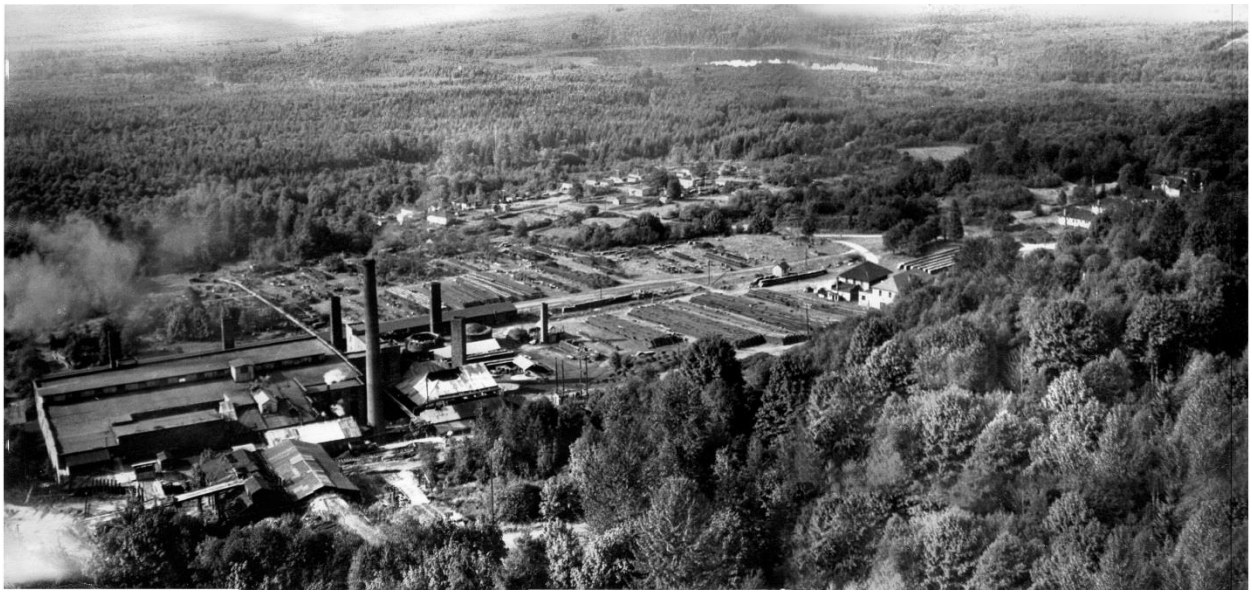
Taylor Townsite Habitat Restoration Project
As-Built Document, 2007 – 2017



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Background

In the early 1900s Taylor was a clay mining and manufacturing town located in the northwestern portion of the Cedar River Municipal Watershed (CRMW, figure 1). It was a company-owned town and in 1910 over 1000 people lived and worked there (figure 2). Clay pipe and bricks were the primary products, and many historical buildings in downtown Seattle still contain bricks manufactured at Taylor.

