**Upper Deschutes Watershed Council**
**Technical Report**

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# Reed Canarygrass at Camp Polk Meadow Preserve
# 2015 Monitoring Report

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# 1. Introduction

## 1.1. Camp Polk Meadow Restoration Project

Beginning in 2006, The Deschutes Land Trust (DLT) collaborated with the Upper Deschutes Watershed Council (UDWC) to restore a 1.2 mile section of Whychus Creek (pre-project length) flowing through Central Oregon's historic Camp Polk Meadow (CPM). Project efforts focused on improving in-stream and wetland habitat for native fish and wildlife, including redband trout and summer steelhead (*Oncorhynchus mykiss*) and spring Chinook (*Oncorhynchus tshawytscha*). Project implementation began in May, 2009. The stream's historic meanders were re-built through the meadow, floodplain roughness was added, plugs were constructed in the old, straightened channel, and the meadow was re-planted with native riparian species. In 2012 Whychus Creek was diverted into the new meadow channel. The last planting took place that fall. The project is summarized in the *Camp Polk Implementation Report* (UDWC 2012).

Despite tireless weed management efforts by DLT and UDWC in the restored meadow, in late 2014 staff noticed a marked increase in reed canarygrass (*Phalaris arundinacea*; RCG), a native invasive that outcompetes other native species, reducing biodiversity, choking waterways, and reducing fish habitat quantity and quality. The restoration efforts in Camp Polk Meadow had generated a high level of site and soil disturbance, with heavy equipment used to excavate gravel substrate, remove duff layers and grade floodplains, creating potential for establishment and expansion of non-native and native invasive species. In addition to site and soil disturbances, flooding frequency increased following construction of the new channel, also promoting RCG establishment. A preliminary review of the literature and first-hand reports suggested that left unattended RCG will continue to expand and take over native vegetation, and has the potential to negatively impact the structure and diversity of existing native vegetation.

In summer 2015, DLT and UDWC intensified reed canarygrass mapping efforts in Camp Polk Meadow to improve our understanding of the scope and severity of the invasion. Mapping was accompanied by a literature review of reed canarygrass ecology and best management practices to inform development of a newly targeted approach to control the spread of RCG in CPM. This report presents the results of this work.

## 1.2. Reed Canarygrass Ecology

Reed canarygrass (*Phalaris arundinacea*) is a perennial in the grass family (Poaceae), characterized by open hollow stems, membranous ligules, and an inflorescence that changes from pale green to straw-colored after fruit development. The species is considered native to North America but has become more widely distributed due to its introduction in agricultural areas as forage (Piper 1924, Wilkins and Hugh 1932, Anderson 1961, Apfelbaum and Sam 1987). Reed canarygrass is a problem species that has necessitated costly control measures in many wetland ecosystems. RGG is designated as a class "C" weed species under the 2015 Deschutes County Weed Policy and Classification System, defined as "…a weed that has the potential to cause economic or ecological harm to agriculture, recreation, wildlife and transportation systems and is locally abundant."(Deschutes County, 2015). Deschutes County recommends control and monitoring of RCG to be enacted by the landowner.

Reed canarygrass has been increasingly documented as taking over various habitats when present in riparian areas, stream banks (Leck, 1996; Barnes, 1999), wetlands (Padgett and Crow, 1994; Galatowitsch et al., 1999, Lavergne and Molofsky, 2004) and wet grasslands (Galatowitsh et al., 2000, Lavergne and Molofsky, 2004). Water movement may be greatly inhibited (Hodgson, 1968) or completely obstructed (Lavergne and Molofsky, 2004) by the spread of RCG along stream banks and deposition of sediment trapped by RCG. Impacts include reducing overall plant biodiversity, filling in wetlands, streams and side channels, decreasing juvenile fish rearing and refuge habitats, decreasing stream flow and dissolved oxygen, and increasing stream temperature (Silver and Eyestone, 2012).

RCG is one of the earliest growing grasses, capable of beginning growth as early as mid-December depending on seasonal weather, allowing growth to reach 0.5 meter as early as mid-March (NRCS 2003). RCG growth begins from seed establishment or sprouting from a rhizome. Tillering and initial growth begin and, after weeks of vertical growth, creeping rhizomes form a thick sod layer. Stems can reach 2 meters tall; leaf blades approximately 0.5 m long by 2 cm wide cast shade under and around the plant, and thick rhizomatous mats trap sediment, aiding in the conversion to RCG-dominated wetlands (Miller et al 2008, Silver and Eyestone 2012). In the Pacific Northwest, each inflorescence produces approximately 600 seeds that are passively dispersed by gravity (Waggy 2010); seeds may also be dispersed by adhering to humans or other animals. Seeds can maintain buoyancy for a few days, allowing further dispersal by water. Although some studies have shown RCG seeds to persist in soil seed banks, longevity of RCG seeds remains unclear (Waggy, 2010).

RCG is highly competitive both above and below ground. It outcompetes for light by overtopping surrounding competitors. Wilkins and Hughs (1932) found RCG to inhibit growth of short perennial grasses within three to five months after invasion, eventually eliminating the smaller grasses. Below ground, RCG is able to reallocate resources to its root system during low moisture or dry conditions. In wet conditions, anoxia tolerance allows canarygrass rhizomes to survive prolonged flooding (Brandle, 1983) including surviving complete inundation for up to 2 years in at least 30 centimeters of water (USDA NRCS 1996). Floodwaters disperse seeds and floating mats of RCG produce nodes with adventitious roots; nodes fragment from the mats to establish new populations (Lavergne and Molofsky, 2004). Its winter-hardiness makes it highly competitive by allowing it to overwinter in the rhizome stage, begin tiller production early in the spring, and continue producing tillers late into the fall (Marten and Hovin, 1980; Lavergne and Molofsky, 2004). When well-established, RCG may reduce the soil seed bank of native species (Apfelbaum and Sams, 1987).

