay on the park’s trails when visiting the park for this purpose. Calgary Parks is beginning to become aware of the real-world park use impacts that may result from the virtual game, but does not yet have a plan to address this.

6. RESTORATION PROJECT NEED AND FEASIBILITY

The following describes the site conditions in need of repair, threats and stressors to the site, and the biotic interventions needed to restore them, as well as proposed disturbance to conduct the project.

6.1. Physical site conditions in need of repair

The McDougall Cairn Natural Area includes many physical site conditions in need of repair, including: dead trees, non-native shrubs, poorly established grasses, bare ground patches in the grasses, poor quality soils, soil compaction, invasive species throughout the site, and poor representation of the forb cover layer aside from invasive plants. In addition, the gravel trail infrastructure was being encroached on by some plants in 2016.

6.2. Threats and stressors

The primary threat to the condition of the site is the presence of invasive plants on site, including regulated noxious weeds and other invasive plants. Additionally, noxious weeds threaten to spread into the park from adjacent TUC lands. For example, yellow toadflax and Canada thistle are two noxious weeds present on site, while black henbane is a noxious weed present in the adjacent road right of way. Smooth brome has established along the fence line, and could spread further into the site. The site was originally seeded with aggressive non-native grass species which threaten the potential establishment of native forbs. The use of herbicides to control invasive plants on site also threatens the successful establishment of native forb species.

The stressors in need of regulation or re-initiation include soil compaction resulting from trucks accessing the site to water trees, the original soil disturbance when the site was constructed (affecting native soils and seedbank), damage to vegetation adjacent to the sidewalk resulting from winter snow removal, and off-leash dog use of the park and dog feces left behind.

Encroachment on the site includes the development of informal trails that access the gaps at the two ends of the back fence, likely from repeated use of park users accessing the green space in the road right of way. Future threats to the site include future overpass construction for 14 St NW at Stoney Trail, which may introduce more invasive plant propagules to the area.

6.3. Interventions needed

6.3.1. Biotic interventions

The kinds of biotic interventions needed to restore the site include:

- Removing and replacing the dead trees,
- Planting native shrub species,
- Planting native forb species (and reduction in use of herbicides to allow their establishment),
- Seeding of native grass and forb species,
- Control of noxious weeds and reduction of overall invasive species cover, and
- Soil amendment.

6.3.2. Site improvements and related disturbance activities

Site improvements that will result in disturbance to the site include:

- Disturbance where new trail to be installed/extended (footprint ~27.6m^2).

- Disturbance associated with moving Nose Creek Historical Society sign.
- Disturbance associated with removing dead trees and planting new trees.
- Disturbance associated with installation of interpretive sign and bench (footprint ~4m^2).

Refer to the Appendix 1: Sheet 3 – Site Preparation Plan for details.

6.5. Feasibility assessment

The feasibility of the project was determined based on available budget, permitting requirements, buy-in from stakeholders, and availability of plant materials.

6.5.1. Provincial approval

Provincial approval was required for this project because it is a registered Provincial Historic Resource. An inspection will be carried out by the Historic Places Stewardship section of the Alberta Government upon completion of the project. This process was led by the Cultural Landscapes Management Lead of Calgary Parks (see Appendix 2), with information provided by the Project Manager. The proposal included five components:

1. Removing the chain link fence surrounding the cairn;
2. Extending the existing interpretive trail to create a walking path around the cairn (with interpretive sign and bench);
3. Planting four Aspen trees, native shrubs, and herbaceous plants in the existing entry planting bed to the west of the cairn;
4. Planting one Aspen tree, native shrubs, and herbaceous plants in the existing planting bed to the east of the cairn; and
5. Moving the Nose Creek Historical Sign to the existing entry planting bed.

Approval was issued by the Assistant Deputy Minister of the Heritage Division of the Alberta Government on July 19, 2017 to carry out the project. Evaluation conducted by the Heritage Division determined that the proposed interventions meet the conservation principles of the Standards and Guidelines for Conservation of Historic Places and Culture in Canada (Government of Alberta *et al.* 2010), and that the "naturalization initiative will improve the overall health of the site's vegetation and conserve the site's heritage values. It will help to conserve the environment of native prairie grasses by increasing diversity of the landscape and reintroducing native species to the site. It will also help to create a sustainable landscape that supports plant, animal and insect life, and help to control weeds and pests."

6.5.2. Urban Forestry's ability to re-plant trees

The Urban Forestry portfolio of Calgary Parks is the asset owner of all trees in the park. They were consulted to determine if dead trees could be removed, and whether new native trees could be planted. The Urban Forestry portfolio approved of, and carried out this portion of work under Calgary Parks' ReTree YYC program, which was a city-wide endeavor that aimed to add more tree canopy back into Calgary after a rapid loss of canopy due to an early fall snowstorm in September 2014. Through consultation with Urban Forestry, it was determined that trembling aspen trees were an available tree species for planting, which are suitable to the region.

6.5.3. Buy-in from Calgary Civic Trust

The Cultural Landscapes Lead consulted with the Calgary Civic Trust to determine the feasibility of installing an interpretive sign in the park. The Calgary Civic Trust had previously received grant funding for the installation of an interpretive sign in the park (CHC 2016), and would be able to cover the cost of installation. The Calgary Civic Trust led engagement with the Stoney Nakoda First Nation in order to come to an agreement on the images and text to be included on this interpretive sign.

6.5.4. Availability of native forbs and grasses

Desired plant materials were determined to be available from the following native plant suppliers:

- Seaborn Seeds Inc. (http://www.crookedpost.ca/seed/)
- Wild About Flowers (http://www.wildaboutflowers.ca/)
- ALCLA Native Plants (http://www.alclanativeplants.com/)
- Bron & Sons Nursery (http://www.bronandsons.com/)

6.5.5. Budget availability

Preliminary meetings with the project sponsor in 2016 determined that a budget of $10,000 for 2017-2018 combined could be made available for the project with Calgary Parks operational funding (Sarah Kellett, personal communication).

7. REFERENCE HABITAT DESCRIPTION

The reference habitat for the habitat restoration project is being described from theoretical data sources, rather than from a physical, non-disturbed reference habitat location. This is for logistical reasons, and because The City's Habitat Restoration Project Framework (The City of Calgary 2014) allows this when appropriate. It is considered appropriate for this project because recreating the reference habitat is not a project goal.

The reference habitat is consistent with expected plant communities within the Foothills Fescue Natural Subregion of the Grasslands Natural Region. The Parry Oatgrass - rough fescue - sedge community, a climax submesic grassland typically found on upper slope positions in the Foothills Fescue Natural Subregion is functioning as the reference habitat description (Table 11). Water is primarily added to submesic areas through precipitiation and available for moderately short periods afterward, and with the site's current top-of-slope position and location within the Foothills Fescue Natural Subregion, snow and rain would be the primary source of water once plant establishment watering has been completed.

Table 11. Parry Oatgrass - rough fescue - sedge (Submesic Grassland, Upper Slope Positions) climax vegetation community description (Source: Adams *et al*. 2003).
*Canopy Cover: T = trace amounts. **Stages: L = late successional species, E = early-mid successional species.

Growth Form	Common Name	Scientific Name	Canopy Cover* [mean(range)]	Successional stage**
Shrubs	Shrubby cinquefoil	*Potentilla fruticosa*	5%	E
	Prickly rose	*Rosa acicularis*	3%	E
	Creeping juniper	*Juniperus horizontalis*	2%	L
	Buckbrush	*Symphoricarpos occidentalis*	1%	E
Forbs	Moss phlox	*Phlox hoodii*	10%	E
	Little club moss	*Selaginella densa*	6%	L
	Cut-leaved anemone	*Anemone multifida*	3%	E
	American/northern sweet vetches	*Hedysarum alpinum/boreale*	3%	E
	Stone-seed	*Lithospermum ruderale*	3%	L
	Blanket flower	*Gaillardia aristata*	2%	E
	Nodding onion	*Allium cernuum*	1%	E
	Alum-root	*Heuchera cyclindrica*	1%	E
	Wild blue flax	*Linum lewisii*	1%	E
	Hairy golden aster	*Heterotheca villosa*	T	E
	Smooth blue beard-tongue	*Penstemon nitidus*	T	E
	White/purple prairie clovers	*Petalostemon candidum/purpureum*	T	E
	Milk vetches	*Astragalus aboriginum/crassicarpus/ tenellus/missouriensis*	T	E
	Prairie cone flower	*Ratibida columnifera*	T	E
	Loco-weeds	*Oxytropis sericea/splendens/viscida*	T	E
	Annual sunflower	*Helianthus annuus*	T	E
Grasses	Parry oat grass	*Danthonia parryi*	23%	L
	Rough fescue	*Festuca campestris*	15%	L
	Awned/slender wheat grass	*Agropyron trachycaulum var. unilaterale/trachycaulum*	15%	E
	Blunt/dryland sedge	*Carex obtusata*	12%	L
	Green needle grass	*Stipa viridula*	5%	E
	Plains reed grass	*Calamagrostis montanensis*	5%	E
	purple reed grass	*Calamagrostis purpurascens*	5%	E
	early blue grass	*Poa cusickii*	4%	E
	Idaho fescue	*Festuca idahoensis*	3%	E
	June grass	*Koeleria macrantha*	2%	E
	Bluebunch wheat grass	*Agropyron spicatum*	2%	E
	Northern wheat grass	*Agropyron dasystachyum*	2%	E
Moss/Lichen Cover			UNKNOWN	
Soil Exposure			UNKNOWN	
Total Vegetation			UNKNOWN	

8. HABITAT RESTORATION APPROACH

8.1. Restoration hypothesis

The project approach being taken is a naturalization level of habitat restoration, which is defined by The City's Habitat Restoration Project Framework (The City of Calgary 2014) as:

- **Naturalization:** A type of habitat restoration; the deliberate reintroduction of species that are native to a given area or are well adapted to the climate circumstance; activities that are intended to improve and enhance the natural environment.

The proposed naturalization aims to improve ecosystem function and biodiversity by reintroducing native species appropriate to the region that will assist the park's succession towards a prairie landscape, using the reference habitat as the model for a climax community but not trying to recreate it (Figure 10). This is because modified grasslands are unlikely to fully recover to native grasslands (Adams *et al.* 2016), which would be even more unlikely in the suburban setting of the park. A full habitat restoration attempting to restore a climax community would therefore be unsuitable at this location. Adams *et al.* 2016 recommend that management objectives for modified grasslands should be to prevent bare soil, erosion, and undesirable forage and weedy species. The naturalization project aims to reduce the degraded condition and aesthetic of the site through biotic interventions, and complete site improvements suitable for the suburban historic site.

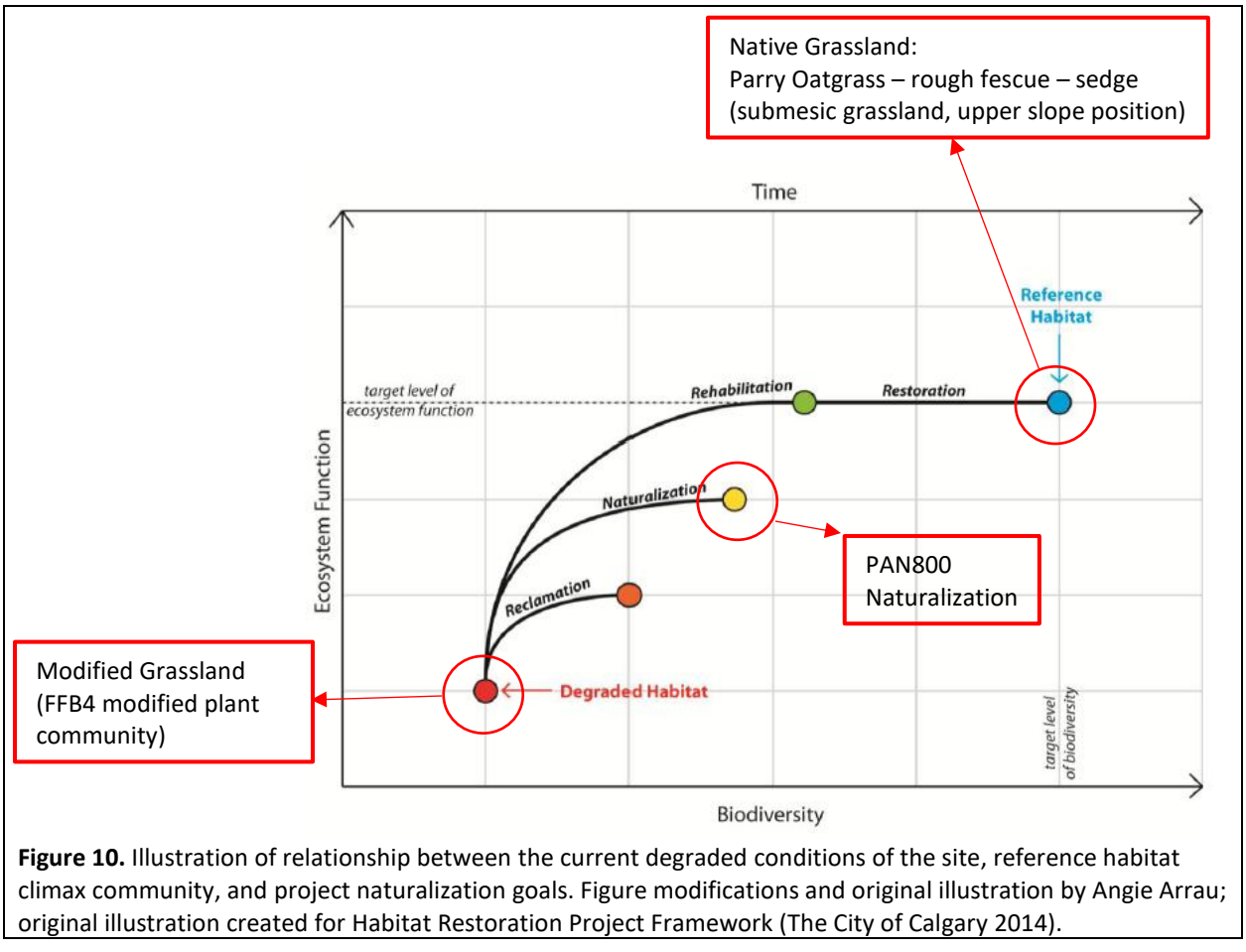


Figure 10. Illustration of relationship between the current degraded conditions of the site, reference habitat climax community, and project naturalization goals. Figure modifications and original illustration by Angie Arrau; original illustration created for Habitat Restoration Project Framework (The City of Calgary 2014).

