Camas Meadow Restoration at Fort Rodd Hill National Historic Site: Fall 2010 – Spring 2011 Progress Report

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Abstract

The Camas Meadow Restoration Project is an initiative funded by the Parks Canada Agency at Fort Rodd Hill National Historic Site (NHS) of Canada. Approval for the project was received in 2009 and government funding followed in the support of $170,000 to be allocated over the course of four fiscal years (2010-2014). The overall purpose of the project is to engage visitors, especially local communities, in learning about the ecological and cultural significance of Garry oak and associated ecosystems by restoring one acre of highly disturbed turf field with attributes of a Garry oak camas meadow. My involvement in the project coincided with an eight month cooperative education placement that began in September, 2010. Together with two other part-time coop students, Rob Underhill and Elizabeth Cronin, our personal objectives were to:

1. Construct a native plant nursery.

2. Initiate a native plant propagation program.

3. Prepare the restoration site for planting.

4. Inform the public about the project and the significance of Garry oak and associated ecosystem types.

In June, 2010 the Camas Meadow Planning and Development Committee was formed to encourage consensus with specific regard to site selection and the future development and planning of the restoration site. Restoration began on September 13th with the construction of a native plant nursery on the restoration site. In late September we initiated a plant propagation program, sowing nearly 175,000 camas seeds. Despite some seed death caused by mould, germination was remarkably high.

In early October we began site preparation activities in preparation for planting. This included the manual removal of spurge-laurel (*Daphne laureola*), scotch broom (*Cytisus scoparius)* and orchard grass (*Dactylis glomerata*). After the first major leaf fall we began transporting leaf mulch on to the restoration site to suffocate alien species of oxygen and light. On February 19th, 2011 a notice of commencement was submitted to the Canadian Environmental Assessment Registry (CEAR). Preparation of an environmental assessment began in January, and was finalized for submission by mid March. The first draft was submitted to Site Managers Leanne Martin and Dave King for comment and approval.

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1. Introduction

1a. Project Approval and Funding

The Camas Meadow Restoration Project is an initiative funded by the Parks Canada Agency at Fort Rodd Hill National Historic Site (NHS) of Canada. Approval for the project was received in 2009 after a proposal was submitted by Species at Risk Manager of the Coastal British Columbia Field Unit, Brian Reader. The project has received the support of $170,000 in government funding, allocated over the course of four fiscal years (2010-2014).

1b. Objective

The restoration of a camas meadow at Fort Rodd Hill NHS is an opportunity to educate visitors about Garry oak ecosystems and their conservation. This project will provide an interactive experience that enhances the ecological, commemorative, and social integrity of the site by engaging site staff, members of the local community, and First Nations in the restoration process.

My involvement in the project has coincided with an eight month cooperative education placement that began in September 2010. Approximately one third of my 37.5 hour work week, along with that portion of two other part-time coop students, Rob Underhill and Elizabeth Cronin, were spent on this project. Under the supervision of Ecosystem Scientist Todd Kohler, our personal objectives were to:

1. Construct a native plant nursery.

2. Initiate a native plant propagation program.

3. Prepare the restoration site for planting.

4. Inform the public about the project and the significance of Garry oak and associated ecosystem types.

The following report summarizes our contribution to the project between September 6th, 2010 and April 22nd, 2011. The format of this report is both descriptive and prescriptive; and meant to provide future stewards of this project with a reference and guide. To others not specifically involved in the Camas Meadow Restoration Project, the report outlines how to select, properly assess and document a site for ecological restoration. It also demonstrates how small, relatively self-sustaining nurseries can be an affordable way to propagate native plants for any restoration program. Elements of this model could be adapted by stewardship groups of urban green spaces to propagate seed and cuttings on the same site they were collected.

1c. Acknowledgements

I would like to thank the Species at Risk (SAR) team at Fort Rodd Hill NHS, most notably my supervisor Todd Kohler and coworkers Rob Underhill and Elizabeth Cronin. Together we would like to acknowledge and thank Fred Hook, Rob Hagel, Irv Banman, Michelle Gorman and members of the Garry Oak Ecosystem Recovery Team (GOERT) Restoration and Management RIG for their ongoing support.

2. Site Description: Fort Rodd Hill National Historic Site

2a. Location

Fort Rodd Hill NHS is located at coordinates 48°25’58.4”N, 123°27’9.1”W in the Pacific Maritime Ecozone. By road, it is approximately 14 km west of Victoria, British Columbia at the southern end of Vancouver Island. Neighbouring Fort Rodd Hill NHS is a second National Historic Site of Canada, the Fisgard Lighthouse.

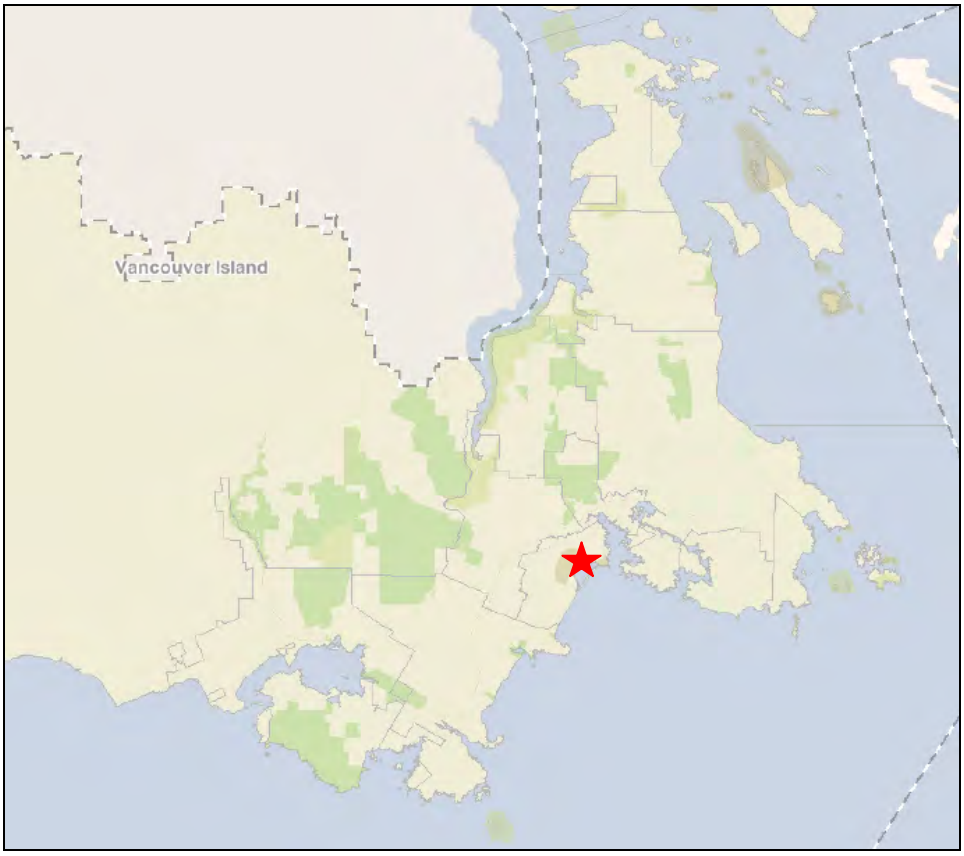

Figure 1: a map displaying FRH relative location on Southern Vancouver island.

Both Fort Rodd Hill and Fisgard Lighthouse National Historic Site are federal property operated by the Parks Canada agency. The site for the Camas Meadow Restoration Project is located on Fort Rodd Hill NHS property. Figure 2 shows you the specific location.

Figure 2: an aerial view of the restoration site selected.

2b. Physical Environment

Fort Rodd Hill NHS lies in the Georgia Depression Ecoprovince, a large basin which contains the Straight of Georgia and Puget Sound as well as the lowlands between the Vancouver Island Mountains and the Southern Coastal Mountains. Located in the Eastern Vancouver Ecoregion and the Nanaimo Lowlands Ecosection, FRH is the westernmost of three ecoregions in the Georgia Depression Ecoprovince. This ecoregion includes leeward slopes and lowlands along southeast of Vancouver Island. The Nanaimo Lowlands Ecosection is the lowest portion of the Eastern Vancouver Island Ecoregion. (Aruncus Consulting, 2002)

Coastal Douglas-fir zone moist maritime subzone (CDFmm) is the only biogeoclimatic classification (BGC) at Fort Rodd Hill NHS. This is one of the smallest and most disturbed forested

subzones in the BGC system. It is characterized by climax forests on zonal sites which are dominated by Douglas-fir as well as grand fir and western red cedar. Understorys are typically dominated by salal (*Gaultheria shallon*), dull Oregon-grape (*Mahonia nervosa*), ocean-spray (*Holodiscus discolor*) and Oregon beaked moss (*Kindbergia oregana*). Overall the climate in the area can be categorized as sub-Mediterranean, though summers are not quite as warm. Winters tend to be especially mild for the corresponding latitude and dry during summer. (Aruncus Consulting, 2002)

Soils in the area are indicative of the climate and vegetation they developed under and the materials they developed from. Fort Rodd Hill NHS is likely dominated by Orthic Dystric Brunisols. These soils have formed from relatively acidic parent materials under moderate rainfall and coniferous or mixed vegetation. In some areas, these soils have developed a strongly cemented hardpan between 50 and 100 cm below the surface and are called Duric Dystric Brunisols (Jungen, 1985; Soil Classification Working Group, 1998). Sombric Brunisols develop on areas that have a long history as grasslands, shrublands and savannahs. The fine roots of grasses, forbs, and shrubs decay slowly in the upper soil layer, enriching it with dark organic matter (Jungen, 1985; Soil Classification Working Group, 1998). (Aruncus, 2002)

2c. Biological Environment

Garry oak and associated ecosystems: habitat at risk

Fort Rodd Hill NHS is host to one of Canada's most endangered ecosystem types: Garry oak and associated ecosystems. These are amongst the rarest in the province. Restricted primarily to the southeast coast of Vancouver Island and the Gulf Islands, they occupy only a very small portion of the Coastal Douglas-fir BGC zone. A study of Fort Rodd Hill/Fisgard Lighthouse NHS prepared by Aruncus Consulting in 2002 recorded eight Garry oak and associated ecosystem plant communities. This study adopted Green and Klinka's system of site series (1994), modifications made by Erickson (1996) and further units defined by the author. The eight ecosystems were defined as westen red cedar – grand fir – foamflower, Douglas-fir – grand fir – Oregon grape, Douglas-fir – salal, Douglas-fir – arbutus, Garry oak – blue wildrye, Garry oak – *Raconmitrium canescens*, beach, and disturbed: orchards, lawns, gardens etc.

Garry oak and associated ecosystems are home to more plant species than any other land based ecosystem in coastal British Columbia. They provide habitat to a diverse living community and over 100 species that are designated "at risk". Several listed plant species have been identified and recorded at Fort Rodd Hill NHS and adjacent properties. The following table is a summary of these findings adapted from Cronin et al., 2010. Additional information on listings and definitions can be found on the BC Species and Ecosystems Explorer website (BC Ministry of Environment, 2011).

Table 1: a list of protected species found at Fort Rodd Hill NHS.

Common and Latin Name	Provincial Conservation Status	BC Listing	COSEWIC
Black knotweed (*Polygonum paronychia*)	S3	Blue	n/a
Carolina meadow-foxtail (*Alopecurus carolinianus)*	S2	Red	n/a
Deltoid balsamroot (*Balsamorhiza deltoidea*)	S1	Red	E
Macoun's meadow-foam (*Limnanthes macounii*)	S2	Red	T
Nuttall's quillwort (*Isoetes nuttallii*)	S3	Blue	n/a
Poverty clover (*Trifolium depauperatum*)	S3	Blue	n/a
Winged water-starwort (*Callitriche marginata*)	S1	Red	n/a
Great blue heron (*Ardea herodias fannini*)	S2S3B, S4N	Blue	SC
olive-sided flycatcher (*Contopus cooperi*)	S3S4B	Blue	T
Pacific sideband (*Monadenia fidelis*)	S3S4B	Blue	n/a
Propertius duskywing (*Errynis propertius*)	S2S3	Blue	n/a

Factors that have all played a significant role leading to the endangerment of these ecosystems include urban and agricultural development, fire suppression, overgrazing by domestic and feral livestock, and the introduction of invasive plants, pests and diseases, (BC Ministry of Environment, Land and Parks, 1993). The presence of invasive exotic species is a major concern at Fort Rodd Hill NHS, making removal of these species a top priority. At present, the site for the Camas Meadow Restoration Site exists outside of previously treated invasive species controls sites. As a result, invasive species populations have not received regular monitoring or control at this given location.

2d. Human Environment

Commemorative Value

Fort Rodd Hill NHS and adjacent federal properties are located on the traditional territories of the Coast Salish First Peoples and have known cultural value to the Songhees and Esquimalt First Nations. The long history of aboriginal use is identifiable in the shell middens and burial cairns scattered throughout the property. It is thought that the presence of Garry oak ecosystems, particularly on deep

soils, may reflect a history of prescribed burning by First Nations to maintain camas meadows for harvest (Aruncus Consulting, 2002). An archaeological survey for adjacent properties was prepared by Ian D. Sumpter and Daryl W. Fedje in November of 2001 to record archaeological features.

The intent of Fort Rodd Hill's designation as a national historic site in 1958 was to commemorate the role of the Victoria – Esquimalt fortifications in the defence of Victoria and the naval base at Esquimalt, and by extension the defence of Canada and the British Empire. The British built the fort in the late 1890's to protect the Esquimalt Naval Base – a relic of the Crimean War during 1854-56 between Britain and Russia. The history of Fort Rodd Hill spans the turbulent period between the late 1890's to 1965 and symbolizes not only the Great War (1915-1918) and the Second World War (1939-1945), but Canada's transformation from a British colony to an independent sovereign nation.

Trends in current land use

Ecological restoration and conservation at Fort Rodd Hill NHS complies by the Standards and Guidelines for the Conservation of Historic Places in Canada (2003). Under these guidelines, the restoration of natural resources is to be completed in a manner that promotes "environmental protection, while conserving character-defining elements and maintain[ing] the heritage value of the site (Parks Canada, 2003)". All restoration to be undertaken for the Camas Meadow restoration project will consider the potential effects of those activities toward cultural resources listed in the commemorative integrity statement (1996) for Fort Rodd Hill NHS.

3. Planning and Development

In June, 2010 the Camas Meadow Planning and Development Committee was formed to encourage consensus with specific regard to site selection and the future development and planning of the restoration site. Committee members represented the many values of Parks Canada operating at FRH National historic site. Persons included Acting Site Manager Barb Brittain, Species at Risk Ecosystem Scientist Todd Kohler, Asset Support Technician Bruce Allward, Interpretation Officer/Coordinator John Bars, Collections Manager Dave King, and Species at Risk Communication and Outreach Officer Susan Macisaac.