## 1.3. RCG Management at CPM

Since acquiring the property in 2000, DLT has inventoried, mapped and managed invasive plant species at CPM; the *Camp Polk Meadow Weed Management Plan* was created in 2002 with yearly revisions occurring since 2009 (UDWC 2012). RCG was among ten priority weed species identified in the meadow prior to project implementation. Because of the known response of RCG to site disturbance, RCG was anticipated to spread following Phase I construction and was accordingly managed to minimize establishment and spread (Table 1).

**Table 1**. Deschutes Land Trust reed canarygrass weed management treatments post-construction (data from UDWC, 2012)

| Treatment Year | Target Species | Treatment | Hours Spent | Treatment Month | Comments |
|---|---|---|---|---|---|
| 2009 | RCG | Clipped seed heads, glyphosate spot treat | 8 | August | As planned |
| 2010 | RCG | Glyphosate spot treat on individual plants | 147 | April- Oct. | As planned |
| 2011 | RCG | Spot herbicide spray on individual plants | Approx. 80 | April- Oct. | As planned; new infestations found in new channel |
| 2012 | RCG | Manual hand pulling or clipping | Unknown | Unknown | Previous populations less abundant, new channel populations from 2011 absent once water was diverted |

RCG was treated post-construction beginning in 2009. Weekly monitoring efforts to inventory and map weed species occurred from the 2009 through 2012 growing seasons. RCG was not found in or along the new channel during 2012 monitoring following diversion of Whychus Creek from the pre-project channel into the new channel. Additionally, no new outbreaks were observed between 2011 treatments and 2012 monitoring, and native species were observed to be successfully competing with weed species. No herbicide treatments were used in 2012 (UDWC, 2012). Prior to mapping of RCG in 2015, weeds were last mapped at CPM in 2013 (Appendix A). Weed populations showed such a positive response to 2013 control measures that weed monitoring was conducted only once per month in 2014, during June, July and August. No weed mapping was conducted during 2014 due to anticipation of minimal changes to weed populations (UDWC, 2015).

## 2. Mapping

### 2.1. Methods

During July 2015, reaches 1 and 2 and a portion of reach 3 were intensively surveyed for reed canarygrass presence. Points and lines were used to map RCG; lines represented a 6-meter width. We assigned area and percent cover categories to each point and to lines where RCG extended beyond a 6 m width (Table 2).

**Table 2**. Area and percent cover categories assigned to points and lines representing reed canarygrass. Lines indicated a 6 m belt width of RCG unless otherwise noted.

| Reed Canarygrass Mapping Categories | |
|---|---|
| **AREA ($m^2$)** | **PERCENT COVER** |
| 2-4 | 0-4 |
| 5-9 | 5-9 |
| 10-19 | 10-24 |
| 20-29 | 25-49 |
| 30+ | 50-74 |
| | 75-99 |

Following the initial mapping of Reaches 1 and 2 and portions of 3, the project team determined mapping RCG throughout the entire CPM project area too labor intensive for the objective of obtaining a rough estimate of cover in the meadow. We decided instead to return to the meadow for two more days of mapping efforts to survey representative samples of RCG infestation in the remainder of reach 3 and in reaches 4, 5, and 6. Five representative survey areas were selected after an observational day spent in CPM. The main channel was surveyed in the western-most third of Reach 3 to capture the aspects (exposures) associated with two changes of stream channel direction, and to include in-stream large woody material and a straight section of channel. The old (pre-2012) channel on the south side of Reach 3 was sampled to represent RCG growth in shaded and sun-exposed riparian areas. A section of the old channel was sampled in Reach 4, to capture high RCG abundance observed in a shaded area. The main channel was surveyed along the lower end of Reach 5, downstream of the aspen grove, where side channels drain from a braided section of the old channel; this area was not planted as part of the restoration project and is characterized by pre-restoration vegetation. Due to the short length of Reach 6, the entire reach was sampled.

Final maps from 2015 RCG surveys are anticipated to be used to inform RCG treatment implementation in 2016 and to track RCG density and extent at CPM over time. To display RCG area and density data for this purpose, we condensed area and percent cover categories into four display categories. Original area and density data are retained in GIS shapefile attribute tables.

## 2.2. Results

Reed canarygrass has spread considerably since the last survey in 2013. In 2015, RCG was consistently found in riparian areas and side channels where the stream accesses the floodplain during high flow events, leaving soil moisture high, and in stream channels where sediment and woody material collect (Figure 1). We did not find reed canarygrass in drier areas above elevations typically flooded by high flows. Whereas we found RCG well-established under a relatively closed canopy in the old channel in Reaches 3 and 4, far less RCG was found under full shade in Reach 6.

