Jonsson Center Natural Area

Approvals for Site Conservation Plan

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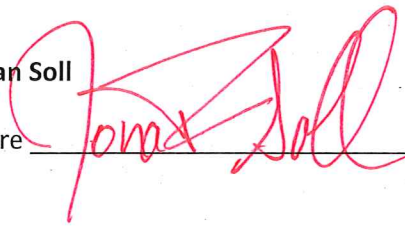
Signature  Date 2/19/2020

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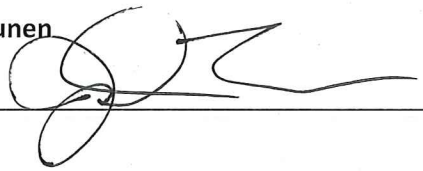
Signature  Date 3/6/20

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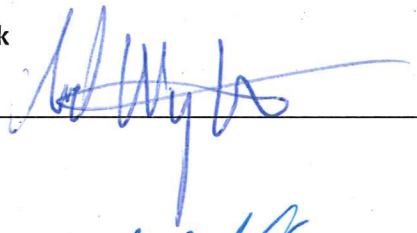
Signature  Date 2/20/20

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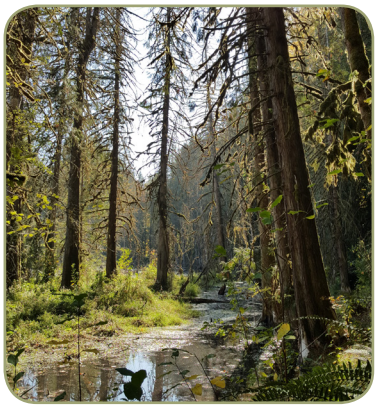
SITE CONSERVATION PLAN

Jonsson Center Natural Area





December 2019

Metro

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SECTION 1: INTRODUCTION

1.1 CONTEXT

The Jonsson Center Natural Area is south of the community of Carver on Clear Creek, a free-flowing tributary to the Clackamas River. Clear Creek is a large tributary supporting relatively abundant salmon populations in the lower Clackamas River and is home to the last significant run of late-run coho salmon (*Oncorhynchus kisutch*) in the lower Columbia River Basin. The stream supports 11 species of fish, including rainbow trout (*Oncorhynchus mykiss*), fall Chinook (*Oncorhynchus tshawytscha*) and coho salmon, steelhead (*Oncorhynchus mykiss*) and coastal cutthroat trout (*Oncorhynchus clarkii*). The Jonsson Center's riparian forests, wooded canyon walls, ravines, terraced uplands, open fields, springs and wetlands provide diverse wildlife habitat. More than 100 species of wildlife have been observed at Clear Creek, including coyotes (*Canis latrans*), cougar (*Puma concolor*), black-tailed deer (*Odocoileus hemionus*), elk (*Cervus canadensis roosevelti*) and nearly 80 species of birds. Clear Creek also contributes to water quality for municipal drinking water intakes downstream on the Clackamas River that serves approximately 200,000 people.

Metro's ownership includes 723 acres at Clear Creek, including the 76-acre Jonsson Center, the 105-acre Clear Creek North Natural Area, and the 542-acre Clear Creek Canyon Natural Area. This site-based conservation plan will only consider the Jonsson Center site.

The Jonsson Center facility is operated by the Oregon Zoo and includes recovery and breeding of California Condors and other species of conservation concern.

The Jonsson Center site conservation plan is a tool for protecting and enhancing the unique characteristics of the site and considering appropriate levels for future facility development. This conservation plan has been developed by Metro Parks and Nature and Zoo staff and includes an overview of the history of the site, existing conditions, conservation targets and facility development objectives for the site. Because of the sensitive nature of the Condor breeding program, public access to the site will not be considered in this site based conservation plan.

1.2 GOALS AND OBJECTIVES OF THE CONSERVATION PLAN

The goal of this site conservation plan is to identify conservation priorities and describe a general course of action that will protect and enhance the area as an environmental resource for Clackamas County and the Portland metropolitan region. With uncommon and special plant, fish and wildlife habitats, Jonsson Center will be managed as an ecological conservation area for native habitats and wildlife. A salmon-bearing stream, wetlands and floodplains add significant value for wildlife and water quality. The area will be maintained and enhanced, to the extent possible, in a manner that is faithful to its natural condition. Only those facility uses that are compatible with the environmental objectives of the conservation plan will be allowed.

To achieve this goal, the site conservation plan establishes a series of priority objectives, including:

- Restore and maintain high quality fish and wildlife habitat including: upland forests, riparian forests, streams and wetland habitats.
- Identify future areas for facility development that are consistent with the conservation objectives.
- Develop funding strategies to implement strategic restoration projects.

Metro's natural areas bond program and Clear Creek target area

During the last 25 years, three voter-approved natural areas bond measures have allowed Metro to protect 17,000 acres across the region. Voters have protected more than 100 miles of river and stream banks, opened four nature parks and supported hundreds of community projects. Metro continues to protect land in 27 target areas, chosen for their water quality, wildlife habitat and outdoor recreation opportunities.

Additional information about the 2006 natural areas bond measure and goals and objectives for the Clear Creek target area can be found on the Metro web site, www.oregonmetro.gov/naturalareas.

Metro's bond for the Clear Creek target area has emphasized the idea of public access. The 1995 Clear Creek Refinement Plan goals stated, "These lands could provide an opportunity for a regionally significant nature park." More recently, the 2006 Refinement Plan stated a goal of, "…protect the public investment made to date in establishing a significant, publicly accessible regional natural area."

Since 1996, Metro has acquired 723 acres in the Clear Creek area of Clackamas County, preserving this area for conservation rather than development of homes and a golf course. Table 1 below shows the history of purchases at Jonsson Center.

Table 1: Metro natural area bond purchased land.

PROPERTY NAME (PREVIOUS OWNER)	ACRES	BOND YEAR	DATE ACQUIRED	MANAGEMENT
Raetz 12.009	44	1995	12/15/2000	Metro
Hewitt 12.011	28	1995	6/02/2003	Metro

Metro's natural areas and parks levy

By law, capital bond measures must be used for capital investments such as property acquisition and stabilization.

In May 2013 and November 2016, the region's voters approved five-year local option levies to care for Metro's growing portfolio of natural areas and regional parks. About half of the levy funds will go towards natural area restoration and maintenance. The levy is the first of its kind in the U.S. The citizens' investment will raise about $10 million per year to maintain and improve water quality; preserve regional parks, natural areas and stream frontages; maintain current and implement new restoration projects; and provide new public access opportunities.

The levy will make a difference for most of the 17,000 acres of natural areas that Metro oversees. Some of the strategic restoration actions identified in this plan will be funded with the levy.

SECTION 2: PLANNING PROCESS SUMMARY

2.1 PLANNING AREA

This conservation plan addresses conditions, plans and activities for the site's 76 acres. Metro ownership and an outline of the planning area are shown on Map 1 and Map 2.

2.2 PLANNING PROCESS

Developing a useful site conservation plan means providing for a site's habitat conservation, enhancement and management. This plan will build on previous planning, restoration and management efforts while acknowledging that future conservation requires analysis of the site, meaningful engagement of stakeholders and integration of historic, current and future needs. This plan includes several important elements: development of conservation targets, considering future facility development needs and implementation of projects.

Planning project goals

The planning goals for both the natural resource conservation and facility development portions of this plan are listed below.

Natural resource conservation

- Map and define major habitat types.
- Establish habitat and species conservation targets.
- Define key ecological attributes and analyze stresses and their sources for the conservation targets.
- Establish strategies and actions to restore habitat.
- Prioritize actions and implement.

Facility and site management

- Assess existing Jonsson Center facilities and consider future needs.
- Analyze existing site management including the road network, fences and signage at the Jonsson Center.
- Identify and implement priority actions.

SECTION 3: EXISTING CONDITIONS

This section of the conservation plan provides background on existing conditions for the Jonsson Center.

Lands surrounding Clear Creek and the Jonsson Center are predominately zoned Exclusive Farm Use (EFU) and Rural Residential Forest Farm. The Jonsson Center site is zoned as EFU. Numerous homes and Christmas tree farms are adjacent to the Jonsson Center.

The topography on the site includes a bench that drops 20 feet down into the floodplain of Clear Creek. The Jonsson Center facility is located on the bench and within the floodplain.

3.1 STREAMS AND WETLANDS

Clear Creek is a relatively large tributary flowing from its headwaters on Goat Mountain in the Cascade Mountain foothills and entering the south side of the lower Clackamas River near the community of Carver. Jonsson Center is approximately 5 miles upstream of the confluence with the Clackamas River. Elevations in the Clear Creek watershed range from 4,226 feet on Goat Mountain to 79 feet where Clear Creek joins the Clackamas River near Carver Park. The large range in elevation in the watershed results in several different ecotypes including terraces and valley foothills in the lower elevations, to western Cascade lowlands and valleys in the higher elevations.

The reach of Clear Creek that runs through Jonsson Center can be described as a low gradient (<1%-3%) floodplain channel. Along the main stem of Clear Creek, the stream channel is incised into old terraces and the stream alternates between unconfined and moderately confined low gradient channel habitat types. The typical pattern observed at several locations along Clear Creek are high mudstone walls alternating with gravel bars or landslide debris along the channel margins.

Springs and tributaries

Three intermittent streams enter the site from the north and east sides of the site.

Wetlands

Hydric soils can be found in numerous areas indicating wetland characteristics. Hydric soils are soils that are, or have been, saturated, flooded or ponded long enough during the growing season to develop anaerobic conditions in the upper horizons. If soils classified as hydric do not currently support wetlands, they may be areas where wetlands formerly were located. The NRCS soil survey of the Clackamas area (Natural Resource Conservation Service 1985, 1998) identifies hydric soils within the Borges Silty Clay Loam, Cove Silty Clay Loam, Delena Silt Loam, Huberly Silt Loam, Wapato Silt Loam and Wapato Silty Clay Loam soil series. Not all of the area within these mapping units contains hydric soils, and not all of the hydric soils necessarily supported wetlands historically. However, this information provides us with an approximation of the extent that may have been occupied by wetlands historically.

Map 3 shows the soils present at the Jonsson Center. Descriptions of hydrologic soil group properties can be found in Appendix A.

Map 4 and Map 5 show the details for topography, streams, wetlands and rivers of Jonsson Center.

3.2 MAJOR HABITAT TYPES

The Jonsson Center Natural Area can be characterized by two natural habitat types: riparian forest and upland forest. Map 6 shows the current habitat types present at the site. Map 7 and Map 8 show historical conditions present at the site.

Riparian forest

Riparian forests are forests that border the shores of wetlands, lakes, streams, rivers and other waterbodies. These forests play an important role in preventing runoff of sediment, nutrients and contaminants from upland areas. They filter and clean water, reduce erosion and provide structural elements like trees and sinuosity that allow in-stream habitats to function. Riparian forests provide homes to most species of wildlife at some point in each species' lifecycle. Riparian forests throughout the region have been moderately to severely degraded due to resource extraction, development and land use activity.

The Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan identifies the Clackamas River and its tributaries as primary habitat necessary to the recovery of coho and winter steelhead, and as important contributing habitat for fall Chinook and chum salmon (*Oncorhynchus keta*) (Primozich and Bastash 2004).

Key plants

Native forbs found in this habitat may include Pacific waterleaf (*Hydrophyllum tenuipes*), false hellebore (*Veratrum* spp.), nodding beggartick (*Bidens cernua*) and skunk cabbage (*Lysichiton americanus*). Sedge and rush species found in this habitat may include slough sedge (*Carex obnupta*), awl-fruited sedge (*Carex stipata*), dewy sedge (*Carex* ssp.), slender rush (*Juncus tenuis*), common rush (*Juncus effusus*) and spreading rush (*Juncus patens*). Shrubs and trees found in this habitat may include red alder (*Alnus rubra*), Oregon ash, Western redcedar (*Thuja plicata*), black cottonwood (*Populus trichocarpa*), bigleaf maple (*Acer macrophyllum*), Pacific ninebark (*Physocarpus capitatus*), red-osier dogwood (*Cornus sericea*), Sitka willow (*Salix sitchensis*) and Pacific willow (*Salix lucida* ssp. *lasiandra*), red elderberry (*Sambucus racemosa*) and Douglas' spiraea (*Spiraea douglasii*).