3a. Site Selection

Method

The site selection process was based upon parameters created by the Camas Meadow Planning and Development Committee. They ensured the final site would have the following characteristics:

- The ecological characteristics of a maritime meadow and Garry oak woodland.
- A low impact on commemorative integrity (both First Nations and European).
- Limited interaction with existing infrastructure.
- Favourable to public exposure through interpretation.

Potential sites for the Camas meadow project were mapped with a Trimble GIS unit and digitally recorded using Arcmap software by Todd Kohler. A site walk-through by several committee members was completed on July 5th, 2010 to visit the five potential restoration sites (Figure 3).

Figure 3: an aerial view of the 5 sites considered for the Camas Meadow Restoration Project.

Site 1 was 1 acre located in the northwest corner of an open lawn field partially covered by an open wooded Garry oak canopy. Just over one acre in size, the site offered moderate drainage, relatively deep soils in addition to adjacent grassland with little to no canopy cover. Its situation near to the admissions kiosk, visitor exit and visitor parking lot enhanced its profile and interpretive value. Concern was shared over changing the commemorative value of the landscapes general form (reminiscent of pasture land), and potentially disturbing one apple tree with historic value along its southern boundary. There was also some concern regarding the underground infrastructure and the active electrical box located on the site.

Site 2 was 1.8 acres located in the southeast corner of an open law field and adjacent to a grove of aspens. Two oak trees were also present. Though this site exhibited some properties of a Garry oak ecosystem, poor drainage causing very wet soils would make restoration difficult. As above, the site landscape had commemorative integrity in addition to several fruit trees with historic value. The site had additional historic value in the form of historic building foundations. Based on the opinion of Dave King, this site would also have high archaeological potential. Several utilities exist on the site including two water valves, two storm manhole cleanouts and a water main. Given its isolated location, the site would need heavy signage to encourage public interest and generate interpretive opportunities.

Site 3 was 0.3 acres in size, located behind the historic WW2 hut. The ecology of this site was suitable for Garry Oak restoration, especially if some of the larger non-culturally modified Douglas fir trees were removed. The site was also highly visible, and easily accessed by the public. Some concern was shared that its location would distract visitors from the WW2 hut, and that it may disturb ornamental vegetation with historic value. In addition, concern was shared about the sites high archaeological potential (Dave King). Other potential issues included: restoration activities affecting underground infrastructure (water main, sanitary pipeline and manholes, water sprinkler, water hydrant, underground telephone line).

Site 4 was roughly 0.2 acres behind the visitor washrooms. There were several large oak and arbutus trees at the site. Soils could be described as rocky and thin. Mixed Douglas fir and arbutus forest surrounded the site, which would require a lot of clearing to maintain an open canopy during and after restoration. The site had low historic value (European) but high archaeological potential in the form of burial cairns and middens. The site had minimal issues related to underground infrastructure.

Site 5 was 0.18 acres in size and located at the north end of the main visitor's parking lot. The ecology of this site was described as Douglas fir forest/rocky outcrop. Soil was noticeably compacted and filled with gravel. The site has little historic value and therefore minimal commemorative value as well. It was decided that the large military gun on the site could be moved, in addition to the picnic tables, if required. One major concern was the underground infrastructure, which is relatively uncharted, yet potentially very pervasive (given the heavy disturbance).

Results & Discussion

The site for the Camas Meadow Restoration Project was selected by the Camas Meadow Planning and Development Committee on August 4th, 2010. Site 1 was selected because it offered the most desirable combination of ecological characteristics, commemorative value, existing infrastructure and public exposure. The southern boundary was tightened to exclude an exotic apple tree, which is a vestige of the areas previous ownership by the Belmont Farm and as such, designated as a level II cultural resource. The northern and western boundaries were also reduced to avoid impacting a red historic fence of commemorative value.

Figure 4: an aerial view of the site selected for the Camas Meadow Restoration Selected.

3b. Site Assessments

Archaeological Survey

Method

An archaeological assessment of the proposed restoration site was completed on Sept 15, 2010 by Parks Canada Archaeologist, Rob Commisio. The assessment included a visual surface inspection of the site. In addition, thirty sub-surface sediment samples were extracted from select locations to explore for buried cultural deposits and/or features within the development area. A 1" Oakfield probe was used to extract the sediment samples and sampling depth varied from 10 to 50cm at individual test locations depending on sediment permeability.

Results and Discussion

No heritage resources were found during the inspection and the sub-surface sediment samples revealed that most of the area had been previously disturbed. Accordingly, the potential for this project to impact heritage resources was determined to be low.

Recommendations and Conclusions

There remains a small probability that there are undisturbed, buried cultural features/deposits in the restoration area which were not found during the original archaeological assessment; and various restoration activities could potentially impact such resources. In the event that archaeological material is noticeably impacted, restoration activities should be immediately stopped in that area and a Park's archaeologist notified.

Vegetation Survey

Method

A survey of vegetation was performed on April 9, 2011 to inventory plant species found on the restoration site. The site was divided into three plant community types based on observable differences in habitat. These were named "woodland," "meadow" and "rock outcrop" (figure 5).

Figure 5: an aerial view of plant communities distinguished.

Each community was surveyed by foot, with the aid of a Garmin GPS unit, a pencil, ground inspection forms (GIF), and a copy of Pojar and Mackinnon's Plants of Coastal British Columbia (1994). Ground Inspection Forms were used to record field data according to methods established in Luttmerding et al. (1990). A layer (E) was added to record leaf litter, bare soil, rock, and fallen woody debris. Geographic information was recorded at a central and representative point of each community.

Results and Discussion

The following tables illustrate geographic and vegetation data collected for each community. The survey revealed a predominance of introduced species, some of which are heavily invasive. The table also demonstrates a welcome variety of native species found in the Woodland and Rock Outcrop community types.

Table 2: Geographic and vegetation information for the "Woodland."

Garry Oak "Woodland" Community Type

UTM Zone: 10 Easting: 466485 Northing: 5364612 Elevation: 20m (+/- 4m) Acres: 0.39 Aspect : 160˚ Slope: 2%			Surveyors: David Tanner and Todd Kohler Date: April. 9/11	
Layer	Scientific Name	Common Name	Percent Cover (%)	Introduced (Y/N)
A			50	
	Quercus garryana	Garry oak	40	N
	Psuedotsuga menziesii	Douglas fir	5	N
	Acer macrophyllum	Big Leaf Maple	5	N
B			8	
	Crataegus douglasii	Black hawthorn	6	N
	Daphne laureola	Spurge-laurel	<1	Y
	Oemleria cerasiformis	Indian-Plum	<1	N
C			39	
	Belis perenis	Common daisy	5	Y
	Hypochaeris radicata	hairy cats ear	3	Y
	Cardamine nuttallii	Nuttall's toothwort	2	N
	Stellaria media	Common chickweed	1	Y
	Taraxacum officinale	Common dandelion	3	Y
	Sanicula crassicaulis	Pacific Sanicle	<1	N
	Aphanes microcarpa	Slender parsley piert	1	Y
	Cardamine oligosperma	Little western bittercress	1	N
	Galium aperine	Cleaver	<1	Y

	Anthriscus caucalus	Bur chervil	1	Y
	Osmorhiza berteroi	Mountain sweet cicely	<1	N
	Vicia sativa	Common Vetch	1	Y
	Trifolium pratense	Red clover	1	Y
	Trifolium repense	White clover	1	Y
	Trifolium subterraneum	Subterraneum clover	1	Y
	Cerastium fontanum	Common mouse-ear	1	Y
	Ranunculus repens	Creeping buttercup	<1	N
	Rumex acetosella	Sheep sorrel	<1	Y
	Claytonia perfoliata	Miner's lettuce	<1	N
	Medicago sp.	Unknown	1	unknown
	Elymus glaucus	Blue wild rye	2	N
	Dactylis glomerata	Orchard grass	1	Y
	Agrostis stolonifera	Creeping bent grass	10	Y
D			13	
	Rhytidephlis squarrosus	Square goose-neck moss	3	N
		Unknown Bryophytes	10	unknown
E			40	
		Leaf litter	35	
		Bare soil	4	
		Natural woody debris	1	

Table 3: Geographic and Vegetation information for the "Meadow."

Garry Oak "Meadow" Community Type				
UTM Zone: 10 Easting: 466510 Northing: 5364595 Elevation: 19m (+/- 3m) Acres:0.66 Aspect : 160˚ Slope: 2%			Surveyors: David Tanner and Todd Kohler Date: April. 9/11	
Layer	Scientific Name	Common Name	Percent Cover (%)	Introduced (Y/N)
A				
B			>1	
	Daphne laureola	Spurge-laurel	>1	y
C			90	
	Belis perenis	Common daisy	15	Y
	Hypochaeris radicata	Catsear	5	Y
	Erodium cicutarium	Common stork's-bill	10	Y
	Taraxacum officinale	Common dandelion	5	Y
	Aphanes microcarpa	Slender parsley piert	>1	Y
	Rumex acetosella	Sheep sorrel	>1	Y
	Trifolium subterraneum	Subterraneum clover	>1	Y
	Cerastium fontanum	Common mouse-ear	>1	Y
	Trifolium repense	White clover	>1	Y
	Stellaria media	Common chickweed	>1	Y
	Narcissus sp.	Daffodil	>1	Y
	Triphysaria pusilla	Dwarf owl-clover	>1	N

D.			10	
	Bryophytes spp.		10	unknown
E			5	
		Leaf litter	5	

Table 4: Geographic and vegetation information for "Rock Outcrop."

Garry Oak “Rock Outcrop” Community Type				
UTM Zone: 10 Easting: 466508 Northing: 5364567 Elevation: 16m (+/- 4m) Acres: 0.39 Aspect : 160˚ Slope: 2%			Surveyors: David Tanner and Todd Kohler Date: April. 9/11	
Layer	Scientific Name	Common Name	Percent Cover (%)	Introduced (Y/N)
A			60	
	Quercus garryana	Garry oak	60	N
B			6	
	Holodiscus discolor	Oceanspray	2	N
	Mahonia aquifolium	Tall Oregon grape	1	N
	Rubus ursinus	Trailing blackberry	>1	N
	Symphoricarpus albus	Snowberry	>1	N
	Lonicera hispidula	Honeysuckle	>1	N
	Daphne laureola	Spurge-laurel	>1	Y
	Hedera helix	English ivy	>1	Y

	Cytisus scoparius	Scotch broom	>1	Y
C			75	
	Camassia sp.	Camas	>1	N
	Polystichum munitum	Sword fern	>1	N
	Galium aperine	Cleaver	4	Y
	Geranium molle	Dovefoot geranium	8	Y
	Anthriscus caucalus	Bur chervil	20	Y
	Stellaria media	Common chickweed	2	Y
	Rumex acetosella	Sheep sorrel	>1	Y
	Cardamine oligosperma	Little western bittercress	5	N
	Erythronium oregonum	White fawn lily	>1	N
	Aphanes microcarpa	Slender parsley piert	>1	Y
	Claytonia perfoliata	Miner's-lettuce	1	N
	Hypochaeris radicata	Catsear	2	Y
	Belis perenis	Common daisy	8	Y
	Plantago lanceolata	English Plantain	>1	Y
	Vicia sativa	Common Vetch	2	Y
	Trifolium subterraneum	Subterraneum clover	1	Y
	Cardamine nuttallii	Nuttall's toothwort	4	N
	Collinsia grandiflora	Large-flowered blue-eyed Mary	>1	N
	Montia Fontana	Water chickweed	2	N
	Taraxacum officinale	Common dandelion	2	Y
	Veronica serpyllifolia	Thyme-leaved speedwell	>1	Y

	Dactylis glomerata	Orchard grass	2	Y
	Poaceae spp.		10	unknown
D			7	
	Racomitrium canscens	Roadside rock moss	5	N
	Bryophytes spp.		2	unknown
E			9	
		Bare Rock	8	
		Fallen woody debris	1	

Recommendations and Conclusions

Each community should be revisited and inspected for additional plant species that were not apparent at the time of our survey. The most appropriate time for this is late spring to early summer, and after a perimeter deer fence is installed. Formulating a comprehensive species list is important for several reasons. For example, it will influence treatment method(s) during site preparation and help when deciding species to propagate in the nursery.

3c. Native Plant Nursery

A native plant nursery was constructed in order to propagate plants for the Camas Meadow Restoration Project with minor allowance or ecological footprint. The economic incentive was overwhelming, as we calculated it would cost a minimum of $105,000 to contract a nursery to cultivate the 175,000 camas seeds we planned to grow (approximately $0.60 a seed).

Site Selection

The site that was chosen for the native plant nursery is located on the north side of the restoration site. It was selected because it possessed the following characteristics:

- partial shade
- adequate drainage of water and air
- flat and open landscape at least 32’ x 36’ in size
- access to a usable water source
- easily accessible to site visitors and staff
- high visibility, accessibility and overall interpretive value

- minimal commemorative value
- minimal ecological value (i.e. degraded habitat)

Site Assessments

Prior to constructing a nursery, the entire restoration site was assessed for its underground infrastructure. Utilities were identified by BC One-call; and to ascertain the precise depth and direction of each utility we contracted Western Utilities Locating Services Ltd. Each utility was marked by staking metal tags into the ground with the name and depth of each utility at frequent intervals. These were then mapped and digitally recorded. For information regarding the specific location of these utilities, refer to the word document called "utilities" located on the G Drive inside the Camas Meadow folder.

3d. Screening Process

On federal property all physical activities tied to a project that permanently alter a site require an official screening report. The native plant nursery avoided a screening report because it passed as a temporary structure (the plan is to remove it after we've propagated the camas). The activities outlined in the official screening report for the Camas Meadow Restoration Project included: the installation of a permanent deer fence around the perimeter of the restoration site, the installation of interpretive signs inside the restoration site, and the installation of a fertilizer injection system for the nursery.

Method

To obtain approval for a screening report, an official screening process must be followed, outlined below.

1. Register Project(s) on the Canadian Environmental Assessment Registry (CEAR). This is done by posting a Notice of Commencement on the CEAR.

2. Prepare Screening Report.

3. Consult with other Departments/Agencies that may have a role in the environmental assessment (EA).

4. Determine if public involvement is needed.

5. Finalise screening report with expert advice and public comment as needed.

6. Forward screening report to decision-maker for review and approval (typically it is the Field Unit Superintendent or site Manager).

7. Once EA is signed (approved), post record of decision on the CEAR.

Results and Discussion

On February 19th, 2011 a notice of commencement was submitted to the Canadian Environmental Assessment Registry (CEAR). Preparation of a screening report began in January, and was finalized for submission by mid March. The first draft was submitted to Site Managers Leanne Martin and Dave King for comment and approval. This version can be seen in the appendices. Due to unforeseen circumstances, we have yet to receive approval, delaying physical activities outlined above indefinitely.