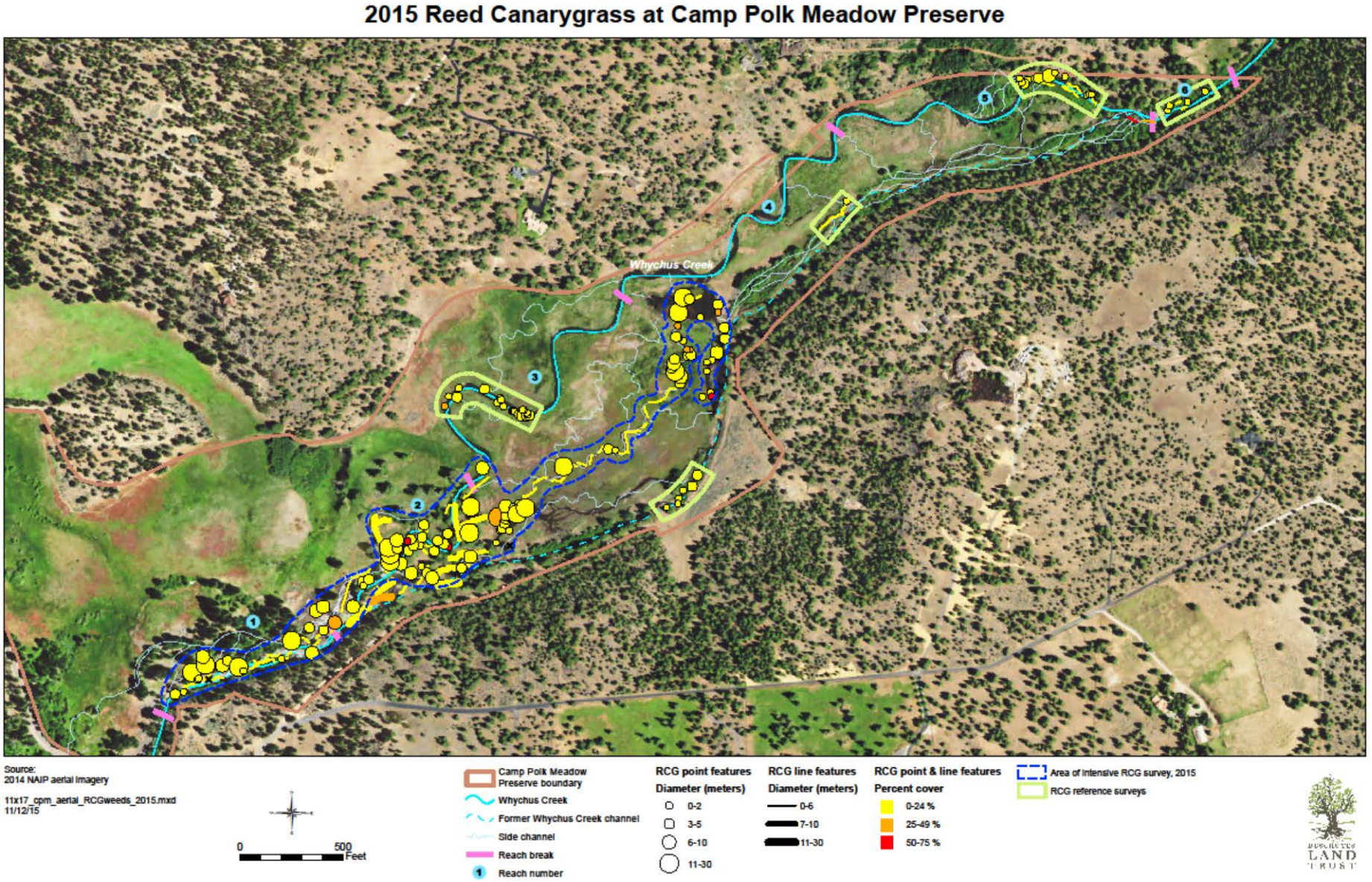


**Figure 1.** 2015 Reed Canarygrass at Camp Polk Meadow Preserve

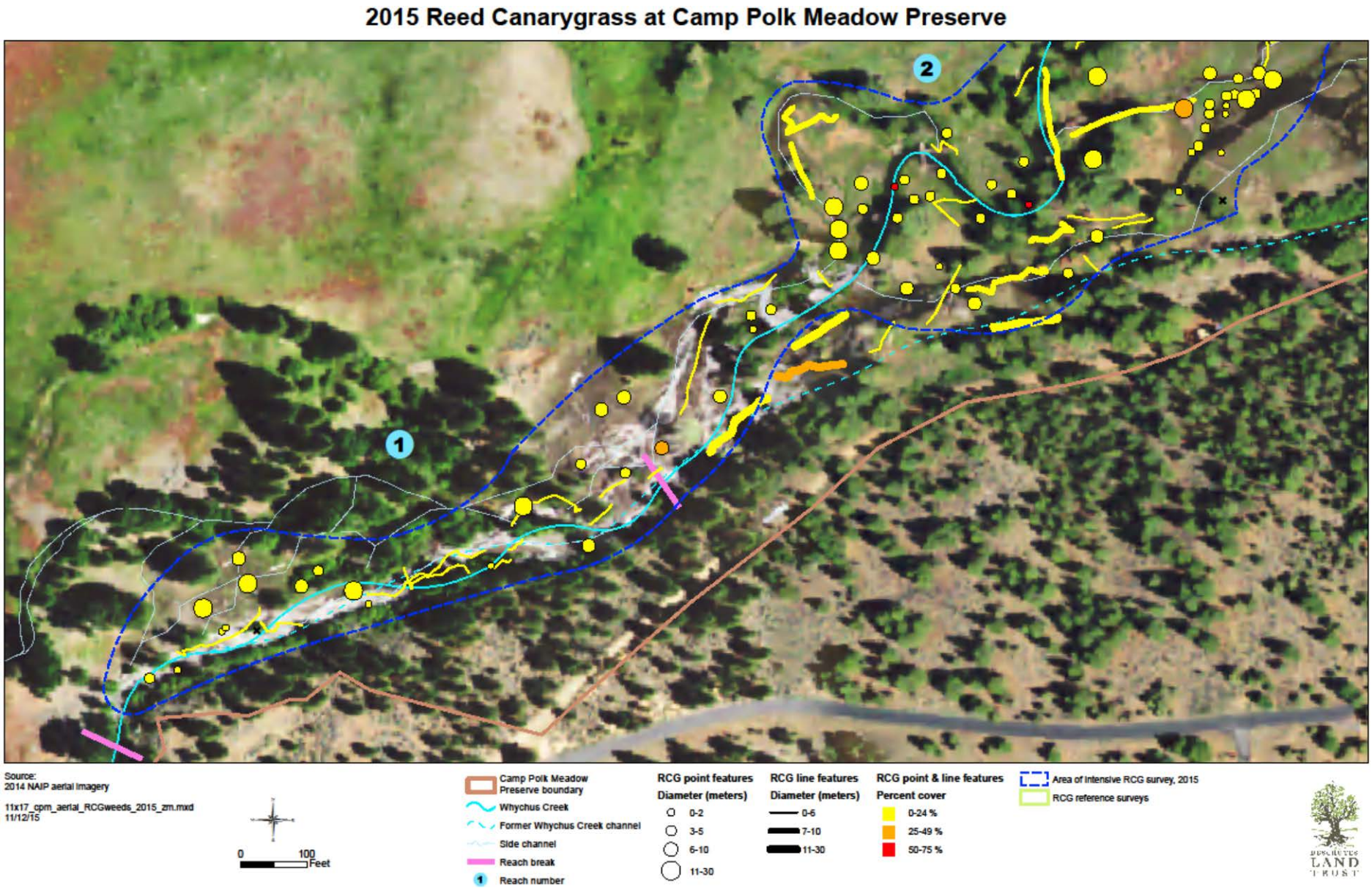


**Figure 2.** Reed canarygrass in Reaches 1 & 2 (zoom)

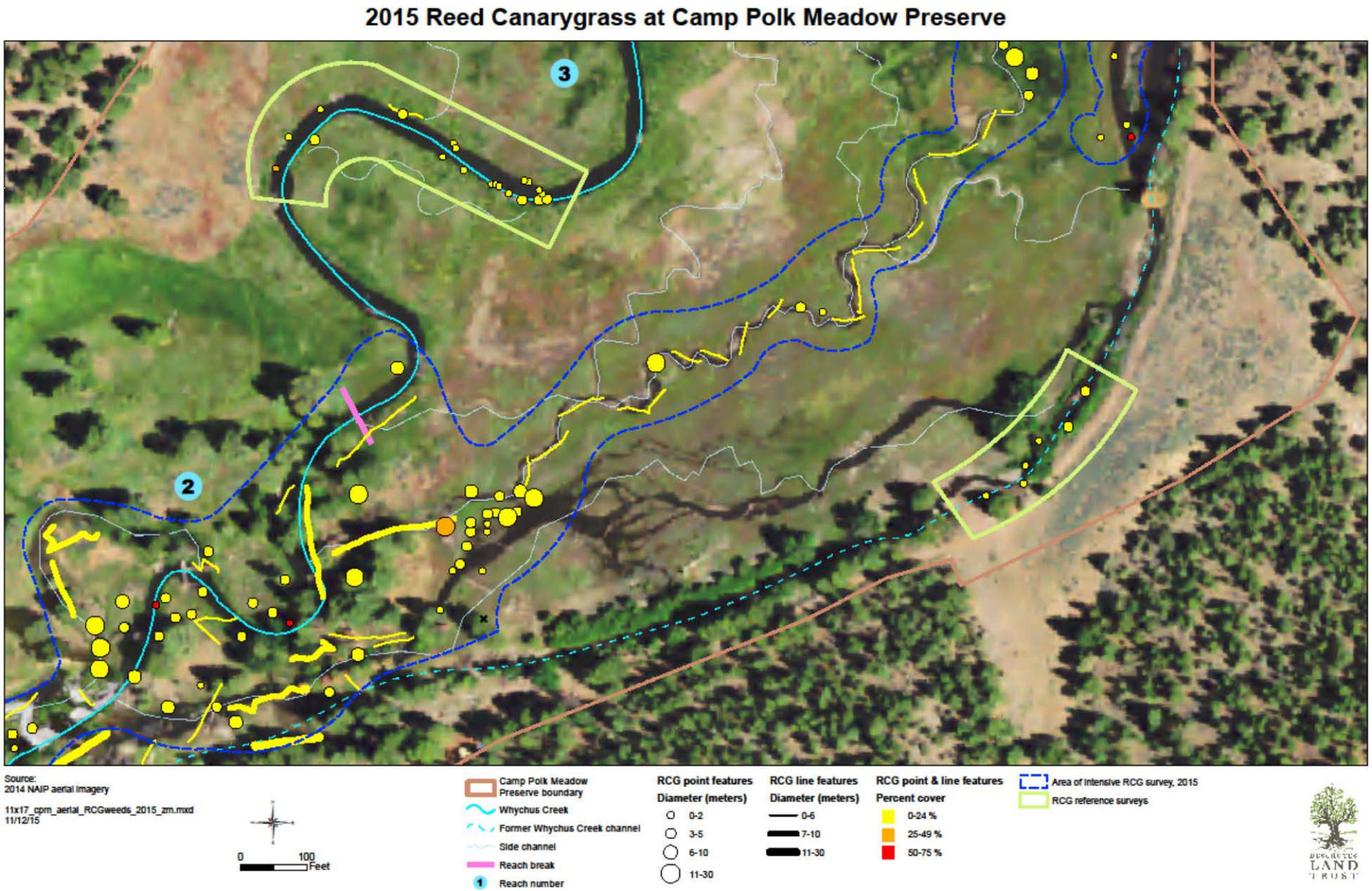


**Figure 3.**Reed canarygrass in Reaches 2 & 3 (zoom)

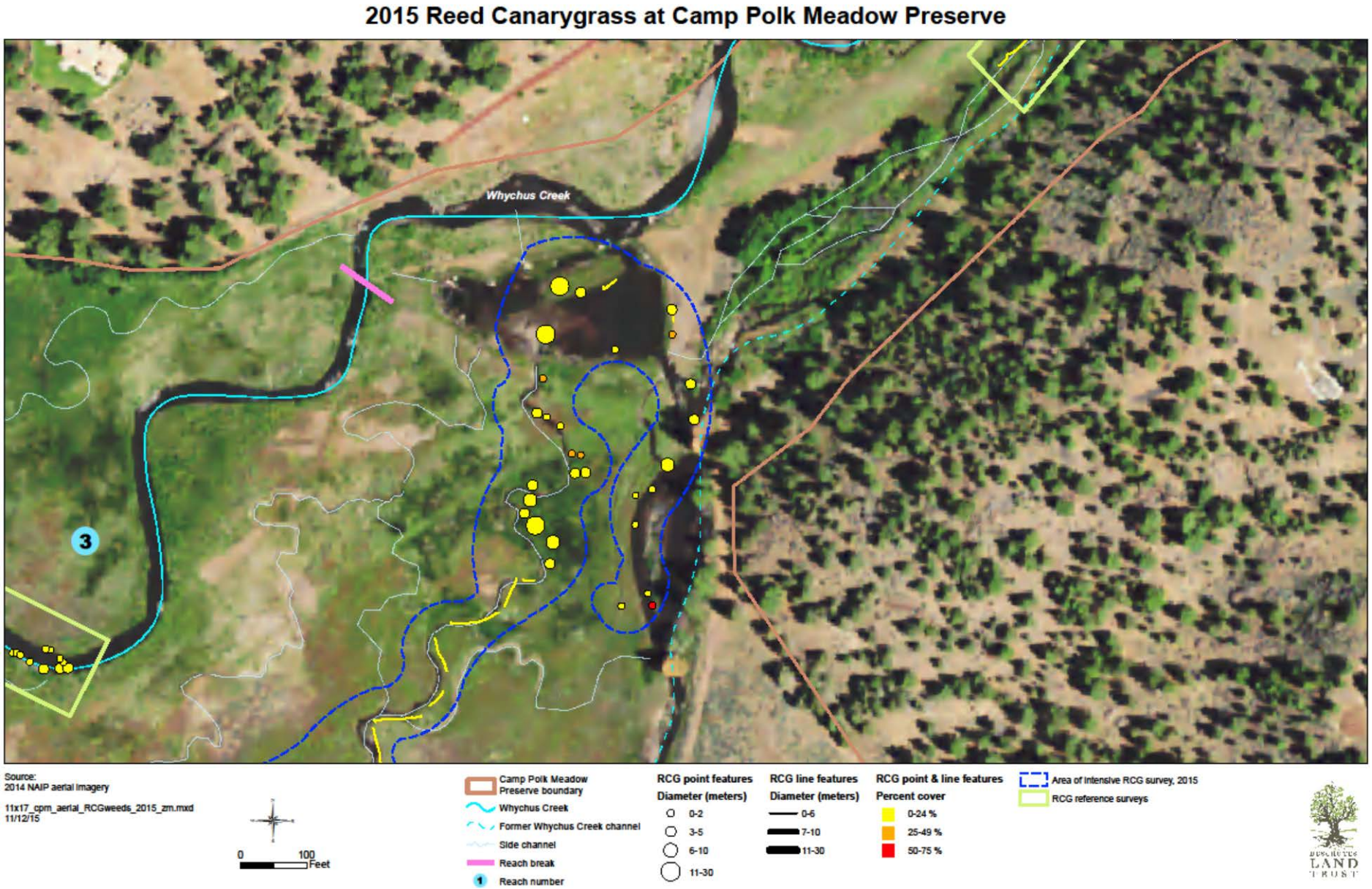


**Figure 4.** Reed Canarygrass in Reaches 3 & 4 (zoom)

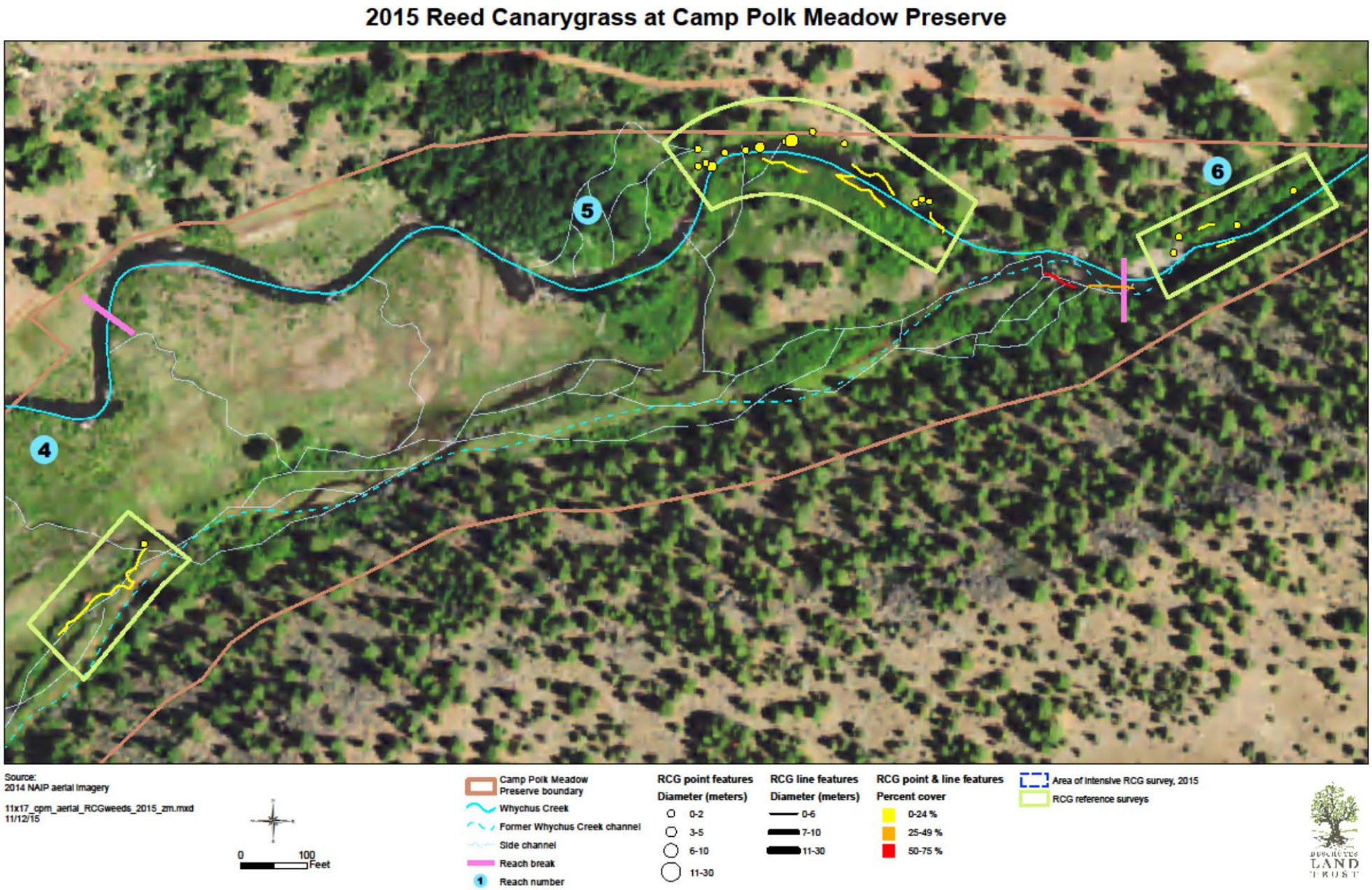


**Figure 5.** Reed canarygrass in Reaches 4-6 (zoom)

# 3. Literature Review

## 3.1. Camp Polk Management Objective

Deschutes Land Trust's management objective for reed canarygrass is to control reed canarygrass to minimize displacement of, and competition for resources with, native vegetation. Restoration project goals outlined in the 2012 *Implementation Report* are as follows:

1. Provide 1.7 miles of high quality redband trout, Chinook and steelhead spawning and rearing habitat.
2. Restore functioning meadow hydrology, including floodplain connectivity, an increase in the groundwater table, and enhanced summer base flow.
3. Restore and enhance high quality riparian wetland habitat along the stream corridor.
4. Provide natural channel stability, including dimension, pattern and profile that meet reference conditions.
5. Decrease stream temperatures to help meet Oregon's state temperature standards.

These project goals will limit the methods appropriate for managing RCG at Camp Polk to those compatible with the outcomes described by project goals. Monitoring and evaluation of restoration efforts including weed management are crucial to understanding success in achieving these goals.