Key wildlife

Partners in Flight identifies the following focal species for bottomland shrub and tree habitats: willow flycatcher (*Empidonax traillii*), red-eyed vireo (*Vireo olivaceus*), yellow warbler (*Dendroica petechia*), Swainson's thrush (*Catharus ustulatus*), downy woodpecker and yellow-billed cuckoo (*Coccyzus americanus*). Other birds utilizing this habitat may include green heron (*Butorides virescens*), great blue heron (*Ardea herodias*), Wilson's (*Cardellina pusilla*) and other warblers, yellow-breasted chat (*Icteria virens*), black-headed grosbeak (*Pheucticus melanocephalus*), common yellowthroat (*Geothlypis trichas*), song sparrow (*Melospiza melodia*), ruby-crowned kinglet (*Regulus calendula*) and red-breasted sapsucker (*Sphyrapicus ruber*). Other wildlife species that regularly use this habitat include Pacific tree frog (*Pseudacris regilla*), northern red-legged frog (*Rana aurora*), various salamanders, common garter snake (*Thamnophis sirtalis*), black-tailed deer (*Odocoileus hemionus*), elk (*Cervus canadensis roosevelti*), coyote (*Canis latrans*) and fox (*Vulpes vulpes*).

Current extent and attributes

The Jonsson Center includes approximately 47 acres of forested riparian habitat. Some variations of canopy structure in this habitat type include bigleaf maple, red alder/western redcedar and bigleaf maple/Douglas-fir community types.

Upland forest

Upland coniferous and deciduous forests are the dominant natural habitat of the region. Low-elevation Pacific Northwest old-growth forests typically are dominated by conifers including Douglas-fir, western redcedar and western hemlock (*Tsuga heterophylla*), with grand fir (*Abies grandis*) and hardwood species also occurring. Under natural conditions, trees of many of the dominant species commonly live to be 350 to 750 years old or older and frequently have diameters of eight feet or more. Plant and animal use of forests follows the changes in forests over time, with different suites of species dominating depending on forest age, canopy closure and site conditions. Biodiversity is higher in forests where some light reaches the forest floor and where standing and fallen dead wood is ample and of mixed age and size. Currently, forests younger than 60 years dominate western Oregon due to current forestry practices, and the decline of old growth-associated species reflects these changes in overall forest structure across the region.

As part of the upland forest habitat at Clear Creek, there are openings or gaps where conifers or other trees have not readily established or are dominated by shrubs in the understory. Shrub habitat (commonly called scrub shrub) includes areas dominated by woody vegetation less than six meters (20 feet) tall (Portland-Vancouver Biodiversity Guide 2012). Characteristic species include shrubs, young trees and trees or shrubs that are small or stunted because of environmental conditions. Shrubs add complexity to forested habitats, greatly increasing the amount of area available for cover and nesting. Numerous studies in the Pacific Northwest document the importance of shrubs to a wide variety of arthropods, amphibians, small mammals and birds. The fruit and flowers of shrubs – particularly deciduous ones – host abundant pollinator and prey species. The diets of deer and elk consist largely of shrub browse. Shrubs also provide important habitat connectivity and may effectively widen a forested biodiversity corridor.

Stands of upland forest can be categorized by the age of trees, species and composition of understory species. Upland forests in the greater Portland-Vancouver region provide primary habitat for at least 94 species and are used by at least 129 more species (Portland-Vancouver Regional Conservation Strategy 2012).

Key plants

Native forbs found in this habitat may include sword fern (*Polystichum munitum*), licorice fern (*Polypodium glycyrrhiza*), false Solomon's seal (*Maianthemum racemosum*), false lily of the valley (*Maianthemum dilatatum*), trillium (*Trillium* spp.), fairy bells (*Prosartes* spp.), miner's lettuce (*Prosartes* spp.), stinging nettle (*Urtica dioica*), hedge-nettle (*Stachys* spp.) and heal-all (*Prunella vulgaris*). Shrubs and trees found in this habitat may include Pacific yew (*Taxus brevifolia*), Pacific madrone (*Arbutus menziesii*), bigleaf maple, red alder, Douglas-fir, Grand fir, Western redcedar, black hawthorn (*Crataegus douglasii*), western serviceberry (*Amelanchier alnifolia*), tall and dull Oregon grape (*Mahonia nervosa*), mock orange (*Philadelphus lewisii*), blue elderberry (*Sambucus nigra* ssp.

cerulea), red elderberry, salal (*Gaultheria shallon*), red huckleberry (*Vaccinium parvifolium*), Indian plum (*Oemleria cerasiformis*), snowberry (*Symphoricarpos albus*) and tall Oregon grape (*Mahonia aquifolium*).

Key wildlife

Partners in Flight identifies the following focal species for coniferous forests in western Oregon: Vaux's swift (*Chaetura vauxi*), brown creeper (*Certhia americana*), red crossbill (*Loxia curvirostra*), pileated woodpecker (*Dryocopus pileatus*) and varied thrush (*Ixoreus naevius*) (old growth and mature forests); hermit warbler (*Dendroica occidentalis*), Pacific-slope flycatcher (*Empidonax difficilis*), Hammond's flycatcher (*Empidonax hammondii*), winter wren (*Troglodytes troglodytes*), black-throated gray warbler (*Dendroica nigrescens*) and Hutton's vireo (*Vireo huttoni*) (mature/young/pole forests); and in young forests, olive-sided flycatcher (*Contopus cooperi*), western bluebird (*Sialia Mexicana*), orange-crowned warbler (*Leiothlypis celata*) and rufous hummingbird (*Selaphorus rufous*) Other birds utilizing this habitat may include Townsend's warbler (*Dendroica townsendi*), evening grosbeak (*Coccothraustes vespertinus*), Swainson's thrush (*Catharus ustulatus*), Anna's hummingbird (*Calypte anna*), cedar waxwing (*Bombycilla cedrorum*), bushtit (*Psaltriparus minimus*), chestnut-backed (*Poecile rufescens*) and black-capped chickadee (*Poecile atricapillus*), American robin (*Turdus migratorius*), Steller's jay (*Cyanocitta stelleri*), Bewick's wren (*Thryomanes bewickii*), golden-crowned kinglet (*Regulus satrapa*) and Cooper's hawk (*Accipiter cooperii*). Other species may include Douglas' squirrel (*Tamiasciurus douglasii*), common garter snake, rubber boa (*Charina bottae*), elk, black-tailed deer, cougar, bobcat, coyote, fox, weasel (*Mustela frenata*) and a variety of small mammals.

Current extent and attributes

The site includes 16 acres of upland coniferous forest habitat, with tree age in the range of 2 to 100+ years. A large portion of the site has large diameter western redcedar and Douglas-fir trees.

Native fish and wildlife

Nearly 100 wildlife species or their sign have been observed at the adjacent Clear Creek Canyon Natural Area. While formal surveys have not been completed at Jonsson Center, a similar suite of species are anticipated for this site. These include at least 76 bird species, eight mammals, three amphibians, one reptile, seven Lepidoptera and numerous aquatic macro invertebrate species. In addition, 11 fish species are known to occur in Clear Creek. It is highly likely that additional amphibians, reptiles, birds and mammals use the site for breeding, nesting, foraging and migration. The site has diverse cover, breeding and travel habitats which provide numerous food sources including seeds, fruit, pollen sources, bark and insects. This would include species such as hawks, falcons; Neotropical migrants such as willow flycatcher and solitary vireo (*Vireo cassinii*), and gallinaceous birds such as ruffed grouse (*Bonasa umbellus*) or ring-necked pheasant (*Phasianus colchicus*). Small and large mammals and birds also provide food for species such as raptors and large predatory mammals including cougar, which is known to occur on site. Wetlands with open water could also provide suitable nesting habitat for painted (*Chrysemys picta*) and pond turtles (Actinemys marmorata). Forest habitats could support additional small mammals including Douglas' squirrel and several bat species. Clear Creek, because of its perennial flow and intact riparian habitat, is potentially suitable for river otter (*Lontra canadensis*). Open grassland habitat could support striped

skunk (*Mephitis mephitis*). Other possible species for this site include wood rat (*Neotoma* ssp.), chipmunks (*Tamias* ssp.), voles and mice, mink (Mustela vison), weasel, bobcat (*Lynx rufus*), cougar, black bear (*Ursus americanus*), black-tailed deer and elk.

Anadromous fish occurring in the Clackamas basin include spring and fall Chinook, coho salmon, winter steelhead, summer steelhead (non-native), migratory cutthroat trout and Pacific lamprey (*Entosphenus tridentatus*) (Runyon and Salminen 2005). Resident native fish potentially occurring in Clear Creek include cutthroat trout, rainbow trout and mountain whitefish (*Prosopium williamsoni*). Other resident fish potentially occurring in Clear Creek include sculpin (*Cottus* ssp.), longnose dace (*Rhinichthys cataractae*), speckled dace (*Rhinichthys osculus*), shiners (*Richardsonius balteatus*), brook lamprey (*Lampetra richardsoni*), Pacific lamprey, suckers (*Catostomus macrocheilus*) and northern pike minnow (*Ptychocheilus oregonensis*).

Biodiversity connectivity (corridors)

Native animals and plants require the ability to establish or re-establish local populations in a specific location to persist over time. Furthermore, ongoing breeding interaction between small populations can create a larger, more genetically robust meta-population. In areas such as ours, where significant habitat fragmentation has occurred, relatively narrow, linear connections (corridors) can help meet these needs.

In 2010-2011, Metro hosted a series of biodiversity corridor workshops on behalf of The Intertwine Alliance. The results were compiled and made available to participants via a map server. The workshops gathered the opinions of wildlife and habitat professionals in the region; the results are best professional opinion only, are not meant to be property specific, and make no attempt to prioritize or assess on-the-ground issues such as barriers. Nonetheless, the information can provide valuable insight into existing and potential connectivity from Jonsson Center to other important habitat areas in the region.

Biodiversity corridors in the area of Jonsson Center include:

- Clear Creek riparian corridor north to the Clear Creek Canyon and North Natural Areas and to the Clackamas River.
- Clear Creek riparian corridor south and east to Clear Creek Canyon Natural Area and eventually Bureau of Land Management forest lands in the upper Clear Creek watershed. This connection provides access to the Cascade Range.
- Pollinator and migratory bird species that are dependent on oak habitat can connect to patches of protected habitat from Mount Talbert Natural Area to North Logan Natural Area and beyond.

Climate change adaptation considerations

In coming decades, climate change is expected to increase summer temperatures and the severity of winter storms, as well as reduce precipitation in summer.

Direct effects that may occur

- Increased summer temperatures.
- Increased severity of winter rain events leading to flashier stream flows.
- Decreased water availability in summer; future summer flow and its deviation from historic conditions are not known.

Indirect effects that may occur

- Range shifts by undesirable plants increasing competition.
- Disease introductions and/or increased vulnerability to disease.
- Loss of synchronicity of plant reproduction and pollinators.
- Loss of synchronicity of resident and migratory animals, habitat and food sources (e.g., insect hatches and stream flows for rearing Chinook salmon).

The Jonsson Center may provide a stepping stone and habitat for organisms that must shift their ranges in response to climate change.

3.3 EXISTING FACILITY USE

To date there has been no formal master plan developed to help identify appropriate levels of public access for the Jonsson Center Natural Area. Currently, there are no plans to propose public access due to the sensitive nature of the facility. Carsonite boundary stakes with natural area rule signs have been installed along the edges of the property. There are no known safety issues with the existing site access via S. McCubbin Road.

The Jonsson Center facility is operated 7 days a week, 365 days a year from 8-12 hours per day by the Oregon Zoo. The Jonsson Center received the first condors in November of 2004. Primary purpose is to breed critically endangered California condors for release into the wild to eventually have a self-sustaining population. Funding to operate the breeding facility comes from Oregon Zoo Foundation, USFWS and private donors.