Recommendations and Conclusions

The progress of the Camas Meadow Restoration Project hinges on receiving approval for the screening report. It is a priority to have it approved so the fertilizer injection system can be installed. This will make fertigating the nursery more resource efficient, reducing operating costs. Materials for the deer fence were purchased in March and are stored inside the SAR storage container. Refer to the purchase invoice in the appendices for a list of materials.

4. Nursery Construction

4a. Cold Frames

A cold frame is an enclosure for propagating or hardening plants. Typically they are built low to the ground and fitted with a transparent, impermeable ceiling to mediate temperature, wind and rain.

Method

The construction of the nursery began on September 13th, 2011 with ten cold frames, 8' x 4' x 2' in dimension (figure 6). Our cold frames were designed by Rob Underhill, and feature wood siding and a ceiling made of 6mm greenhouse plastic. It was decided that five of the ten cold frames would be made of cedar and the other five of spruce. Though cedar is naturally more weather resistant, spruce was a reasonable and more affordable alternative. Of the ten cold frame lids, nine were fitted with greenhouse plastic and one with thin plastic wire mesh.

Figure 6 in: a photo of rob constructing cold frames

As the cold frames were constructed, the nursery ground was prepared for installation using the following procedure:

1. Demarcate 10 8’ x 4’ foundation plots with 3’ spacing (facing south).

2. Using an edger, spade and level, level each plot.

3. Cover each plot with nursery fabric, leaving 1’ of excess material on each side.

4. Install cold frames.

5. Make necessary adjustments to level the frames.

6. Pour 0.5’ of coarse gravel into the frames using a wheel barrow; level gravel with a hard metal rake.

7. Attach cold frame lids and cold frame lid safety latch.

4b. Deer Fence

Method

A 7.5’ high, deer proof fence was installed in early October to exclude deer and other grazing animals from entering the nursery. Enough materials were procured from the Species at Risk inventory at Fort Rodd Hill NHS to enclose a 40’ x 60’ area around the cold frames. The deer fence was a model

sold by Naturescape fencing, a local company in Nanoose Bay, B.C. It was easy to set-up and features weather resistant material that blends in with most surroundings. The entire fence was installed by three persons in less than one day by using the following procedure:

1. Take time to study the deer fencing already in place at Fort Rodd Hill NHS, particularly where the same model has been used.

2. At your installation site, measure and clearly demarcate your fence line and any fence gates.

3. Clearly mark out utility lines.

4. Mark the locations for each fence post by flagging every corner of your perimeter (if your perimeter is a square or has sharp angles); make sure there is a flag for every 20' interval and consider the spacing of any access or driveway gates.

5. Fabricate access or driveway gates in a clear, open area.

6. At each flag, pound a heavy metal insert into the ground using a maul, a heavy duty metal insert and a heavy duty driving cap. Confirm each insert is pounded 1.5' into the ground.

7. Insert heavy duty metal posts into heavy duty metal inserts. Put prefabricated gates into place.

8. Weave two strips of polypropylene tension cable horizontally through the top and bottom row of the standard deer fence.

9. Erect standard deer fence against heavy duty metal posts and fasten into place using cable ties.

10. Make adjustments to the cable ties and tension cable to fasten the deer fence to the posts (as taut as possible).

11. To reinforce the fencing from burrowing pests, a second layer of rabbit/otter fence may be attached to the bottom 2' of the standard deer fence using hog rings and a Stanley hogringer.

12. Stake fencing into the ground using metal ground stakes (to prevent burrowing intruders).

Figure 7: the cold frames in place and protected by deer fencing.

4c. A Sand Plunge

A sand plunge is an insulated container filled with a coarse (sharp) sand medium wherein, hardwood cuttings can be propagated with the aid of rooting hormone.

Method.

The first of two sand plunges was built on January 20th, 2011 in the Northeast corner of the nursery. Installing the sand plunge took a one person crew 3-4 hours using the following procedure:

1. Mark out desired location for sand plunge.

2. Dig a 24" wide x 13" deep pit with a standard spade.

3. Insert one 25 gallon 24" x 13" plastic potting container. Make sure the container is fitted tightly in the ground.

4. Fill the container with 2-3" of course gravel for additional drainage (optional).

5. Fill the container with sharp or "builders" sand, stopping approximately 2-3" from the rim to prevent any spillage. Sharp or "builders" sand is preferable and was recommended by Restoration Technician for the City of Victoria, Fred Hook. It is easy to identify by pinching a sample between your fingers; if it feels gritty "like sandpaper," you have sharp sand.

5. Propagation

In late September we began a propagation program at Fort Rodd Hill NHS by sowing native plant seeds in the nursery. During planning for the Camas Meadow Restoration Project, it was decided that a large portion of the nursery would be committed to growing camas (*Camassia spp*.). Camas is a cultural and ecological keystone, indicative of Garry oak ecosystems.

5a. By Seed

Method

In late September we began dividing and preparing our native seed stock for planting, including a total of 176,000 Camas seeds collected in 2007, 2009, and 2010. All seed for the Camas Meadow Restoration Project were collected within 1km of the restoration site on federal property in or adjacent to Fort Rodd Hill NHS and stored in a dry, cool container. Each year seed was weighed, and then divided equally into small paper envelopes representing a single 10" x 20" seed tray of sowing space (1400 seeds per seed flat). The number of envelopes depended on the total number of seeds collected per year and the total amount of available cold frame space.

To maximize germination, select seeds received special preparations prior to sowing. The following table summarizes the pre-treatments we utilized.

Table 5: seed information and pre-treatments utilized in the fall, 2010.

Seed	Collected (Year and location)	Pre-treatment	Rationale
Camassia sp.	2007 & 2009, Fort Rodd Hill NHS	Soaked in water for 24hrs, kept at room temperature.	Seed was wrinkled and dry.
Danthonia californica	2010, Fort Rodd Hill NHS	Hand removed the lemma and palea of each seed	Notably difficult grass to germinate (GOERT website). However, we have observed nearly 100% germination.

The vast majority of planting occurred between September 17 and 22nd 2010. Save for grasses, all seed was sown using the following procedure:

1. Fill a 20” x 10” perforated plastic seed tray with a mixed medium of 2:1 sea soil and sharp sand.

2. Tamp down soil by dropping the tray 1-2” against a hard surface.

3. Sprinkle the prepared amount of seeds evenly across the surface of the soil mixture.

4. Thinly spread crushed granite or “turkey grit” on top to deter birds.

5. Insert seed tray into cold frame.

6. Insert label into seed tray with the following information: scientific name of species, date sown, and cold frame location.

7. Lightly water the prepared seed tray until thoroughly moistened.

Figure 8: from left to right: Todd, Rob and David sowing seeds in Fall, 2010.

2010 procedure for sowing grass seeds:

1. Fill a plug tray with a mixed medium of 2:1 Sunshine mix #1 and sharp sand.

2. Lightly tamp down soil by dropping the plug tray 1-2" against a hard surface.

3. Using a pencil if necessary, dimple your medium and sow 1-3 grass seeds per plug.

4. Cover seeds with a thin (0.5-1") layer of medium, lightly tamp down with your finger to ensure seeds are in full contact with the soil.

5. Thinly spread crushed granite or "turkey grit" on top to deter birds.

6. Insert sown plug tray into cold frame.

7. Lightly water the prepared plug tray until thoroughly moistened.

Results and Discussion

Approximately 1400 camas seeds were sown on to each 10x20" seed tray. This resulted in 127 seed trays sown with camas seed: 47 of which contained 2007 stock, 35 containing 2009 and 45 with 2010. In order to identify different species during monitoring, each tray was assigned a number and letter that distinguish its location. Table 6 summarizes propagation information for seeds sown in fall, 2010. As you can see, a small portion of seed collected from the Gulf Island (GI) projects was sown. The table also shows how the 2007, 2009, 2010 camas seeds were kept in separate cold frames. Finally, the table shows the diversity of species we propagated in addition to camas. This seed was lumped with the GI seed in cold frame #6. Native grasses were designated to cold frame #7 with the unique mesh covering because some species of grass required a natural cold stratification.

Table 6: a summary of seed sown in the fall, 2010.

Cold Frame #	Seed Tray	Year of Collection	Species	Date Sown	Provenance
1	a-p	2007	*Camassia Sp.*	17/10/2010	FRH
2	a-p	2007	*Camassia Sp.*	17/10/2010	FRH
3	a-l, n-p	2007	*Camassia Sp.*	17/10/2010	FRH
	m	2010	*Lomatium*	21/10/2010	FRH

			utriculatum		
4	a-p	2009	*Camassia Sp.*	17/10/2010	FRH
5	a-pl	2009	*Camassia Sp.*	17/10/2010	FRH
6	a	2010	*Sanicula crassicaulis*	20/10/2010	GI
	b	2010	*Allium cernuum*	20/10/2010	GI
	c	2010	*Camassia Sp.*	20/10/2010	GI
	d	2010	*Lomatium nudicaule*	20/10/2010	GI
	e	2010	*Lomatium utriculatum*	21/10/2010	FRH
	f	2010	*Allium acuminatum*	21/10/2010	FRH
	g	2009	*Dodecatheon hendersonii*	20/10/2010	FRH
	h	2010	*Dodecatheon hendersonii*	20/10/2010	FRH
	i	2010	*Plectritis congesta*	22/10/2010	FRH
	j	2010	*Lomatium utriculatum*	21/10/2010	FRH
	k	2010	*Lomatium utriculatum*	21/10/2010	FRH
	l	2007	*Dodecatheon hendersonni*	20/10/2010	FRH
	m	2010	*Fritillaria camschatcencis*	04/10/2010	FRH
	n	2010	*Plectritis congesta*	22/10/2010	FRH
	o	2009	*Rosa sp.*	21/10/2010	FRH

	p	2010	*Lomatium utriculatum*	21/10/2010	FRH
	q	2007	*Erythronium oregonum*	20/10/2010	FRH
	r	2010	*Erythronium oregonum*	20/10/2010	FRH
	s	2010	*Ozmorhiza berteroi*	22/10/2010	FRH
	t	2010	*Lomatium utriculatum*	21/10/2010	FRH
	u	2010	*Plectritis congesta*	22/10/2010	FRH
	v	2010	*Lomatium utriculatum*	21/10/2010	FRH
7	a-f	2010	*Malika subulata*	21/10/2010	FRH
	g	2010	*Danthonia californica*	21/10/2010	FRH
	h	2010	*Bromus carinatus*	28/09/2010	GI
	i	2010	*Bromus carinatus*	28/09/2010	GI
	j	2010	*Koeleria macrantha*	28/09/2010	GI
8	a-p	2010	*Camassia Sp.*	20/10/2010	FRH
9	a-l,p	2010	*Camassia Sp.*	20/10/2010	FRH
	m,n,o	2009	*Camassia Sp.*	17/10/2010	FRH
10	a-f,h-k,m-p	2010	*Camassia Sp.*	20/10/2010	FRH
	g,h	2010	*Camassia Sp.*	17/10/2010	FRH

5b. By Hardwood Cuttings

Hardwood cutting are taken in the fall and later winter/early spring when plant growth has ceased and the tissues are ripened. Ease of propagation, low associated costs, minimal space requirements, are all reasons which make propagating hardwood cuttings the ideal method for growing native deciduous shrubs.

Method

Hardwood cuttings were taken from several native species known to propagate well using this technique. For detailed information on plants propagated by hardwood cuttings, refer to the appendices. The following procedure incorporated best practices outlined by Bruce Macdonald in "Practical Woody Plant Propagation for Nursery Growers" to fit with the scale of our operation.

To successfully propagate hardwood cuttings you need the following supplies: a field notebook, clean and sharp secateurs, string, a knife, a measuring stick, rooting hormone (0.4-1.0% butyric acid), a mason jar, and a sand plunge (or some other growing medium).

1. Develop a list of plants you would like to collect cuttings from. It is best to collect and treat a number of cuttings at once, so as not to waste rooting hormone.

2. Confirm online or by visual inspection that the species are sufficiently dormant to collect cuttings from.

3. Locate young plant specimens that display well-ripened vigorous wood of the current season's growth with plenty of buds.

4. Selecting the well-ripened, vigorous, one-year-old shoot with one hand, use clean secateurs to remove cuttings that are between 20-30 cm long and approximately pencil-width, cutting just below a bud.

5. Find a clean, flat surface to prepare your collection of cuttings; in the winter of 2011, we set up a table in the nursery, directly beside the sand plunge. Start by discarding weak and bent shoots. Next, use clean, sharp pruners to prepare 15cm long cuttings by making a sloping cut away from the tip bud and a horizontal nodal cut to form the base. The sloping cut will remind you which end is "up" and also discourage water from collecting on the tip. Make all cuttings of a particular species uniform in length to expedite subsequent operations.

6. With a string or a cut elastic band, tie approximately 12 cuttings together to form a bundle. Make sure the bottom of the bundle sits flush when placed on a flat surface. Depending on the thickness of your cuttings, you may choose to add or decrease the number of cuttings per bundle. Note that larger bundles are more difficult (and sometimes impossible) to push into the sand plunge.

7. Read instructions on the rooting hormone bottle to confirm the strength is appropriate for hardwood cuttings. Consult the MSDS sheet located in the red MSDS binder and employ a safety protocol if necessary.

8. Pour 1-2” of rooting hormone into a deep dish or jar, wide enough to fit the largest of your bundles.

9. Dip the bottom end of your bundles into the hormone. Follow the procedure recommended on the bottle.

10. Stick bundles into the sand plunge, half-way submerged. Leave a 5” spacing between bundles to prevent their roots from interacting.

Figure 9: a display of hardwood cutting propagation.

6. Maintenance and Monitoring

6a. Germination Rate

Method

Starting October 16th, each seed tray was inspected for seed germination and health as part of a weekly monitoring regime. Germination success was recorded by estimating the percentage of germinating seeds in a representative 10cm x 10cm portion of each flat. Over time, this also indicated the rate at which each species germinated. In the field, percent germination was recorded and later entered in a spreadsheet to illustrate each species germination over time. Both blank survey forms and the germination spreadsheet are located on the G drive in the Camas Meadow Folder.

Results and Discussion

While monitoring the nursery on October 29th we discovered a white mould actively destroying the 2010 camas seeds in cold frames # 9 and 10 (figure 10). Over the next 12 days we monitored the camas closely. The mould continued to spread and destroy seed, eventually affecting the 2010 camas in cold frame # 8. On November 9th we sent a sample of the mould to a diagnostic laboratory in Abbotsford. On the following day we changed our cold frame protocol to encourage better air circulation. November 12th we received a diagnosis. *Penicillium sp*. was the dominant fungus (white turning into green color) observed. A low level of *Aspergillus sp*. was also observed on a few seeds. Although no specific information is available on the pathogenicity of these fungi on the host plant, both have been observed to cause seed, seedling and bulb rot in some other members of the family Liliaceae. Equipped with the lab's diagnosis and advice from Fred Hook, Michelle Gorman, and Rob Hagel, we decided on a treatment strategy. On November 16th, cold frames # 8, 9 and 10 were flushed with a dilute solution of hydrogen peroxide to kill the fungus. The following day we manually removed the most contaminated seeds using hand tweezers and disposed of them in a plastic bag.