Biotic interventions

Biotic interventions for the project are focused on reintroducing native species. This will be completed through planting of native trees, shrubs, and forbs, as well as by seeding native grasses and forbs. The native species chosen for the project are aggressively spreading, early successional species that will assist the site's trajectory toward a prairie landscape. They will offer a variety of bloom colours and seasons to improve the poor aesthetic of the park.

Invasive species will be managed in a manner that reduces chemical inputs into the system, which will help to increase the establishment of forbs and shrubs on site. Reducing invasive species cover will also help to reduce pressures on native species by reducing competition. A soil amendment (compost tea solution) will be applied on site that help reduce soil compaction and increase biological materials within the soil in order to improve species establishment.

The interventions will integrate with the landscape by providing additional shrub habitat for birds, and improve hunting area for predatory birds by improving grassland prey habitat. Weed pressures on adjacent private properties will be reduced by managing invasive plants, and adding colourful grassland wildflowers will improve the aesthetic and integrate with the Provincial Historic Resource requirement of a prairie landscape.

Site improvements

Temporary improvements to the site include garbage pick-up throughout the project's duration, and pruning of the shrubs on the left and ride side of the park to address citizen complaints. Temporary signage to communicate the project to park users will help to explain the activities happening in the park as well as the rapid changes.

The removal of the black fence surrounding the cairn will give the park a more open prairie aesthetic and allow the historic significance to be more accessible to park users. Permanently moving the Nose Creek Historical Society sign to the entrance area of the park may draw more passersby onto the trail, and will allow the interpretive trail to be extended around the cairn. Extending this gravel trail will provide a more functional park space, and provide an appropriate location for the installation of an interpretive sign and bench for park users.

8.2. Restoration plan zones

To reflect the park's vegetation communities of modified grassland and anthropogenic shrubland, and for practical reasons, the project site was divided into zones which will each have different interventions and restoration activities (Table 7, Figure 3).

8.3. Budget

Following completion of the project, the Cultural Landscapes Lead will apply for a HeRMIS grant to recover costs of the project. As some project activities remain to be completed following project hand-off, this application has not yet been submitted. Budget and spending were approved by the Project Sponsor and tracked by a Parks Business Assistant, and budget numbers were not available for reporting.

8.4. Goals and objectives

The goals and objectives for the project are listed in Table 12.

Table 12. Goals and objectives of the McDougall Cairn Natural Area Habitat Restoration Project.

Goal #	Goal	Objectives
1	Increase the prairie landscape character-defining elements of the provincial historic resource, including an environment of native prairie grasses and plants appropriate to the reference habitat.	1.1. Increase cover of native grasses 1.2. Increase cover of native forbs with a variety of bloom colours and bloom periods 1.3. Increase cover of native shrubs 1.4. Increase overall native species biodiversity
2	Native tree plantings that had previously died on site are replaced with new native trees that survive.	2.1. Remove dead tree plantings 2.2. Plant new native trees and ensure their survival
3	Invasive weeds on site are managed to reduce pressures on native species and as per legislated requirements.	3.1. Control spread of noxious weeds 3.2. Decrease total cover of all invasive and exotic plants
4	Collaborate with site stewardship stakeholders.	4.1. Involve City asset stewards in the project 4.2. Involve Nose Creek Historical Society in the project 4.3. Involve the Calgary Civic Trust in the project 4.4. Approval from Alberta Government for project
5	Communicate the project to nearby homeowners.	5.1. Deliver communication pamphlet to homeowners 5.2 Ensure signage is placed on site
6	Create an ongoing site maintenance and monitoring plan.	6.1. Establish photomonitoring points 6.2. Monitor plant establishment and changes in plant cover
7	Improve site infrastructure to bring attention to historical resource and improve site function.	7.1. Extend trail around cairn 7.2. Install interpretive sign 7.3. Install bench 7.4. Remove fence around cairn
8	Mapping activities and planting / seeding locations for long-term monitoring	8.1. Develop file geodatabase for the project to identify specific planting locations of trees, shrubs, and forb planting clumps 8.2. Use General Observations App to record photomonitoring points 8.3. Use Weed Collector App to map weed polygons and their control 8.4. Use Habitat Restoration Collector App to track restoration project activities 8.5. Ensure PARIS asset database is updated to reflect asset changes in relation to project

8.5. Work plan

Early meetings and site visits were held with the Project Sponsor to develop a preliminary work plan for the project. Meetings were held on a regular basis to check on project progress, discuss changes and scheduling needs, and adapt the work plan as needed. The work plan shown in Table 13 provides the final schedule for prescribed activities, including site improvements and biotic interventions.

Table 13. Timeline for restoration project work plan.

Type of intervention	Intervention activity	2017				2018			
		JUL	AUG	SEP	OCT	MAY	JUN	JUL	AUG
Site improvement	Extend trail				X				
	Fence removal				X				
	Remove metal stakes				X				
	Install interpretive sign							X	
	Install bench							X	
	Garbage pick-up	X	X	X	X	X	X	X	
	Install temporary signs	X							
	Prune shrubs								
Biotic intervention	Reduce pesticide application		X						X
	Seed grasses				X		X		X
	Seed forbs				X		X		X
	Remove dead trees								
	Plant trees				X				
	Plant shrubs				X				
	Plant forb plugs				X		X		
	Regulated weed control				X		X	X	X
	Non-regulated weed control		X			X	X	X	X
	Soil amendment (compost tea)				X				X
	Invasive plant mapping		X	X			X	X	

9. HABITAT RESTORATION PLAN

This restoration prescription accompanies the Habitat Restoration Plan drawings (Appendix 1). The site improvements and biotic interventions in those drawings are described below.

9.1 Integrated Pest Management Plan

9.1.1. Methods

Invasive plant control methods for 2017 and 2018 include a combination of control efforts (Table 14), including mechanical control methods (weed-whipping, cutting, and hand-pulling), and chemical control herbicide treatment for noxious weeds only). See Appendix 1: Sheet 2A – Integrated Pest Management Plan (2017) and Sheet 2B – Integrated Pest Management Plan (2018) for location specifics.

Table 14. Invasive weed control planned for 2017-2018. Regulatory status is based on the Alberta Weed Control Act (Province of Alberta 2010). Control methods include C = Chemical control, HP = Hand-pull, HC = Hand-cut, W = weed-whip cutting, N = no control but present, ~ = not present on site.

Common Name	Scientific Name	Regulatory Status	Control Method	
			2017	2018
Canada thistle	*Cirsium arvense*	Noxious	C	2X HP/HC
Perennial sowthistle	*Sonchus arvensis*	Noxious	C	2X HP
Yellow toadflax	*Linaria vulgaris*	Noxious	C	2X HP & 2X W/C
Caragana	*Caragana arborescens*	Formerly “Noxious”	HC	HC/C
Bull thistle	*Cirsium vulgare*	N/A	HP	HP
Cicer milkvetch	*Astragalus cicer*	N/A	N	HP/W
Yellow sweetclover	*Melilotus offinicalis*	N/A	N	HP
Common goat’s beard	*Tragopogon dubius*	N/A	~	HP
dog mustard	*Erucastrum gallicum*	N/A	~	HP
flixweed mustard	*Descurainia sophia*	N/A	~	HP
kochia	*Kochia scoparia*	N/A	~	HP
spear-leaved goosefoot	*Monolepis nuttalliana*	N/A	~	HP
blueburr	*Lappula squarrosa*	N/A	~	HP
stinkweed	*Thlaspi arvense*	N/A	~	HP
Common peppergrass	*Lepidium densiflorum*	N/A	~	HP
Canola/rapeseed	*Brassica rapa*	N/A	~	HP
wild tomato*	*Solanum triflorum*	(Native – Toxic; S3)	~	HP

Additional non-regulated species found in 2018 that were not present in 2018 are shown in Table 14, but not mapped. These included wild tomato (*Solanum triflorum*) that is a native S3 species (Figure 11), but is toxic (Colorado State University 2018). Due to its toxicity, and its appearance as a food plant, it was decided to remove the plant from the site to avoid ingestion by park users or dogs.

Due to the discovery of yellow toadflax biocontrols *Brachypterolus pulicarius* and *Calophasia lanula* in the park in 2018, chemical control for toadflax was not carried out in 2018. Instead, mechanical control was used. The *B. pulicarius* beetles were shook off of plants when hand-pulled prior to bagging the plants; these beetles feed on the flowers and shoots of common toadflax and have been found to result in a reduction of seed production of up to 74% (McClay 1992). The yellow toadflax leaves that *Calophasia lanula* larvae were feeding on were carefully pulled from the plant stem and placed in the toadflax patches that crossed the back fence line to the highway right of way property. It has been

released unsuccessfully in central and northern Alberta, but may be an effective control in southeastern Alberta (McClay and Hughes 1995). Neither species has been intentionally released anywhere in the city by Calgary Parks, however it is unclear whether neighbouring counties have released these biocontrols, or whether they have naturally spread from historical releases elsewhere in Alberta.

In 2018, noxious weeds were hand-pulled and/or cut twice in one season in order to reduce root vigour. One patch of yellow toadflax in the right shrub bed was weed-whipped twice and will have follow-up chemical control in August 2018 due to the density of the infestation.

Figure 11. Wild tomato (Solanum triflorum). Photo by Angie Arrau.

9.1.2. Monitoring and maintenance

Annual monitoring for regulated and non-regulated invasive plants is needed for the site in order to reduce overall invasive plant cover and reduce competition for native plants. Annual checks for new invasive plants should be completed, as well as checks for species already known to have existed on site. For species not included in the IPM Invasive Weeds Collector App, notes should be recorded on which zone they occur, and the activity should be recorded in the Habitat Restoration Collector App.

IPM Invasive Weeds Collector App

The IPM (Integrated Pest Management) Invasive Weed Collector App is an AGOL mapping platform used by Calgary Parks to record infestation and control data for regulated and some unregulated weeds. The App was used to record infestation points and polygons for regulated weeds, as well as a few unregulated weeds which the App permits mapping for (e.g., cicer milk vetch, Caragana). The App was also used to record mechanical control (i.e., hand-pulling) of these species. All herbicide application for weed control was recorded by the Integrated Pest Management staff and/or contractors that completed chemical control, as per Calgary Parks' protocols.

9.2 Site Preparation Plan

9.2.1. Methods

Site preparation includes the following activities (see Appendix 1: Sheet 3 – Site Preparation Plan for exact locations):

- Infrastructure work:
    - Remove and re-install Nose Creek Historical Society sign into entry shrub bed zone
    - Remove fence surrounding cairn
    - Install gravel trail extension around cairn
    - Install bench adjacent to trail
- Tree work:
    - Remove 3 dead trembling aspen trees and metal stakes in entry shrub bed
    - Remove 1 dead white spruce tree and metal stakes in rear shrub bed
- Operational work:
    - Prune shrubs overtopping residential fences on left and right side of park
- Contractor work:
    - Apply soil amendment (compost tea) to outer prairie zone, cairn prairie zone, and shrub beds (Living Soil Solutions)
    - Install interpretive sign adjacent to trail (Chalmers Heritage Conservation Ltd.)

Infrastructure work was carried out by the Capital Projects portfolio of Calgary Parks, while tree work was completed by the Urban Forestry portfolio, and operational work was carried out by Calgary Parks' Zone 4 Operations. A contractors applied the compost tea in both 2017 and 2018. The interpretive sign was manufactured by the Calgary Civic Trust Society and installed by the contractor that also represented the Society.

9.2.2. Monitoring and maintenance

The asset-based changes for infrastructure and trees were submitted by the respective portfolios carrying out the work for updating and tracking in the PARIS system (Calgary Parks 2018). Activities were also recorded in the Habitat Restoration Collector App to have a complete record of activities on the site.

9.3 Planting Plan

9.3.1. Methods

See Appendix 1: Sheet 4 – Planting Plan for planting and seeding details.

Tree Planting

Trembling aspen were chosen for tree planting to replace the dead trees in the entry and rear shrub beds as they are native to the area, though less typical of the grasslands. This species was also an available tree species based on Urban Forestry's ReTree YYC program.

Shrub Planting

Shrub species were selected based on the reference habitat (Table 11), availability of native plant stock from suppliers (all were purchased through Bron & Sons Nursery), and because they are increasers (Alberta Agriculture and Forestry (2018) in response to grazing (Table 15).

Table 15. Shrubs included in planting plant. Supplier = Bron & Sons Nursery. Grazing Response is based on Alberta Agriculture and Forestry (2018).

Common Name	Scientific Name	Plant Code	Size	Supplier	2017 Qty	Grazing Response
Prickly rose	*Rosa acicularis*	ROSAACI	#1 pot size	B & S	10	Increaser
Buckbrush	*Symphoricarpos occidentalis*	SYMPOCC	#1 pot size	B & S	8	Increaser
Creeping juniper	*Juniperus horizontalis*	JUNIHOR	#2 pot size	B & S	4	Increaser
TOTALS	3 species			**1**	**22**	

Forb Planting

The reference habitat (Table 11) was used to select forb species, as most are considered early-mid successional species in the reference habitat, and should therefore assist with successional trajectory on the site. Availability of native plant stock was also a consideration; most were purchased from Wild About Flowers, except for golden bean which was purchased through ALCLA Native Plants (Table 16). Only perennial species that increase in response to grazing were selected (Alberta Agriculture and Forestry 2018, Tannas 2004), with preference to those with an aggressive growth habit (Appendix 5, Table A5.1).

Table 16. Forb plug purchases for October 2017 and June 2018 plantings. Suppliers are ALCLA Native Plants (ALCLA) and Wild About Flowers (WAF). Life span (P = perennial) and grazing response (I = increaser) are based on Alberta Agriculture and Forestry (2018) or Tannas (2004).