## 3.2. Best Management Practices

To survey RCG control methods and evaluate possible management approaches for Camp Polk Meadow, we reviewed publications and reports from the Pacific Northwest and Midwest outlining reed canarygrass best management practices. We summarize best practices and key recommendations below.

**King County Noxious Weed Control Program: Best Management Practices. King County, 2015.**

King County lists reed canarygrass as a Class C noxious weed. The county identified early detection and prevention methods coupled with Integrated Pest Management (IPM) as the best practice for RCG control. IPM takes each site's specific qualities into consideration to select the control methods best suited to maximize successful control of RCG and minimize associated environmental, social or economic impacts. Available funding, time, labor, site land use goals and any specific community or landowner goals or values all influence control method selection.

Best Management Practices:

- Prevention
- Remove existing plants
- Deplete seed bank
- Revegetate
- Monitor and maintain

Early Detection and Prevention:

- Search for established areas during the winter by looking for straw-colored stalks.

- Prevent spread by washing boots and vehicles after visiting infested sites.
- Heavily mulch new plantings following restoration work.

**Reed Canary Grass (*Phalaris arundinacea*) Management Guide: Recommendations for landowners and restoration professionals, Wisconsin Reed Canarygrass Management Working Group, 2009.**

The Wisconsin Reed Canarygrass Management Working Group highlights the vulnerability of new seedlings to treatments and to inter-specific competition. In contrast, seedlings that are not eradicated in the first growing season can become well-established by the end of the first growing season by allocating the majority of resources to tiller development and to accumulation of underground reserves.

Management Considerations:

- Ensure management techniques suppress *both* above-ground growth and underground rhizomes and seed banks. The Wisconsin Reed Canarygrass Working Group cautions that if one component of control is neglected, success will be limited and frustration levels high.
- Timing of treatment is crucial to accomplish multiple benefits. Treatment in late spring will reduce seed development while allowing sufficient time for growth of native vegetation in the treatment area.
- Be persistent. Once RCG management has begun, do not allow a growing season to go by without some type of effort to interrupt its growth. Treatment of a site is recommended to continue for a minimum of 3 to 5 years.
- Sites with a greater diversity of native vegetation tend to have higher rates of treatment success than monotypic stands.
- Practice adaptive management: no single approach works for every case and site.
- If treatment measures create bare ground it is recommended to reseed with native vegetation to increase competition.

**Reed Canarygrass Control in the Quinault Watershed. Silver and Eyestone, 2012.**

The Quinault River Watershed (QRW) 2012 Reed Canarygrass Control Protocol combines Early Detection/Rapid Response (ED/RR) and IPM approaches, drawing from strategies used in the Hoh River watershed that emulate successful knotweed control strategies. Steps identified to significantly control RCG in wetland settings include:

- Beginning treatment in upper reaches of focus area
- Addressing vectors
- Treating in the early stages of an invasion
- Eliminating small source populations to save time, resources, funds and chemical applications for larger, established populations

**Reed Canarygrass (*Phalaris arundinacea* L.) Control and Management in the Pacific Northwest. Tu, 2004. The Nature Conservancy.**

The Nature Conservancy (TNC) recommends planting fast-growing shrub or tree cover to shade out RCG, which is intolerant of deep, year-round shade. Newly planted trees are better able to out-compete RCG that has been mowed; trees planted on soil mounds are also more successful. Deciduous cottonwood (*Populus trichocarpa*) and Oregon ash (*Fraxinus latifolia*) do not provide adequate shade to control RCG,

which has been shown to establish and expand under these species. Based on City of Portland Bureau of Environmental Services practices, TNC recommends planting live stakes of trees and shrubs or shrub clusters in transition zones between emergent vegetation and upland communities where native grasses and sedges are often outcompeted by RCG .

# 4. Recommendations

## 4.1. Conditions influencing RCG establishment at CPM

As of summer 2015, Camp Polk Meadow is characterized by an abundant and diverse native riparian community. King County's *Best Management Practices* (King County, 2015) notes that invasion by RCG is slow when native plant communities are healthy. The abundant native riparian vegetation at CPM may aid in the control of RCG as treatment is implemented.