Figure 10: 2010 camas seed infected with *Penicillium sp*. and *Aspergillus sp*. mould.

The treatment, combined with the new cold frame protocol, successfully eliminated the mould. We estimate that between 20-30% of our 2010 camas seed was lost. The surviving seeds began to germinate approximately 14 weeks after planting, around the same time as the 2007 and 2009 camas seeds. Figure 11 is a graph which illustrates the relationship between percent germination and weeks since planting for the 2007, 2009 and 2010 camas seed. As you can see, the vast majority of our seed survived and germinated. We had similar success propagating other native seeds, only two of which experienced germination success under 30%. Table 7 displays percent germination for all seed propagated in the fall, 2010. Any germination that took place after the final monitoring date (March 2, 2011) was not recorded.

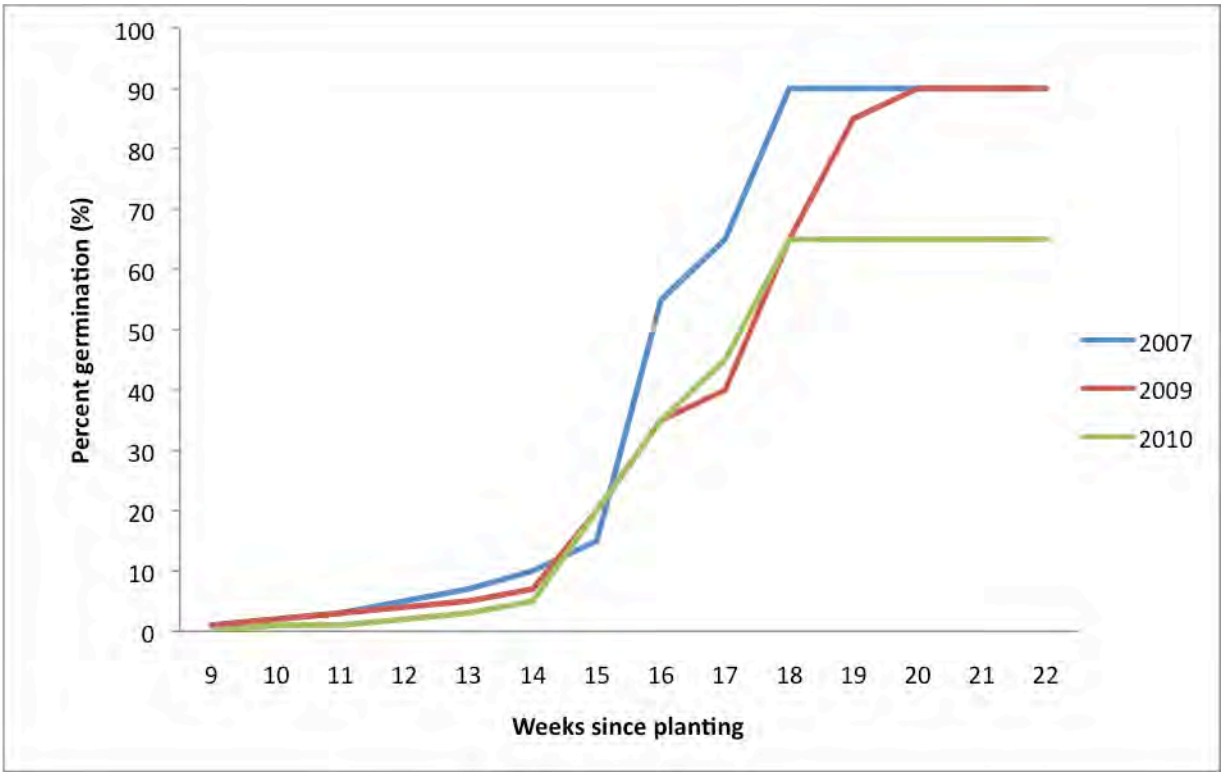

Figure 11: a graph illustrating the relationship between percent germination (y) and weeks since planting (x) for the 2007, 2009 and 2010 camas seed.

Table 7: percent germination for native plant seeds sown in the fall, 2010.

Year collected and Scientific Name	Common Name	% Germination
2007 Camassia spp.	Camas	75-100%
2009 Camassia spp.	Camas	75-100%
2010 Camassia spp.	Camas	50-75%
2010 Lomatium nudicaule	Indian consumption plant	75-100%
2010 Allium cernuum	Nodding onion	50-75%
2010 Sanicula crassicaulis	Pacific sanicle	75-100%

2007 Dodecatheon hendersonii	Broad-leafed shooting star	25-50%
2009 Dodecatheon hendersonii	Broad-leafed shooting star	50-75%
2010 Dodecatheon hendersonii	Broad-leafed shooting star	25-50%
2007 Erythronium oregonum	White fawn lily	75-100%
2010 Erythronium oregonum	White fawn lily	75-100%
2010 Lomatium utriculatum	Spring gold	75-100%
2010 Melica subulata	Alaska oniongrass	75-100%
2010 Danthonia californica	California oatgrass	75-100%
2010 Rosa sp.	Rose	25-50%
2010 Allium acuminatum	Hookers onion	No record
2010 Plectritis congesta	Sea blush	75-100%
2010 Ozmorhiza berteroi	Mountain sweet cicely	50-75%
2010 Bromus carinatus	California brome	75-100%
2010 Koeleria macrantha	Prairie junegrass	75-100%
2010 Fritillaria affinis	Chocolate lily	25%

In early April, the 2010 camas began showing damage to their leaf tips (figure 12). A photo was taken and immediately sent to Fred Hook and Michelle Gorman for comment. Both agreed that the new expression was unlikely caused by disease. Rather, the brown spots are probably caused by residual tissue damage from the mould infestation, exacerbated by recent frosts. The second possibility is that the leaves have suffered sun scald. This happens when the sun is magnified by very cold water droplets on the leaves early in the morning. The latter explanation would explain why the seed trays in the shaded front row have very minor damage. However, this does not explain why all of the 2007 and 2009 have shown very little damage at all.

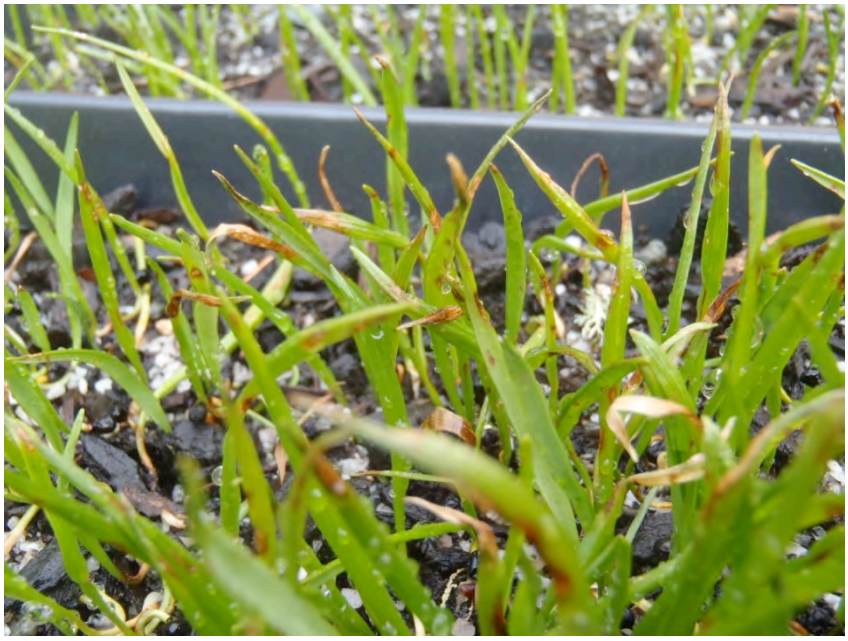

Figure 12: 2010 camas showing damage to their leaf tips.

Recommendations and Conclusions

The camas should continue to be monitored for any spread of the symptoms. Note that 2009 camas in cold frame #5 also showed minor leaf damage in the form of browning leaf ends. If these symptoms continue to spread, refer to Michelle Gorman and Fred Hook to decide on a possible treatment or solution.

The excellent germination of our fall sowing is encouragement to continue the propagation program next fall. Those species that had mediocre or poor germination success can be sown again, with specific planting criteria now available through GOERT's compendium, Chapter 10: Species propagation and Supply, located on the G Drive in the Camas meadow folder. Depending on available space in the nursery, new species should be introduced to the program. These species must be selected in late spring, so their seeds can be collected over summer. Be aware that camas will take between 4-5 years to produce flowers. During this period of time the nursery space they require will increase by up to ten times that currently used. Refer to correspondence section of the nursery binder for Fred Hook's instructions on propagating camas.

6b. Venting

Method

On October 1st, 2010 a protocol was written that explained basic guidelines for operating the cold frames. This protocol was shared with the two commissionaires who operate the admission kiosk to the historic sites, as both offered to manage the cold frame lids on the weekends.

The original protocol was based on maintaining temperatures inside the cold frames that were conducive to optimal seed germination and growth. It recommended closing the cold frame lids when:

- Predicted temperatures would drop below 10˚C.
- Heavy rainfall was expected.
- Leaves were falling or seeds were dispersing.
- High winds were expected.

The same protocol recommended opening the lids during temperatures above 10 Celsius, particularly on sunny days and regardless of wind, leaf fall, seed dispersal, or rain. This was to prevent the seeds from "steaming" in really hot temperatures – one of our chief concerns.

Results and Discussion

The spread of *Penicillium sp.* and *Aspergillus sp.* fungi in cold frames # 8, 9 and 10 required a thoughtful revaluation of our cold frame protocol. On November 10th we decided to leave the lids permanently open unless a hard frost was forecasted. Combined with a dilute treatment of fungicide and manual removal, the new protocol quickly discouraged algae growth and completely eradicated the mould problem. Even with our new hands-off protocol to managing the cold frames, the forecast was reviewed every day to anticipate for any unexpected weather events. On February 23rd a late, hard frost hit southern Vancouver Island, leaving a thick blanket of a snow (figure 13). Aware of the incoming weather, we closed the cold frames the evening before. Temperatures dropped to -12˚C, and lower when accounting for wind chill. In the early afternoon I arrived at the nursery to find the cold frames inundated with more than 1' of snow. The soil in the seed trays was frozen solid, along with the camas, which by now had germinated and started showing cotyledons. Still, the air inside the cold frames felt several degrees warmer than the ambient temperature, likely helped out by the insulation provided by the snow.

Figure 13: the nursery thickly blanketed by snow, February 23rd, 2010.

On February 25th we removed approximately 70% of the snow from the cold frame lids, to minimize any stress to the plastic. A small, circular window was cleared on each lid to permit sunlight. We then hilled snow up against each frame to add further insulation (figure 14).

Figure 14: the cold frames hilled with snow for insulation, February 25th, 2010.

Recommendations and Conclusions

Witnessing the dramatic spread and effect of the mould, leaving the cold frames lids open left me revaluating my role as caretaker of the nursery, and my perspective and approach to growing native plants. What I recognized was that native plants (when grown in their natural habitat) didn't need to be actively propagated in the sense one would propagate ornamental plants or vegetables. Native seed has evolved to germinate, grow and reproduce in their specific climate (temperature fluctuations and all!) under natural conditions. The best thing I could do was try to replicate these conditions to the best of my ability.

6c. Watering & Liquid Feed

Method

During the germination phase, the seed trays were monitored daily to ensure the soil was kept moist but not wet. At this time, we also removed fallen detritus (leaves, twigs etc.) and weeds from each seed tray, which could retard or inhibit seed germination and growth. To water the nursery, we initially used the light shower setting on a standard garden nozzle attachment. Water was applied using a 50' hose connected to a sprinkler line on the restoration site. For any concerns or questions regarding this line, contact Bruce Allward. We followed this regime until the first frost, after which the sprinkler line is shut off for several months to prevent freeze damage. When the sprinkler line is turned off, we used a 2 gallon plastic watering can, filled at a water outlet on the World War II hut.

In January 2011, we initiated a liquid feed program to meet the nutrient requirements of grasses and seedlings that were showing true leaves. The following instructions help to calculate the amount of soluble fertilizer needed to obtain a specific parts per million (ppm).

1. Obtain the amount of nitrogen (N), phosphorous (P) and potassium (K) in the fertilizer from the fertilizer's label. These are the so-called N-P-K values, such as 10-20-10. The numbers refer to percentages. A 10-20-10 fertilizer contains 10 percent nitrogen, 20 percent phosphorous and 10 percent potassium by weight.

2. Determine the mass (in grams) of fertilizer to dissolve per liter of water to achieve the desired ppm value by dividing by the percent (in decimal form) of the desired nutrient, then divide by 1,000 to convert from kg to grams (1 liter = 1 kg). If a fertilizer of 200 ppm nitrogen is desired, then: 200 ppm / 0.10 / 1,000 = 2 g of fertilizer per liter (L).

3. Determine the number of liters of fertilizer to be prepared. For sake of convenience, 1 gallon = 3.8 liters. Thus, if the quantity is known in gallons, multiply this quantity by 3.8 to convert to liters.

4. Multiply the grams of fertilizer from Step 2 by the desired number of liters from Step 3 to determine the quantity of fertilizer to use. For example, to prepare 1 gallon: (2 g) x (3.8 L) = 7.6 g fertilizer.

5. Weigh the desired quantity of fertilizer on a scale or balance.

6. Combine the weighed fertilizer and the measured quantity of water and mix well.

Fertilizer was mixed in an open space on clean surface using a small measuring cup, a bag of 20-20-20 all purpose, water soluble fertilizer and a 2 gallon watering can. Safety protocol was based on MSDS recommendations. A fertigation record was maintained to record date, ppm of application, method and notes. This can be found in the black nursery binder.

Results and Discussion

In early March we began fertilizing the camas when over 50% of the seedlings had put up a strong first leaf. At this stage, Fred Hook recommended feeding the plants once a week, at a rate of 75 ppm Nitrogen (N). We tried to fertigate when the soil was partially dry to avoid spreading fertilizer in the rain; as the rainfall would quickly wash away and dilute any soluble nutrients available to the plants. Unfortunately, weather in late winter is rarely conducive to these conditions, particularly in British Columbia.

Recommendations and Conclusions

Beginning May 1rst, the fertigation rate should be doubled to 150ppm N. Plants should be fed with every watering, frequently enough to keep the soil moist, but not wet. By late spring the sprinkler line should be on, and used. This protocol could change if a fertilizer injection system is installed. In January one was purchased, along with a rain water collection tank. If approved, the rain water collection tank will be located south west of the restoration site, next to the admission kiosk. A small trench 0.6” trench will be dug and fitted with polyethylene piping to carry water from the fertilizer injector to the restoration site nursery. In the event that the fertilizer injection system needs to be connected to the public water supply, the Capital Regional District’s (CRD) Cross-connection control department will have to be contacted. Actions that follow should be completed in accordance with CRD cross connection bylaw No. 3516. The current status of this initiative is pending with the approval of a screening report for the Camas Meadow Restoration Project.