Common Name	Scientific Name	Plant Code	Size	Supplier	2017 Qty	2018 Qty	Total Qty	Life Span	Grazing Response
Golden bean	*Thermopsis rhombifolia*	THERRHO	Plug	ALCLA	N/A	27	27	P	I
Nodding onion	*Allium cernuum*	ALLICER	Plug	WAF	4	6	10	P	I
Cut-leaved anemone	*Anemone multifida*	ANEMMUL	Plug	WAF	5	4	9	P	I
Prairie sagewort	*Artemisia ludoviciana*	ARTELUD	Plug	WAF	3	10	13	P	I
Brown-eyed Susan	*Gaillardia aristata*	GAILARI	Plug	WAF	5	6	11	P	I
Hairy false golden aster	*Heterotheca villosa*	HETEVIL	Plug	WAF	4	7	11	P	I
Round-leaved alumroot	*Heuchera cyclindrica*	HEUCCYC	Plug	WAF	3	6	9	P	I
Silky locoweed	*Oxytropis sericea*	OXYTSER	Plug	WAF	4	5	9	P	I
Showy locoweed	*Oxytropis splendens*	OXYTSPL	Plug	WAF	4	6	10	P	I
Smooth blue beardtongue	*Penstemon nitidus*	PENSNIT	Plug	WAF	4	6	10	P	I
Yellow coneflower	*Ratibida columnifera*	RATICOL	Plug	WAF	4	8	12	P	I
TOTALS	11 species			2	40	91			

In addition, forbs were selected in order to provide a variety of bloom colours and bloom periods and to add vertical height variety in the forb structural layer (Appendix 5), with specific planting locations determined by micro-site suitability in the park. Goldenbean/buffalo bean (*Thermopsis rhombifolia*) was specifically selected for its cultural significance, as it flowering time was used by First Nations people to indicate when bison return to their summer range (Tannas 2004).

Forbs were clumped together for planting to make it easier for watering truck operators to locate and water the plants (Appendix 5, Table A5.2). Forb clumps had between 6-10 plants per clump, with some planted in 2017 and some in 2018. A pink pin flag was placed in the center of each planting clump for watering truck operators to locate the clumps in the park.

Seeding

A site-specific 'PAN800 seed mix' of native grasses and forbs (Table 17) was developed based on an existing xeric grass mix that had been used in other natural area parks in Calgary (Jenna Cross, personal communication), with preference to increaser and early-successional decreaser species (Table 17). The species and percentage by weight in the xeric grass mix were adjusted based on alternate species desired for the reference habitat, and then adjusted again based on availability from the Seaborn Seeds supplier. The final proposed seed mix was reviewed internally by a native plant specialist within Calgary Parks (Jenna Cross, personal communication). The internal consultant provided the following recommendations for application which were used as application methods for this project:

- Hand broadcast at a rate of 45 kg/ha; lightly rake in seed so seed to soil contact is maximized
- 0.2 ha of land will require 9 kg of seed
- To increase seed to soil contact, mow, then rake the site thoroughly, removing all thatch and litter to expose soil

Table 17. 'PAN800 Seed Mix' applied in fall 2017. Some of same seed mix remained and was re-seeded in cairn prairie zone in 2018. A net weight of 20lbs of this mix was used. Grazing response is based on Alberta Agriculture and Forestry (2018) or Tannas (2004).

Growth Form	Common Name	Scientific Name	% by Weight	Target Cover	Grazing Response
Grass	Idaho fescue	*Festuca idahoensis*	15%	10%	Increaser
	Green needle grass	*Stipa viridula*	6%	6%	Decreaser
	June grass	*Koeleria macrantha*	5%	5%	Increaser
	Awned wheatgrass	*Agropyron trachycaulum var. unilaterale*	8%	15%	Decreaser
	Northern wheatgrass	*Agropyron dasystachyum*	8%	15%	Decreaser
	Rocky Mountain fescue	*Festuca saximontana*	15%	15%	Increaser
	Western porcupine grass	*Stipa curtiseta*	10%	5%	Decreaser
	Needle & thread grass	*Stipa comata*	10%	5%	Increaser
	Blue grama	*Bouteloua gracilis*	10%	7%	Increaser
Forb	Blue flax	*Linum lewisii*	5%	10%	Increaser
	Cut-leaf anemone	*Anemone multifida*	1%	1%	Increaser
	Creeping white prairie aster	*Aster fulgens*	2%	1%	Increaser
	Smooth aster	*Aster laevis*	1%	1%	Increaser
	Northern sweet vetch	*Hedysarum boreale*	1%	1%	Increaser
	Low goldenrod	*Solidago missouriensis*	1%	1%	Invader
	Ascending purple milkvetch	*Astragalus crassicarpus*	1%	1%	Decreaser
	Purple prairie clover	*Petalostemon purpureum*	1%	1%	Increaser

Due to their availability, additional seed mixes will be applied to the site in late summer or early fall of 2018 (Table 18, Table 19), as well as a pure blue flax seed. These seed mixes are suitable to the site conditions and based on the recently released Calgary Seed Mixes document (The City of Calgary Parks 2018).

Table 18. Native Bright Seed Mix (Calgary Seed Mixes, pg. 71)

Current botanical name	Previous botanical name	Common name	% by weight
Linum lewisii	*NA*	blue flax	25
Solidago missouriensis	*NA*	low (Missouri) goldenrod	25
Astragalus canadensis	*NA*	Canada milkvetch	16
Artemisia ludoviciana	*NA*	prairie sagewort (sage)	10
Solidago canadensis	*NA*	Canada goldenrod	5
Vicia americana	*NA*	American vetch	5
Anemone multifida	*NA*	cut-leaved anemone	2
Dalea purpurea	*Petalostemon purpureum*	purple prairie clover	2
Drymocallis arguta	*Potentilla arguta*	white cinquefoil	2
Erigeron philadelphicus	*NA*	Philadelphia fleabane	2
Gaillardia aristata	*NA*	gaillardia (blanket flower)	2
Monarda fistulosa	*NA*	wild bergamot	2
Symphyotrichum laeve	*Aster laevis*	smooth aster	2

Table 19. Colourful Mesic Grassland Mix (Calgary Seed Mixes, pp. 54-55)

Current botanical name	Previous botanical name	Common name	% by weight
Deschampsia cespitosa	*NA*	tufted hair grass	14
Elymus trachycaulus ssp. trachycaulus	*Agropyron subsecundum*	slender wheatgrass	14
Festuca idahoensis	*NA*	bluebunch (Idaho) fescue	14
Festuca saximontana	*NA*	Rocky Mountain fescue	14
Pascopyrum smithii	*Agropyron smithii*	western wheatgrass	14
Poa palustris	*NA*	fowl bluegrass	14
Agrostis scabra	*NA*	rough hair grass	8
Nassella viridula	*Stipa viridula*	green needle grass	8
Astragalus canadensis	*NA*	Canada milkvetch	3
Dalea purpurea	*Petalostemon purpureum*	purple prairie clover	3
Linum lewisii	*NA*	blue flax	3
Erigeron philadelphicus	*NA*	Philadelphia fleabane	1
Drymocallis arguta	*Potentilla arguta*	white cinquefoil	trace
Gaillardia aristata	*NA*	gaillardia	trace
Lithospermum ruderale	*NA*	woolly gromwell	trace
Monarda fistulosa	*NA*	wild bergamot	trace
Symphyotrichum laeve	*Aster laevis*	smooth aster	trace

9.3.2. Monitoring and maintenance

Planted trees

The Urban Forestry portfolio of Calgary Parks will be conducting ongoing watering of trees for an establishment period of 5 years. Tree health assessments are also conducted by this portfolio.

Planted shrubs and forbs

Native shrubs and forbs planted in 2017 were watered twice per week until the end of October. Forbs planted in 2018 are being watered twice per week from June – September. Shrubs and forbs planted were assessed for survival in 2018. Future assessments will include an evaluation of whether or not the plants are spreading.

Seeded species

Informal assessments were conducted in 2018 to determine if native species seeded have established.

Monitor for appearance of volunteer native species

On all site visits, incidental observations were recorded for any new species observed on site that were not known to have been planted or seeded in the past, and the species observed were checked against the 2014 planting list.

9.4 Site maintenance

9.4.1. Methods

On all site visits, pink pin flags at planting sites that were missing were replaced so that watering truck operators could locate the watering locations. Litter picks were conducted on most site visits in order to improve the aesthetic appearance of the project to neighbouring residents.

9.4.2. Monitoring and maintenance

Ongoing litter picks should be conducted on the site, particularly in spring following snow melt. As needed, the shrubs on the left and right shrub beds should be pruned back if they are overtopping the private property fence.

9.5. Communication and signage

9.5.1. Methods

Temporary 'naturalization in progress' signs were installed in the park in 2017 and 2018 in order to communicate the project and changing site conditions to park users (Figure 12). Letters and an information sheet (Appendix 6) about the project were mailed out to 23 nearby residential addresses to communicate the project in 2017. At the same time, the Parks Community Liaison informed the Community Association and Ward Councilor.

9.5.2. Monitoring and maintenance

The placement of signs in the park was checked upon each site visit.


Figure 12. Naturalization in progress temporary H-frame wire and chloroplast sign. Photos by Angie Arrau.

9.6. General monitoring plan

9.6.1. Activity tracking

Habitat Restoration Collector App

Calgary Parks' Habitat Restoration Collector App is an ArcGIS Online (AGOL) mapping system designed to record, at a high level, all activities occurring at a given restoration site. The Habitat Restoration Collector App was used to record all restoration activities recorded for this site.

Site visit and meeting notes

Notes and photos recorded on all site visits and off-site meetings were recorded and provided a single document record to the Project Sponsor.

9.6.2. Photomonitoring

General Observations App / UC General Management Info AGOL Map

UC General Management Info map in ArcGIS Online (AGOL) to record photomonitoring points (Figure 13), as per Calgary Parks Urban Conservation's process to record photomonitoring locations. Photo point names and directions were recorded as attributes within AGOL (Figure 13, Table 20).

Photos were originally established during a cursory 2016 site visit to provide an overview photograph from each corner of the park, and from the entrance trail (photos 01A-05A). Supplementary photos were taken from the park-corner photos on some site visits, facing along park edges (e.g., along side fences toward shrub beds, back fence, or along sidewalk). Additional points were established in 2018 in order to provide a better view of the cairn prairie zone, entry shrub bed and rear shrub bed, since native forbs were planted in these areas. Photos were repeated on all site visits to match with photos taken on site in previous years.

Figure 13. Screen shot of the UC General Management Info AGOL Desktop map, showing photomonitoring locations, and pop-out of point attributes (PAN800-02A shown as an example). Labels of photo point name and arrows illustrating general photo direction added to figure for clarity.

Table 20. Selection of attribute details in Photomonitoring layer of UC General Management Info AGOL Desktop map. Restoration Site ID is based on Habitat Restoration Collector App. **Time is recorded in 15-minute intervals in AGOL.

*Restoration Site ID	Photomonitoring point name	Direction	Date established	**Time established	Observer
Z1-PAN800-16-01	PAN800-01A	14°	6/16/2016	11:00 AM	Angie Arrau
Z1-PAN800-16-01	PAN800-02A	284°	6/16/2016	11:00 AM	Angie Arrau
Z1-PAN800-16-01	PAN800-03A	184°	6/16/2016	11:00 AM	Angie Arrau
Z1-PAN800-16-01	PAN800-04A	100°	6/16/2016	11:00 AM	Angie Arrau
Z1-PAN800-16-01	PAN800-05A	77°	6/16/2016	11:00 AM	Angie Arrau
Z1-PAN800-16-01	PAN800-06A	53°	7/15/2018	11:30 AM	Angie Arrau
Z1-PAN800-16-01	PAN800-07A	235°	7/15/2018	11:30 AM	Angie Arrau
Z1-PAN800-16-01	PAN800-08A	69°	7/15/2018	11:30 AM	Angie Arrau
Z1-PAN800-16-01	PAN800-09A	340°	7/15/2018	11:30 AM	Angie Arrau
Z1-PAN800-16-01	PAN800-10A	60°	7/15/2018	11:30 AM	Angie Arrau

9.6.3. Asset and budget tracking

PARIS ParcMap asset database

Calgary Parks uses the Parks Asset Reporting & Information System (PARIS) to spatially locate assets that it stewards and to track work conducted on those assets (Calgary Parks 2018). The mapping component, ParcMap, was reviewed by the Project Manager on a regular basis to ensure that all assets moved, removed, or installed, were included in the system and represented by an accurate spatial location or shape. When errors were found, the stakeholder primarily responsible for the asset (e.g., Urban Forestry for trees) was contacted to ensure that changes to the system were submitted and confirmed.

For this project, asset mapping was confirmed for the following: trees, fence, permanent signs, trail, planting bed boundaries, monument location. Individual shrubs, forbs, and temporary signs were not included as they are not considered to be assets within the system.

Budget

The project budget was tracked by a Parks Business Assistant assigned to Zone 4, and is outside of the scope of this project report. This Assistant also tracked asset-based work orders using PARIS WAM (Work Asset Management) system.

9.6.4. ArcMap File Geodatabase

To improve restoration project record keeping and long-term management capabilities for the park, the Project Manager created an ESRI ArcMap File Geodatabase that includes spatially accurate information about the project. This includes data such as restoration zone boundaries, removed/moved assets, planting details by location, seeding details, and historical records of invasive plant mapping and control from 2014-2018 (to date). This database is being delivered to the Project Sponsor upon completion of the project, but will be update first to reflect remaining seeding and invasion plant control for 2018.

10. RESULTS

10.1. Integrated Pest Management

Invasive plant controls completed are illustrated in Figure 14.