Flooding frequency has increased dramatically following restoration of floodplain connectivity in the meadow. In the upper reaches 1 and 2, flooding occurs when flows exceed 30 cubic feet per second (cfs). In the lower four reaches, flooding occurs at approximately 200 cfs and above, flows typically seen four to five times a year (P. Powers, personal communication, 2015). These flows deposit sediment and RCG seeds and rhizomes on the floodplain, promoting RCG establishment. In turn, RCG establishment in stream channels and sediment deposits recruits more sediment and more RCG, with potential to choke channels, depleting flow and accessibility to fish. RCG can also survive prolonged drought conditions in seasonally wet or flooded areas that occur at Camp Polk throughout much of the year.

RCG is known to occur in Indian Ford Creek, a tributary to Whychus Creek upstream of Camp Polk Meadow. No plan or coordinated effort is currently in place to manage RCG in Indian Ford Creek. This population is assumed to be a source of rhizomes and seeds that wash into CPM; other upstream sources may also exist. Upstream sources of RCG make complete eradication an unrealistic goal. Instead, minimizing further invasion and displacement of native species at Camp Polk, the upstream-most DLT property and stream channel restoration project, is a feasible management approach, and of the utmost priority to maintain project benefits and prevent degradation of this and future, downstream restoration projects.

## 4.2. Treatment methods and priorities

Based on the flooding regime and plant community characteristics at Camp Polk Meadow and best practices from the PNW and Midwest, we developed the following recommendations for management practices to control RCG at Camp Polk:

1. Focus attention on 1) new shoots, 2) isolated patches along riparian zones, 3) areas of high to monoculture density, and 4) in-stream mats posing threat of clogging side channels.
2. Prioritize reaches 1 and 2. These reaches represent the most frequent flooding, and therefore the most regular sediment deposition and source of rhizomes and seeds, and are also the upstream-most reaches of CPM.
3. Begin hand-pulling seedlings in early spring and continue this effort frequently in an effort to deplete carbohydrate reserves.
4. Hand-pull in-stream mats.
5. Apply herbicide to well-established, high-density areas.

6. Solarize large, high-density infestations located in the braided side channels of Reaches 4 and 5 during summer months. Follow solarization efforts with removal of remaining roots and rhizomes by hand.
7. Reseed treated areas where soil is exposed with native, shade-bearing species as appropriate for the site and desired vegetation. Augment seeding with live plugs in spring to decrease erosion potential and create shade (Table 3). Evaluate use of native perennial companion crops (*Elymus virginicus or Elymus Canadensis*) to reduce competition while perennials establish.
8. Actively manage reed canarygrass *every year* for 3-5 years to ensure continued interruption of above- and below-ground growth.

**Table 3.** Recommended actions for revegetation of treatment areas.

| Post-Treatment Action | Timing |
|---|---|
| **Plant/seed:** Forbs, sedges, cool-season grass | Late Fall |
| **Seed:** Warm-season grasses | Spring |
| **Plant:** Live plugs | Spring |

DLT and UDWC staff met in late October, 2015, to discuss findings from reviews of literature and best management practices and from RCG surveys (Appendix B). Further recommendations were identified for treatment and future mapping, summarized as follows:

- Target representative areas from those surveyed in 2015 as reference sites to be revisited on a rotating schedule to monitor changes in RCG extent at CPM.
- Develop a monitoring schedule and refine the mapping strategy and survey protocol used in 2015 for use at downstream sites.
- Evaluate delaying mapping at Whychus Canyon Reach 4 until restoration project implementation has been completed, contingent on pre-project RCG extent.
- Explore collaborating with the OSU Restoration Ecology course to recruit students to hand-pull RCG “starts” and potentially implement a solarization experiment.
- Review and incorporate Sisters Ranger District ribbongrass treatment trial findings comparing backpack spraying (more efficient and effective and less environmentally harmful) to wanding.

## 4.3. Preventing RCG establishment at future sites

Successful management of reed canarygrass at downstream restoration projects will require an early detection and rapid response approach to RCG infestations. Development of an Integrated Pest Management approach is also recommended to best address the different characteristics of each site.

At Camp Polk, curtailment of RCG management efforts in 2013 coincided with the first growing season subsequent to diversion of Whychus Creek into the meadow channel, the associated restoration of floodplain connectivity, and a concurrent increase in frequency of flooding and deposition of both sediment and RCG seeds and rhizomes. Increasing the intensity of RCG management efforts when floodplain connectivity is restored and the stream begins accessing the floodplain may prevent or reduce RCG establishment at downstream restoration sites.

RCG management at CPM has been constrained by limited funding secured for long-term stewardship. Strategic development of funding and allocation of resources (volunteers, technicians, budget for

herbicide and application) for future projects will support implementation of sufficient management measures to prevent or minimize RCG establishment.

For any future mapping efforts, we recommend including the DLT GIS consultant during initial study planning to incorporate insights regarding data collection for mapping. Including a simple canopy cover measurement protocol, e.g. using a densiometer, would contribute valuable information about the relationship between canopy cover and reed canarygrass density.