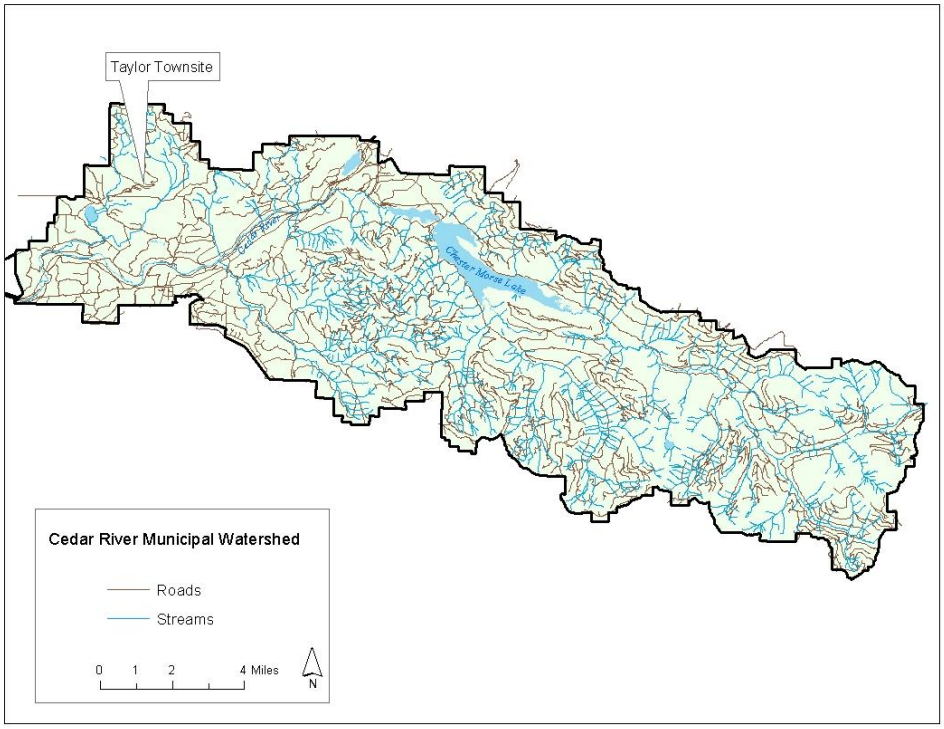

Figure 1. Location of the town of Taylor in the Cedar River Municipal Watershed

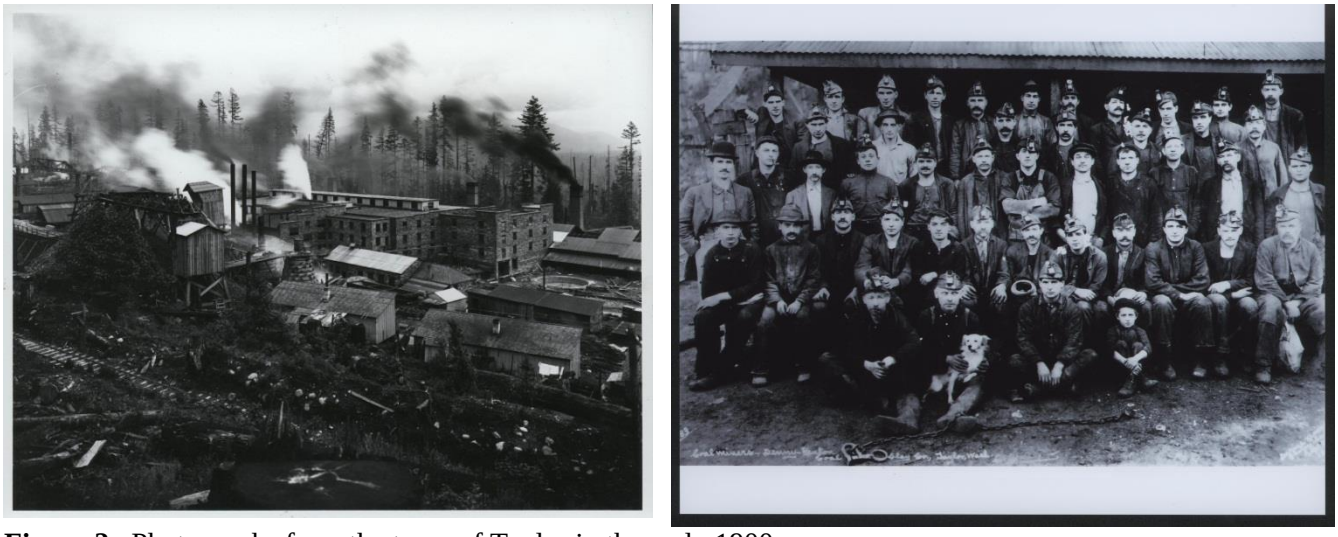

Figure 2. Photographs from the town of Taylor in the early 1900s

The town included not only mines and manufacturing plants, but also staff housing, churches, a school, hotel, and ball field (figure 3). The Columbia & Puget Sound Railroad carried products to and from the town.