7. Site Preparation

Method

In late September, site preparation began on the restoration site. The method we chose integrated research by Bein and Eastman (2006) with recommendations made by the GOERT Restoration and Management RIG. Our goal was to mulch the entire 1 acre restoration site with a 2-3’ layer of mostly oak leaves, after manually removing more resilient invasive species.

The manual removal of select invasive species took place between October 13 and 15th. Three species were treated, including spurge-Laurel (*Daphne laureola*), scotch broom (*Cytisus scoparius*), and

orchard grass (*Dactylis glomerata*). Daphne and broom were removed by hand pulling small individuals and cutting larger individuals below the root collar with secateurs. Patches of orchard grass were removed manually using a carpet knife and mechanically using a brush saw. In the case of orchard grass removal our goal was reduce re-sprouting by cutting below the basal meri-stem.

After the first major leaf fall, we began collecting leaves at Fort Rodd Hill NHS using a rake, 8x9' tarpaulins, and a gasoline gator hitched to a trailer. The leaves we collected were transported to the restoration site and spread out (figure 15).

Figure 15: collecting and spreading leaf mulch on to the restoration site.

The quantity of oak leaves we required would not be met by materials collected on the property alone. In an effort to extend the length of our rakes, we contacted Glen Hamilton at Waste Services for the municipality of Saanich. Glen manages the leaf collection program at Saanich, which generously donates leaf mulch at a small price. Unlike other districts, Saanich separates oak leaves during collection, and is willing to deliver outside of their municipal boundary. We calculated our need would require a delivery of 3 to 4 dump-truck loads, $400 each. Glen visited the site in November to work out logistics for the drop off.

Results and Discussion

Our order of leaf mulch did not arrive. Issues which prevented our delivery included: unexpected snowfalls, a high regional demand for leaf mulch, and the distance and logistics of planning our delivery. The leaf material we recovered from Fort Rodd Hill NHS was only sufficient to mulch

approximately 15% of the total area. However, due to winter winds, I would estimate 30% of this mulch was lost.

Recommendations and Conclusions

Research suggests mulching can effectively reduce invasive plant cover on open fields (Bein and Eastman, 2006). Actually procuring enough mulch to cover the restoration site with 2-3' of oak leaves should be a priority next fall. Establish contact with Glen Hamilton in early September by calling Saanich Waste Services: (250) 475-5595. I would recommend pinning the mulch down using plastic wire mesh. Once the mulch is spread into place, the mesh can be laid overtop and staked into the ground. This will help secure the mulch during heavy wind events.

If we are unable to procure enough mulch next fall, we should revaluate our site preparation plan and potentially use alternative treatments. For example, each vegetation community could be separated, and prescribed a treatment based on the specific landscape and ecology. The Garry oak woodland could still be mulched, but perhaps using plastic solarisation on the meadow is equally efficient, and relying on manual removal (e.g. hand picking and surface scalping) to prepare the rock outcropping would be more suitable given the terrain.

8. Outreach & Education

The main objective for the Camas Meadow Restoration Project is to educate visitors about Garry oak and associated ecosystems, and the need for their conservation. After the nursery was constructed in the fall, it became a "living" classroom to spread this message. Between September and April, we hosted volunteers every second Saturday to remove invasive species at Fort Rodd Hill NHS and adjacent properties. As part of their site introduction, we visited the nursery and highlighted the different project components (figure 16). By April, nearly 180 volunteers had visited the nursery. This does not include the countless visitors benefitting from spontaneous interpretation efforts performed by either myself, Rob or Liz.

As official Species at Risk Communication and Outreach Officer, Susan Macisaac was heavily involved with Liz in managing the volunteer program. Susan also met with representatives of the Esquimalt and Songhees Nations to discuss their involvement with the project. Early meetings covered the potential use of the Camas Meadow by First Nations as a special place to communicate traditional culture to youth and the general public. These meetings also identified activities where Parks and First Nations could work collaboratively. One idea included creating interpretive display panels for the site, using First Nation concepts in art and design.

Figure 16: David showing volunteers the nursery.

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Appendices

Table of Appendices

Appendix 1: Project spending, Sept. 10 – Apr. 19, 2011.

Budget			
Date of Purchase	Project Component	Materials and Services	Total Cost (including HST)
Sept. 10, 2010	Nursery (cold Frame construction)	Lumber and Hardware	$1951.31
Sept. 13, 2010	Nursery (cold Frames construction)	Gravel and Delivery	$154.11
Sept. 14, 2010	Nursery (cold Frames construction)	Sand	$26.45
Sept. 14, 2010	Nursery (seed propagation)	Sea soil, potting trays, sunshine mix, turkey grit, fertilizer	$595.21
Sept. 15, 2010	Nursery (seed propagation)	Labels and tray inserts	$20.59
Sept. 17, 2010	Nursery (seed propagation)	Tray inserts	$18.93
Sept. 17, 2010	Nursery (seed propagation)	Strainer	$10.07
Sept. 17, 2010	Nursery (cold Frame construction)	3” screws	$13.62
Sept. 20, 2010	Nursery (cold Frame construction)	Greenhouse plastic	$184.24
Sept. 20, 2010	Nursery (irrigation)	Spray nozel	$17.64
Sept. 22, 2010	1. Nursery (cold Frame construction) 2. Restoration (site preparation)	1. Latch hooks 2. Metal garden rakes	$74.64
Sept. 28, 2010	Nursery (maintenance)	2x Plastic garbage bins	$42.54
Oct. 1, 2010	1. Nursery (maintenance)	1. Bungee cords 2. Galvanized nails, tape	$36.87

	2. Restoration (Site assessment)	measure	
Oct. 2, 2010	Restoration (site assessment)	Locates contractor	$280.00
Nov. 10, 2010	Nursery (camas mould)	Shipping seed to lab	$16.31
Nov. 12, 2010	Nursery (camas mould)	Seed pathogen identification	$33.60
Nov. 16, 2010	Nursery (camas mould)	Fungicide – H202	$35.73
Nov. 16, 2010	Nursery (monitoring)	Outdoor max/min Thermometer	$21.22
Nov. 22, 2010	Nursery (camas mould)	Chlorine Bleach	$11.18
Jan. 10, 2011	Nursery (irrigation)	Superdos 20 fertilizer applicator and shipping	$456.70
Jan. 10, 2011	Nursery (irrigation)	Water tank (305 gal.), water tank accessories (1 fitting, 1 reducer, 1 valve/boiler? drain ¾")	$402.21
Jan. 17, 2011	Nursery (cutting propagation)	2x Twine	$6.61
Jan. 17, 2011	Nursery (cutting propagation)	2x Plant containers (25 gal.)	$37.52
Jan. 17, 2011	Nursery (cutting propagation)	Root growth hormone	$88.82
Feb. 8, 2011	Nursery (seed propagation and irrigation)	200 tray inserts, water tank accessories (12" tubing, reducer gushing? -2.25)	$227.64
Feb. 8, 2011	1. Nursery (irrigation) 2. Restoration (Tools)	1.Down pipe, 2x elbow pipe, 2x elbow pipe, "dandlenoz", hose ¾" x 50' 2. Transplanter, cultivator	$191.13

Apr. 5, 2011	1. Restoration (site preparation)	One acre of Brenner's deer fencing and 2 latch and hinge sets		$6464.60
		2010-11	Budget	$31,000
			Total expenditures	$11,419.49*
*Does not include staff salary. Information could not be release due to a confidentiality agreement.				

Appendix 2: Propagation history, Sept. 17th - Apr. 19th, 2011.

Propagation History					
Sown	Material	Year Collected	Genus	Species	Common Name
Sept. 17, 2010	Seed	2007	*Camasia*	*spp.*	Camas
Sept. 17, 2010	Seed	2009	*Camasia*	*spp.*	Camas
Sept. 17, 2010	Seed	2010	*Camasia*	*spp.*	Camas
Sept. 20, 2010	Seed	2010	*Lomatium*	*nudicaule*	Indian consumption plant
Sept. 20, 2010	Seed	2010	*Allium*	*cernuum*	Nodding onion
Sept. 20, 2010	Seed	2010	*Sanicula*	*crassicaulis*	Pacific sanicle
Sept. 20, 2010	Seed	2007	*Dodecatheon*	*hendersonii*	Broad-leafed shooting star
Sept. 20, 2010	Seed	2009	*Dodecatheon*	*hendersonii*	Broad-leafed shooting star

Sept. 20, 2010	Seed	2010	*Dodecatheon*	*hendersonii*	Broad-leafed shooting star
Sept. 20, 2010	Seed	2010	*Camasia*	*spp.*	Camas
Sept. 20, 2010	Seed	2007	*Erythronium*	*oregonum*	White fawn lily
Sept .20, 2010	Seed	2010	*Erythronium*	*oregonum*	White fawn lily
Sept. 21, 2010	Seed	2010	*Lomatium*	*utriculatum*	Spring gold
Sept. 21, 2010	Seed	2010	*Melica*	*subulata*	Alaska oniongrass
Sept. 21, 2010	Seed	2010	*Danthonia*	*californica*	California oatgrass
Sept. 21, 2010	Seed	2009	*Rosa*	*sp.*	Rose
Sept. 21, 2010	Seed	2010	*Allium*	*acuminatum*	Hookers onion
Sept. 22, 2010	Seed	2010	*Plectritis*	*congesta*	Sea blush
Sept. 22, 2010	Seed	2010	*Ozmorhiza*	*chilensis*	Mountain sweet cicely
Sept. 28, 2010	Seed	2010	*Bromus*	*carinatus*	California brome
Sept. 28, 2010	Seed	2010	*Bromus*	*carinatus*	California brome
Sept. 28, 2010	Seed	2010	*Koeleria*	*macrantha*	Prairie junegrass
Oct. 4, 2010	Seed	2010	*Fritillaria*	*camschatcencis*	Chocolate lily
Jan. 21, 2011	Hardwood Cutting	2011	*Horticolos*	*discolor*	Oceanspray
Jan. 21, 2011	Hardwood Cutting	2011	*Oemleria*	*cerasiformis*	Indian Plum
Jan. 24, 2011	Hardwood Cutting	2011	*Horticolos*	*discolor*	Oceanspray
Jan. 24, 2011	Hardwood Cutting	2011	*Oemleria*	*cerasiformis*	Indian Plum
Jan. 24, 2011	Hardwood Cutting	2011	*Rosa*	*Sp.*	Rose species

Jan. 24, 2011	Hardwood Cutting	2011	*Symphoricarpus*	*albus*	Snowberry
Feb. 17, 2011	Hardwood Cutting	2011	*Philadelphus*	*lewisii*	Mock-Orange

Appendix 3: Plant diagnostic lab results.

PLANT DIAGNOSTIC LAB

BRITISH COLUMBIA

Printed: 12-Nov-2010

Submission: 7435

SUBMITTER: Todd Kohler
COMPANY: Parks Canada
603 Fort Rodd Hill Road
Victoria BC V9C 2W8
Tel: (250) 478-2424
Fax: (250) 478-8415
email: todd.kohler@pcgc.ca

Received: 10-Nov-2010
via: Courier

PRIORITY: URGENT

SAMPLE SITE: Greenhouse
COLLECT DATE: 09-Nov-2010
SYMPTOMS: See attached notes.

CROP: Camassia quamash
VARIETY: seeds

Copies to: Gayle Jesperson
Siva Sabaratnam

CROP AGE:

NUMBER of SPECIMEN: 1

OTHER CROP OR WEEDS SHOWING SYMPTOMS:

Severity:

SYMPTOMS DATE:

IRRIGATION TYPE:
DRAINAGE:

PH: Grower:
Lab:

EC: Grower:
Lab:
(1:2 ratio test)

PESTICIDES BEFORE:
PESTICIDES AFTER:

ORGANIC: ☐

FERTILIZER PROGRAM:

CONDITION OF SAMPLE:

DIAGNOSIS:

Penicillium sp. was the dominant fungus (white turning into green color) observed in seeds submitted to the lab. A low level of Aspergillus sp. was also observed on a few seeds. Although no specific information is available on pathogenicity of these fungi on the host plant seeds submitted to the lab, both have been observed to cause seed, seedling and bulb rot in some other members of the family Liliaceae (onion, garlic - APS Compendium).

Coding: REGION: Victoria
GROWER: Commercial

Diagnostician:
Vippen Joshi
Maria Jeffries

In Consultation with:

INCUBATION: ☑ PHOTO: ☐ CULTURE: ☐ ELISA: ☐ BIOLOG: ☐ PCR: ☐

Prelim.REPLY:
Final REPLY: 12-Nov-2010

MAIL: ☐ FAX: ☐ PHONE: ☐ INPERSON: ☐ EMAIL: ☑

Referred to:

Ministry of Agriculture and Lands
Food Safety and Quality Branch

Mailing Address:
Abbotsford Agriculture Centre
1767 Angus Campbell Road
Abbotsford, BC Canada
V3G 2M3

Telephone: (604) 556-3126
Facsimile: (604) 556-3154

Appendix 4: Cold Frame protocol, edited Jan. 7th, 2011.

Fort Rodd Hill Camas Propagation: Cold frame protocols

Written October 1, 2010 by Rob Underhill based on advice given by Fred Hook, Rob Hagel, and Irvin Banman.