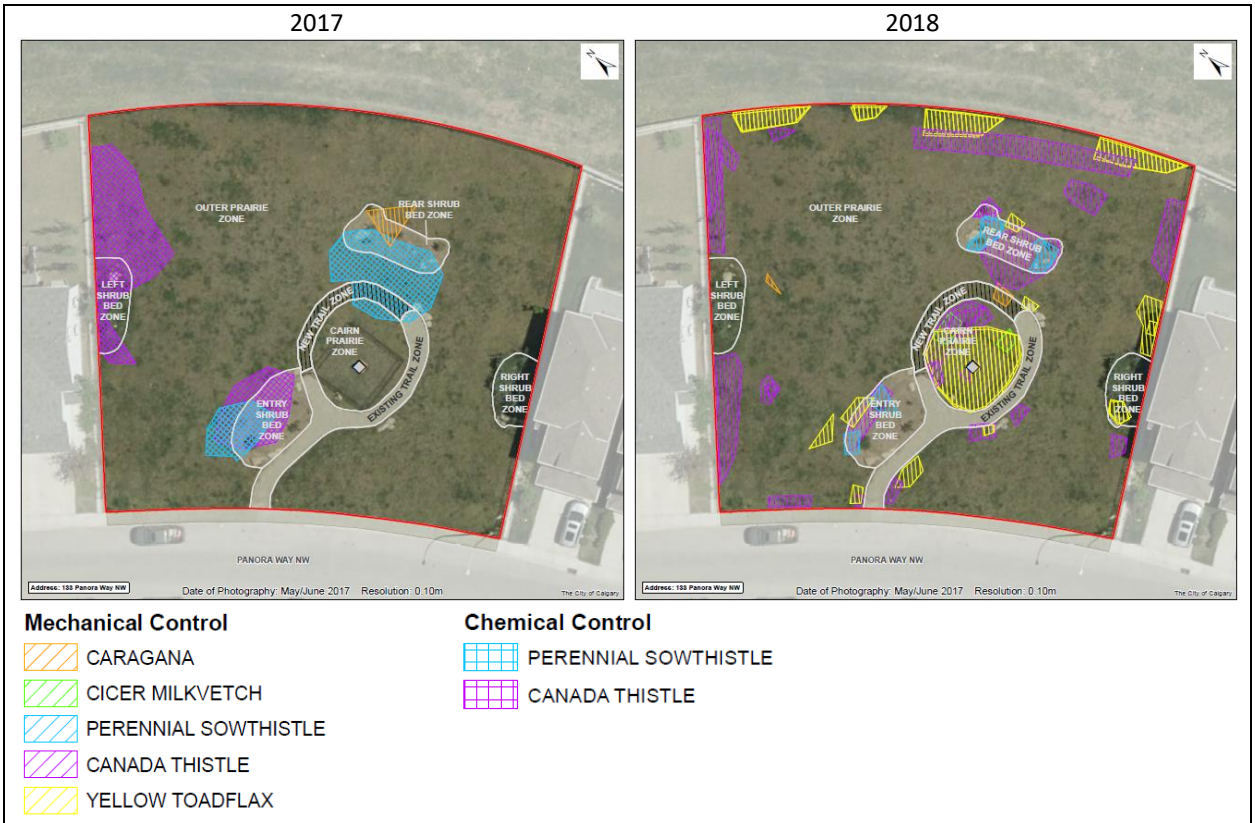


Figure 14. Invasive plant controls completed in 2017 and 2018 (to date).

<u>Invasive Weeds Collector App</u>

Difficulties arose with consistently using the App to record mechanical control when site visits were required to be scheduled on days when location accuracy on the App was poor (e.g., 65m) whereby data could not be collected. Due to logistical constraints, these mechanical control dates could not be rescheduled, and data was recorded on hard copy maps instead. As a result, data quality control within the App's Desktop AGOL interface was required to reference the hand-drawn maps as well as field notes. This process was faster and easier when both hard copy maps and notes recorded sufficient detail, however was challenging when insufficient detail existed.

The App may be used to determine the total infestation area, with each point considered to be a $1m^2$ infestation (Calgary Parks Urban Conservation 2017), as well as control effort (e.g., amount of time spent hand-pulling), however this information has not yet been derived from the App. Once all invasive plant control has been completed in August 2018, this information should be exported from the App's database for site-specific tracking purposes. Over time, this information may be used to compare effectiveness of chemical vs. mechanical control methods.

10.3. Site preparation

The fence removed around the cairn provides a more open prairie appearance and makes the cairn more accessible for park visitors to read the plaque (Figure 15).

Figure 15. Before (July 2017) and after (October 2017) fence removal around cairn. Photos by Angie Arrau.

The Nose Creek Historical Society sign was moved to the entry shrub bed, however an infestation of stinkweed appeared at the new location, which suggests stinkweed seeds may have spread to the site through this process. This may have been the result of contaminated equipment or a dormant seed bank at either the new sign location or from where it was moved. The extended gravel trail was observed to be used by park visitor within a month of installation.

After a full year of consultation conducted by the Calgary Civic Trust Society between the Stoney Nakota First Nation and Calgary Parks, an agreement was reached on the interpretive sign content. The sign includes one panel with a historical focus (information about George McDougall), and another with an ecological focus (removal of bison from the prairie). The Calgary Civic Trust funded and carried out the manufacture and installation of the sign, which took place on July 19, 2018 (Figure 16). An unveiling event is scheduled for August 24, 2018.

Figure 16. Location of bench and interpretive sign along trail behind the cairn and panels of interpretive sign. Photos by Angie Arrau.

10.3. Planting and seeding

10.3.1. Tree planting results

By July 2018, 100% of the trembling aspen trees planted in 2017 (Table 21) had survived. The PARIS system (Calgary Parks 2018) includes the preliminary tree health ratings for each tree that were determined at the time of planting (Figure 17), and these will be used by Urban Forestry to assess the health of each tree during the 5-year establishment period.

Table 21. Trees planted in 2017 (June 14, 2017).

Common Name	Scientific Name	Hort Code	Size	Qty	Planting location	Preliminary Tree Health Rating
Trembling aspen	*Populus tremuloides*	POTR1	DBH = 3cm, 3cm, 3cm, 4cm, 5cm; Medium maturity; planting method = punch and plant; stock = wire basket	5	1 in Rear Shrub Bed, 4 in Entry Shrub Bed	70, 70, 70, 70, 72

Figure 17. Post-tree planting photos taken on 2017-JUL-07 of entry shrub bed (left) and rear shrub bed (right). Four (4) trembling aspens planted in entry shrub bed. One (1) new trembling aspen tree planted in rear shrub bed. Rear shrub bed contains two (2) existing white spruce trees. Photos by Angie Arrau.

10.3.2. Shrub planting results

Shrub survival was assessed in June 2018, and there was a 100% survival rate at that time. However, by July 2018, one of the rose bushes had dried out and died in the rear shrub bed. The resulting survival rate was 95% of the 22 shrubs planted. Photographs were taken of each grouping of shrubs for future reference of survival and spread (Figure 18), and the species-specific individual locations were recorded in a geospatial database for the project site to ease future monitoring.

Figure 18. Sample of shrub assessment photos with each shrub flagged. Portion of entry shrub bed (left) and rear shrub bed (right). Photos by Angie Arrau.

10.3.3. Forb planting results

Separate assessments were conducted to determine survival of the 2017 forb plantings and 2018 forb plantings. 100% of the 40 forbs planted in October 2017 did not survive into July 2018. A preliminary assessment was completed on July 21, 2018 for the survival of 2018 forb planting clumps. Out of the 91 forbs planted in June 2018, 80 were alive in July, with an 88% survival rate. Some had appeared to be browsed, and planting clumps were then wired steel mesh to protect from further browse. Overhead photographs were taken of each 2018 forb planting clump for future reference of survival and spread (Figure 19), and each clump's location was recorded in the project's geospatial database for future monitoring.

Figure 19. Sample of 2018 forb planting clump assessment photos prior to wiring clumps. Left: Rear shrub bed, clump 4. Center: Entry shrub bed, clump 5. Right: Cairn zone, clump 1. Photos by Angie Arrau.

10.3.4. Seeding results

Formal plant cover assessments were not completed for seeded areas due to logistical constraints. However, some native forbs seeded in 2017 were observed growing in the outer prairie zone (Figure 20).

Low goldenrod
(*Solidago missouriensis)*

Ascending purple milkvetch
(Astragalus crassicarpus)

Figure 20. Seeded forbs establishing in outer prairie zone. Photos by Angie Arrau.

Monitor for any new native species

Four native species were found in the park in 2018 that were not previously planted or seeded in the park, including wild gooseberry and pin cherry shrubs (Figure 21), common horsetail (*Equisetum arvense*) and narrow-leaved hawkweed (*Hieracium umbellatum*). These species were added to a complete species list spreadsheet developed for the park that will be submitted to the Project Sponsor upon project completion.

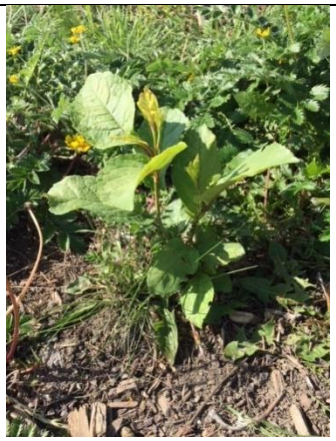


Figure 21. Native forbs and shrubs that were found in the entry shrub bed but not previously observed, planted, or seeded. Left: wild gooseberry (*Ribes hirtellum*); centre: Pin cherry (Prunus pennsylvanica); right: Narrow-leaved hawkweed (*Hieracium umbellatum*). Photos by Angie Arrau.

10.4 Site maintenance

Truck tire tracks were observed in July 2018, which were expected for vehicles accessing the site to install infrastructure (bench, interpretive sign). However, it was also observed that watering trucks were driving onto and around the outer prairie zone, which would increase compaction of the soil, particularly with the heavy weight of watering trucks, and frequency of visits.

In addition, sidewalk snow clearing areas adjacent to the sidewalk were observed to have vegetation damage, more bare soil, and an increase in weedy species that were not present until 2018.

10.5. Communication and signage

Because no further complaints for the site were received in 2017 or 2018 (to date), it is believed that the communication sent to residents and signage in the park have been effective.

10.6. General monitoring

10.6.1. Activity tracking

All restoration activities recorded in the Habitat Restoration Collector App are listed in Table 22.

Table 22. Activities recorded for the project (Habitat Restoration Site ID: Z1-PAN800-16-01) within the Habitat Restoration Collector App, as of July 26, 2018.

Restoration Activity Type	Completed By	Completion Date	Comments
Photomonitoring	Angie Arrau	6/16/2016	Photomonitoring points established. First photos taken.
Site Preparation	Dale Silbernagel	8/17/2016	Dead trees and metal stakes removed by Urban Forestry. Approximate date.
Other	Dale Silbernagel	6/14/2017	Four aspen trees planted by Urban Forestry; 3 in entry bed; 1 in rear bed.
Signage	Angie Arrau and Sarah Kellett	7/4/2017	Installed temporary naturalization signage onsite
Photomonitoring	Angie Arrau	7/7/2017	Photomonitoring photos repeated.
Weed Control - Regulated	IPM	7/17/2017	Herbicide treatment for Canada thistle
Signage	Sarah Kellett	7/20/2017	Installed temporary naturalization signage
Weed Control - Regulated	IPM	7/20/2017	Herbicide treatment for Perennial Sow Thistle
Communication	Angie Arrau	7/6/2017	Communication mail-out sent to nearby residents (23 addresses).
Site Preparation	Tannus Betzler	7/19/2017	Interpretive trail extension installed. Nose Creek Historical Society sign moved to entry bed. Fence around cairn removed.
Invasive Species Control - Non-Regulated	IPM	8/28/2017	Mechanical control of Caragana
Shrub Planting	Contract crew supervised by AArrau and SKellett	10/11/2017	Refer to restoration plan for planting plan

Restoration Activity Type	Completed By	Completion Date	Comments
Forb Plug Planting	Contract crew supervised by AArrau and SKellett	10/11/2017	See restoration plan for planting details
Seeding	Contract crew supervised by AArrau and SKellett	10/11/2017	See restoration plan for seeding details, site was rototilled then hand broadcast seeded
Maintenance	AArrau	10/11/2017	Garbage pick
Photomonitoring	Angie Arrau	10/11/2017	Photomonitoring photos repeated.
Soil Amendment	Living Soil Solutions	10/20/2017	Compost tea application at the outer prairie and cairn prairie zones (see restoration plan)
Photomonitoring	Angie Arrau	3/23/2018	Photomonitoring photos repeated.
Photomonitoring	Angie Arrau	5/13/2018	Photomonitoring photos repeated.
Maintenance	Angie Arrau	5/13/2018	Garbage pick up. Collected 2 grocery bags of garbage from site.
Maintenance	Angie Arrau	5/13/2018	Replaced several pink survey flags at 2017 fall planting locations of forbs and shrubs.
Weed Control - Regulated	Angie Arrau	6/8/2018	Canada thistle pulled/cut throughout site. Old carcasses and weed heads removed. Approximately 1 large garbage bag total.
Soil Amendment	Living Soil Solutions	6/8/2018	Compost tea (biological) application on entire site (see restoration plan).
Photomonitoring	Angie Arrau	6/8/2018	Photomonitoring photos repeated. Additional photos taken.
Other	Living Soil Solutions	6/8/2018	Compost tea used to water trees to add mycorrhizae.
Maintenance	Angie Arrau	6/8/2018	Garbage pick up (1/2 small grocery bag).
Signage	Angie Arrau and Sarah Kellett	6/13/2018	Installed 2 temporary Naturalization in Progress signs on H frames.
Weed Control - Regulated	Angie Arrau and Erin Sabourin	6/14/2018	Yellow toadlfax weed whipped in right shrub bed. Canada thistle pulled throughout.
Planting	Erin Sabourin	6/14/2018	Total of 92 native forbs planted in clumps in entry shrub bed, cairn zone, rear shrub bed.
Site Preparation	Erin Sabourin	6/14/2018	Grass weed whipped in entry shrub bed and pockets of planting clump areas in cairn zone.
Photomonitoring	Angie Arrau	6/17/2018	Photomonitoring photos repeated.
Weed Control - Regulated	Angie Arrau	6/17/2018	Perennial sowthistle pulled in entry shrub bed and rear shrub bed. Yellow toadflax pulled in cairn prairie zone. Mapped in Weed App.
Other	Angie Arrau	6/17/2018	Assessed survival of 2017 plantings of shrubs and forbs.
Seeding	Erin Sabourin	6/18/2018	See restoration plan for seeding details. Cairn zone was hand broadcast and seed was raked in.
Invasive Species Control - Non-Regulated	Angie Arrau	6/14/2018	Bull thistle pulled in entry shrub bed.
Weed Control - Regulated	Angie Arrau	6/24/2018	Yellow toadflax hand-pulled along back fence.