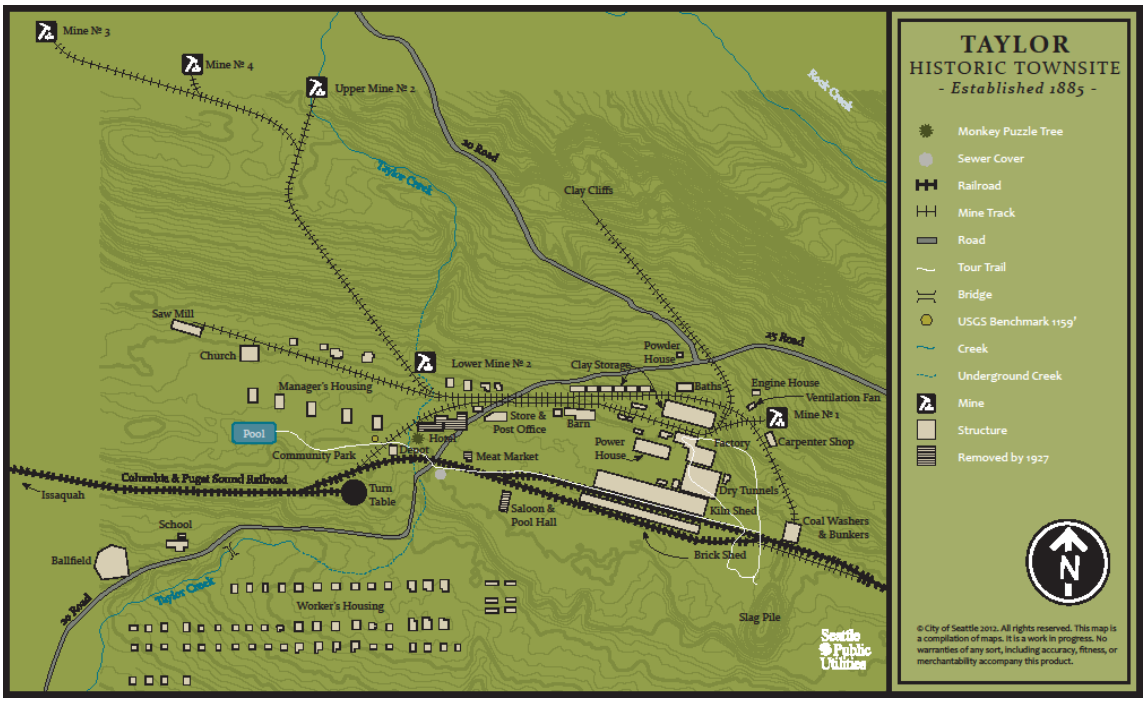

Figure 3. Map of the historical town of Taylor

There were concerns about the town's impact on the quality of Seattle's drinking water as early as 1908, because Taylor Creek that flowed through town ultimately drained into the Cedar River upstream of the Landsburg municipal water intake. A drainage ditch (Taylor Ditch) was constructed to shuttle effluent from the town away from tributaries to the Cedar River, but it was never completely successful. Consequently, in 1944 Seattle began condemnation proceedings to acquire the property to protect the drinking water quality. In 1947, after a successful legal condemnation judgment, the city bought the property and the town shut down. Buildings were removed and much of the area was subsequently bulldozed and replanted to Douglas-fir trees.

As a result of the disturbance from mining, construction and deconstruction of the town, and the variety of non-native plant species planted by town residents, by the early 2000s large areas were covered by invasive plant species. The townsite includes a variety of habitats, including wetlands, riparian areas, a small pond (formerly used as the town swimming hole), and upland deciduous and conifer-dominated forest. Because of its historical significance, the large footprint of the townsite, and its potential as high quality low-elevation wildlife habitat, the site was a high priority for habitat restoration work.

Project Objectives

The project objectives are to restore native plant systems, wildlife habitat, and ecosystem functioning in wetland, riparian, and upland areas. Specific objectives include eradicating

knotweed and ivy, and reducing or eliminating selected large thickets of blackberry, thereby greatly reducing the ecological influence of these species.

Restoration Treatments

Project objectives will be achieved in phases over many years. Treatments are prioritized and implemented as funding and staffing allows (discussed in order of priority below). During all work, historical artifacts are protected and left in place (figure 4). Details of all treatments by year can be found in Appendix I.

Treatments include:

- Invasive plant species control and eradication by various methods
- Planting a variety of native plant species to restore native plant systems and ecosystem functions, as well as suppress non-native invasive species

Figure 4. Historical artifacts seen and protected during restoration activities.

Knotweed Treatment

Bohemian knotweed (*Polygonum* x *bohemicum)*, a hybrid between Japanese (*P. cuspidatum*) and giant knotweed (*P. sachalinense*), is a highly invasive, non-native plant that poses one of the greatest ecological threats of any plant species present in the CRMW. It forms large stands that out-compete all native vegetation, are persistent, and are extremely difficult to eradicate. It can reproduce from tiny root or stem fragments, which are readily transported by water, animals, or humans. If unchecked, stands continue to expand and provide propagules that exacerbate or create new infestations. This is a particular problem if the stand is located on a stream, as propagules are easily moved during high water or flood events. Knotweed was apparently planted as an ornamental by early residents of Taylor. Once the town was deconstructed, the knotweed expanded and formed mono-specific stands in large areas of the townsite (figure 5). By 2013, a total of 9.3 acres of knotweed was measured in the Taylor townsite and ditch.

In 1989 Seattle passed an ordinance prohibiting the use of herbicides in the CRMW. The intent was to stop broadcast spraying of herbicide to control vegetation along forest roads, a typical

forest management technique at that time. This was prior to the widespread recognition of the damage that certain non-native invasive plants can do to ecosystems and water quality.