SECTION 4: CONSERVATION

This section provides a comprehensive framework for conservation planning at Jonsson Center Natural Area. This framework generally follows The Nature Conservancy's Conservation Action Planning template (The Nature Conservancy, 2007) and includes analyzing the site, establishing conservation targets, evaluating key ecological attributes for each conservation target, analyzing threats affecting conservation targets and developing action plans to abate serious threats. More detailed information is available in Appendix B.

4.1 CONSERVATION TARGETS

Conservation targets are composed of a species, suites of species (guilds), communities and ecological systems that represent and encompass the full array of native biodiversity of the site, reflect local and regional conservation goals and are viable or at least feasibly restorable (The Nature Conservancy, 2007). Map 9 shows the conservation targets for Jonsson Center.

The methodology for determining conservation targets and key ecological attributes is discussed in detail in Appendix B.1, Conservation Targets, and Appendix B.2, Key Ecological Attributes. Using onsite natural habitat types and regional conservation planning efforts as guides, conservation targets were selected that encompass the site's biodiversity values and regional conservation priorities.

These conservation targets are:

- Riparian forest
- Upland forest
- Native fish

The habitat conservation targets represent the most regionally rare and threatened major habitat types present at the site, as well as patches of coniferous forest, one of the region's most representative habitats. The site's habitat diversity, connectivity at the landscape level and importance to anadromous fish can help conserve rare and at-risk species and keep our common native species common. More detail about each of these conservation targets can be found in Appendix B.1.

4.2 KEY ECOLOGICAL ATTRIBUTES

Key ecological attributes (KEAs) are aspects of a conservation target's biology or ecology that, if missing or altered, would lead to the loss of that target over time (The Nature Conservancy, 2007). KEAs define the conservation target's viability. They are the biological or ecological components that most clearly define or characterize the conservation target, limit its distribution or determine its variation over space and time. They are the most critical components of biological composition, structure, interactions and processes, and landscape configuration that sustain a target's viability or ecological integrity. KEAs are rated from poor to good. This rating helps establish the restoration goals and guide us in development of restoration actions for the conservation targets.

Appendix B.2 (Key Ecological Attributes) and Table 2 below describes the site's KEAs and indicators for each of the three conservation targets in more detail.

4.3 THREATS AND SOURCES

An effective conservation strategy requires understanding the threats to conservation targets and the sources of those threats. For example, adjacent development and subsequent disruption of natural systems place stress on the resource and its inhabitants and threaten the health of the greater ecosystem. At the Jonsson Center, the following threats are evident:

- Increased competition (invasive species throughout the site; see Appendix B.4).
- Altered vegetation structure.
- Human disturbance.
- Altered hydrology.

The methodology for defining threats and sources was established by The Nature Conservancy. It is a well-established, objective methodology with a scientific basis, and is described in more detail in Appendix B.3, Threats and Sources.

Information on the Jonsson Center's conservation targets, KEAs, significant threats and management actions to address those threats is summarized in Table 2 below. More detailed information is available in Appendix B.1, B.2 and B.3, and in the Clear Creek Stewardship Plan. The following section outlines short- and long-term management strategies for conservation targets.

Table 2: Jonsson Center conservation targets.

CONSERVATION TARGET	ATTRIBUTES OF HEALTHY HABITAT
Riparian forest	Includes the riparian and floodplain forest along Clear Creek and its perennial tributaries, as well as associated wetlands. Riparian forests in this case are associated with streams and are relatively linear. Healthy riparian forests are relatively wide (100-200+ feet each side of stream) with few gaps and have a good mix of native trees and shrubs with good native species diversity in all layers. Downed wood and snags are important components. *Current cover:* Approximately 47 acres
Upland forest	An abundant natural habitat of the region, low-elevation Pacific Northwest old-growth forests are typically dominated by Douglas-fir, western redcedar, and western hemlock, with grand fir and hardwood species also occurring. Plant and animal use of forests follows the changes in forests over time, with different suites of species dominating depending on forest age, canopy closure and site conditions. Biodiversity is higher in forests where some light reaches the forest floor and where standing and fallen dead wood is ample and of mixed age and size. The size of habitat (patch size) is a key consideration for wildlife diversity. *Current cover:* Approximately 16 acres
Native fish habitat	Clear Creek and its tributaries provide important habitat to native salmonids and lamprey because the water quality is fairly good, the riparian area is relatively intact and the flow regime has not been altered much compared with many streams in the Portland region. Healthy native fish habitat includes riffle-pool sequences, off-channel habitat, gravel and rocky substrate, and large wood in the stream. *Current cover:* Approximately 5000 linear feet of stream reach

SECTION 5: STRATEGIC RESTORATION AND STEWARDSHIP

5.1 RESTORATION

This conservation plan outlines strategic actions to be carried out at the Jonsson Center over the next 10-15 years. They are based on the short- and long-term goals for the conservation targets. The strategic actions described here are general courses of action to achieve these objectives and not highly prescriptive courses of action. Specific prescriptions will be developed by Metro staff to address site-specific conditions encountered in the areas targeted for restoration action.

About 14 acres of habitat are in need of intensive restoration throughout the Jonsson Center site. This primarily includes restoration of the riparian forest and upland forest habitat areas. The information below summarizes conservation targets' key ecological attributes, significant threats to the habitat, and strategic restoration and stewardship actions that can be taken to keep or bring the KEAs into the desired range.

Conservation target: Riparian forest

Short-term goals 2019-2023

- Increase cover of native tree and shrub (vegetation structure) and native tree and shrub species richness in all riparian and floodplain forest habitat areas.
- Decrease gaps in woody vegetation so no undesirable gaps exist.
- Increase floodwater access to the floodplain. Floodwaters should inundate large portions of the floodplain during two-year or higher flood events in the winter.

Long-term goal

The desired future condition is to have the majority of the key ecological attributes ranked as good to very good thereby maintaining and restoring habitat suitable for riparian forest-dependent wildlife species. Healthy riparian areas are also linked to native fish conservation listed below.

Summary of riparian forest restoration work completed through 2019

Restoration work in riparian forest areas adjacent to Clear Creek started in 2014. A full site assessment of invasive species was completed prior to the implementation of invasive species management. Between 2015 and 2019 multiple treatments were completed to prepare for future native tree and shrub plantings in the riparian areas.

Key ecological attributes outside normal range of variation

- *Percent cover of native trees and shrubs:* much of the area classified as riparian and floodplain habitat is still dominated by reed canary grass and has limited canopy cover of trees and shrubs.
- *Gaps in woody vegetation:* numerous large gaps in intact riparian vegetation exist.
- *Standing and downed dead trees:* lack of intact mature forest has resulted in limited quantities of downed wood on the ground.
- *Floodwater access to the floodplain:* floodwaters only inundate the floodplain during extreme high water events in the winter due to historic channel alterations.

Critical threats very high and high range

- *Altered native species composition:* non-native species out-compete native plant species.
- *Ecosystem degradation:* historic logging on the site (and upstream in the watershed) reduced the extent of intact forests and large wood on the ground in the system.
- *Altered hydrology:* widespread altered hydrology due to increased impermeable surfaces associated with development leads to stream bank erosion, channel damage, loss of gravel and cobble substrate and overall habitat simplification.

Strategic restoration and stewardship actions

- Restoration actions will be initiated to control non-native invasive species and increase the cover of native trees and shrubs. This action has been initiated through site preparation treatments in 2018 for plantings planned for 2019-2022.
- Early detection and treatment of invasive species should target high priority species such as false brome (*Brachypodium sylvaticum*), knotweed (*Polygonum* spp.), yellow archangel (*Lamium galeobdolon*), evergreen bugloss (*Pentaglottis sempervirens*), creeping bellflower (*Campanula rapunduloides*) and other EDRR species. Treatments would occur bi-annually.
- Monitoring for new infestation of invasive weeds should occur annually, especially in riparian areas exposed to annual flood events.

Conservation target: Upland forest

Short-term goals 2019-2023

- Increase native tree and shrub cover to greater than 75 percent canopy cover.
- Maintain diversity in the age and structure of young and medium aged conifer stands.
- Increase understory species, including shrubs in young and medium aged conifer stands.

Long-term goal

The desired future condition is to have all key ecological attributes ranked as good to very good thereby maintaining and restoring habitat suitable for upland conifer forest-dependent wildlife species. This habitat type is most likely to see increase in use by large migratory mammals like elk, deer, coyote and cougar.

Summary of upland forest restoration work completed through 2019

Restoration work in upland forest areas adjacent to Clear Creek started in 2014. A full site assessment of invasive species was completed prior to the implementation of invasive species management. Bi-annual treatments have occurred since 2014 and the understory native herbaceous layer is recovering back to its historical state.

Key ecological attribute outside normal range of variation

- *Percent cover of native trees and shrubs:* shrubs and trees are lacking in areas impacted from previous development.
- *Standing and downed dead trees:* most upland forest areas on the site lack dead wood. This is primarily due to historic logging and the age of the trees.
- *Number and size of mature trees:* Mature Douglas-fir, western redcedar, western hemlock and grand fir trees are lacking.

Critical threats very high and high range

- *Altered native herbaceous species composition:* non-native species out-compete native species, particularly false brome.
- *Ecosystem conversion:* forest structure has been simplified due to historic logging and homesite development.

Strategic restoration and stewardship actions

- Restoration actions have been initiated to control non-native invasive species and planting to increase the cover of native trees and shrubs.
- Early detection and treatment of invasive species should target high priority species such as false brome, creeping bellflower, knotweed, and other EDRR species. Treatments would occur bi-annually. Existing patches of false brome should be maintained to below 10 percent cover.
- Monitoring for new infestation of invasive weeds should occur annually.

Conservation target: Native fish habitat

Short-term goals 2019-2023

Increase the complexity of in-stream habitat and the number of key large wood pieces in Clear Creek and off channel habitat areas.

Long-term goal

The desired future condition is to have all key ecological attributes ranked as good to very good thereby maintaining and restoring habitat suitable for native fish species present in Clear Creek. More specifically the long-term goal is to support the recovery of ESA-listed coho and winter steelhead populations.

Summary of native fish restoration work completed through 2018

In 2007 restoration work on native fish habitat began with placement of large wood and construction of a side channel in Clear Creek with grant funding from Portland General Electric (PGE).

Key ecological attributes outside normal range of variation

- *Complexity of habitat:* Clear Creek lacks complex habitats that native fish require for spawning and rearing.
- *Key pieces of large wood:* historic logging on the site (and upstream in the watershed) has reduced the number of key large wood pieces in the stream and off channel habitats.

Critical threats very high and high range

- *Altered hydrology and simplified stream structure:* lack of side channel, sparse riffle-pool sequences and limited large wood that provides complex habitat for fish.
- *Impaired fish passage:* manmade structures that block fish migration including dams, weirs and culverts.

Strategic restoration and stewardship actions

- Install single or multi-piece large log structures on the main channel of Clear Creek. Log placement should be designed to restore long-term processes that develop and maintain complex habitats for native fish. Project work will be considered as part of a larger reach scale project that is developed in 2021-2023.
- Replace 2 culverts on maintenance roads in floodplain areas to promote passage for native fish and wildlife. Replacement of the culverts will also reduce long term maintenance costs.

5.2 PRIORITIZING STRATEGIC RESTORATION AND STEWARDSHIP ACTIONS

It is important to prioritize restoration and stewardship activities for several reasons. Budgetary or time constraints are likely to limit how much work can be accomplished at a given site during a given time period. Specific actions may rise to the top due to the scarce or unique nature of a habitat type or because abating a certain threat now will save time and money in the future. Table 3 assigns priority rankings to key actions; this does not mean that the other actions are not important, simply that they are not the most important actions within the next 3-5 years.

Table 3: Priority status for the Jonsson Center conservation targets.

CONSERVATION TARGET	PRIORITY
Riparian forest	High
Upland forest	Medium
Native fish	High

5.3 ONGOING STEWARDSHIP AND RESTORATION PROGRAMS

The following actions represent ongoing systems or programs that are in place and practices that will be continued and/or enhanced. These actions align with maintaining the conservation targets in good or very good condition.