Restoration Activity Type	Completed By	Completion Date	Comments
Weed Control - Regulated	Angie Arrau	6/24/2018	Canada thistle pulled/cut in previous control mapping polygons for repeated reduction of root vigour.
Invasive Species Control - Non-Regulated	Angie Arrau	6/24/2018	Goatsbeard (~20 plants) pulled throughout outer prairie zone. Not mapped in Weed App.
Weed Control - Regulated	Erin Sabourin, Angie Arrau	7/11/2018	Yellow toadflax weed-whipped in right shrub bed. Few Canada thistle plants beginning to flower weed-whipped to prevent flowering and reduce vigour. Toadflax patch to right of trail hand-pulled.
Photomonitoring	Angie Arrau	7/11/2018	Photomonitoring photos repeated.
Maintenance	Erin Sabourin, Angie Arrau	7/11/2018	Litter pick. Replaced pink pin flags that had been pulled at planting clumps. Placed circle of pin flags and survey tape around planting clumps in cairn prairie zone.
Invasive Species Control - Non-Regulated	Erin Sabourin, Angie Arrau	7/11/2018	Hand-pulled and bagged weeds from entry shrub bed, rear shrub bed, along sidewalk (dogwood mustard, flixweed mustard, kochia, goosefoot, blueburr, stinkweed, pepperweed, canola, wild tomato). Hand-pulled grasses and left in place where grasses choking out planting clumps.
Photomonitoring	Angie Arrau	7/15/2018	Photomonitoring points repeated. Added new points for entry shrub bed, rear shrub bed, cairn prairie zone.
Maintenance	Angie Arrau	7/15/2018	Litter pick (1/2 small bag)
Weed Control - Regulated	Angie Arrau	7/15/2018	Hand-pulled yellow toadflax, Canada thistle, perennial sowthistle (see notes for location details).
Invasive Species Control - Non-Regulated	Angie Arrau	7/15/2018	Hand-pulled goatsbeard, yellow sweetclover, dog mustard, blueburr, pepperweed, and some cicer milkvetch. See notes for details on locations.
Photomonitoring	Angie Arrau	7/21/2018	Photo points repeated including new points established on July 15.
Maintenance	Angie Arrau	7/21/2018	Litter pick (1/2 small grocery bag)
Weed Control - Regulated	Angie Arrau	7/21/2018	Yellow toadflax hand-pulled in cairn prairie zone. A few Canada thistle plants hand-pulled in outer prairie and cairn prairie zones.
Invasive Species Control - Non-Regulated	Angie Arrau	7/21/2018	Goatsbeard, yellow sweet clover, and stink weed hand-pulled.
Maintenance	Angie Arrau and Jonathan Kozak	7/23/2018	Installed mesh wire around all 11 of the 2018 forb clumps.
Photomonitoring	Angie Arrau	7/23/2018	Repeated select photos to show new wiring.
Other	Don Betts	7/17/2018	Bench installed.
Other	Chalmers Heritage Conservation Ltd.	7/19/2018	Calgary Civic Society interpretive sign installed.

10.6.1. Photomonitoring

Photomonitoring photos for the project, including pre-project photos on site in previous years are found in Appendix 7.

10.6.3. Asset/budget tracking

Some discrepancies still exist within the PARIS asset database for the park, and these will be corrected by the time summer project activities have been completed. For example, the interpretive sign has not been added to the system, and some trees are still missing from the database.

10.6.4. ArcMap File Geodatabase

This file geodatabase was delivered to the Project Sponsor upon completion of the project.

11. DISCUSSION AND RECOMMENDATIONS

11.1. Invasive species management

11.1.1. Regulated and non-regulated weed control

Regulated weed control must be legally continued to ensure that noxious weeds do not spread. It is recommended that mapping is completed to the same level of detail as it was completed in 2018, using both the Weed App and hard copy maps to quality-control the data in order to improve the records for control. Prior to herbicide treatments on toadflax, any beneficial biocontrol insects should be collected and redistributed. Non-regulated plants such as Caragana should be continually monitored for and controlled to ensure that native species are not out-competed on the site.

11.1.1. Invasive Weeds Collector App

In order to ease the process of Weed App data quality control, it is recommended that back-up data be created on hard copy for the purposes of restoration projects, to improve the ability to monitor invasive species over time. Data sheets should be used that include a map of the site on one side, with restoration zones if applicable, and with points or polygons labelled. This will provide a spatial reference for the quality control process. The opposite side of the data sheet should include a table for data entry which includes all of the required fields applicable to the Weed App (Table 23), including point/polygon label ID, weed name, growth stage, distribution code, density code, control method (for control polygons), and a notes field.

Table 23. Table of required fields in Weed App (infestation point, Mapped Infestations polygon, Mechanical Control polygons).

Point/Polygon ID	Weed Name	Growth Stage	Distribution Code	Density Code	Control Method	Notes
[point ID]						
[polygon ID]						

11.2. Site preparation

Chemical soil test are recommended for the site in order to provide more prescriptive soil amendments. Similarly, objective soil compaction tests should be conducted on the site. Soil compaction resulting from watering trucks driving onto the outer prairie should be halted immediately, and watering hoses

should be drawn into the park. Although this may take more time, it will reduce overall maintenance costs in the park in the long-term.

The installation of the interpretive sign should be re-communicated to the community association following the unveiling event, so it can be ensure that the park's educational value is increased for park users. The sign provides both nature and history education, and the site may be suitable for school visits and natural history education, which can increase stewardship by the local community.

11.3. Planting and seeding

Native forbs planted

The loss of native forbs planted in 2017 was likely due to the late-season planting time (October), since the growing season peaks between May-September (Natural Regions Committee 2006). These forbs may have not had enough time to establish, and due to the longer-than usual winter that Calgary had this year, it may have been more challenging for the plants to establish in the spring. Some of the 2018 forbs may have been lost due to browse by rabbits, so they were wired afterward. It is recommended that all forbs planted in the park in the future are wired to protect from browsers immediately after planting. Although they are increaser species, they may need more time for the roots to establish before they have an increaser response to grazing.

Additional loss of forbs may have been the result of pin flags being moved/removed by park visitors, and a resulting inability for watering truck operators to properly locate the plantings. It is recommended that the site is checked for flags as frequently as is logistically possible to avoid this. There is a possibility that some forbs may have been lost due to herbicide residues in the soil, however a detailed assessment of the timing of herbicide application compared to planting timing has not been conducted. To ensure this is not a risk to native forbs, it is recommended that the project manager is on site during herbicide application.

Monitor for any new native species

The growth of newly arrived native species should be monitored and encouraged.

Range health assessment for prairie zones

For the modified grassland areas in the park, it is recommended that a formal range health assessment is completed following the methods in Adams *et al.* 2016, and using standardized vegetation plots throughout the park. This will allow for a more objective assessment of native plant cover changes over time, including % cover for native grasses, forbs, and shrubs, as well as % cover of noxious weeds and bare ground.

12. CONCLUSION

With continued site maintenance and invasive species control, this site is likely to achieve a "prairie landscape" naturalized condition representative of its historical significance. The project records can be a basis for educational materials about the native species on site, and if stewardship by nearby schools and the community association is encouraged, the site has the potential to offer increased value and as a cultural resource that connects the community to the historical native grassland landscape.

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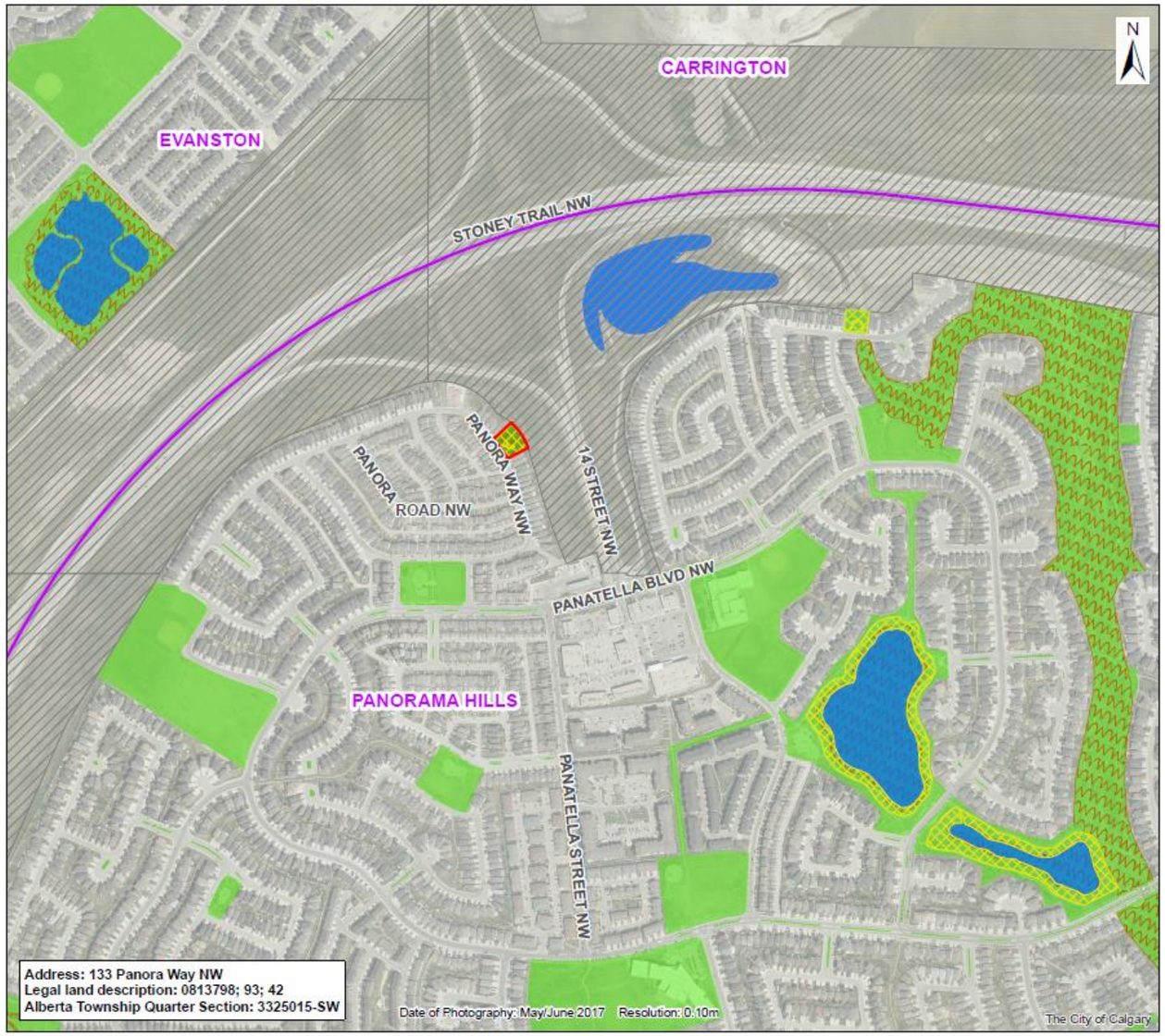
Appendix 1. Habitat Restoration Plan

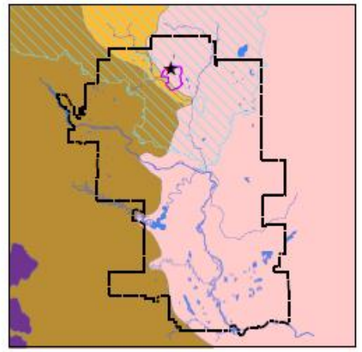
MCDOUGALL CAIRN NATURAL AREA HABITAT RESTORATION PROJECT

Habitat Restoration Plan: Sheet 1 - Location Plan



DRAWING LIST

1. LOCATION PLAN
2A. INTEGRATED PEST MANAGEMENT (IPM) PLAN (2017)
2B. INTEGRATED PEST MANAGEMENT (IPM) PLAN (2018)
3. SITE PREPARATION PLAN
4. PLANTING PLAN
5. DETAILED SPECIFICATIONS



CONTACTS

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Parks Ecologist / Project Sponsor
Calgary Parks, Zone 4/5, North & West Region
City of Calgary
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Email: Sarah.Kellett@calgary.ca

NOTES

This document is to be read in conjuction with the City of Calgary Parks - Development Guidelines and Standard Specifications: Landscape Construction 2018 (current edition) unless specifically noted otherwise.

Legend

- Project Location
- Calgary City Limit
- Project Area
- Panorama Hills Community
- Municipal Parks
- Natural Environment Parks
- Habitat Restoration Sites
- Water
- Nose Creek Watershed
- Transportation Utility Corridor