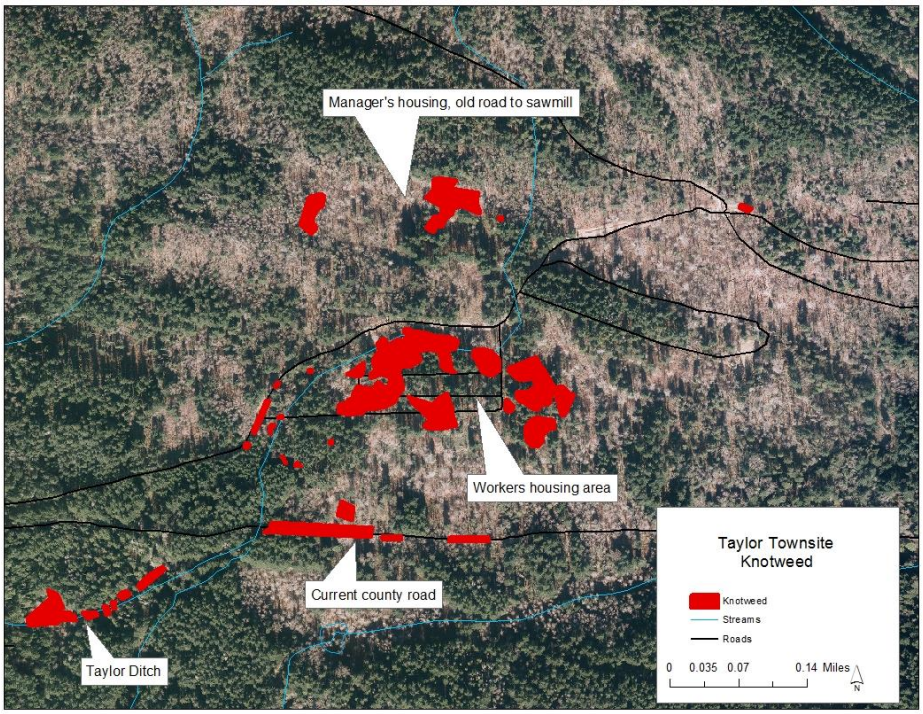

Figure 5. Location of knotweed patches in the Taylor townsite and vicinity

From 2005-2010 Seattle Public Utilities (SPU) staff attempted to control small patches of knotweed in the CRMW by covering with fabric in an attempt to starve the roots. This treatment was successful on very small patches if the fabric was maintained multiple times a year for many years. However, on slightly larger patches where fabric was maintained for eight continuous years, it was unsuccessful in killing the roots. We attempted to use fabric to control patches immediately adjacent to Taylor Creek starting in 2008. Because these patches appeared to be connected via roots to the large continuous areas of knotweed, covering there was unsuccessful and abandoned in 2010.

The only viable treatment option to eradicate large patches of knotweed is herbicide. After extensive literature review and consultation with experts (including toxicologists), SPU staff concluded that the risk posed by knotweed was very high, viable treatment options were extremely limited, and the risk to water quality posed by treating the knotweed with the herbicide imazapyr was essentially nil. Seattle City Council agreed with this assessment, and in 2010 passed an ordinance to allow limited application of the herbicide Imazapyr to treat knotweed within the CRMW. The first ordinance was effective from 2010-2012. Follow-up ordinances were passed in 2013 and 2015, each for additional three years. The current ordinance authorizes treatment through 2018.

The first herbicide treatment at Taylor took place in 2011 on 7.66 acres. Knotweed canes were pre-treated by bending four to six weeks prior to the first herbicide application (figure 6). This allowed sprayers access through the dense mass of canes and ensured the applicators could safely

and efficiently spray all portions of the plant. A small patch was missed in 2011 and subsequently treated for the first time in 2012. In 2013 staff did extensive surveys (see following section) and found two more large patches (near the old managers housing and road to the mill). These patches were treated for the first time in 2013 (figure 7). Acreage of knotweed treated annually within the Taylor townsite and ditch now totals 9.3 acres.

Figure 6. Pre-treatment of knotweed by bending canes

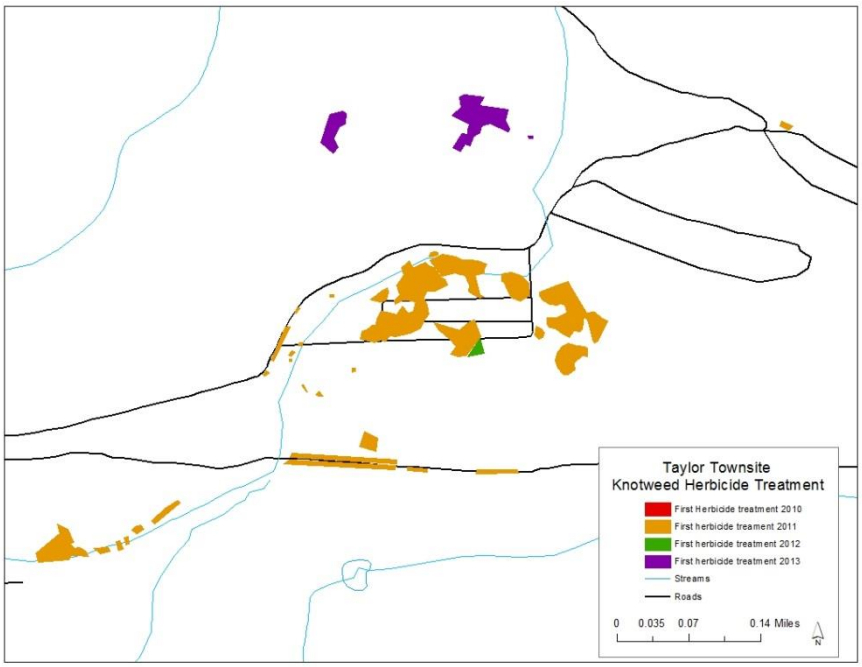

Figure 7. Knotweed patches treated with herbicide, by first year treated

For complete information on knotweed treatment within the CRMW, see reports on: http://www.seattle.gov/util/EnvironmentConservation/OurWatersheds/Habitat_Conservation_Plan/ManagingtheWatershed/StreamRiparianHabitatRestoration/Metrics/index.htm

After the first two herbicide treatments (2011 and 2012), above-ground knotweed biomass was greatly reduced. A variety of native and non-native herbs and shrubs regrew within the area formerly dominated by the knotweed. Native species were dominated by red elderberry (*Sambucus racemosa*), sword fern (*Polystichum munitum*), bleeding heart (*Dicentra formosa*), and salmonberry (*Rubus spectabilis*). Non-native species included Himalayan (*Rubus armeniacus*) and evergreen (*R. laciniatus*) blackberry, Canada thistle (*Cirsium arvens*), bull thistle (*Cirsium vulgare*), foxglove (*Digitalis purpurea*), periwinkle (*Vinca minor*) and common mullein (*Verbascum thapsus*). All these non-native species have been observed to become invasive in the CRMW. As such, starting in 2013, contract crews have pulled these non-native species from the former knotweed areas, to allow native species to flourish.