The *Camassia lechtlinii* seed is being grown in coldframes for the following reasons:

1. Extend the growing season by maintaining a higher temperature in the late Fall and early Spring
2. Reduce seed and bulb mortality caused by cold winter temperatures
3. Prevent heavy rain from washing the soil out the bottom of the seed trays
4. Reduce the amount of time spent removing leaves from the surface of the seed trays
5. Reduce the amount of non-native seed landing on the seed trays
6. Protect the seed trays from winter storms (wind)

When the lids should be closed:

1. When the temperature is below 0°C
2. When heavy rainfall is expected
3. When leaves are falling or seeds are dispersing
4. When high winds are expected

When the lids should be open:

1. When the temperature is above 14°C, especially on a sunny day

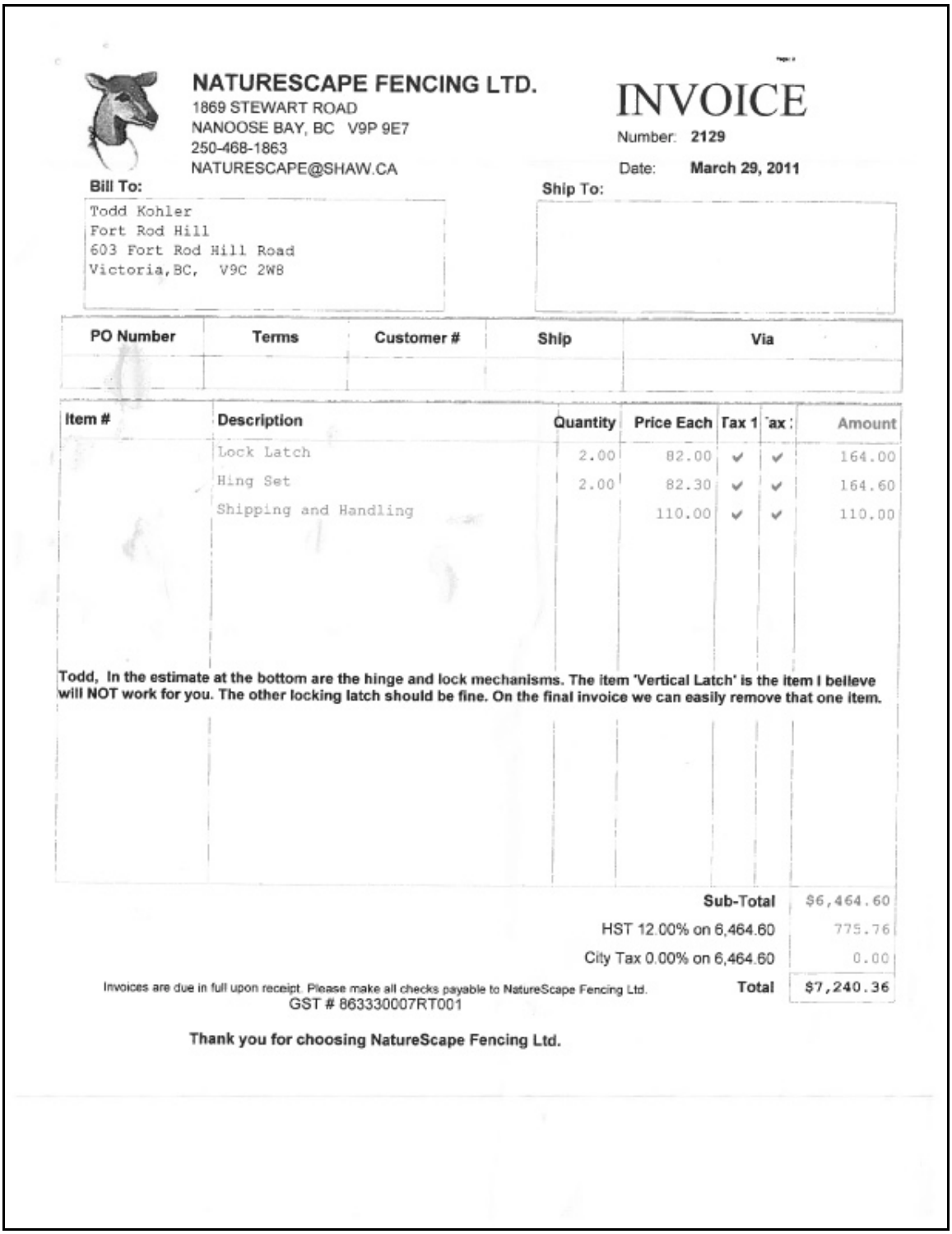
Important: On a sunny day with a temperature forecast over 14°C the lids should be left open regardless of wind, leaf fall, seed dispersal, or rain. This is to prevent "steaming" the seeds in extremely hot temperatures. Jan7th/2011/ In early December 2010 the Camas seed collected in 2010 had a fungus growing on it that was killing the seed. This is hypothesized to have occurred partly due to the conditions (constantly moist, poor air circulation) created by having the cold frame lids closed too often.

Watering: Seed trays should be kept moist but not overly wet during seed germination and during the growing season. The growing season is defined as when the Camas bulbs have green leaves. To accomplish the desired moisture you should water thoroughly, then allow the soil to dry out before the next watering (do not allow the soil to dry so much it cracks). Dormant bulbs should not be watered; they should be allowed to stay dry during the hot summer months.

Fertilizing: Seed trays should only be fertilized when the Camas are actively growing using a fertilizer injection system.

Re-flatting: During the second summer drought season (late August 2012), the dry seed flats should by filtered through a screen mesh to separate out the bulbs (hand sifting may be the only option due to large wood fragments in the growing media). The largest should be flatted at a density of about 100 - 200 per seed tray, the smaller bulbs at 500 - 600 per seed tray.

Appendix 5: Purchase invoice for perimeter deer fence.



NATURESCAPE FENCING LTD.
1869 STEWART ROAD
NANOOSE BAY, BC V9P 9E7
250-468-1863
NATURESCAPE@SHAW.CA

INVOICE

Number: **2129**
Date: **March 29, 2011**

Bill To:
Todd Kohler
Fort Rod Hill
603 Fort Rod Hill Road
Victoria,BC, V9C 2W8

Ship To:

PO Number	Terms	Customer #	Ship	Via

Item #	Description	Quantity	Price Each	Tax 1	Tax 2	Amount
	Lock Latch	2.00	82.00	✔	✔	164.00
	Hing Set	2.00	82.30	✔	✔	164.60
	Shipping and Handling		110.00	✔	✔	110.00

Todd, In the estimate at the bottom are the hinge and lock mechanisms. The item 'Vertical Latch' is the item I believe will NOT work for you. The other locking latch should be fine. On the final invoice we can easily remove that one item.

Sub-Total	$6,464.60
HST 12.00% on 6,464.60	775.76
City Tax 0.00% on 6,464.60	0.00
Total	$7,240.36

Invoices are due in full upon receipt. Please make all checks payable to NatureScape Fencing Ltd.
GST # 863330007RT001

Thank you for choosing NatureScape Fencing Ltd.

NATURESCAPE FENCING LTD.
1869 STEWART ROAD
NANOOSE BAY, BC V9P 9E7
250-468-1863
NATURESCAPE@SHAW.CA

Copy
Mar 30/11

INVOICE

Number: **2129**

Date: **March 29, 2011**

Bill To:

Todd Kohler
Fort Rod Hill
603 Fort Rod Hill Road
Victoria,BC, V9C 2W8

Ship To:

PO Number	Terms	Customer #	Ship	Via

Item #	Description	Quantity	Price Each	Tax 1	Tax 2	Amount
STK	Stakes 30/bundle	3.00	40.00	✔	✔	120.00
TC1000	Tension Cable 1000'	2.00	165.00	✔	✔	330.00
GATE 14x7	Gate Kit Driveway 14' c/w posts, caps, hardware	1.00	799.00	✔	✔	799.00
GATE 5' X 7'	Gate Kit 5' x 7'	2.00	358.00	✔	✔	716.00
HDP KIT 9'	Post Heavy Duty Kit c/w cap and insert	35.00	47.00	✔	✔	1,645.00
DCH	Driving Cap Heavy Duty	1.00	28.00	✔	✔	28.00
GRP	Gripples	20.00	3.00	✔	✔	60.00
RBF150	Rabbit Barrier 150'x2'	7.00	189.00	✔	✔	1,323.00
SDF10075	Fence Standard 100'x7.5'	1.00	175.00	✔	✔	175.00
SDF33075	Fence Standard 330'x7.5'	2.00	415.00	✔	✔	830.00

Invoices are due in full upon receipt. Please make all checks payable to NatureScape Fencing Ltd.
GST # 863330007RT001

Thank you for choosing NatureScape Fencing Ltd.

Appendix 6: Project screening report, final draft.

Environmental Assessment Screening Report Form

Garry Oak Meadow Restoration Project at Fort Rodd Hill National Historic Site (FRHNHS)

Date: March 19th 2011
Location: Fort Rodd Hill Fisgard Lighthouse National Historic Sites of Canada, British Columbia
Authors: Todd Kohler and David Tanner

Parks Canada / Parcs Canada

Canada

1. PROJECT TITLE	Garry Oak Meadow Restoration Project at Fort Rodd Hill National Historical Site (FRHNHS)		
2. EA START DATE	January 5, 2011	**3. DATE OF CEARIS REGISTRATION**	
4. CEARIS NUMBER		**5. INTERNAL PROJECT FILE NUMBER**	

6. AUTHORITY	☒	EA prepared under CEAA		
	☐	EA prepared under Management Directive 2.4.2		
7. NATURE OF PROJECT	☐	Physical work not on the Exclusion List Regulations		
	☒	Physical activity not in relation to a physical work on the Inclusion List Regulations Inclusion List paragraph number:		
8. TRIGGER	☐	Law List	☐	Funding
	☒	Proponent	☐	Disposal of an interest in land

Contact Information	
Trigger	
Date of Referral	
SARA Notification	
Outcome of Notification	
3rd Responsible Authority	
Department/Agency	
Contact Information	
Trigger	
Date of Referral	
SARA Notification	
Outcome of Notification	

12. FEDERAL COORDINATION continued	
FEDERAL AUTHORITIES	
2nd Federal Authority	
Department/Agency	
Reason for Referral	
Date of Referral	
Outcome of Referral	
Contact Information	
3rd Federal Authority	
Department/Agency	
Reason for Referral	
Date of Referral	
Outcome of Referral	
Contact Information	

13. OTHER EXPERTS CONSULTED		
Department/Agency and Name & Title	Nature of Consultation	Response (include date)
Rob Commisso, Parks Canada Agency Archaeologist Western and Northern Service Centre 300-300 West Georgia St. Vancouver, BC, V6B 6B4 **Ph**: 604-658-2862 **Fax**: 604-666-8849 **Email** : rob.commisso@pc.gc.ca	Archaeological Assessment	An archaeological assessment of the proposed camas field was done on Sept. 15, 2010.No heritage resources were found during the inspection and the sub-surface sediment samples revealed that most of the area has been previously disturbed. Accordingly, the potential for this project to impact heritage resources is low. However, there is a small probability that there are undisturbed , buried cultural features/deposits in the development area which were not found during the assessment, and ground preparation through surface scalping and/or planting could potentially impact such resources .
NatureScape Fencing Ltd. 1869 Stewart Rd. Nanoose Bay, BC V9P 9E7 **Ph.**: 250-468-1863 **e-mail**: naturescape@shaw.ca	Fence Materials	

Western Utilities, Locating Services Ltd. 2519 Ludgate St, Victoria B.C. V8T 4S2 **Ph.**: (250) 220-8129 **Fax**: (250) 361-9030 **e-mail**: www.westernutilities.ca	Locating underground utilities	Utilities found: Telus power telephone, storm drain, water line and electric. All utilities were more than 3' in depth.
BC One Call Suite 222, 4259 Canada Way, Burnaby, BC, V5G 1H1 **Ph.**:1-800-474-6886 **email**: info@beonecall.bc.ca	Locating underground utilities	Provided aerial maps of utilities at the site

14. EA COORDINATOR CONTACT INFORMATION		
EA COORDINATOR	Name:	Steve Oates
	Title:	Acting Manager, Resource Conservation
	Phone:	604-666-0286
EA AUTHOR	Name:	1) Todd Kohler 2) David Tanner
	Title:	1) Ecosystem Scientist I 2) Garry Oak Ecosystems Restoration Technician
	Phone:	1) 250478-2424 2) 250-812-8133

15. PROJECT DESCRIPTION

Fort Rodd Hill National Historic Site (FRHNHS) is responsible for 54 hectares of land within an urban landscape (Figures1 and 2). The proposed project seeks to create a Garry oak ecosystem camas meadow on approximately 0.4 hectares of this land at a restoration site located in the northern corner of an open field. The ecology of the site is characterized by open Garry oak woodland with a sub-canopy of native black hawthorn (*Crataegus douglasii*) and a groundcover of regularly mown agronomic grasses. Three large Douglas fir (*Pseudotsuga menziesii*) trees are present on the site. The soil layer is deep and drains moderately to the east.

The restoration process will include four aspects: 1. Fence and Post Installation, 2. Site Preparation 3. Site Planting and 4. Site Monitoring and Maintenance

1. Fence and Post Installation

Deer are hyper-abundant at FRHNHS due to a lack of predators and the protected nature of Fort Rodd Hill NHS, which excludes dogs and other harassments. The project requires that a deer fence be constructed around the perimeter of the restoration site 7.5' high. The fence material is made of a black plastic mesh, which is attached to metal poles at 20 ft intervals. The metal poles are staked in to the ground at a depth of approximately 1.5 ft with a metal insert. The fence will prevent over-browsing by deer, geese and introduced rabbits. A padlocked access gate will ensure public safety during short periods when the restoration site is unsafe do to restoration work. The majority of the time the gate will be unlocked, and visitors will be encouraged by staff to view and participate in the restoration process. Sign posts will be installed inside the restoration site to increase its interpretive value through educational displays alongside a nature trail. Posts will be either inserted directly into the soil or, into a cement footing built on top of or below ground.

2. Site Preparation

Following the fence's installation, the restoration site will be prepared for planting. Site preparation will include a combination of solarisation and leaf mulching for durations sufficient to kill targeted plant species (approximately one to two years). Both treatments are non-invasive and cause minimal soil disturbance; though effectively suffocate invasive grasses and forbs of light and oxygen. Targeted species that survive the treatment will be carefully removed by hand cutting/pulling.

3. Site Planting

Over the fall of 2010, ten cold frames were constructed and installed at the restoration site, and a temporary 40' by 50' deer fence was erected around the cold frames to deter vandals and animals. The enclosed space will form a nursery for the restoration project, enabling staff to propagate native plants with minimal allowance or ecological footprint.

After the site preparation is complete, native plants will be out-planted from the nursery into the restoration site. All plantings of bulbs, plugs and immature plants will take care not to needlessly disturb the soil by

making considerate use of small hand trowels and mattocks. Wherever possible the method of surface-scattering seed will be adopted to further mitigate soil disturbance. To limit the introduction of undesirable species and pathogens, native plants will be propagated from seeds and cuttings collected at FRHNHS and grown in our nursery. When circumstances don't allow us to propagate our own plants, native plants grown at the Pacific Forestry Centre, or at a nursery off-site may be introduced, in which case measures will be taken to ensure plants and soil are free of any pathogens or weed seed.

A fertilizer injection system will be installed as part of the liquid feed program for the nursery. Water for the system will be supplied by a rain water tank located south west of the restoration site. A small trench approximately 0.6" in depth will be dug and fitted with polyethylene piping to carry water from the fertilizer injector to the restoration site nursery. In the event that the fertilizer injection system needs to be connected to the public water supply, the Capital Regional District's (CRD) Cross-connection control department will be contacted. Actions that follow will be completed in accordance with CRD cross connection bylaw No. 3516.

4. Site Monitoring and Maintenance

Ongoing site care is pivotal to the projects overall success. A portion of this will be maintaining a layer of mulch around woody, cultivated species, as required. Mulching will increase the survival rate of certain plants by reducing competition from weed species, conserving moisture, and mediating changes in soil temperature. Weeds that survive this treatment will be hand removed by cutting/pulling. Plants that are establishing themselves will be closely monitored for physiological stress and actions such as irrigating by hose or watering can will be taken if necessary. As a last resort, a plant may be transplanted to a different area of the restoration site that is more likely to meet its ecological needs. The surrounding deer fence will be monitored for tears and holes which will be repaired immediately upon discovery.