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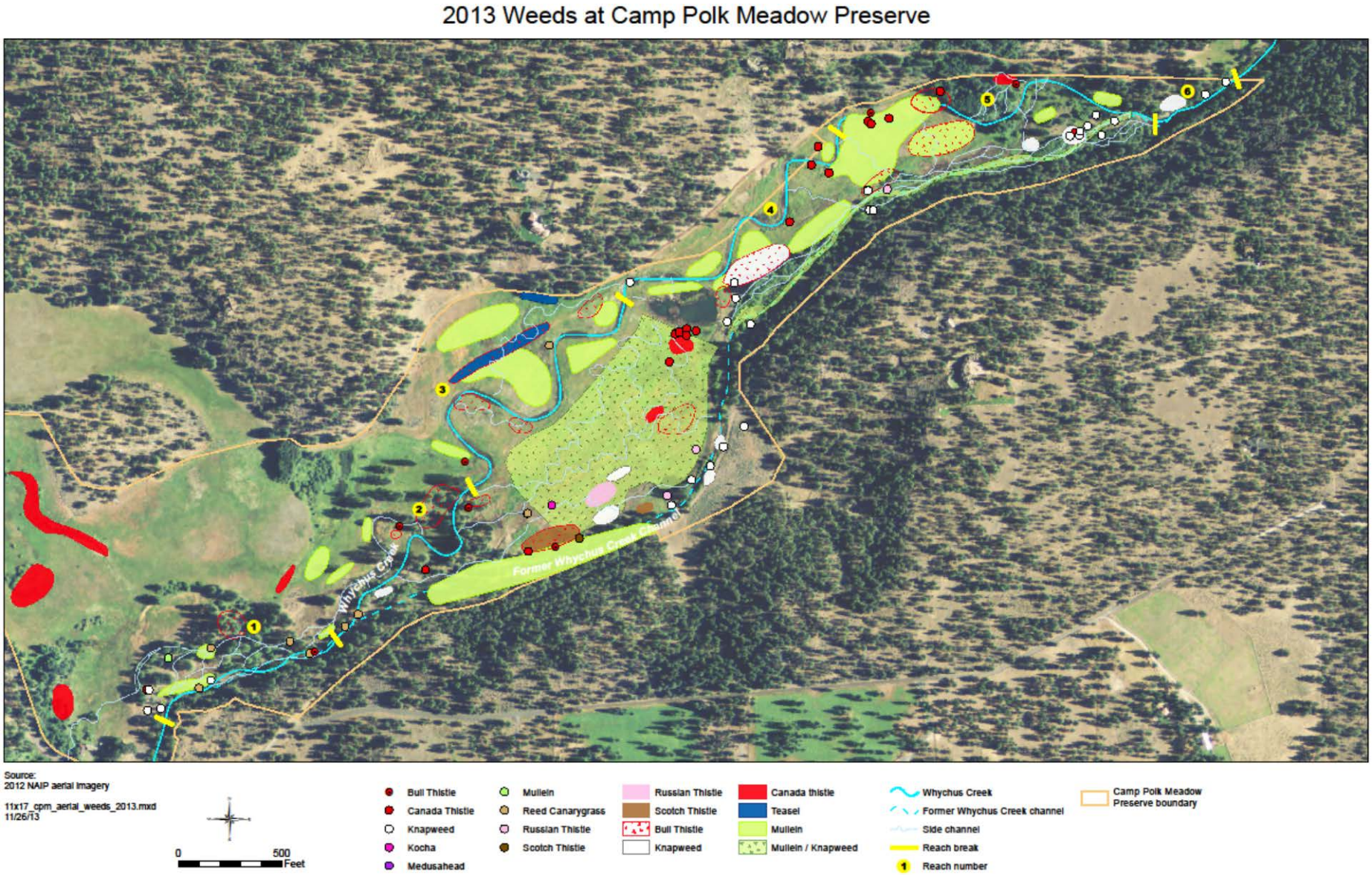
**APPENDIX A. 2013 Camp Polk Meadow Preserve priority weed species distribution.**



## APPENDIX B. October 26, 2015 RCG Management Meeting Notes.

Camp Polk Meadow Preserve - Reed Canary Grass
DLT and UDWC RCG Management Meeting
Amanda Egertson (DLT); Jen Zalewski (DLT); Lauren Mork (UDWC); Ellen Incelli (UDWC)

- Review updated weed maps – Lauren and Ellen's; Jen and Ellen's
    - Looked at map w compiled data points.
    - Still need to work w Deb to determine how to best illustrate different categories (area size, % cover); may need to have fewer categories (?)
    - Would be useful to somehow denote area surveyed in addition to location of weeds.

- Monitoring methods and protocol – moving forward
    - Level of mapping from 2015 isn't sustainable. Great info to have, but not really necessary.
    - Target representative areas from those surveyed in 2015 as reference sites and revisit that subset on some rotating schedule (yet to be determined). Need to develop a monitoring schedule and then adjust as necessary once we start treatments. Will ultimately have to extend downstream to WCP and RR.
    - Nail down mapping strategy and survey protocol before moving downstream.
    - Funding is an issue. Have $ for downstream but not for CPM.
    - Ellen suggested possibly working w OSU Restoration Ecology class (talk to Matt Orr or Karen Allen); get students to pull "starts" and dig roots. May be able to fit that into curriculum.

- Management and treatment options
    - Jen reviewed Sisters Ranger District ribbongrass tx trial project: backpack spraying is actually more efficient and effective (and better water quality-wise) than wanding and hand spraying. Water quality monitoring still happening – 30 day trial. Will request results from study once available.
    - Target upstream reaches of CPM.
    - Also target dense monocultures and starts.
    - Monitor but don't treat (for now) the rcg that is mixed in w a lot of natives.
    - Possibly let students do a side experiment w solarization if they can find a plot out of the way of potential high flows.
    - Log jams - spray late summer/fall – when water levels are low.
    - Restored mainstem – also a priority; should be relatively easy to treat.
    - Time to get cost estimate from a couple different contractors on treatment
    - Need to plan/budget for annual rcg treatment (to keep it at bay and prevent mass population expansion).

- Literature review
    - Ellen – could you please synthesize your conclusions here? ☺ (*Included in report*)

- Source population(s); Indian Ford Creek – coordination with landowners upstream.

- Mapping downstream at WCP&A, RR

  - We know rcg is downstream. Potentially in quantities similar to those at CPM pre-restoration. If there aren't any primary targets down there (dense monocultures), maybe we wait to map and treat until after restoration of R4 and reintro of water to historic floodplain?

- Other Notes
  - Jen shared her review/synopsis of RCG mapping and treatment prior to 2015 (printout) (*Summarized in report*).
  - Ellen mentioned weather trends. When we have warm wet winters, rcg is evergreen and can spread/grow throughout year – instead of dying off in colder/snowy winters.
  - Consider partnering w DNF for funding (RAC?) or treatment, sharing information and strategies, working w landowners, developing larger scale strategies and priorities, upstream (source population) treatments.
  - Once we have some treatment quotes, DLT will explore potential funding sources.