Invasive Plant Surveys

In 2013- 2016 extensive surveys of the Taylor townsite, ditch, and surrounding areas were conducted and all non-native invasive species mapped (figure 8). The primary goals were to ensure that all large knotweed patches had been found, and to document all other non-native invasive plant species present in the vicinity.

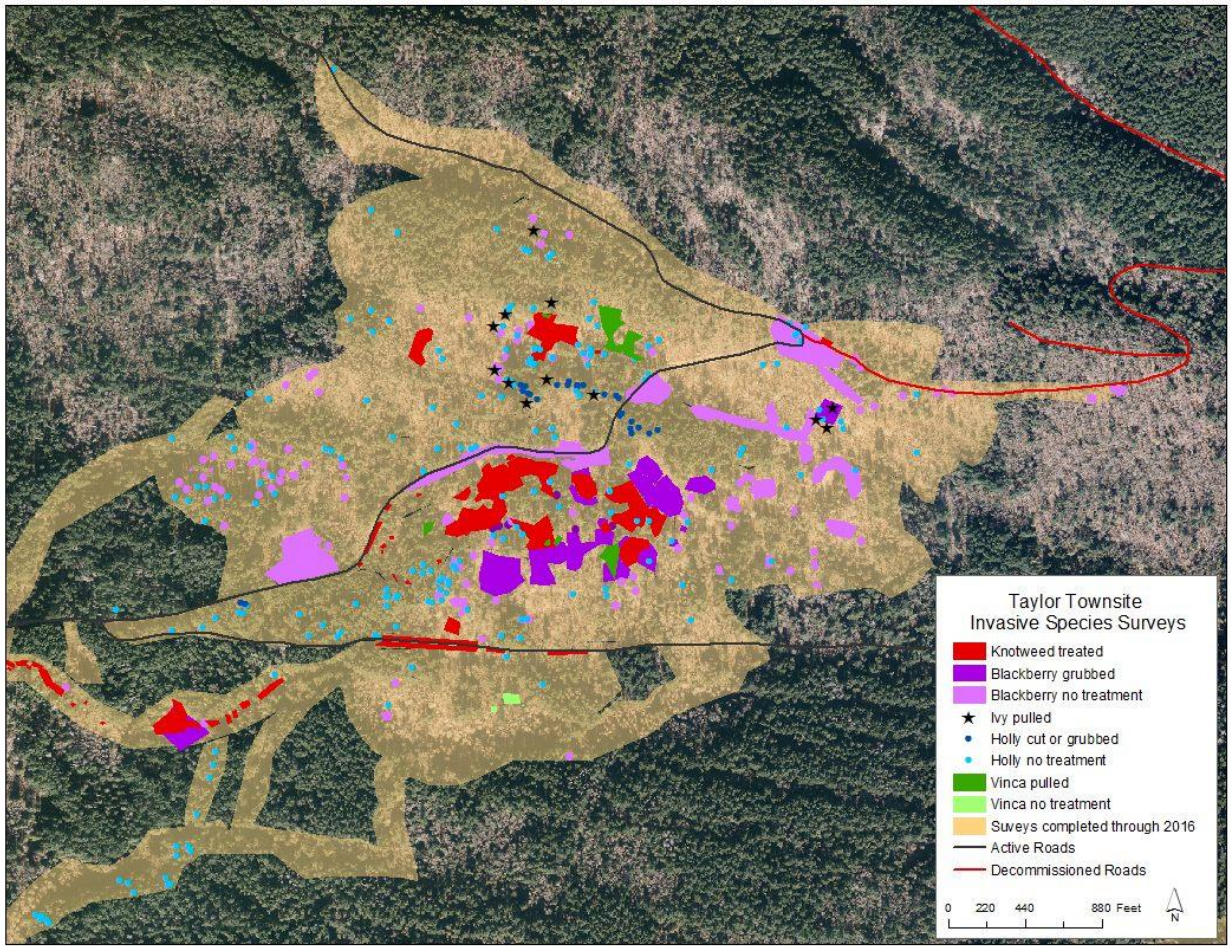

Figure 8. Area surveyed and invasive species mapped through 2016

In addition to the large knotweed patches found, there are large areas dominated by Himalayan and evergreen blackberry, plus many isolated large blackberry plants. The blackberry thickets are concentrated in wetland and riparian areas, along roads, and in open patches of deciduous forest. Large English holly trees (*Ilex aquifolium*) are scattered throughout the site. There are several patches of *Vinca* (both *V. minor* and *V. major*) that dominate the understory in portions of the upland conifer forests. Finally, there are nine large patches of English ivy (*Hedera helix*), plus scattered small patches.

English Ivy Treatment

English ivy is a very aggressive perennial woody vine that poses an especially serious ecological threat because it can grow in a wide range of conditions, from dry to moist soils and from full sun to full shade. It easily outcompetes native species and forms thick mats that blanket the forest floor, the shrub layer and individual trees and into the tree canopy (figure 9). It often girdles trees, killing them. It also adds substantial weight to a tree, contributing to premature blowdown and shortening the useful lifetime of the snag. The entire ivy plant contains slightly toxic compounds, and essentially no native wildlife species use it for forage or nesting.