Natural Subregions

- Foothills Fescue
- Central Parkland
- Foothills Parkland
- Montane

REVISIONS

REV	DATE	DRAWN
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MCDOUGALL CAIRN RESTORATION

CALGARY PARKS
URBAN CONSERVATION

Calgary

0 50 100 150 200 250 Meters

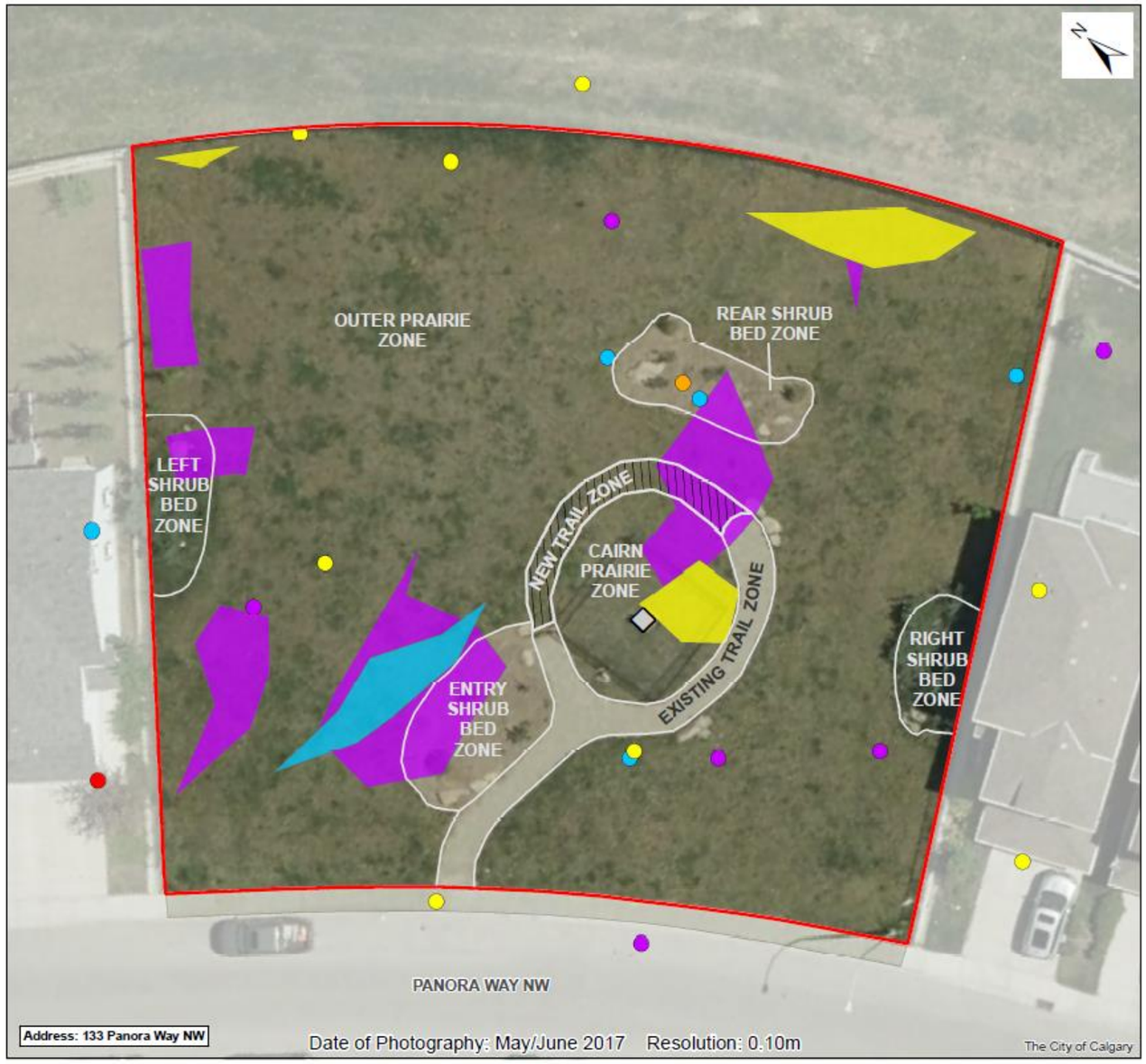
Projection: Calgary_3TM_WGS_1984_W114

LOCATION PLAN

DRAWN BY: ANGIE ARRAU	SHEET #:
DATE: JULY 30, 2018	1 OF 5

MCDOUGALL CAIRN NATURAL AREA NATURALIZATION PROJECT

Habitat Restoration Plan: Sheet 2A - Integrated Pest Management Plan (2017)



WEED CONTROL - REGULATED WEEDS

CANADA THISTLE
1. Outer prairie, cairn prairie, entry shrub bed, and rear shrub bed infestations to be controlled with spot spray herbicide treatment in 2017.
2. Herbicide selection as per Integrated Pest Management Supervisor instruction.

PERENNIAL SOWTHISTLE
1. Outer prairie, entry shrub bed, and rear shrub bed infestations to be controlled with spot spray herbicide treatment in 2017.
2. Herbicide selection as per Integrated Pest Management Supervisor instruction.

YELLOW TOADFLAX
1. Outer prairie and cairn prairie zone infestations to be treated in 2018.

INVASIVE SPECIES CONTROL - NON-REGULATED

CARAGANA
1. Hand-cut plants.

BULL THISTLE
1. Hand-pull rosettes.

NOTES

All infestation points and areas are located within park boundaries. Mapping accuracy error results in locations appearing outside of park boundary. Target plants must be field-located prior to treatment.

This document is to be read in conjuction with the City of Calgary Parks - Development Guidelines and Standard Specifications: Landscape Construction 2018 (current edition) unless specifically noted otherwise.

Legend

- McDougall Cairn
- Project Area
- Project Zones
- New Trail

Weed Infestation Point

- CARAGANA
- BULL THISTLE
- PERENNIAL SOWTHISTLE
- CANADA THISTLE
- YELLOW TOADFLAX

Weed Infestation Area

- PERENNIAL SOWTHISTLE
- CANADA THISTLE
- YELLOW TOADFLAX

REVISIONS

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MCDOUGALL CAIRN NATURALIZATION

CALGARY PARKS
URBAN CONSERVATION

Calgary

0 2 4 6 8 Meters

Projection: Calgary_3TM_WGS_1984_W114

LOCATION PLAN

DRAWN BY: ANGIE ARRAU DATE: JUNE 29, 2018	SHEET #: 2A OF 5

MCDOUGALL CAIRN NATURAL AREA NATURALIZATION PROJECT

Habitat Restoration Plan: Sheet 2B - Integrated Pest Management Plan (2018)

WEED CONTROL - REGULATED WEEDS

CANADA THISTLE

1. Outer prairie, cairn prairie, entry shrub bed, and rear shrub bed infestations to be controlled by hand-pulling plants twice in single 2018 season.

PERENNIAL SOWTHISTLE

1. Entry shrub bed and rear shrub bed infestations to be controlled by hand-pulling plants twice in single 2018 season.

YELLOW TOADFLAX

1. Outer prairie, cairn prairie, entry shrub bed and rear shrub bed infestations to be hand-pulled twice in single 2018 season.
2. Right shrub bed infestation to be weed-whipped twice in July 2018, followed by single herbicide treatment in August 2018.

INVASIVE SPECIES CONTROL - NON-REGULATED

CARAGANA

1. Plants in outer prairie to be hand-cut.
2. Plants in left shrub bed and right shrub bed to be cut and treated with herbicide in August 2018.

CICER MILK VETCH

1. Plants in cairn prairie zone to be hand-pulled.
2. Plants in outer prairie zone to have mature seed heads removed by hand-cutting, remaining plants to be hand-pulled and rototilled into soil prior to native seeding in August 2018.

NOTES

All infestation points and areas are located within park boundaries. Mapping accuracy error results in locations appearing outside of park boundary. Target plants must be field-located prior to treatment.

This document is to be read in conjuction with the City of Calgary Parks - Development Guidelines and Standard Specifications: Landscape Construction 2018 (current edition) unless specifically noted otherwise.

Legend

- McDougall Cairn
- Project Area
- Project Zones
- New Trail

Weed Infestation Point

- CARAGANA
- CICER MILKVETCH
- CANADA THISTLE
- YELLOW TOADFLAX

Weed Infestation Area

- CICER MILKVETCH
- CANADA THISTLE

REVISIONS

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MCDOUGALL CAIRN NATURALIZATION

CALGARY PARKS
URBAN CONSERVATION

Calgary

0 2 4 6 8 Meters

Projection: Calgary_3TM_WGS_1984_W114

LOCATION PLAN

DRAWN BY: ANGIE ARRAU DATE: JUNE 29, 2018	SHEET #: 2B OF 5

MCDOUGALL CAIRN NATURAL AREA HABITAT RESTORATION PROJECT

Habitat Restoration Plan: Sheet 3 - Site Preparation Plan

Restoration Zone	Area (m^2)	% of Total Area
Outer Prairie	1602	82.60%
Cairn Prairie	90.3	4.70%
Entry Shrub Bed	55	2.80%
Rear Shrub Bed	41.9	2.20%
Left Shrub Bed	31.3	1.60%
Right Shrub Bed	27.4	1.40%
Existing Trail	63.6	3.30%
New Trail	27.6	1.40%
TOTAL	1939.2	100.00%

SITE PREPARATION INSTRUCTIONS

NEW TRAIL ZONE
1. Remove existing Nose Creek Historical Society sign for re-installment in Entry Shrub Bed Zone.
2. Install new trail extension using Parks Gravel Trail Mix as per Development Guidelines and Standard Specifications.

ENTRY SHRUB BED ZONE:
1. Remove three (3) dead trembling aspen (POTR) trees and metal stakes.
2. Apply compost tea soil amendment (see Notes).
3. Re-install Nose Creek Historical Society sign at location shown on plan.

REAR SHRUB BED ZONE:
1. Remove metal stake of dead white spruce (PIGL) tree stump and 3 other metal stakes not associated with trees.
2. Apply compost tea soil amendment (see Notes).

LEFT AND RIGHT SHRUB BED ZONES:
1. Prune shrub branches overtopping property fence.
2. Apply compost tea soil amendment (see Notes).

CAIRN PRAIRIE ZONE:
1. Remove wrought iron fence surrounding memorial cairn.
2. Apply compost tea soil amendment (see Notes).

OUTER PRAIRIE ZONE:
1. Apply compost tea soil amendment (see Notes).
2. Install bench and interpretive sign.

NOTES

Compost tea soil amendment:
2017 - Apply compost tea (biological) solution to following zones: Outer Prairie, Cairn Prairie. Do not apply in following zones: Entry Shrub Bed, Rear Shrub Bed, Left Shrub Bed, Right Shrub Bed, Existing Trail, New Trail.
2018: Apply compost tea solution with root rescue, humic acid and liquid fish to all zones except Existing Trail Zone and New Trail Zone.

This document is to be read in conjuction with the City of Calgary Parks - Development Guidelines and Standard Specifications: Landscape Construction 2018 (current edition) unless specifically noted otherwise.

Legend
- McDougall Cairn
- Interpretive sign
- Nose Creek Historical Society sign (existing location)
- Nose Creek Historical Society sign (re-installation location)
- Dead white spruce
- Dead trembling aspen
- Wrought iron fence
- Project Area
- Project Zones
- New Trail (Disturbance Footprint)
- Bench (footprint)

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MCDOUGALL CAIRN NATURALIZATION
CALGARY PARKS
URBAN CONSERVATION

Calgary

0 2 4 6 8 Meters

Projection: Calgary_3TM_WGS_1984_W114

SITE PREPARATION PLAN

DRAWN BY: ANGIE ARRAU	SHEET #:
DATE: JULY 29, 2018	3 OF 5

MCDOUGALL CAIRN NATURAL AREA HABITAT RESTORATION PROJECT

Habitat Restoration Plan: Sheet 4 - Planting Plan

SEEDING NOTES

1. Hand broadcast PAN800 SEED MIX at a rate of 45 kg/ha to outer prairie zone and cairn prairie zone in fall 2017.
2. Lightly rake in seed so seed to soil contact is maximized. To increase seed to soil contact, mow then rake the site thoroughly, removing all thatch and litter to expose soil.
3. Area of 0.2 ha of land will require 9 kg (20 lb) of seed.
4. Any remaining seed mix to be applied in 2018 to cairn prairie zone only.

PAN800 SEED MIX

GROWTH FORM	COMMON NAME	SCIENTIFIC NAME	% BY WEIGHT	TARGET COVER
Grass	Idaho fescue	*Festuca idahoensis*	15%	10%
	Green needle grass	*Stipa viridula*	6%	6%
	June grass	*Koeleria macrantha*	5%	5%
	Awned wheatgrass	*Agropyron trachycaulum var. unilaterale*	8%	15%
	Northern wheatgrass	*Agropyron dasystachyum*	8%	15%
	Rocky Mountain fescue	*Festuca saximontana*	15%	15%
	Western porcupine grass	*Stipa curtiseta*	10%	5%
	Needle & thread grass	*Stipa comata*	10%	5%
	Blue grama	*Bouteloua gracilis*	10%	7%
Forb	Blue flax	*Linum lewisii*	5%	10%
	Cut-leaf anemone	*Anemone multifida*	1%	1%
	Creeping white prairie aster	*Aster fulgens*	2%	1%
	Smooth aster	*Aster laevis*	1%	1%
	Northern sweet vetch	*Hedysarum boreale*	1%	1%
	Low goldenrod	*Solidago missouriensis*	1%	1%
	Ascending purple milkvetch	*Astragalus crassicarpus*	1%	1%
	Purple prairie clover	*Petalostemon purpureum*	1%	1%

PLANTING NOTES

1. Spacing is as shown. See Detailed Specifications for planting methods.

PLANTING LIST

CODE	QTY	GROWTH FORM	COMMON NAME	SCIENTIFIC NAME	SIZE
POTR1	5	Tree	Trembling aspen	*Populus tremuloides*	DBH 3cm-5cm
ROSAACI	10	Shrub	Prickly rose	*Rosa acicularis*	#1 pot size
SYMPOCC	8	Shrub	Buckbrush	*Symphoricarpos occidentalis*	#1 pot size
JUNIHOR	4	Shrub	Creeping juniper	*Juniperus horizontalis*	#2 pot size
THERRHO	27	Forb	Golden bean	*Thermopsis rhombifolia*	Plug
ALLICER	10	Forb	Nodding onion	*Allium cernuum*	Plug
ANEMMUL	9	Forb	Cut-leaved anemone	*Anemone multifida*	Plug
ARTELUD	13	Forb	Prairie sagewort	*Artemisia ludoviciana*	Plug
GAILARI	11	Forb	Brown-eyed Susan	*Gaillardia aristata*	Plug
HETEVIL	11	Forb	Hairy false golden aster	*Heterotheca villosa*	Plug
HEUCCYC	9	Forb	Round-leaved alumroot	*Heuchera cyclindrica*	Plug
OXYTSER	9	Forb	Silky locoweed	*Oxytropis sericea*	Plug
OXYTSPL	10	Forb	Showy locoweed	*Oxytropis splendens*	Plug
PENSNIT	10	Forb	Smooth blue beardtongue	*Penstemon nitidus*	Plug
RATICOL	12	Forb	Yellow coneflower	*Ratibida columnifera*	Plug

NOTES

This document is to be read in conjuction with the City of Calgary Parks - Development Guidelines and Standard Specifications: Landscape Construction 2018 (current edition) unless specifically noted otherwise.