Project Management

Overall responsibility for the project rests with Brian Reader, Species At Risk Manager, Parks Canada Agency, Coastal B.C. Field Unit. Day-to-day coordination of the project rests with the Parks Canada Fort Rodd Hill

16. PROJECT RATIONALE

By engaging site staff, members of the local community and First Nations in the restoration process, this project will provide an interactive experience that enhances the ecological, commemorative and social integrity of Fort Rodd Hill NHS of Canada by fostering conversation and education with the broader public about the importance of Garry oak and associated ecosystems, and the need for their conservation.

Climate and ecosystem models suggest Garry oak and associated ecosystems will play an increasingly important role in the future as the regional climate changes to drier summers. Without comprehensive ecosystem and species conservation this opportunity will not exist, therefore we must ensure these biological resources persist within the landscape so that native species can occupy new habitat as it becomes available. (GOERT 2002). The Garry oak meadow restoration project will increase the distribution of Garry oak ecosystem and associated community types at FRHNHS.

17. POSSIBLE ALTERNATIVES

Possible alternatives include not restoring the site: in which case human disturbance, the introduction of invasive species and grazing by Native black-tailed deer (*Odocoileus hemionus*) and other vertebrates will continue to negatively affect the ecological integrity of the site.

18. COMPATIBILITY WITH MANAGEMENT PLAN

☒	The project has been reviewed and found to be compatible with the park or site management plan
☐	The project is not compatible with the park or site management plan (provide explanation of the conflict in the space below)

Comment [TK1]: Project Review with Site Managers

19. SCOPE OF ENVIRONMENTAL ASSESSMENT

SCOPE OF PROJECT

The scope of the project includes those activities associated with the restoration plan. The environmental assessment will consider impacts to environmental and cultural resources, impacts to human health and safety, and to the sites overall aesthetics and accessibility. The scope of the assessment will focus on impacts and mitigations at the local and regional level. Impacts will be considered for the life of the project and over the long term.

SCOPE OF FACTORS TO BE CONSIDERED

The scope of factors will include all physical activities involved in ecological restoration on 0.4 hectares of land. These include:

1) Installation of a deer fence and sign posts
2) Site preparations including mulching, solarization, and hand removal of select species
3) Hand planting native species grown on and off-site
4) Ongoing site monitoring and maintenance

Below is a list of factors that will be considered for each activity:

- The change in public accessibility, health and safety
- The change in staff accessibility, health and safety
- The change in habitat for plants and wildlife
- The disturbance of the existing soil regime and the integrity of other natural processes
- The disturbance of protected species and other non-targeted species.
- The introduction of weed seeds, pests and diseases
- The disturbance of underground utilities
- The disturbance of known and unknown cultural and heritage resources.
- The change in aesthetic, including heritage view-points and site-lines at FRHNHS
- The sites long term use, including maintenance and monitoring.

20. DESCRIPTION OF ENVIRONMENT

Physical Environment

The following body of information is transcribed from "Vegetation of Fort Rodd Hill/Fisgard Lighthouse National Historic Sites" prepared for Parks Canada by Arunicus Consulting in 2002.

Fort Rodd Hill (FRH) lies in the Georgia Depression Ecoprovince, a large basin which contains the Straight of Georgia and Puget Sound as well as the lowlands between the Vancouver Island mountains and the southern coastal mountains. Located in the Eastern Vancouver Ecoregion and the Nanaimo Lowlands Ecosection, FRH is the westernmost of three ecoregions in the Georgia Depression Ecoprovince. This ecoregion includes leeward slopes and lowlands along southeast of Vancouver Island. The Nanaimo Lowlands Ecosection is the lowest portion of the Eastern Vancouver Island Ecoregion.

Fort Rodd Hill's only biogeoclimatic classification (BGC) is Coastal Douglas-fir zone moist maritime subzone (CDFmm). This is one of the smallest and most disturbed forested subzones in the BGC system. It is characterized by climax forests on zonal sites which are dominated by Douglas-fir as well as grand fir and western red cedar. Understories are typically dominated by salal (*Gaultheria shallon*), dull Oregon-grape (*Mahonia nervosa*), ocean-spray (*Holodiscus discolor*) and Oregon beaked moss (*Kindbergia oregana*). Overall the climate in the area can be categorized as sub-Mediterranean, though summers are not quite as warm (Kerr 1951, Roemer 1972). Winters tend to be especially mild for the corresponding latitude and summers dry.

Soils in the area reflect the climate and vegetation they developed under and the materials they developed from. Fort Rodd Hill is likely dominated by Orthic Dystric Brunisols. These soils have formed from relatively acidic parent materials under moderate rainfall and coniferous or mixed vegetation. In some areas, these soils have developed a strongly cemented hardpan between 50 and 100 cm below the surface and are called Duric Dystric Brunisols (Soil Classification Working Group 1998, Jungen 1985, Synergy West 1976). Sombric Brunisols develop on areas that have a long history as grasslands, shrublands and savannahs. The fine roots of grasses, forbs and shrubs decay slowly in the upper soil layer, enriching it with dark organic matter (Soil

Classification Working Group 1998, Jungen 1985).

Biological Environment

A vegetative survey of the 0.4 hectare restoration site found no species at risk, and very few native forb and grass species relative to its size. The cover canopy is a native assemblage of old Garry oak (*Quercus garryana*) trees with a subcanopy of black hawthorn (*Crataegus douglasii*). Three large Douglas fir (*Pseudotsuga menziesii*) trees are present on the site. Due to browsing by native black-tailed deer and human disturbance (mostly lawn care), there are very few native shrub species present at this site. Small clusters of common snowberry (*Symphoricarpus albus*) persist near a single rocky outcrop offering protection from the mower. Several individuals of Western trumpet honeysuckle (*Lonicera hispidula*) and oceanspray (*Holodiscus discolor*) are also protected here, though growth in both is severely retarded by grazing. Another species found in limited abundance is Oregon grape (*Mahonia spp.*). True to its agronomic history, most of the site is dominated by invasive grass species such as orchard grass (*Dactylis glomerata*) and sweet vernalgrass (*Anthoxanthum odoratum*), though patches of native blue wildrye (*Elymus glaucus*) can be found around the trunks of several Garry oaks.

Garry Oak and Associated Ecosystems

Garry oak ecosystems are amongst the rarest in the province and occupy only a very small portion of the Coastal Douglas-fir zone (they are restricted to primarily to the southeast coast of Vancouver Island and the Gulf Islands). Factors that include urban and agricultural development, fire suppression, overgrazing by domestic and feral livestock, and the introduction of invasive plants, pests and diseases have all played significant role leading to the endangerment of these ecosystems, particularly over the past two decades (BC Ministry of Environment, Land and Parks, 1993). A study of Fort Rodd Hill/Fisgard Lighthouse prepared by Aruncus Consulting in 2002, mapped eight different Garry oak and associated ecosystem plant communities. This study adopted Green and Klinka's system of site series (1994), modifications made by Erickson (1996) and further units defined by the author. The eight ecosystems were defined as Western red cedar – grand fir – foamflower, Douglas-fir – grand fir – Oregon grape, Douglas-fir – salal, Douglas-fir – arbutus, Garry oak – blue wildrye, Garry oak – reconnitrium canescens, beach, and disturbed: orchards, lawns, gardens etc.

Species at Risk

Garry oak and associated ecosystems are home to more plant species than any other land based ecosystem in coastal British Columbia. They provide habitat to a diverse living community and over 100 species that are designated "at risk". Several listed plant species have been identified and recorded at Fort Rodd Hill NHS and adjacent properties. The following table is a summary of these findings adapted from a 2010 final report for species and ecosystems at risk at Fort Rodd Hill NHS. Additional information on listings and definitions can be found on the BC Species and Ecosystems Explorer website (BC Ministry of Environment, 2011).

Common and Latin Name	Provincial Conservation Status	BC Listing	COSEWIC
Black knotweed (*Polygonum paronychia*)	S3	Blue	n/a
Carolina meadow-foxtail (*Alopecurus carolinianus*)	S2	Red	n/a
Deltoid balsamroot (*Balsamorhiza deltoidea*)	S1	Red	E
Macoun's meadow-foam (*Limnanthes macounii*)	S2	Red	T
Nuttall's quillwort (*Isoetes nuttallii*)	S3	Blue	n/a
Poverty clover (*Trifolium depauperatum*)	S3	Blue	n/a
Winged water-starwort (*Callitriche marginata*)	S1	Red	n/a
Great blue heron (*Ardea herodias fannini*)	S2S3B, S4N	Blue	SC
olive-sided flycatcher (*Contopus cooperi*)	S3S4B	Blue	T
Pacific solehead (*Ideanidemia fidelis*)	S3S4B	Blue	n/a
Propertius duskywing (*Erynnis propertius*)	S2S3	Blue	n/a

Invasive Species

The presence of invasive exotic species at Fort Rodd Hill is a top priority amongst staff and volunteers. The Summer 2010 Annual report recorded the number of hours spent treating individual invasive exotic species. This provides a relative indication of a species' distribution and significance. The following list is in order of the percentage time spent treating (eradicating) each species: Scotch Broom (*Cytisus scoparius*) 47%, Daphne (*Daphne laureola*) 35%, Bur Chervil (*Anthriscus caucalis*) 7%, Thistle (*Cirsium* spp.) 6% and other 5%. Many other invasive exotic species inhabit the site but are not sufficiently represented by percentage hours spent removing.

Human Environment

Comment [SM2]: 07 (Species/Wildlife/FRH-Resources) Management Planning FRHNHS Cultural Integrity Statement Values & Standards and Guidelines for Historic Sites

According to the Fort Rodd Hill National Historic Site Commemorative Integrity Statement, in pursuit of ensuring the site's overall integrity, natural features will be respected by all those whose decisions or actions affect the site. Located in the western-most extension of a very dry component tie of the Coastal Douglas Fir Biogeoclimatic Zone, the site protects significant ecological characteristics, some of which are considered rare in Canada, such as Garry oak and arbutus stands, and possibly some 63 rare and endangered vascular plants. The camas meadow project will help to enhance the ecological integrity of rare Garry oak ecosystems within the site while providing interactive, educational opportunities for the public to learn about the importance of these unique habitats. Visitors will be offered guided site tours and self-guided, explorative experiences through interpretive signage along well-designed trails. The focus will be on ecological values, potential First Nation values and how the natural landscape interacted with the objectives of the military operations. There will also be opportunities for visitors to actively participate with certain aspects of restoring the area.

Fort Rodd Hill National Historic Site and associated properties are located within the traditional territories of the Coast Salish First Peoples and have known cultural value to the Songhees and Esquimalt Nations. The long history of aboriginal use is easily recognizable in the shell middens and burial cairns found on the site and adjacent properties. It is also thought that the presence of Garry oak ecosystems, particularly on deep soils, may reflect a history of prescribed burning by First Nations to maintain camas meadows for harvest (Aruncus Consulting, 2002). An archaeological survey for adjacent properties to FRHNHS was prepared by Ian D. Sumpter and Daryl W. Fedji in November of 2001 to record archaeological features (Fedji, 2001). An archaeological survey of the restoration site in October, 2010 found no archaeological deposits or features.

To date, both the Esquimalt and Songhees Nations have been notified about the project and discussions will be ongoing regarding their involvement. Depending on the level of interest, we hope to receive First Nations participation in multiple aspects of the restoration project. Early discussions have addressed the potential to use the area as a way to communicate aspects of First Nations culture to youth and the general public. These early discussions also included the potential to collaboratively create interpretive display panels to educate visitors about the restoration process and Garry oak ecosystems. After the meadow has been established, if the Songhees and Esquimalt Nations are interested in ceremonial harvests and feasts as special events where visitors will learn about Garry oak ecosystems and First Nations culture, the site would be an ideal place to host such an event.

The intent of Fort Rodd Hill's designation as a national historic site in 1958 was to commemorate the role of the Victoria – Esquimalt fortifications in the defense of Victoria and the naval base at Esquimalt, and by extension the defense of Canada and the British Empire. Ecological restoration and conservation at Fort Rodd Hill National Historic Site complies by the Standards and Guidelines for the Conservation of Historic Places in Canada (2003). Under these guidelines, the restoration of natural resources is to be completed in a manner that promotes environmental protection, while conserving character-defining elements and maintain[ing] the heritage value of the site (Parks Canada, 2003). Abiding by this general tenet, the restoration activities undertaken for this project will consider the potential effects of those activities toward known cultural resources listed in the commemorative integrity statement (1996) for Fort Rodd Hill (NHS).

The Camas meadow restoration site was selected by a project planning committee based on its known ecological characteristics, commemorative value, existing infrastructure and public exposure. Several site options were considered before one was selected by the committee. The chosen site is separate from cultural resources protected by the historic site and very ecologically disturbed already (Figure 3). To further mitigate any potential impact, the restoration sites original boundary was adjusted to exclude one exotic apple tree, which is a vestige of the areas previous ownership by the Belmont Farm. The northern and western boundaries were also reduced to avoid any potential impact on a red historic fence of commemorative value.

Figure 3: Cultural Resources Adjacent to Project Area

The outer parameters of the restoration site will be delineated by a deer fence made of black plastic mesh. This material was selected for its strength, size and ability to blend in with the surrounding environment. It will have minimal influence over existing heritage site-lines and view-points. Maintaining an appropriate aesthetic is important for the restoration project because of the historic values at FRHNHS and the restoration sites proximity with the main parking lot, admission kiosk and visitor exit. Visitors exit using a pathway that runs parallel with the south west boundary of the restoration site. The deer fence will protect visitors from entering the restoration site at times, but still offer transparency to the restoration work at hand.

To locate potentially hazardous underground utility lines, BC One-Call was contacted during planning. In addition to this, a Locate Contractor was hired to map the precise depth and direction of each utility line in the restoration site. These findings were permanently recorded by staking metal tags into the ground with utility information. Though highly visible, the actual restoration area is not frequently used by visitors. During the warmer months the open field (of which the restoration site is part of) is often used by families and groups for picnics and other forms of recreation, though ostensibly, the majority of this activity takes place further south where there is less shade and the convenience of picnic tables and a public washroom.

21. METHODOLOGY (optional)

A planning document is being prepared that will outline the methods in detail.

22. ENVIRONMENTAL EFFECTS

Physical Environment

Air

1. Noise and pollution caused by vehicles and power tools on site.

Soil

1. Compaction caused by human traffic and vehicles.
2. Contamination of soil caused by vehicles and equipment.
3. Soil disturbance and erosion caused by the removal of invasive species.
4. Disturbance caused by planting native species.
5. Disturbance caused by digging a 6" trench for a fertigation line.