Figure 9. Ivy blanketing a tree at Taylor and extremely large ivy stems growing up a tree.

We began grubbing out the easternmost patch of ivy in 2009, removing and bagging all roots and disposing of them in the garbage. Any vines growing up trees are severed and left in place to die. Work has continued annually, using staff, volunteer, and contractor labor (see Appendix I). Each patch needs to be grubbed for several years to remove all roots and eradicate the patch. We began work on patches as they were found, and currently all known patches have been grubbed from two to 13 times, depending on when they were discovered and how extensive the patch was. All patches are checked and controlled at least every two years until they are eradicated.

Infested sites need to be monitored for many years to ensure eradication, as small ivy root fragments can take years to regrow to a size that is easily found amongst the leaf litter.

Invasive Blackberry Treatment

Both Himalayan and evergreen blackberry are very prevalent throughout the Taylor townsite (figure 8). Although non-native blackberries do provide some habitat functions (food and cover), a diversity of native plant species supports a much wider array of native wildlife species. Restoration efforts to date have focused on areas within and adjacent to knotweed patches, especially the large wetland just north of the main knotweed at the workers housing area, and the areas south of the knotweed where the blackberry had formed several very large monoculture thickets.

We use contract crews to hand-grub the blackberry, removing as much root as possible. We pile the canes and roots and allow them to desiccate on site (figure 10)

Figure 10. During and after blackberry clearing in the Taylor townsite

Once the canes and roots are dead, they are chopped into small pieces and scattered so they decompose more quickly. We started the work in 2011, and continue as funding allows. There were major efforts to clear the wetland in 2013, 2014, and 2015. In 2015 and 2016 the thickets to the south of the workers housing area were initially cleared, and all sites were re-grubbed in 2017. All blackberry thickets require annual re-clearing for several years until the seed bank is greatly reduced and native plants become dominant.

Planting Native Species

The diversity of native plant species repopulating the areas formerly dominated by invasive species was limited. In addition, only a few species were present in the vicinity that could provide propagules. To increase the number of plant species and provide long-term shade and other competition that would help suppress future invasions, in 2014 we initially planted the knotweed sites first treated in 2011 (figure 11, central group of knotweed patches), plus the adjacent wetland. The sites were divided into planting areas, and a specific prescription (species and spacing) was developed for each area, depending on soil moisture and available sunlight. These sites had additional plantings in 2015 and 2016, plus other sites were added, including knotweed sites first treated in 2013 (sites to the north and south) and more recently cleared blackberry thickets. Through 2017 a total of 2,545 overstory trees (8 species) and 7,997 small trees and shrubs (31 species) have been planted throughout the site (Table 1). This variety will provide early, mid, and late flowering species to support native pollinators, as well as a variety of fruits and seeds, plus habitat complexity as it develops over time.

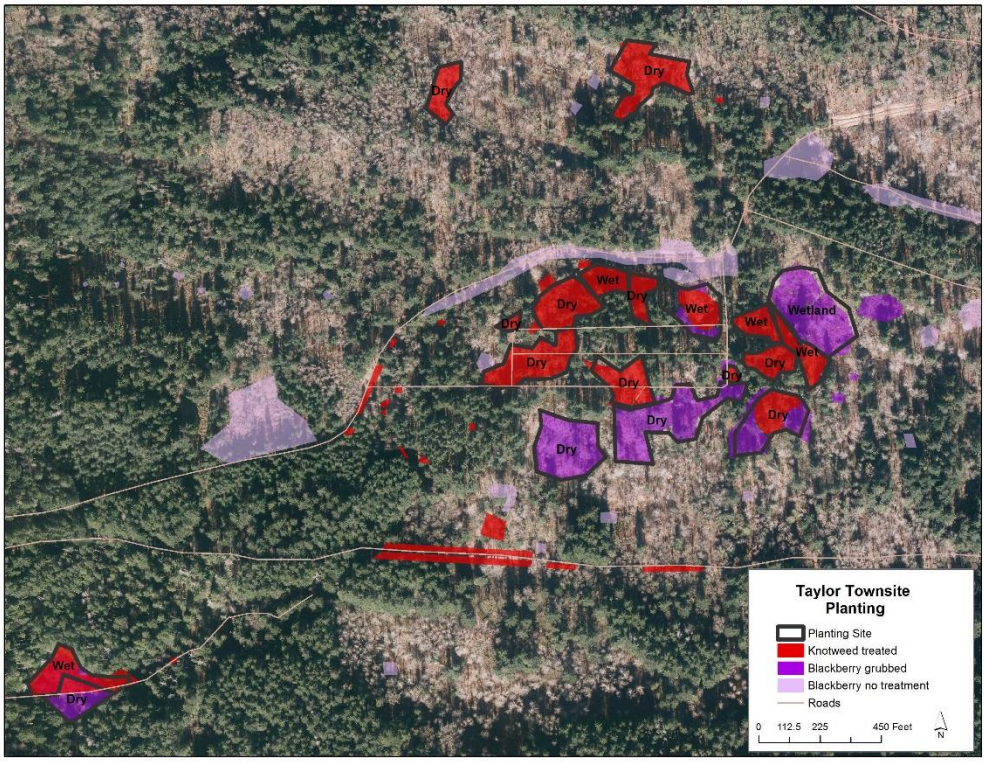

Figure 11. Planting sites at and near Taylor townsite

Table 1. Number and species of native trees and shrubs planted at and near the Taylor townsite, 2014-2017