Stewardship

Metro's Natural Areas Program is committed to long-term stewardship of Jonsson Center site. Metro and Zoo staff will conduct multiple site walks per year to monitor natural resource condition of the

natural area. As determined necessary by staff and consistent with this plan, specific treatments or actions will be implemented to ensure that the health and condition of the natural area is maintained. Some periodic stewardship actions that are implemented by staff include invasive species management, visits to monitor for illegal use of the site, cleanup of illegal dumping, mowing of buffer and roadside areas for fire safety, replacing signage and response to complaints. Table 4 describes high and medium priority maintenance action at the site. Additional details about the stewardship of the site can be found in the Jonsson Center Site Stewardship Plan.

Table 4: High and medium priority stewardship actions.

ACTIVITY	FREQUENCY/DURATION	PRIORITY
Site walk	4 times per year	High
EDRR (weed invasion treatments)	2 times per year	High
Culvert and road inspections	1 time per year	Medium
Property line encroachments	1 time per year	Medium
Entry/rule sign inspection	2 times per year	Medium
Gates and fence inspection	2 times per year	Medium

Invasive species management

Invasive plant species can impact the habitat values for which land is conserved. Natural lands are not fully protected unless they also are managed for the features that first motivated preservation. Invasive species can change community structure, composition and ecosystem processes on these lands in ways that may not be anticipated or desirable. Careful management can minimize these negative impacts. Metro has initiated an early detection and rapid response program (EDRR) for invasive species including false brome, yellow arch angel, evergreen bugloss, knotweed and, which have been documented in the area. Invasive species will be controlled by hand pulling or herbicide application as they are detected in the natural area. Other invasive plant species will be controlled as part of restoration projects or ongoing management of habitat areas. See Appendix B.4 for a list of invasive species.

5.4 LONG-TERM STRATEGIES

The following actions may be necessary to achieve the long-term goals of this site conservation plan but are not identified as priority actions during the time period of this plan.

- Restore upland forest areas including completing forest stand management activities. Thinning of mature trees may be necessary in the coming 20+ year timeline to promote the development of old growth forests.
- Acquisition of fee title or conservation easements of adjoining private lands adjacent to Riparian forest and upland forest habitat areas.
- Relocation of facilities outside of the floodplain to restore high priority native fish and riparian forest habitats.

- Removal of dumped debris located on steep slopes of the property. An assessment of the historic nature of the material may be needed before this action can be completed.

SECTION 6: FACILITY AND SITE MANAGEMENT

The facility and site is collaboratively managed by Metro's Oregon Zoo and Parks and Nature teams. An agreement has been developed to identify roles and responsibilities of each team in coordinating restoration, site management and facility activities.

6.1 FUTURE PUBLIC ACCESS AND FACILITY DEVELOPMENT

The 2016 Parks and Nature System Plan identified Jonsson Center as a natural area. Given the sensitive nature of the facility no public access is being considered for this site.

6.2 SITE MANAGEMENT

Management of the site will include enforcement of the posted rules to provide protection for wildlife and water quality, and security for the Jonsson Center facilities.

Archeological resources

The area along Clear Creek and the Jonsson Center site is steeped in history and may contain archeological resources. If, during any site investigation, alteration or improvement, an archaeological resource is discovered, Metro will work with the State Historic Preservation Office to evaluate and document the find. If any damage or unlawful use is identified, Metro would partner with the Clackamas County Sheriff to investigate.

6.3 STRATEGIC ACTIONS (FACILITY AND SITE MANAGEMENT)

The following actions describe the proposed facility and site management improvements over the life of this plan. The projects were established as part of the development of this plan and should be revisited every two to three years for additions and updates. Cost estimates for these actions are included in Section 7.2 of this document.

Maintenance roads

In order to continue using the existing maintenance roads some improvements will need to be made during the life of this plan. These improvements may include surfacing with ¾" minus top dressing to 10 feet wide, brushing and ditching of roadside areas, replacement of failing culverts and restoration of slope failures.

Fencing

Replace and repair existing fences to control site boundaries.

SECTION 7: COORDINATION

The conservation plan has laid out the history and context of the Jonsson Center Natural Area, along with the conservation, facility and site management projects for the next five years. For those projects to be realized, coordination will be needed on a number of fronts. Important coordination points include:

- Balancing future facility development with natural resource (habitat) improvements.
- Monitoring restoration efforts to track effectiveness and make changes to the priorities and goals as needed.
- Funding to realize the strategic restoration, facility and site management actions identified in this plan.

7.1 MONITORING FRAMEWORK

Monitoring at the Jonsson Center site is an integral part of an adaptive management approach to restoration and stewardship. Based on the monitoring plan developed by Metro, a feedback loop is created between monitoring and management decisions. Monitoring will be done to evaluate habitat, population responses to management action, as well as progress toward achieving habitat and population objectives.

The monitoring strategy is based on threats and key ecological attributes associated with conservation targets. Monitoring addresses threats directly and indirectly by tracking changes in certain ecological attributes. It implements techniques that are well-established and continues many monitoring efforts already in place.

Monitoring techniques

Some monitoring techniques are used to monitor more than one conservation target. This discussion is intended to provide a general introduction but not detailed methods.

Remote sensing/GIS

Several metrics for health of conservation targets relate to canopy cover and size of a habitat. Where a desired condition is a minimum canopy cover, it can be estimated with GIS software using current aerial photography. Similarly, important connections within the natural area and to off-site habitat can be inspected with aerial photographs.

Transects

These are lines or strips of ground along which measurements are made of plant species presence or absence. Permanent transects can be installed and tracked over the years to track progress toward goals. They are useful in tracking the cover and composition of native plants and invasive species in Oregon white oak savanna and riparian forest habitat areas.

Wildlife monitoring

Monitoring of pond-breeding amphibians using egg mass surveys, limited land-based amphibian surveys and breeding bird surveys using breeding season point counts is conducted by staff,

contractors or Metro-trained volunteers at Clear Creek Natural Area. In some cases, wildlife monitoring can establish a baseline for and tracked post-project response to restoration efforts.

Site walk

Ocular (visual) estimates can be used to determine the presence or absence of a species within a short timeline and at a very low cost. This method of monitoring is typically used to determine intervals for treatments or success of a planting when managing projects.

Photos

Permanent photo points are established to provide long term documentation of changes to habitats over time. Typically, photo points are marked by a permanent landscape feature or metal stakes and photos are taken at a landscape scale over long term periods of time.

Conservation targets and monitoring techniques

Riparian forest

A combination of site walks, transects and photo points will be used to monitor key ecological attributes of this conservation target.

Upland forest

Annual site walks will be used to monitor this conservation target. When large scale restoration work is implemented, the monitoring actions for this conservation target should be revisited.

Native fish

Metro will rely on the Oregon Department of Fish and Wildlife to provide monitoring data for this conservation target. Monitoring is part of their annual stream survey of Clear Creek and is subject to staff availability and allocation of resources in annual budgets.

Table 5: Habitat monitoring actions.

HABITAT	MONITORING ACTIVITY (TECHNIQUES)	FREQUENCY/DURATION	PRIORITY
Riparian forest	Site walk (project management)	1 time per year	High
	Transects (% cover vegetation)	1 time per year	Medium
	Photo points	1 time per year	Medium
Upland forest	Site walk (project management)	1 time per year	Low
Native fish	Transect (habitat complexity)	1 time per year	High[1]
	Wildlife (spawning survey)	1 time per year	High[1]

[1] Completed by Oregon Department of Fish and Wildlife

7.2 FUNDING

Costs in Tables 6 and 7 are general estimates for the purpose of understanding the magnitude of costs to implement the structural elements of the plan, as described in Sections 4 and 5. The costs are estimated of hiring contractors to complete the work and include a construction contingency for time and materials. In addition to these project implementation costs we have included staff time and annual stewardship costs for the Jonsson Center in Table 8.

Table 6: Facility and site management strategic action cost estimates.

STRATEGIC ACTION	COST
Maintenance road repairs	$15,000
Total	**$15,000**

Table 7: Conservation target strategic restoration action cost estimates.

STRATEGIC ACTION	COST
Riparian forest Plant native tree and shrubs, invasive species treatments	$75,000
Upland forest Invasive species treatments and additional plantings	$50,000
Native fish Install logs and log jams in Clear Creek Repair maintenance road and install culverts	 $75,000 $90,000
Total	**$290,000**

Table 8: Annual stewardship cost estimates.

ANNUAL STEWARDSHIP*	COST
EDRR surveys and invasive weed treatments (entire site)	$2,500
Maintenance of existing Infrastructure (average of multiple small actions)	$1,000
Total (per year cost)	**$3,500**

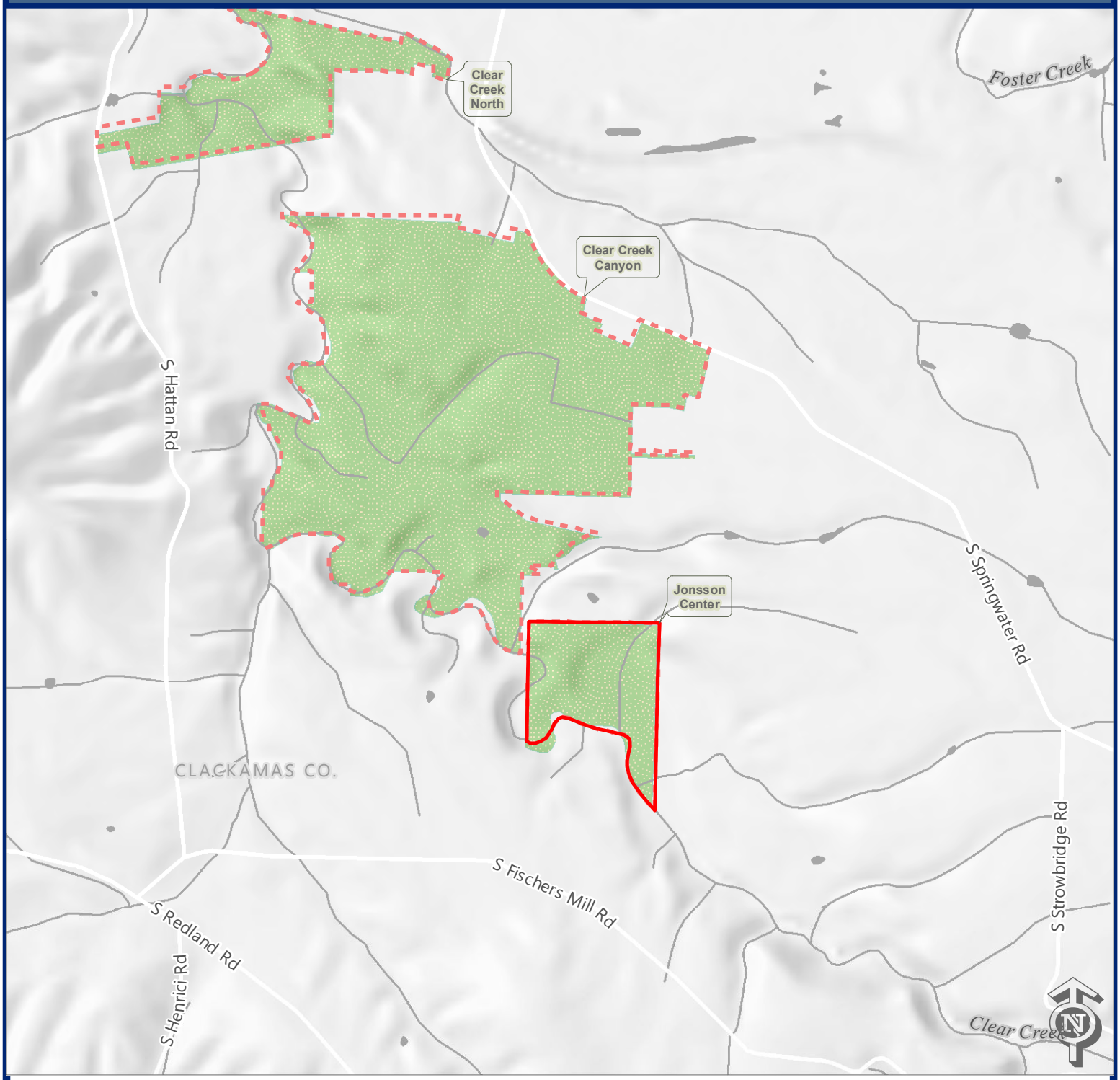
* Stewardship actions and costs are described in more detail in the Jonsson Center Stewardship Plan

7.3 PUBLIC INVOLVEMENT

As projects are developed, Metro will provide local stakeholders and residents near the Jonsson Center with pertinent information about the work before it is implemented. Project information may include background on the project, timing, cost, materials types and other information as necessary for interested parties to be aware of the project and its implications.