Biological Environment

Terrestrial Flora

1. Damage to native flora caused by a general increase in human traffic and disturbance
2. Damage to native trees caused by using them as 'natural posts' to tie fencing materials.
3. Damage to native flora caused by a leak or spill in the fertigation line.

Terrestrial Fauna

1. Disturbance caused by an increase in human presence and noise.
2. Injury to terrestrial fauna caused by contact with or entrapment inside the deer fencing
3. Impact to terrestrial fauna caused by a loss of terrestrial habitat (for grazing, nesting etc.).

Terrestrial Habitat

1. Alterations to the terrestrial habitat caused by the removal of invasive species and subsequent planting of native species.
2. Alterations to the terrestrial habitat caused by the mulching/solarisation of the site's lawn component.
3. Partitioning of the terrestrial habitat caused by the installation of a deer fence, sign posts and a mulch trail. The exclusion of vertebrate species caused by the deer fence.

Aquatic Habitat

1. Contamination of the water table and nearby aquatic environments caused by a leak or spill in the fertigation line.

Human Environment

Archaeological & Historic Features

1. Disturbance of underground archaeological features due to the installation of fence and sign posts, invasive plant removals, native plantings, and digging a 0.6" trench for irrigation. Damage to surface artefacts caused by an increase in human foot traffic and restoration activities.

Scenery

1. Changes in FRHNHS's overall aesthetic and visual landscape caused by different physical aspects of the restoration site.

Visitor Experience

1. Changes in visitor access to the restoration site will change overall visitor experience at FRHNHS.

Health and Safety

1. Risks to visitor and staff health and safety caused by tools and equipment on the restoration site, and restoration activities.
2. Risks to visitor and staff health and safety caused by damaging underground utilities while installing the deer fencing and sign posts.
3. Risks to visitor and staff health and safety caused by drinking water connected to the fertigation system.

23. MITIGATION MEASURES

Physical Environment

Air

1. Construction activities will be scheduled to minimize impacts to wildlife and visitors. The use of vehicles and power tools will be minimal.

Soil

1. Compaction is already an issue at the restoration site. Efforts will be taken to reduce any further compaction

caused by the restoration process by minimizing the use of heavy machinery and vehicles. After the restoration process is completed a trail system will be constructed to localize compaction caused by foot traffic.

2. Fuelling of equipment will be conducted in a manner which restricts the potential release of petroleum products into the soil. All fuels and hazardous materials will be kept inside a fire rated and non-combustible chemical storage building located on site. All mixing and dispensing of fuels will take place inside this building which will ensure that any spillage is captured by the floor grating and disposed of safely. One exception to this procedure will be fuelling utility vehicles. Utility vehicles will be parked outside the storage bay entrance and fuel hand-pumped to the vehicle from a gasoline barrel located inside the storage building. This is the existing protocol at FRHNHS for fuel mitigation.
3. Removing invasive plants by surface mulching and/or solarizing is less disruptive to the soil than hand pulling, and will be used whenever possible. Hand pulling, pruning and scalping will be carefully executed by trained staff and supervised volunteers capable of removing invasive species with minimal soil disturbance. Additionally the site will be monitored to prevent further infestations from becoming established. New weed germinants will be removed early on to minimize the effort and soil disturbance involved in their removal. Mulch or plantings (plugs, plants, or broadcast seeding) will be used to cover areas where there has been excessive soil disturbance or where particularly dense infestations have been removed. This will help to reduce any subsequent erosion.
4. The practice of planting native plants in already disturbed soil (where invasive species have previously been removed) will be adopted. Young plants will be planted rather than older, larger plants to reduce the amount of soil preparation that is necessary. The planting of bulbs, plugs and live stakes will be carried out by trained staff and supervised volunteers capable of causing minimal soil disturbance with small hand tools. The practice of surface sowing native seed by hand will be exploited as necessary.
5. Digging the trench for the irrigation pipe will cause minimal soil disturbance due to its shallow depth (6"). After piping is inserted inside the trench, it will be backfilled immediately to prevent any further soil movement.

Biological Environment

Terrestrial Flora

1. Parks staff involved with the restoration project will be educated on the identification characteristics of different native and non-native plants common to the restoration site. In general, extra precaution will be taken to avoid disturbing existing native plants within the restoration area. However, it should be noted that a vast majority of the plants at the site are invasive non-natives.
2. To further reduce the visual impact, segments of the deer fence will be attached to trees. This will also reduce the number of posts inserted in to the ground and therefore minimize the chances of disturbing archaeological resources, utility infrastructure and tree rooting systems. To ensure this arrangement does not girdle or harm the tree, we will follow the guidelines of a tree-friendly method provided to us by a professional arborist in 1994 for very similar conditions. This semi-permanent tree friendly method involves using clear coated clothesline tied around the trunk of the tree; the plastic mesh is then attached to the clothesline. This method would require periodic readjustment of the clothesline; Garry oaks add about 1.5mm of growth a year and the clothesline would need to be adjusted approximately every six years. Further consultations will be sought if necessary.
3. Where ever possible the fence line will be adjusted so as to avoid any native species and natural features.
4. Leaks or spills along the fertigation line will have little effect on terrestrial flora due to the diluted nature of our peak fertigation rate (150ppm). In addition, the likelihood of a spill or leak will be mitigated by irrigating with break resistant polyethylene piping, and by ensuring that the water pump is off after each use. If a breakage does occur, very little water will leak out because the pump will only be on during watering.

Terrestrial Fauna

1. Efforts will be taken to reduce disturbance by consulting with Park biologists. When possible, work schedules will be adjusted to accommodate terrestrial fauna (i.e. delay work until later in season, wait for the animals to leave, work with fewer people in the area). Note: There are no federally listed species at risk known to reside in the restoration area.
2. As per the directions for installing the fence, flagging will be attached at regular intervals and will remain on the fence for the first few months to increase the visibility, giving animals a chance to learn to avoid the fence.
3. The area enclosed by the fence is small and heavily disturbed relative to the surrounding 54ha park area. Therefore the loss of vertebrate habitat will likely have little impact. If necessary, small holes through the fence could be installed at a later date to allow the movement of small non-target vertebrates into and out of the area. However, the addition of holes will need to be carefully assessed such that the original purpose of the fence is maintained (ie. excluding hyper-abundant deer and introduced rabbits).

Terrestrial Habitat

1. The invasive species have occupied pre-empted space that would previously have been used by native species. Removing these species will return the ecosystem to a more natural state.
2. Leaf mulching and/or solarization will be focused on areas of the site heavily populated by agronomic grasses and other forbs that are not feasible to remove by hand. Eliminating these species will make room to introduce a native plant community that is representative of the surrounding habitat.
3. The fence is being erected to exclude problematic species which are having a negative effect on ecosystem integrity. As before mentioned, the area enclosed by the fence is small and heavily disturbed relative to the surrounding 54ha park area. Erected a fence is unlikely to partition the terrestrial habitat in such a way that significantly disrupts any natural processes or the living community.

Aquatic Habitat

Comment [dt3]: Effects of irrigation

1. All components of the fertigation system will be located at a minimum distance of 300 meters from known aquatic systems. Leaks or spills along the fertigation line will have little effect on the water table or aquatic habitat due to the very diluted nature of our peak fertigation rate (150ppm). In addition, the likelihood of a spill or leak will be reduced by irrigating with break resistant polyethylene piping, and by ensuring that the water pump is turned off after each use.

Human Environment

Archaeological & Historic Features

1. To reduce the potential of disturbing archaeology features or utilities when driving in fence posts, sign posts, or planting native species, an archaeological assessment of the proposed restoration site was done on Sept 15, 2010. The assessment included a visual surface inspection of the entire proposed meadow restoration site. An additional thirty sub-surface sediment samples were extracted from select locations to explore for buried cultural deposits and/or features within the development area. A 1" Oakfield probe was used to extract the sediment samples and sampling depth varied from 10 to 50cm at individual test locations depending on sediment permeability. No heritage resources were found during the inspection and the sub-surface sediment samples revealed that most of the area has been previously disturbed. Accordingly, the potential for this project to impact heritage resources is low. However, there is a small probability that there are undisturbed, buried cultural features/deposits in the development area which were not found during the assessment, and site preparation and/or planting could potentially impact such resources.If any material of archeological interest is uncovered during the restoration process, work will stop in that area and a Parks archaeologist will be notified immediately.

Scenery

1. A black plastic mesh is the fence material that will be used; this black mesh blends with the forest backdrop reducing the visual impact. To further reduce the visual impact, segments of the deer fence may be attached to trees.

Visitor Experience

1. The fence will be routed around known structures such as historic buildings which require public access. Interpreters on the site will also be given information to interpret the area to visitors turning the fenced restoration site into a point of interest. Visitors will have two gates to access the restoration site with a trail system interconnecting each. Interpretive display signs will be installed at various points of the trail to educate visitors about the restoration process and Garry oak ecosystems. Access gates may be padlocked for short periods when restoration activities or materials on site are deemed hazardous to visitor health and safety. In which case, a sign will be posted on both gates to explain for the temporary closure.

Health and Safety

1. A trail system inside the restoration site will encourage visitors to stay on a flat pathway cleared of debris and other potential hazards. All access gates to the restoration site will be padlocked and access restricted to qualified Park personnel during periods wherein restoration activities and materials are hazardous to public safety.
2. Restoration activities will be completed by qualified staff operating with due care. A staff member certified with at least an occupation First Aid & CPR-C will be present at all times restoration work is underway. The number of certified staff will increase appropriately in proportion to the number of workers.
3. Inspections have been carried out to minimize the chance of hitting utility infrastructure when setting posts or planting. Underground utilities were queried through BC OneCall and later identified and surface marked by a locate contractor from Western Utilities locating services ltd. using spray paint. Afterwards these findings were recorded and the ground surface was marked with the more permanent method of staking labelled metal tags into the ground to indicate location and depth of the underground infrastructure.
4. All sources of fertilized discharge will be protected by padlock and labeled with a non-potable water sign.

24. RESIDUAL EFFECTS

The perimeter deer fence will impact the scenery of the Historic site and fence/sign posts could potentially affect archeological resources or utility infrastructure. The fence and trail will alter public use of the restoration site. The fence will make some habitat unavailable to certain vertebrates and may interrupt wildlife paths causing animals to run into the fence. Vertebrates that will be or might be affected by the fence include black-tail deer (*Odocoileus hemionus columbianus*), raccoons (*Procyon lotor*), birds (*Aves*), river otters (*Lutra canadensis*), introduced Eastern cottontail rabbits (*Sylvilagus floridanus*) and resident Canadian geese (*Branta canadensis*). It is possible that these or other animals could somehow get inside the fenced area and be unable to get out. The use of trees as posts could harm the trees.

25. CUMULATIVE EFFECTS

The proposed project is geared to compliment other management objectives at Fort Rodd Hill. Cumulatively this project is not anticipated to have any negative cumulative effect.

26. PUBLIC CONSULTATION/PARTICIPATION	
☐	Public participation was sought
☒	Public participation was not sought
State why public participation was or was not sought in the space below, referring to the criteria in the Ministerial Guideline	
Input from Site Managers requested	
Public Participation Process	
Public Comments	

Comment [TK4]: Steve Cross (review): "Public consultation typically implies targeted actions to engage stakeholders in planning and review. This is usually done in the EA world only when there is a very high level of public interest or controversy over a proposed project. Public consultation wouldn't be required in the present case. Public participation is much more informal ranging from posting a notice at the site that an impact assessment is being prepared and a copy can be read at the following location(s), to meeting with parties likely to be interested in the project. I'll leave it up to you and the managers at Fort Rodd to decide if this would be appropriate/useful in the circumstances."

27. SIGNIFICANCE OF IMPACT
Significant adverse effects are not expected.
28. IMPACT ON ECOLOGICAL AND/OR COMMEMORATIVE INTEGRITY
This project is expected to improve the ecological integrity at the site and not cause any loss to its commemorative integrity.

29. SURVEILLANCE	
☒	Surveillance monitoring is not required
☐	Surveillance monitoring is required (provide surveillance contact and surveillance details below)

30. FOLLOW-UP	
☐	A follow-up program will not be conducted
☒	A follow-up program will be conducted (state the reason(s) for the follow-up program in the sp below)
A follow up program will be conducted in order to measure and document the successes and failures of restoring a Camas Meadow. This record is part of good adaptive management, and will provide a toolkit for future restoration w	

Comment [TK5]: Steve Cross (review): "The SAR and ecosystem restoration work being conducted at Fort Rodd Hill has a follow-up component built into it. The measurement (e.g. recruitment success, areas cleared of exotic invasive species, etc) and reporting on program progress, is equivalent to a follow-up program. Assuming that there will be assessment and reporting on the success of Camas Meadow establishment, I would check the "A follow-up program will be conducted" Reasons for the program would include reporting on ability to restore Camas meadow, and documentation/communication of successes and failures so that learning can take place through adaptive management."

31. SPECIES AT RISK MONITORING	
☒	Species at risk monitoring is not required
☐	Species at risk monitoring is required and is compatible with the applicable recovery strategy a action plan

32. EA DETERMINATION	
☒	Taking into account the implementation of any mitigation measures that the responsible author considers appropriate, the project is not likely to cause significant adverse environmental effec The responsible authority may exercise any power or perform any duty or function that would permit the project to be carried out in whole or in part.
☐	Taking into account the implementation of any mitigation measures that the responsible author considers appropriate, the project is likely to cause significant adverse environmental effects that cannot be justified in the circumstances. The responsible authority shall not exercise any power or perform any duty or function conferred on it by or under any Act of Parliament that would permit the project to be carried out in whole or in part.
☐	Refer the project to the minister for a referral to a mediator or a review panel where ➢ it is uncertain whether the project, taking into account the implementation of any mitigation measures that the responsible authority considers appropriate, is likely to cause significant adverse environmental effects; ➢ the project, taking into account the implementation of any mitigation measures that the responsible authority considers appropriate, is likely to cause significant adverse environmental effects and paragraph (b) does not apply; or ➢ public concerns warrant a reference to a mediator or a review panel.

Comment [TK6]: Steve Cross (review): "Select the top box "not likely to cause significant adverse environmental effects". The types of impacts and impact pathways are well known for the work activities involved in this project. Same with the ability and methods to mitigate effects."

33. REFERENCES

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34. SIGNATURES

EA AUTHOR

Signature: _____

Todd Kohler	CBCFU Ecosystem Scientist I	
Name	Title	Date

OTHER:

Signature: _____

Leanne Martin	FRH & FL Site & Visitor Experience Manager	
Name	Title	Date

Signature: _____

John Aldag	CBCFU Manager, Historic Sites	
Name	Title	Date

SUPERINTENDENT OR DESIGNATE

Signature: _____

Steve Langdon	CBC Field Unit Superintendent	
Name	Title	Date

35. LIST OF ATTACHMENTS