Overstory Trees		
Big-leaf Maple	*Acer maccrophyllum*	380
Black Cottonwood	*Populus balsamifera (trichocarpa)*	325
Noble fir	*Abies procera*	135
Shore pine	*Pinus contorta*	50
Sitka Spruce	*Picea sitchensis*	604
Western hemlock	*Tsuga heterophylla*	220
Western redcedar	*Thuja plicata*	494
Western white pine	*Pinus monticola*	305
Total overstory trees planted		**2,545**
Small Trees and Shrubs		
Birch, paper	*Betula papyrifera*	80
Cascara	*Rhamnus purshiana*	475
Ceanothus, red-stem	*Ceanothus sanguineus*	300
Cherry, bitter	*Prunus emarginata*	345
Choke cherry	*Prunus virginiana*	25
Crabapple, Pacific	*Malus fusca*	320
Current, red-flowering	*Ribes sanguineum*	350
Dogwood, Pacific	*Cornus nuttallii*	20
Dogwood, red osier	*Cornus sericea*	325
Hazelnut, beaked	*Corylus cornuta*	7
Indian plum	*Oemleria cerasiformis*	310
Lewis Mock-orange	*Philadelphus lewisii*	320
Ninebark, Pacific	*Physocarpus capitatus*	350
Oceanspray	*Holodiscus discolor*	120
Rose, clustered	*Rosa pisocarpa*	150
Rose, Nootka	*Rosa nutkana*	350
Sedge, Dewey's	*Carex deweyana*	400
Sedge, slough	*Carex obnupta*	200
Sedge, thick-headed	*Carex pachystachya*	200
Serviceberry, western	*Amelanchier alnifolia*	300
Snowberry, western	*Symphoricarpos occidentalis (albus)*	300
Snowbrush	*Ceanothus velutinus*	300
Spirea	*Spirea douglasii*	50
Sweet gale	*Myrica gale*	200
Thimbleberry	*Rubus parviflorus*	200
Twinberry	*Lonicera involucrata*	300
Vine maple	*Acer circinatum*	200
Willow, hooker	*Salix hookeriana*	350

Willow, Pacific	*Salix lucida*	550
Willow, Scoulers	*Salix scouleriana*	300
Willow, Sitka	*Salix sitchensis*	300
Total small trees and shrubs planted		**7,997**

Browse protectors were installed around all western red cedar because both black-tailed deer (*Odocoileus hemionus*) and elk (*Cervus elaphus*) browse extensively on cedar in the CRMW (figure 12).

Figure 12. Planting in former knotweed-dominated sites, with browse protectors installed on western redcedar

Monitoring

A key tenant of the Major Watersheds Invasive Species Program is the Early Detection/Rapid Response (EDRR) protocol. This strategy involves routine surveys for invasive species, including surveying for species already present as well as species that potentially could invade but have not yet been documented. If a new infestation is found, it is rapidly treated while it is still small enough to eradicate in a cost-effective manner and before it has a chance to spread and cause ecological damage. This strategy has been proven world-wide to be the most cost-effective way to deal with invasive species. The full Invasive Species Program Management Plan may be viewed at:
http://www.seattle.gov/util/EnvironmentConservation/OurWatersheds/Habitat_Conservation_Plan/ManagingtheWatershed/ProtectWatershedHabitats/ProtectionEfforts/index.htm#invasiveSpecies

All knotweed sites are monitored and treated at least once per year. Sites formerly occupied by knotweed are surveyed not only for knotweed regrowth, but also for any other invasive species that might be present. In addition, the wetland and other areas formerly dominated by blackberry are monitored annually for blackberry regrowth, as well as other non-native invasive species. A subset of the planted trees and shrubs will be monitored for survival. Supplemental planting will occur as needed to densify native plants and maintain a high diversity native plant species.

Appendix I

Details of habitat restoration work conducted in the Taylor Townsite

Year	Focus	Restoration Work	Notes	Staff Person Days	Contractor Person Days	Contractor Cost	Volunteer Person Days
2007	Decommission	25 Road decommissioned	SPU Operations	na			
2008	Knotweed	Install fabric	Install 300 ft^2 fabric, patch on decommissioned 25 Road	0.1			
2009	Survey	Survey	Staff survey portions of old townsite for knotweed, ivy, holly,	1			
	Knotweed	Install & maintain fabric	Install 3,220 ft^2 fabric on patches along stream. Maintain/repair throughout year.	3.5			
	Ivy	Grub out	Loop road #1 - 2 large patches found and grubbed (~ 5500 ft2)	3			9
	Holly	Grub out	Grub smaller plants, limb up larger plants in selected area along path to pool and within forest (total of 2.7 ac)	1			3
2010	Knotweed	Maintain fabric	Maintain/repair all fabric. Pull/cover all plants found	1			
	Ivy	Grub out	Loop road #1 - Patches much larger than previously found. Staff grub out. Pool site - contractor grub (~6300 ft2).	1.5	5	$750	
2011	Knotweed	Prepare for herbicide treatment	Prepare all patches (7.5 ac) by bending canes	1	5	$750	16
	Knotweed	Herbicide treatment	Apply herbicide with backpack spray	1	13.5	$4,175	