VICINITY MAP

Metro

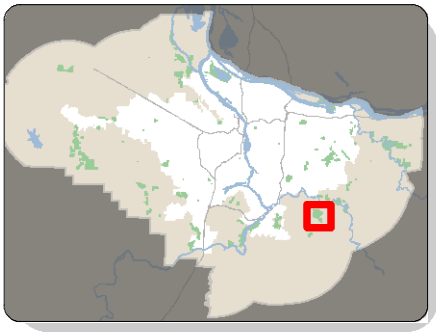


Jonsson Center site

Other Metro sites

Parks and/or Natural Areas

0 0.55 1.1 Miles

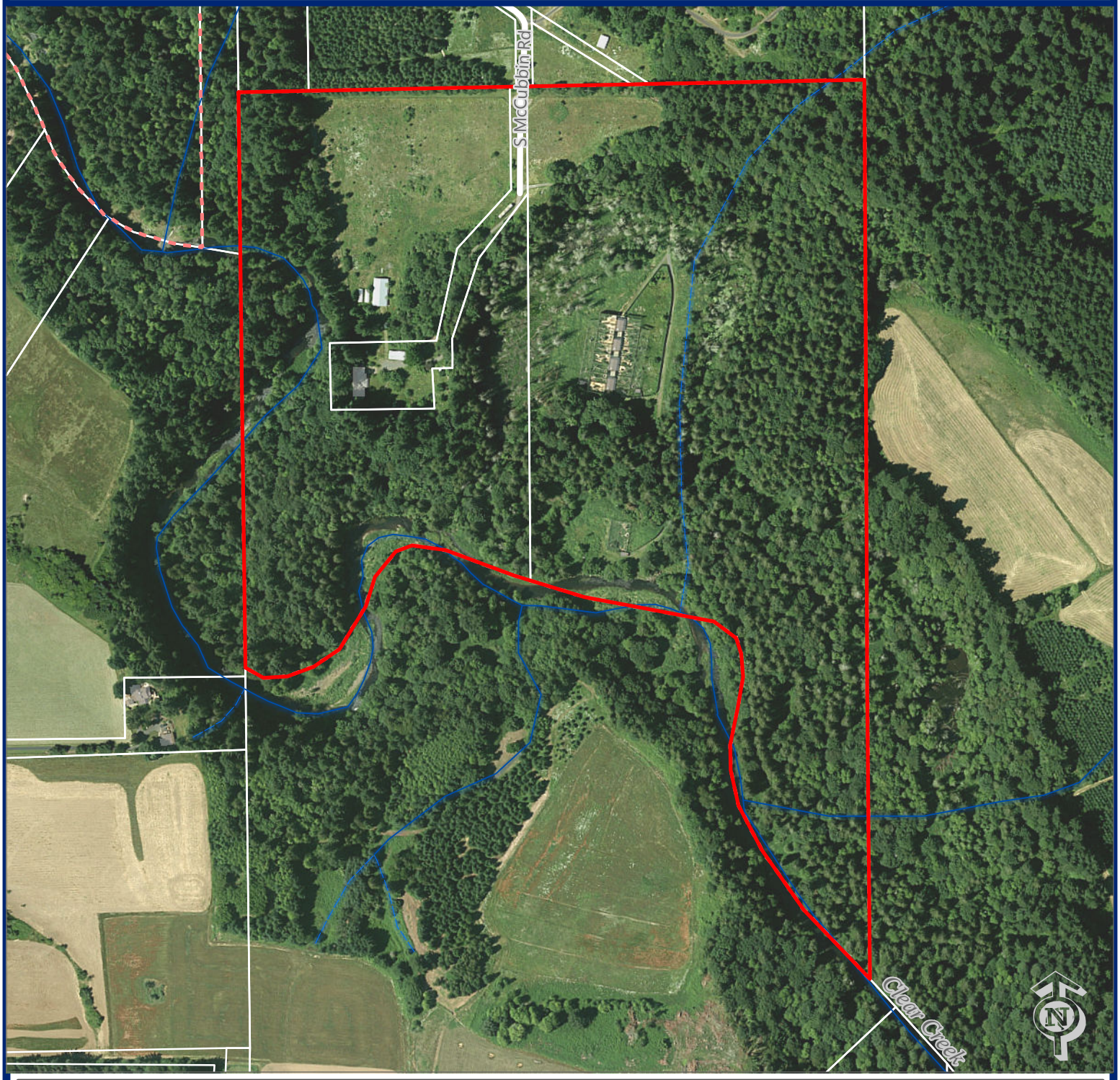


Jonsson Center Site Conservation Plan

map date: 11/19/2019

SITE MAP

Metro



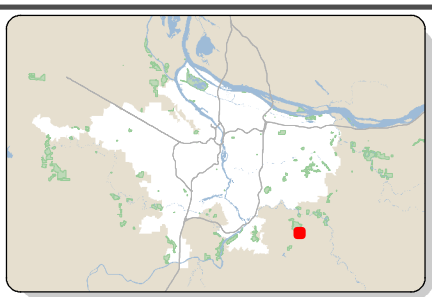
Jonsson Center site

Other Metro sites

Perennial stream

NHDplusStrmFlowline

Intermittent stream



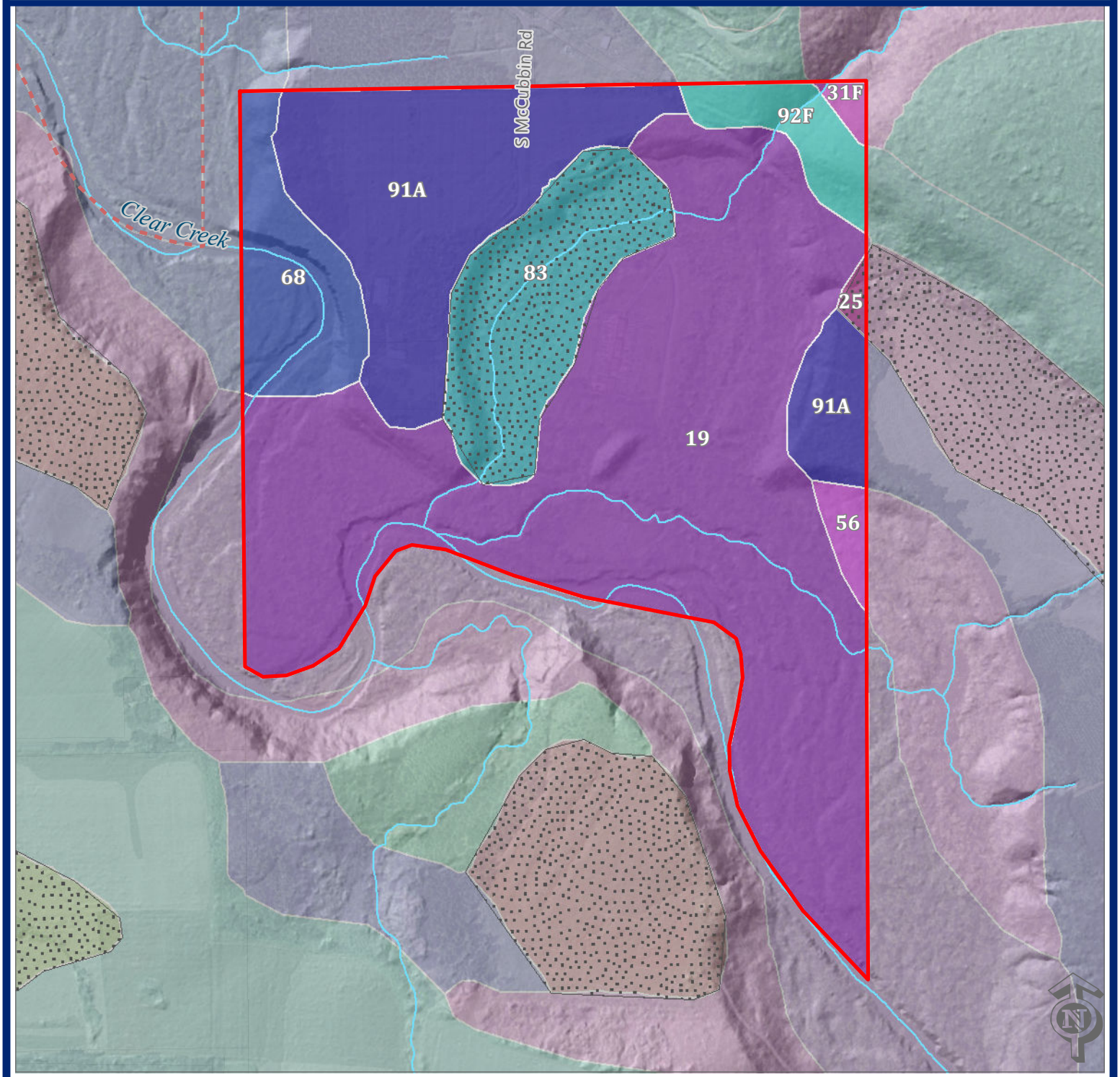
0 580 1,160 Feet

Jonsson Center Site Conservation Plan

map date: 3/27/2018

SOILS

Metro



Jonsson Center site

Other Metro site

Hydric soils

19 - Cloquato silt loam

25 - Cove silty clay loam

31F - Dystrochrepts, very steep

56 - McBee silty clay loam

68 - Newberg loam

83 - Wapato silt loam

91A - Woodburn silt loam, 0 to 3 percent slopes