Legend

- McDougall Cairn
- Project Area
- Project Zones
- New Trail

Trees to be Planted

- POTR1

Shrubs to be Planted

- JUNIHOR
- ROSAACI
- SYMPOCC

Forb Clumps to be Planted

- 2017 Forb Planting Clumps
- 2018 Forb Planting Clumps

REVISIONS

REV	DATE	DRAWN
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MCDOUGALL CAIRN NATURALIZATION

CALGARY PARKS
URBAN CONSERVATION

Calgary

0 2 4 6 8 Meters

Projection: Calgary_3TM_WGS_1984_W114

LOCATION PLAN

DRAWN BY: ANGIE ARRAU
DATE: JULY 29, 2018

SHEET #: 4 OF 5

Appendix 2. Project team and stakeholders (external version)

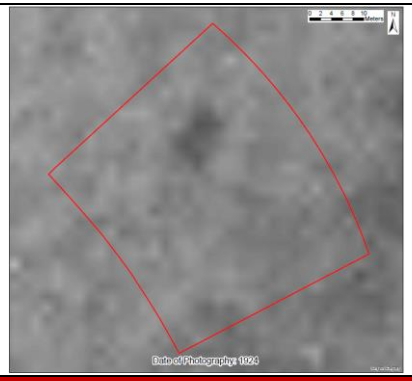
Table A2.1. Project team roles and contacts responsible for implementing the project. Last updated: 2018-Jun-22. Contact information not normally publicly available has been omitted for the purposes of this report.

ROLE	CONTACTS
PROJECT SPONSOR: Approves project plan, design, and budget. Oversees implementation. Reports to Zone 4 Superintendent.	**Sarah Kellett**, Parks Ecologist (Zones 4/5) Calgary Parks, North and West Region, The City of Calgary
PROJECT MANAGER: Develops project plan, oversees implementation and monitoring. Reports to project sponsor.	**Angie Arrau**, Parks Ecologist (student, University of Victoria, Restoration of Natural Systems Diploma Program) Calgary Parks, Urban Conservation, The City of Calgary
TECHNICAL TEAM: Completes specific activities to implement the project.	
GARDENER (Calgary Parks): Completes horticultural actions under direction of project manager and project sponsor.	**Erin Sabourin**, Zone 4 Gardener (2018 season)
Integrated Pest Management (Calgary Parks): Completes invasive plant chemical control.	**Tara Wittenburg**, Integrated Pest Management Foreman Calgary Parks, Urban Conservation, The City of Calgary
Capital Projects (Calgary Parks): Completes construction activities related to infrastructure assets.	**Tannus Betzler**, Park Construction Inspector Calgary Parks, Capital Projects, The City of Calgary
Living Soil Solutions (external contractor): Provides consultation for, and completes, soil amendment.	**Mike Dorion**, Owner Living Soil Solutions Phone: 403-605-6669 | Email: mike@livingsoil.ca Website: http://www.livingsoil.ca/
Watering trucks (external contractors): Completes watering of trees, shrubs, and forbs as assigned.	TBD
TECHNICAL CONSULTANTS: Provides specific consultation by subject matter expertise (SME).	
Plants SME: Provides SME consultation on plant identification and seed mixes.	**Jenna Cross**, Parks Ecologist Calgary Parks, Urban Conservation, The City of Calgary
Wildlife SME: Provides SME consultation on bird identification.	**Tanya Hope**, Parks Ecologist Calgary Parks, Urban Conservation, The City of Calgary
SITE ASSET STEWARDS: Steward portfolio-specific assets on the site.	
Urban Forestry (Calgary Parks): Oversees removal of dead trees, planting of new trees, and tree watering truck schedule.	**Nikki Anguish**, Urban Forestry Superintendent (Zone 1-4) Calgary Parks, Urban Forestry, The City of Calgary
Cultural Landscapes (Calgary Parks): Consults Nose Creek Historical Society and Calgary Civic Trust; completes project permit application with Alberta Government; applies for HeRMIS grant.	**Michelle Reid**, Cultural Landscapes Management Lead Calgary Parks, Cultural Landscapes, The City of Calgary

Table A1.2. Internal and external project stakeholders.

ROLE	CONTACTS
PARK INTERNAL ASSET STEWARDS: Steward portfolio-specific assets on the site.	
Infrastructure (Calgary Parks): Asset steward of infrastructure in park (signs, fences, monument).	**Don Betts**, Infrastructure Supervisor Calgary Parks, Infrastructure, The City of Calgary
Pathways and Trails (Calgary Parks): Asset steward of trail in park.	**Duane Sutherland**, Parks Pathways Lead Calgary Parks, Pathways & Trails Portfolio, The City of Calgary
CALGARY PARKS OPERATIONS CONTACTS: Provide operations-specific approvals as needed.	
North and West Region Manager: Oversees all of Calgary Parks' operations in North and West Region.	**Todd Reichardt**, Manager Parks North & West Region Calgary Parks, The City of Calgary
Zone 4 Superintendent: Oversees Zone 4 operations. Reports to North and West Region Manager.	**Catherine Stotschek**, Zone Superintendent (Zone 4) Calgary Parks, North and West Region, The City of Calgary
Parks Community Strategist: Communicates project with Community Association and Ward Councillor.	**Guy Beavers**, Parks Community Strategist (Zones 1, 2, 4, 6) Calgary Parks, North and West Region, The City of Calgary
OTHER CITY OF CALGARY STAKEHOLDERS	
Ward 3 Councillor: Elected City of Calgary Councillor representing citizens.	**Jyoti Gondek**, Ward 3 Councillor The City of Calgary
EXTERNAL STAKEHOLDERS	
Nose Creek Historical Society: Steward of existing sign in park.	
Calgary Civic Trust Society: Proposes design, manufactures, and installs interpretive sign. Consults Stoney Nakoda on content of sign.	**Dave Chalmers**, Owner, Chalmers Heritage Conservation Ltd. Representative, Calgary Civic Trust Society Phone: 403-998-5698 |Email: dave@chc.works
Alberta Culture: Provincial Historic Resource steward.	
Residents: Citizens living in the vicinity that may be affected by project work. Receive communication letters about the project.	(contact information is private)

Appendix 3. Historical aerial photos



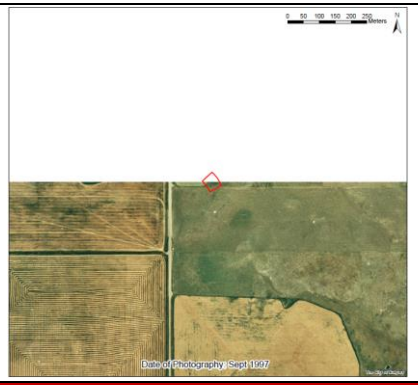
1924

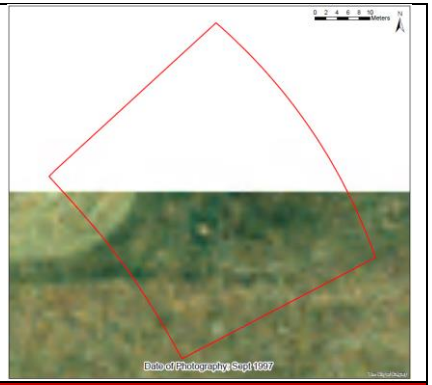
1948

1962

1979 (March)

1988





1997 (September)

1999 (September)

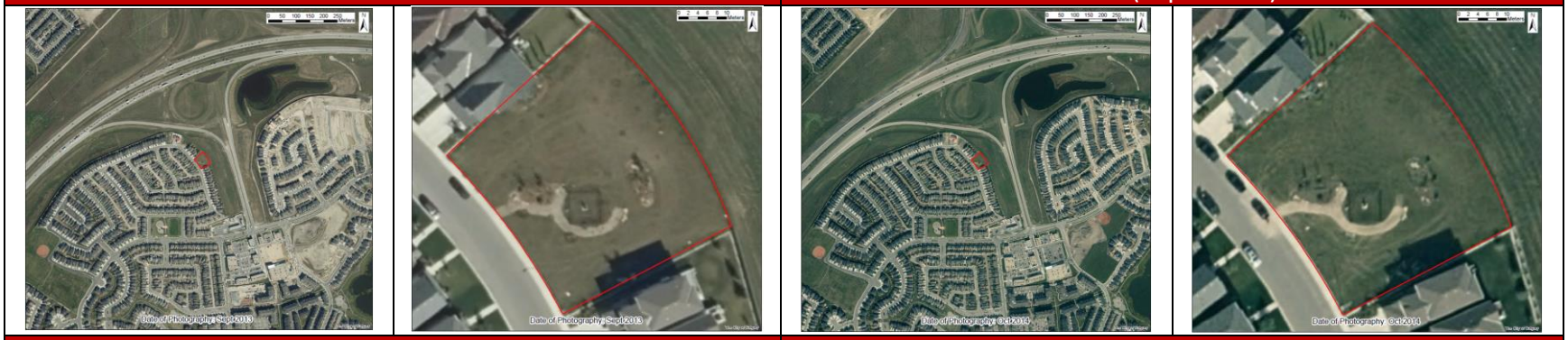
2006 (September)

2007 (October)

2008 (September)

2009 (September) | 2010 (September)

2011 | 2012 (September)



2013 (September) | 2014 (October)

Appendix 4. Plant species existing in the park prior to restoration activities

Table A4.1. List of forbs, grasses, mosses, shrubs, and trees that existed in, or were planted or seeded in park PAN800 prior to project activities commencing. S Rank, N Rank, G Rank and Origin are based on data from the Alberta Conservation Information Management System element occurrence data (ACIMS 2018). Life Span and Grazing Response are based on available information from Alberta Agriculture and Forestry (2018); TBD denotes information is not available and to be determined. Exotic species are bolded.

Family	Common Name ("varietal name")	Species Name	S Rank	N Rank	G Rank	Origin	Life Span	Grazing Response
FORBS								
Asteraceae	**black eyed Susan**	*Rudbeckia hirta*	SNA	N5	G5	**Exotic**	TBD	TBD
Asteraceae	**common dandelion**	*Taraxacum officinale*	SNA	N5	G5	**Exotic**	Perennial	Invader
Asteraceae	**Canada thistle**	*Cirsium arvense*	SNA	NNA	G5	**Exotic**	Perennial	Invader
Asteraceae	**common goat's-beard**	*Tragopogon dubius*	SNA	NNA	GNR	**Exotic**	Biennial	Invader
Asteraceae	**bull thistle**	*Cirsium vulgare*	SNA	NNA	GNR	**Exotic**	TBD	TBD
Asteraceae	**perennial sowthistle**	*Sonchus arvensis*	SNA	NNA	GNR	**Exotic**	TBD	TBD
Asteraceae	brown-eyed Susan (ACIMS: Great blanket flower)	*Gaillardia aristata*	S5	N5	G5	Native	Perennial	Increaser
Asteraceae	common yarrow	*Achillea millefolium*	S5	N5	G5	Native	Perennial	Increaser
Asteraceae	meadow Arnica	*Arnica chamisonnis*	S5	N5	G5	Native	Perennial	Increaser
Asteraceae	prairie sagewort (in ACIMS as pasture sagewort)	*Artemisia frigida*	S5	N5	G5	Native	TBD	TBD
Asteraceae	Rosy pussytoes	*Antennaria rosea*	S5	N5	G5	Native	Perennial	Increaser
Asteraceae	smooth aster	*Symphyotrichum laeve*	S5	N5	G5	Native	TBD	TBD
Asteraceae	smooth fleabane	*Erigeron glabellus*	S5	N5	G5	Native	TBD	TBD
Asteraceae	tall golden rod	*Solidago altissima*	S5	N5	G5	Native	Perennial	Invader
Asteraceae	cut-leaved fleabane	*Erigeron composites*	S5	N5	G5	Native	TBD	TBD
Asteraceae	tufted white prairie aster	*Symphyotrichum ericoides*	S5	N5	G5	Native	TBD	TBD
Asteraceae	rhombic-leaved sunflower	*Helianthus pauciflorus ssp. subrhomboideus*	SU	N5	G5T5	Native	TBD	TBD
Boraginaceae	**bluebur**	*Lappula squarrosa*	SNA	NNA	GNR	**Exotic**	TBD	TBD
Boraginaceae	**houndstongue**	*Cynoglossum officinale*	SNA	NNA	GNR	**Exotic**	TBD	TBD
Brassicaceae	**stinkweed**	*Thlaspi arvense*	SNA	NNA	GNR	**Exotic**	TBD	TBD

Family	Common Name ("varietal name")	Species Name	S Rank	N Rank	G Rank	Origin	Life Span	Grazing Response
Brassicaceae	**yellow rocket**	*Barbarea vulgaris*	SNA	NNA	GNR	**Exotic**	TBD	TBD
Campanulaceae	harebell	*Campanula rotundifolia*	S5	N5	G5	Native	Perennial	Increaser
Convolvulaceae	**field bindweed**	*Convolvulus arvensis*	SNA	NNA	GNR	**Exotic**	TBD	TBD
Fabaceae	**cicer milk vetch**	*Astragalus cicer*	SNA	NNA	G5	**Exotic**	Perennial	Increaser
Fabaceae	**alfalfa**	*Medicago sativa*	SNA	NNA	GNR	**Exotic**	Perennial	Invader
Fabaceae	**black medick**	*Medicago lupulina*	SNA	NNA	GNR	**Exotic**	Perennial	Invader
Fabaceae	**white clover**	*Trifolium repens*	SNA	NNA	GNR	**Exotic**	Perennial	Increaser
Fabaceae	Showy locoweed	*Oxytropis splendens*	S5	N5	G5	Native	Perennial	Increaser
Fabaceae	milk vetch species	(unknown species)						
Iridaceae	common blue-eyed grass	*Sisyrinchium montanum*	S5	N5	G5	Native	Perennial	Increaser
Lamiaceae	wild bergamot	*Monarda fistulosa*	S5	N5	G5	Native	TBD	TBD
Liliaceae	nodding onion	*Allium cernuum*	S5	N5	G5	Native	TBD	TBD
Onagraceae	willowherb	*Epilobium* sp.					Perennial	Increaser
Ranunculaceae	cut-leaved anemone	*Anemone multifida*	S5	N5	G5	Native	Perennial	Increaser
Rosaceae	three flowered avens	*Geum triflorum*	S5	N5	G5	Native	Perennial	Increaser
Rosaceae	silverweed	*Potentilla anserina*	S5	N5	G5	Native	Perennial	Increaser
Scrophulariaceae	**yellow toadflax**	*Linaria vulgaris*	SNA	NNA	GNR	**Exotic**	TBD	TBD
Scrophulariaceae	yellow penstemon	*Penstemon confertus*	S5	N4N5	G4G5	Native	Perennial	Increaser
Scrophulariaceae	smooth blue beardtongue	*Penstemon nitidus*	S5	N5	G5	Native	Perennial	Increaser
GRASSES								
Poaceae	**smooth brome**	*Bromus inermis*	SNA	NNA	G5	**Exotic**	Perennial	Invader
Poaceae	**"hard fescue"**	Unknown (may be *Festuca trachyphylla*)	SNA	NNA	GNR	**Exotic**	TBD	TBD
Poaceae	**"lowgrow perennial ryegrass"**	Unknown (may be *Lolium perenne)*	SNA	NNA	GNR	**Exotic**	TBD	TBD
Poaceae	**tall fescue**	*Lolium arundinaceum*	SNA	NNA	GNR	**Exotic**	TBD	TBD
Poaceae	creeping red fescue	*Festuca rubra*	S5	N5	G5	Native	Perennial	Invader
Poaceae	Kentucky blue grass (3 varieties)	*Poa pratensis*	S5	N5	G5	Native	Perennial	Invader