Year	Focus	Restoration Work	Notes	Staff Person Days	Contractor Person Days	Contractor Cost	Volunteer Person Days
2011 cont	Knotweed	Clear dead canes	Remove dead canes from ~1.5 ac to allow easier detection of regrowth in 2012	0.5	10	$1,250	
	Ivy	Grub out	Re-grub Loop road #1, Pool site	2	0.6	$100	
	Blackberry	Grub out	Grub blackberry adjacent to knotweed to prevent invasion.		7	$1,600	
	Holly	Grub out	Grub holly adjacent to knotweed and pool		2	$500	
2012	Knotweed	Prepare for herbicide treatment	Remove all remaining fabric. Clear storm debris and dead canes from all knotweed sites first sprayed in 2011.	0.5	21.5	$2,750	
	Knotweed	Herbicide treatment	Apply herbicide with backpack spray	1.75	7	$3,440	
	Ivy	Grub out	Loop Road #1 & Pool patch checked and re-grubbed	0.5			
2013	All Invasives	Survey	Survey most of townsite, focusing on areas near knotweed, wet areas and areas dominated by deciduous trees and shrubs	18			
	Knotweed	Prepare for herbicide treatment	Prepare newly found patches by bending canes	0.5	6.5	$875	
	Knotweed	Herbicide treatment	Apply herbicide with backpack spray	1.5	10	$3,130	
	Ivy	Grub out	Re-grub Loop road #1 & Pool sites. Cut trail to 6 newly found sites; Grub all	2	36	$6,125	
	Foxglove, mullein, vinca, thistles	Pull	Pull wherever found in knotweed areas		3	$520	

Year	Focus	Restoration Work	Notes	Staff Person Days	Contractor Person Days	Contractor Cost	Volunteer Person Days
2013 cont	Blackberry	Grub out	Start clearing blackberry from wetland	1	48.5	$7,000	
2014	All Invasives	Survey	Survey areas north of the townsite	0.5			
	Knotweed	Prepare for herbicide treatment	Clear storm debris and dead canes from knotweed sites first sprayed in 2013	0.5	9	$1,320	
	Knotweed	Herbicide treatment	Apply herbicide with backpack spray	1	7	$2,090	
	Ivy	Grub out	Work on grubbing out largest remaining patch	0.5	10	$1,750	
	Foxglove, mullein, vinca, thistles	Pull	Pull wherever found in knotweed areas		10	$1,750	
	Blackberry	Grub out	Continue clearing blackberry from wetland	1	37.5	$7,950	
	Planting	Plant natives	Plant 6,935 native trees & shrubs in knotweed sites and adjacent wetland. Cost includes plant purchase & delivery.	1.5	10	$8,000	
2015	All Invasives	Survey	Survey deciduous forest dominated forest east of the townsite	2			
	Knotweed	Herbicide treatment	Apply herbicide with backpack spray	1	7	$2,090	
	Ivy	Grub out	Grub ivy sites	0.4	4	$440	
	Foxglove, mullein, vinca, thistles	Pull	Pull wherever found in knotweed areas		3	$520	

Year	Focus	Restoration Work	Notes	Staff Person Days	Contractor Person Days	Contractor Cost	Volunteer Person Days
2015 cont	Blackberry	Grub out	Finish clearing blackberry from wetland, & clear from within and areas surrounding knotweed patches. Clear BB #1	1.5	64.5	$18,100	
	Planting	Plant natives	Plant 1418 native trees & shrubs in knotweed sites and adjacent areas. Cost includes plant purchase & delivery.	2	3	$2,400	
2016	Knotweed	Herbicide treatment	Apply herbicide with backpack spray	1	6	$1,800	
	Ivy	Grub out	Grub all ivy sites	0.75			
	Foxglove, mullein, vinca, thistles	Pull	Pull wherever found in knotweed areas		3	$520	
	Blackberry	Grub out	Re-grub wetland & within and areas surrounding knotweed patches & BB #1	1	203	$61,400	
	Planting	Plant natives	Plant 810 native trees & shrubs in knotweed sites and adjacent areas. Cost includes plant purchase & delivery.	0.6	4.5	$1,250	
2017	Knotweed	Herbicide treatment	Apply herbicide with backpack spray	2.5			
	Ivy	Survey, grub	Survey & grub selected sites	0.3	2	$400	
	Foxglove, mullein, vinca, thistles	Pull	Pull wherever found in knotweed & blackberry areas		3	$520	
	Blackberry	Grub out	Re-grub wetland, BB#1 and BB#2	1	118	$34,100	
	Planting	Plant natives	Plant 587 native trees & shrubs in knotweed sites and adjacent areas. Cost includes plant purchase & delivery.	0.5	3.5	$2,050	

Year	Focus	Restoration Work	Notes	Staff Person Days	Contractor Person Days	Contractor Cost	Volunteer Person Days
Grand Totals, 2007 - 2017				**61.9**	**683.6**	**$181,415**	**28**