92F - Xerochrepts and Haploxerolls, very steep

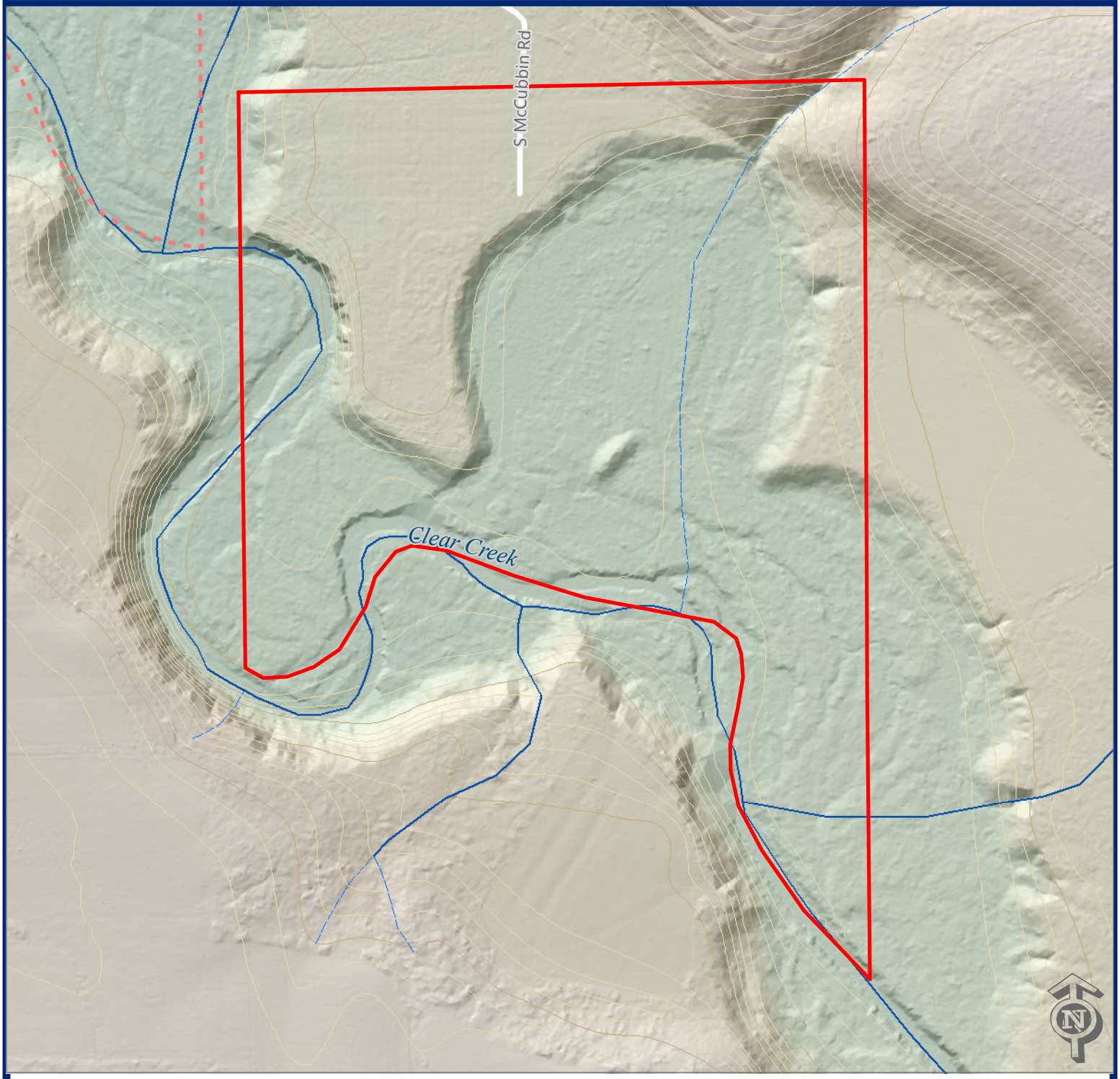
0 520 1,040 Feet

Jonsson Center Site Conservation Plan

map date: 3/27/2018

TOPOGRAPHY

Metro



Jonsson Center site

Other Metro sites

NHDplusStrmFlowline

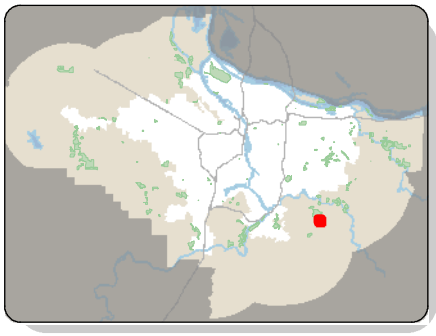
Intermittent stream

Perennial stream

10 ft contour

50 ft contour

0 590 1,180 Feet

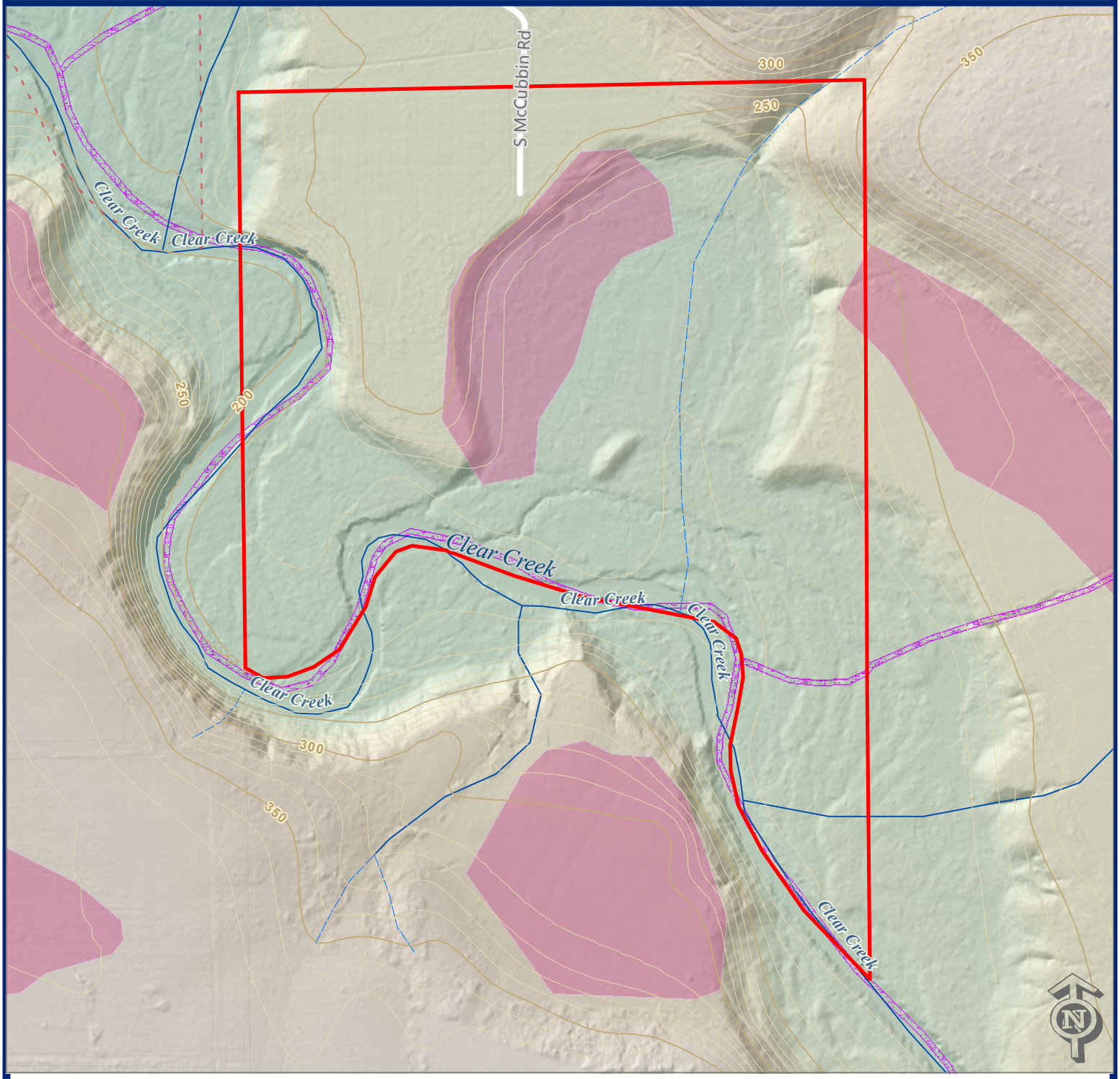


Jonsson Center Site Conservation Plan

map date: 3/27/2018

HYDROLOGY

Metro



Jonsson Center site

Other Metro sites

Wetlands (Wetlands Conservancy data)

NHD Flowlines

Intermittent stream

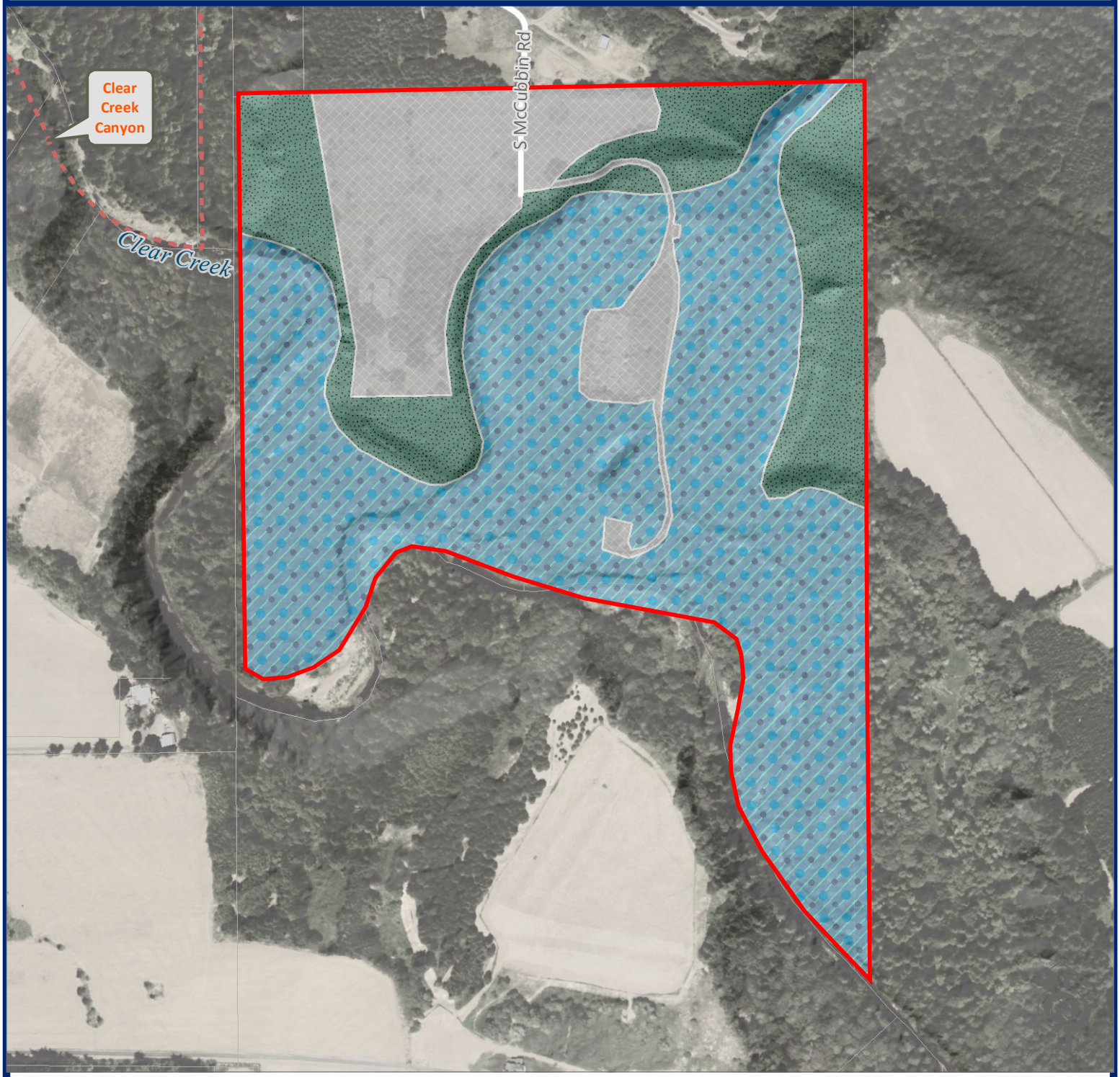
Perennial stream

Hydric soils

0 575 1,150 Feet

CURRENT COVER

Metro



Jonsson Center site

Other Metro site(s)

Developed - (pervious/non ag)