Family	Common Name ("varietal name")	Species Name	S Rank	N Rank	G Rank	Origin	Life Span	Grazing Response
Poaceae	foxtail barley	*Hordeum jubatum*	S5	N5	G5	Native	Perennial	Invader
Poaceae	Idaho fescue	*Festuca idahoensis*	S5	N5	G5	Native	Perennial	Increaser
Poaceae	Canada wild rye	*Elymus canadensis*	N/A	N/A	N/A	Native*	Perennial	Decreaser
MOSSES								
Unknown	"moss"	Unknown	Unknown	Unknown	Unknown	Unknown	TBD	TBD
SHRUBS								
Elaeagnaceae	Silver Buffaloberry	*Shepherdia argentea*	S3	N5	G5	Native	Perennial	Increaser
Fabaceae	**"Sutherland" Caragana**	*Caragana arborescens*	SNA	NNA	GNR	**Exotic**	TBD	TBD
Rosaceae	"Katherine Dykes Potentilla"	*Potentilla fruticosa* (in ACIMS now as *Dasiphora fruticosa* ssp. *floribunda*)	S5	N5	G5T5	Native	Perennial	Increaser
Salicaceae	"Blue Fox Willow"	*Salix brachycarpa* 'Blue Fox'	S3	N5	G5	Native	Perennial	Increaser
TREES								
Pinaceae	white spruce	*Picea glauca*	S5	N5	G5	Native	Perennial	Increaser
Salicaceae	trembling aspen	*Populus tremuloides*	S5	N5	G5	Native	Perennial	Increaser/Invader

Appendix 5. Forb planting details

Table A5.1. Characteristics of native forbs planted in the park. Source of information and photos: Wild About Flowers (http://www.wildaboutflowers.ca/index.php).

Common name	Nodding onion	Cut-leaved anemone	Prairie sagewort	Brown-eyed Susan	Hairy false golden aster	Round-leaved alumroot	Silky locoweed	Showy locoweed	Smooth blue beardtongue	Yellow coneflower	Golden bean
Scientific name	*Allium cernuum*	*Anemone multifida*	*Artemisia ludoviciana*	*Gaillardia aristata*	*Heterotheca villosa*	*Heuchera cyclindrica*	*Oxytropis sericea*	*Oxytropis splendens*	*Penstemon nitidus*	*Ratibida columnifera*	*Thermopsis rhombifolia*
Flower Photo											
Light conditions	sun to light shade	sun to light shade	sun	sun to light shade	sun	Sun to part shade	sun	sun	sun	sun	sun
Soil Conditions	dry to well drained	dry to well-drained	dry to well-drained	dry to well-drained	dry	well-drained to moist	dry	well-drained to dry	dry	dry	dry to well drained
Exposure conditions	exposed to sheltered	full exposure	exposed	exposed	exposed	moderate	exposed	exposed	exposed	exposed	exposed
Size	6-16" tall	6-16" T & 8-14" W	6-24" T & spreading	12-30" T & 12-24" W	4-12" T & 12-18" W	16-20" T & 8-14" W	3-12" T & 6-12" W	4-12" T & 4-12" W	12-16" T & 8-14" W	10-24" T & 12-30" W	6-14" T
Bloom period	June - early Aug	May - Aug	June - Oct	June - early Aug	July - Sept	July - Sept	May - July	June - Aug	June - July	July - Sept	May-June
Bloom colour	white or pink	white, pink or wine red	yellowish	yellow/ orange	yellow	pale yellow	creamy yellow	pinky/purple	blue	yellow	yellow
Growth habit	moderate grower from a bulb	moderate	fast to aggressive	moderate to fast	fast to aggressive	moderate	moderate	moderate	moderate	moderate	aggressive
Spreads by		seed	creeping rhizomes & seed	seed	seed	short rhizomes & seed	seed	seed	seed	seed	creeping rhizomes

Table A5.2. Forb plug plantings for each planting clump in October 2017 and June 2018.

RESTORATION ZONE	ENTRY SHRUB BED						CAIRN PRAIRIE ZONE					REAR SHRUB BED						TOTAL QTY		
PLANTING YEAR	2017			2018			2018					2017			2018			2017	2018	Total
PLUG SPECIES	1	2	3	4	5	6	1	2	3	4	5	1	2	3	4	5	6			
Buffalobean (THERRHO)				1	1	1	4	4	4	4	4				1	1	2	0	27	27
Nodding onion (ALLICER)		2	2	1		1	1	1		1							1	4	6	10
Cut-leaved anemone (ANEMMUL)					2				1			2		3		1		5	4	9
Prairie sagewort (ARTELUD)		1		1	1		1	1	1	1	1	2			1	1	1	3	10	13
Brown-eyed Susan (GAILARI)	1	2			1	1	1		1		1	1	1		1			5	6	11
Hairy false golden aster (HETEVIL)	2			1		1			1			2			2	2		4	7	11
Round-leaved alumroot (HEUCCYC)		1			1	1	1			1				2		1	1	3	6	9
Silky locoweed (OXYTSER)	2		2	1		1		1			1				1			4	5	9
Showy locoweed (OXYTSPL)			1	1		1		1		1	1		2	1			1	4	6	10
Smooth blue beardtongue (PENSNIT)	2			1			1			1	1		2		1	1		4	6	10
Yellow coneflower (RATICOL)		1	2	1		1	1	1	1	1	1		1				1	5	8	13
TOTALS	**7**	**7**	**7**	**8**	**6**	**8**	**10**	**9**	**9**	**10**	**10**	**7**	**6**	**6**	**7**	**7**	**7**	**40**	**91**	**131**

Appendix 6. Communications sent to nearby residents

Calgary

06 July 2017

Residents near McDougall Cairn Natural Area

Calgary, AB

Dear Resident(s):

Calgary Parks is excited to bring forward a naturalization project in your neighbourhood. More information about this project is enclosed.

The naturalization initiative is a city-wide program that will increase the diversity of landscapes within our parks and green spaces by reintroducing native species to open spaces. Calgary Parks uses this initiative to implement The City's commitments in *Our BiodiverCity: Calgary's 10-year Biodiversity Strategic Plan*, including a target to restore 20% of open space across the city by 2025.

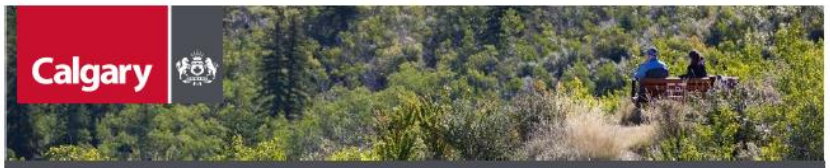
Among the benefits of naturalization projects are: enhancing biodiversity, supporting pollinators (like bees), and improving soil condition, habitat connectivity, overall ecological health and the resilience of our parks to changes in uses and climate over time. In addition to these benefits, naturalization projects may lower park maintenance costs and provide a more diverse appearance to these open spaces.

Thank you for your time,

Calgary Parks

Attached: McDougall Caim Natural Area Naturalization Project Summary

The City of Calgary | P.O. Box 2100 Stn. M | Calgary, AB, Canada T2P 2M5 | calgary.ca



Calgary

Parks

McDougall Cairn Natural Area Naturalization

June 2017

Project Description
Calgary Parks is naturalizing selected portions of the natural area at 133 Panora Way NW. The goal of this naturalization project is to enhance native grassland species that existed in the historic environment of this Provincial Historic Resource. Activities will focus on reducing non-native weeds, establishing plants native to this area, and improving park amenities. Naturalization in this location will improve the overall health of the park.

Schedule
Weed control: July 2017 – September 2018
Planting, seeding, and watering: June – Sept 2017
Installing interpretive sign and trail: July – Oct 2017
Completion: October 2018

What is Naturalization?
The naturalization initiative is a city-wide program that will increase the diversity of landscapes within our parks and green spaces by reintroducing native species to open spaces. This practice will create sustainable landscapes that help support plant, animal and insect life (biodiversity); and also help control weeds and pests. Because naturalized areas are well-suited to Calgary's climate, they will likely reduce long-term maintenance costs associated with mowing, fertilizing, applying pesticides and irrigating.

As outlined in Calgary's 10-year biodiversity strategic plan, we aim to restore 20% of Calgary's open space by 2025. Naturalization is one of several actions being used by The City to achieve this target.

Please visit Calgary.ca/biodiversity or contact 311 for more information.

Blue flax is a native wildflower that grows in western North America. This is one of the plants often included in naturalization plantings.

2016-10-12

Appendix 7. Photomonitoring results

PAN800-01A. From south corner of park, facing north corner of park. Direction: 14°.

(NO PHOTO)
2014-JUL-15


2016-JUN-16

(NO PHOTO)
2016-SEP-05


2017-JUL-07


2017-OCT-11


2018-MAR-23


2018-MAY-13


2018-JUN-08


2018-JUN-17


2018-JUL-11


2018-JUL-15


2018-JUL-21

PAN800-02A. From east corner of park, facing west corner. Direction: 284°.

(NO PHOTO)
2014-JUL-15


2016-JUN-16

(NO PHOTO)
2016-SEP-05


2017-JUL-07


2017-OCT-11


2018-MAR-23


2018-MAY-13


2018-JUN-08


2018-JUN-17


2018-JUL-11


2018-JUL-15


2018-JUL-21

PAN800-03A. From north corner of park, facing south corner. Direction: 184°.

(NO PHOTO)
2014-JUL-15


2016-JUN-16

(NO PHOTO)
2016-SEP-05


2017-JUL-07


2017-OCT-11


2018-MAR-23


2018-MAY-13


2018-JUN-08


2018-JUN-17


2018-JUL-11


2018-JUL-15


2018-JUL-21

PAN800-04A. From west corner of park, facing east corner. Direction: 100°.

(NO PHOTO) 2014-JUL-15	 2016-JUN-16	(NO PHOTO) 2016-SEP-05	 2017-JUL-07
 2017-OCT-11	 2018-MAR-23	 2018-MAY-13	 2018-JUN-08
 2018-JUN-17	 2018-JUL-11	 2018-JUL-15	 2018-JUL-21

PAN800-05A. From left side of entrance trail, facing Nose Creek Historical Society sign. Direction: 77°.

(NO PHOTO)
2014-JUL-15


2016-JUN-16

(NO PHOTO)
2016-SEP-05


2017-JUL-07


2017-OCT-11


2018-MAR-23


2018-MAY-13


2018-JUN-08


2018-JUN-17


2018-JUL-11


2018-JUL-15


2018-JUL-21

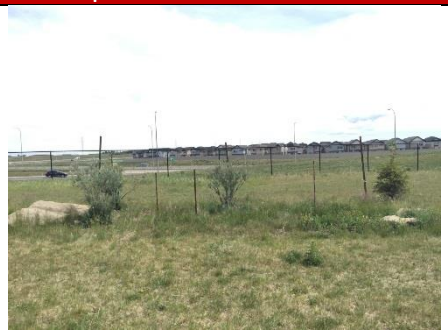
PAN800-06A. Entry shrub bed, from front of park. Direction: 53°.

 2014-JUL-15	 2016-JUN-16	 2016-SEP-05 (similar)	 2017-JUL-07
(NO PHOTO) 2017-OCT-11	(NO PHOTO) 2018-MAR-23	(NO PHOTO) 2018-MAY-13	(NO PHOTO) 2018-JUN-08
(NO PHOTO) 2018-JUN-17	 2018-JUL-11	 2018-JUL-15	 2018-JUL-21

PAN800-07A. Entry shrub bed, from trail behind bed. Direction: 235°.			
(NO PHOTO) 2014-JUL-15	(NO PHOTO) 2016-JUN-16	(NO PHOTO) 2016-SEP-05	(NO PHOTO) 2017-JUL-07
 2017-OCT-11	(NO PHOTO) 2018-MAR-23	(NO PHOTO) 2018-MAY-13	(NO PHOTO) 2018-JUN-08
(NO PHOTO) 2018-JUN-17	 2018-JUL-11	 2018-JUL-15	 2018-JUL-21

PAN800-08A. Cairn prairie zone, facing concrete obelisk from entrance trail. Direction: 69°.			
 2014-JUL-15 (similar)	 2016-JUN-16 (similar)	(NO PHOTO) 2016-SEP-05	 2017-JUL-07 (similar)
 2017-OCT-11	 2018-MAR-23 (similar)	(NO PHOTO) 2018-MAY-13	(NO PHOTO) 2018-JUN-08
(NO PHOTO) 2018-JUN-17	(NO PHOTO) 2018-JUL-11	 2018-JUL-15	 2018-JUL-21

PAN800-09A. Rear shrub bed, from right end of bed. Direction: 340°.			
(NO PHOTO) 2014-JUL-15	 2016-JUN-16	 2016-SEP-05 (similar – from left end)	 2017-JUL-07
 2017-OCT-11	 2018-MAR-23	 2018-MAY-13	 2018-JUN-08
(NO PHOTO) 2018-JUN-17	 2018-JUL-11	 2018-JUL-15	 2018-JUL-21

PAN800-10A. Rear shrub bed, from cairn prairie behind concrete obelisk. Direction: 60°.			
(NO PHOTO) 2014-JUL-15	 2016-JUN-16	(NO PHOTO) 2016-SEP-05	 2017-JUL-07
 2017-OCT-11	(NO PHOTO) 2018-MAR-23	(NO PHOTO) 2018-MAY-13	(NO PHOTO) 2018-JUN-08
(NO PHOTO) 2018-JUN-17	 2018-JUL-11	 2018-JUL-15	 2018-JUL-21