Riparian forest

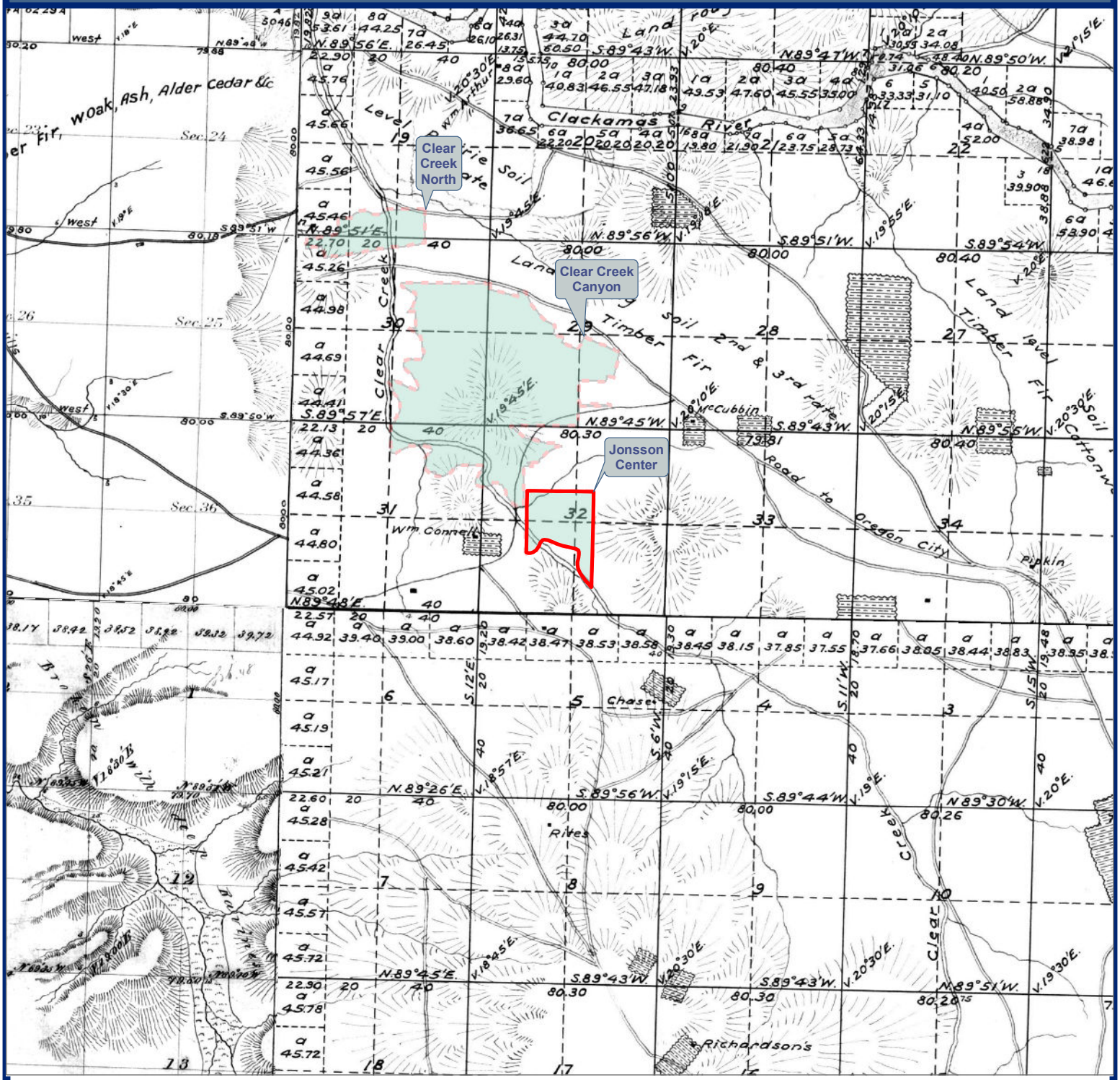
Upland forest - coniferous

0 520 1,040 Feet

GENERAL LAND OFFICE (GLO) MAP

This map is the 1852 public land survey of the Portland, OR region.

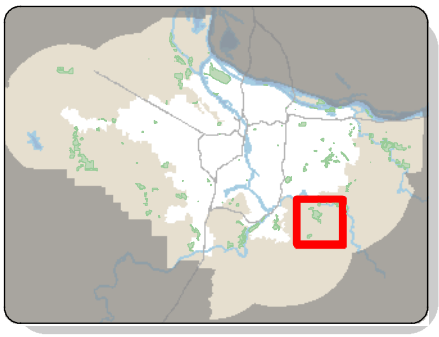
Metro



Jonsson Center site

Other Metro sites

0 1 2 Miles

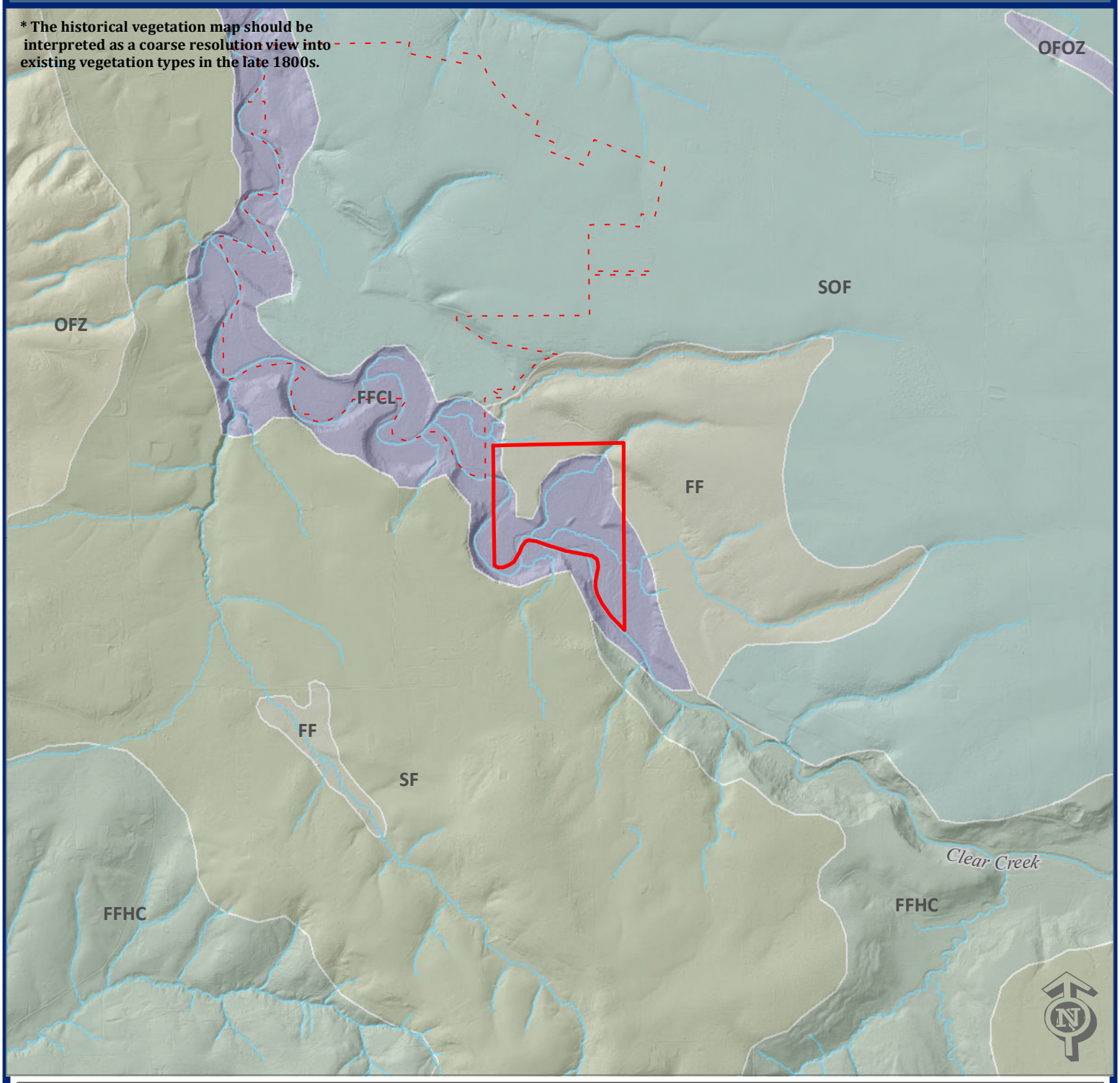


Jonsson Center Site Conservation Plan

map date: 3/27/2018

HISTORICAL VEGETATION

Metro



Jonsson Center site

Other Metro sites

Historical vegetation

- FF - Closed forest; Upland
- FFCL - Closed forest; Riparian & Wetland
- FFHC - Closed forest; Upland
- OFOZ - Woodland
- OFZ - Woodland
- SF - Savanna
- SOF - Savanna

* Labels refer to vegetation subclasses. Detailed descriptions can be found in T:\OBMO\GIS\DATA_V\vegetation\Historical

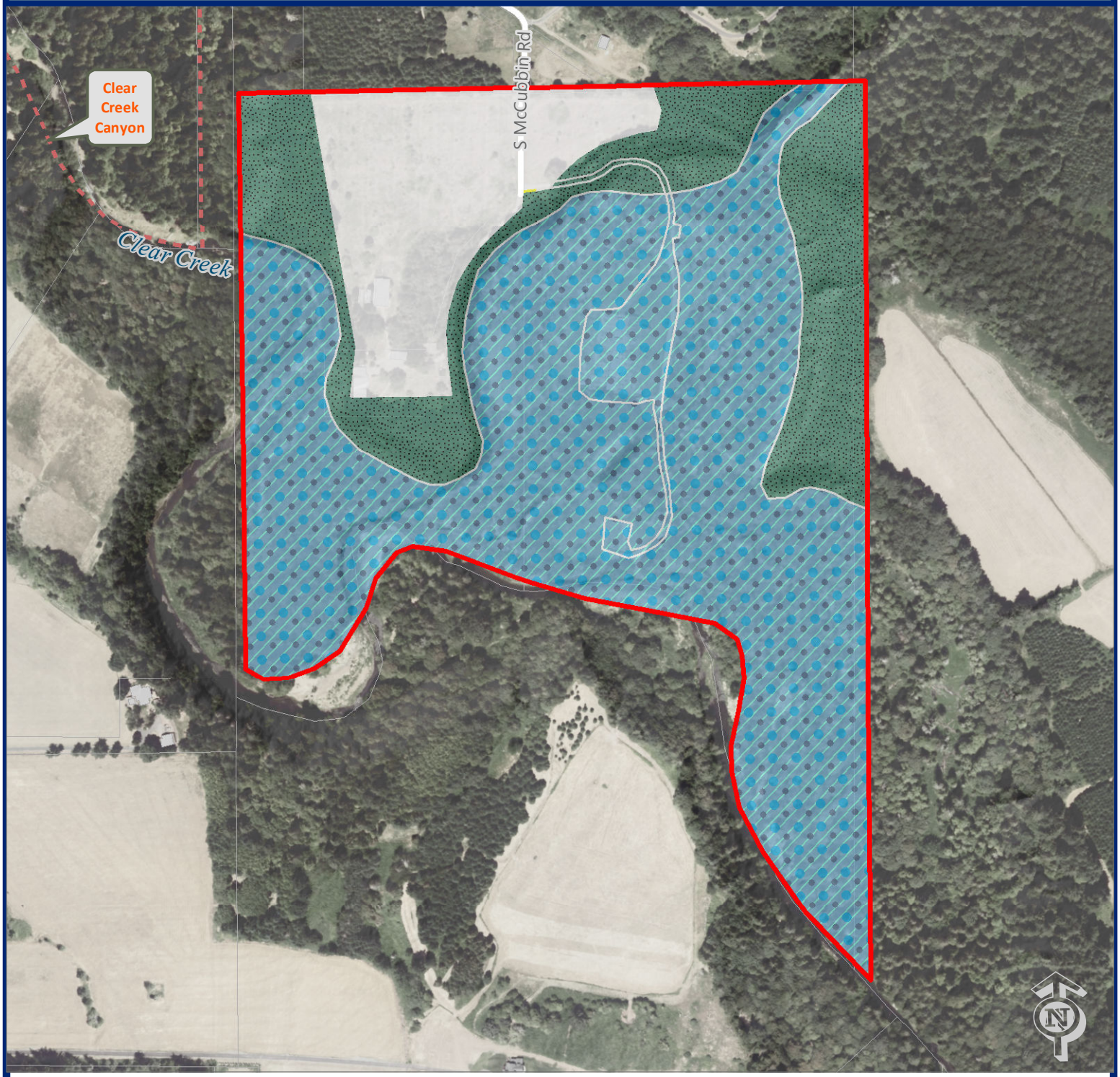
0 2,000 4,000 Feet

Jonsson Center Site Conservation Plan

map date: 3/27/2018

CONSERVATION TARGETS

Metro



Jonsson Center site

Other Metro site(s)

No targets

Riparian forest

Upland forest

0 520 1,040 Feet

Jonsson Center Site Conservation Plan

map date: 12/13/2019

APPENDIX A | PHYSICAL ENVIRONMENT

The following excerpt is from the Clear Creek and Foster Creek Watershed Assessment that was developed by the Clackamas River Basin Council in September of 2002.

GEOLOGY: ROCKS AND LANDFORMS

The geologic history of the lower Clackamas region, spanning about 15 million years (15 Ma), has been characterized by the interaction of volcanic and depositional processes along the border between the Cascade Range and the Portland Basin (part of the Willamette structural trough).

The materials include volcanic and sedimentary rocks, poorly-inundated to unconsolidated fluvial and mudflow deposits, and the soils formed on them. Four major geologic units include the Sardine Formation, the Troutdale Formation, the Boring Lava, and Alluvial Deposits: Terraces and Floodplains. These units are briefly described below, and in greater detail in the Sediment Sources Section.

The Goat Mountain highlands are built of the oldest rocks in the study region, Western Cascade volcanic rocks named the Sardine Formation or Rhododendron Formation by various workers. Andesitic lava flows erupted from vents at Goat Mountain, Soosap Peak, and other sites east and south of the study area, about 15-5 Ma. Along with associated flow breccias, the lavas built thick volcanic piles around the vents; mudflows carried some of the material north and west, where it was deposited in the lowlands (and is exposed in the bottom of Clear Creek almost to Viola). All of these rocks are now well cemented.

As the Cascade Range rose (after about 4 Ma), the ancestral Columbia River and streams flowing off the growing mountains deposited sediments in the trough to the west. These fluvial conglomerates, sandstones, and siltstones form one of the thickest layers of materials in the Portland Basin. In the study area, they lap onto the Goat Mountain highlands near Dodge and Elwood, and thicken northwestward; as much as 500 ft is exposed in the canyon of Clear Creek.

High Cascade-like volcanic activity extended across the Portland Basin in the late Pliocene and Pleistocene (about 3.2-0.5 Ma), creating the Boring Lava formation. Named for the Boring Hills, these basaltic flows and associated agglomerates and tuff-breccias erupted intermittently from dozens of vents in the region, forming cinder cones, shield volcanoes, and some extensive lava plateaus. In the Clear-Foster area, the main sources were in the Outlook buttes (3.15 Ma, among the oldest Boring Lavas yet dated), in the hills between Redland and Four Corners, and at Highland Butte. The Clackamas River, Clear Creek, and their tributaries later eroded into and broke up the nearly continuous surface of Boring Lavas and cones that probably once stretched from Oregon City to the Cascade foothills.

The site's terraces and floodplains arise, in part, from alluvial deposits. Erosion and deposition processes continued throughout occasional eruption of the Boring Lavas. There are some breccias that were probably formed by mudflows coming off the volcanoes; meanwhile, streams continued to bring sediment down from the Cascades. The highest surface in the study area, called the Springwater surface, is mantled with fluvial conglomerate (with lesser sands, silts, and debris flows), deposited over Troutdale sediments and interbedded with Boring Lavas. The Springwater is thickest

next to the Cascades near Dodge, and thins westward toward Logan, where it laps against the Boring volcanic plateau; it probably once formed a near continuous piedmont or bajada surface at the foot of the Cascades. Now about 2 Ma old, it is commonly highly weathered to about 75 ft depth.

GEOLOGIC CHANNEL FORMING PROCESSES

Channel characteristics in the Clear and Foster Creek basins reflect the geologic and geomorphic processes that have been active in the region, especially over the past couple of million years. Uplift of the Cascades, volcanic eruptions, and deposition of fluvial sediments created the materials and relief of the area; abundant rainfall has generated surface and subsurface runoff that stimulated mass wasting and stream erosion. The channels in the basin can be sorted into a small number of landform types based on their combinations of geologic materials, terrain, and history.

The terrain in about two-thirds of the Clear Creek Watershed is dominated by a series of plateaus and terraces, built up by a combination of local volcanic eruptions (from Boring Lava vents) and the deposition of fluvial sands, silts, and gravels by streams flowing off the Cascades. The weathered soils and rocks of the lava plateaus and the older/higher terraces have been eroded into rolling surfaces by small tributary streams, flowing away from the volcanic centers or down the inherited terrace slopes at gentle gradients. But where they flow over the terrace edges into the deeper canyons, these streams have eroded ravines of varying lengths and depths. The channels in these ravines are typically narrow and steep, and local gradients are controlled by the rocks' resistance to incision. In many places, hard layers of basalt, conglomerate, sandstone, or mudstone form ledges, waterfalls, and step-pools (such as on Swagger Creek); in others, stream incision has left narrow slices into bedrock (as at the mouth of Foster Creek).

The Clackamas River, Clear Creek, and their major tributaries have eroded deeply into the old upland surfaces, while stream meandering (particularly by the Clackamas) shaped the terraces and left steep terrace scarps. Along Clear Creek (especially from Dodge-Elwood to Fischer's Mill) and the major tributaries (Mosier, Little Clear, Little Cedar, and Bargfeld Creeks, etc.), the combination of stream incision and land sliding has produced deep, complex ravines. Almost all of the scarps have been affected by shallow mass movement to one degree or another, and most show evidence of deep-seated land sliding, with some slide complexes hundreds of acres in area. Where the ravines are narrow, such sliding has on occasion blocked the creeks (at least temporarily), altering local base levels and depositional patterns. Even in the wider Clear Creek canyon, sliding has deflected the stream toward the opposite wall in places, changing local erosional patterns and channel behavior. The smaller tributaries that cross or originate on the irregular surfaces of the large landslide bodies typically have gentle gradients, commonly interrupted by small ponds and wetlands. The landslides are major contributors to the supplies of coarse sediment (including boulders and cobbles, locally) and large woody debris to the streams.

Although terrace scarps and bluffs remain important elements, in terms of constraining channel migration and supplying sediment from landslides, downstream of Springwater Clear Creek flows dominantly on alluvium (as opposed to bedrock) in a generally wider valley bottom. There, low-gradient streams meander across their valley bottoms, occasionally abandon channel segments, and inundate their floodplains and low terraces during high flows. The younger/lower terraces of the

north end of the area (including most of the Foster Creek basin) are typically flatter than the rolling higher surfaces in the south. Consequently, the tributaries flowing on them tend to have very gentle gradients, except where they have eroded ravines into the terrace scarps, as near the mouth of Foster Creek. On the lower terraces and floodplains, small streams can flow into abandoned channels or onto the inboard edges of lower terraces, or originate there from seepage. These small back-terrace or wall-base channels provide important rearing and refuge habitat.

SOILS

The properties of soils found within a watershed influence to a large extent the movement of water through and within the soil layers. Information on soils in the Clear and Foster Creek watersheds is available from the soil survey of the Clackamas area (NRCS, 1985; 1998) published by the USDA Natural Resources Conservation Service (NRCS; formerly the Soil Conservation Service). The NRCS has classified soils into hydrologic soil groups (HSGs) to indicate the rates of infiltration and transmission (rate at which the water moves within the soil).

Table 1: Descriptions of hydrologic soil group properties for the Jonsson Center Natural Area

SOIL SYMBOL	SOIL NAME	DESCRIPTION
68	Newberg Loam	This deep, somewhat excessively drained soil is on flood plains. It formed in mixed alluvium. Slope is 0 to 3 percent.
92F	Xerochrepts	This map unit is on terrace escarpments. Slope is 20 to 60 percent.
25	Cove Silty Clay Loam	This deep, poorly drained soil is on flood plains. It formed in clayey alluvium. Slope is 0 to 2 percent.
83	Wapato	This deep, poorly drained soil is on flood plains. It formed in mixed alluvium. Slope is 0 to 3 percent.
56	McBee	This deep, moderately well drained soil is on flood plains. It formed in mixed alluvium. Slope is 0 to 3 percent.
31F	Dystrochrepts	These deep, well drained soils are on terrace escarpments. They formed in colluviums derived dominantly from basalt and andesite.
19	Cloquato	This deep, well drained soil is on flood plains. It formed in mixed alluvium. Slope is 0 to 3 percent.
91A	Woodburn	This deep, moderately well drained soil is on broad valley terraces. It formed in stratified glaciolacustrine deposits.

APPENDIX B-1 | CONSERVATION TARGETS

INTRODUCTION

Conservation targets are composed of a suite of species, communities and ecological systems that represent and encompass the full array of native biodiversity of the site, reflect local and regional conservation goals, and are viable or at least feasibly restorable (The Nature Conservancy 2007). Priority conservation targets represent species or habitats that are the conservation focus for a given area or management unit.

Conservation targets establish the basis for setting goals, carrying out conservation actions, and measuring conservation effectiveness. They are the foundation of conservation planning. Key ecological attributes (KEAs) for each conservation target will be evaluated. KEAs are aspects of a conservation target's biology or ecology that, if missing or altered, would lead to the loss of that target over time (The Nature Conservancy 2007). Viability of the conservation target is inferred by the condition of the KEAs. Analysis of threats affecting conservation targets inform the development of action plans to abate serious threats and monitoring plans to gauge success of the action plans. Conservation targets then should consist of species or communities that will provide the focus of management actions and monitoring. Species or communities that for whatever reason are too expensive to manage or monitor are not good candidates for conservation targets.

BACKGROUND

Historically, the Willamette Valley was dominated by extensive prairie, oak savanna and woodland habitats totaling approximately 2 million acres that supported a wide diversity of plant and animal species, including several endemic to the Willamette Basin (Floberg et al 2004). These habitats were primarily maintained by Native American-ignited fires. Agricultural and residential development in the Willamette Subbasin and the cessation of widespread prescribed fires has resulted in a substantial loss of native habitat especially at the lowest elevations, leaving less than two percent of all historic prairies and seven percent of oak habitat extant today.

METHODS

Regional conservation plans were referenced to align the conservation goals of the Jonsson Center Site Conservation Plan (see Table 1). These plans included the Oregon Department of Fish and Wildlife's Oregon Conservation Strategy (ODFW 2006), The Nature Conservancy's Ecoregional Assessment of the Willamette Valley – Puget Trough-Georgia Basin (Floberg et al 2004), the Northwest Power and Conservation Council's Willamette Subbasin Plan (NWPCC 2005), and Partners in Flight's Conservation Strategy for Landbirds in Lowlands and Valleys of Western Oregon and Washington (Altman 2000). These plans identify both focal habitats and focal species as conservation targets.

The Jonsson Center Natural Area is large with diverse habitats and species. Reflecting this complexity, several sensitive species and onsite habitats as mapped by Metro staff were used as the foundation for selecting conservation targets.

RESULTS

Using onsite habitat types and regional conservation planning efforts as guides, conservation targets were selected that encompass the site's most threatened biodiversity values as well as regional conservation targets (Table 1). Each of the conservation targets are represented in one or more of the regional conservation plans listed in Table 1.

Table 1: Jonsson Center conservation targets and relationships to other conservation strategies.

JONSSON CENTER NATURAL AREA CONSERVATION TARGETS	**OREGON CONSERVATION STRATEGY** *(ODFW 2016)*	**WILLAMETTE BASIN SUBBASIN PLAN** *(Primozich 2004)*	**LANDBIRD CONSERVATION STRATEGY** *(Altman 1999, 2000)*	**ECOREGIONAL ASSESSMENT** *(Floberg et al 2004)*
Riparian forest	Freshwater aquatic, riparian and wetland habitats are all priorities for the Willamette Valley	Basinwide priority	Riparian	Riparian forests and shrublands
Upland conifer-hardwood forest	Late successional conifer forests	Old growth conifer forest	Low elevation western hemlock/western redcedar	Douglas fir-western hemlock-western redcedar forests
Native fish habitat	All are strategy species in the Willamette Valley ecoregion[1]	Anadromous fish species and their habitats are basin-wide priorities	N/A	Ecoregional target species

While not elevated to the level of "conservation targets," certain fish and wildlife species that depend on savannah and riparian habitats are integrated into these habitats' Key Ecological Attributes. These species are rare or declining, and implementing specific management practices may aid their conservation. Some Jonsson Center Natural Area species with special state or federal status are listed in Table 2.

Table 2: Federal and state status for species of conservation interest at the Jonsson Center

SPECIES OF CONSERVATION INTEREST	**FEDERAL STATUS**	**STATE STATUS**	**OR CONSERVATION STRATEGY SPECIES?**	**NOTES**
Coho, Lower Columbia River ESU	Threatened	Endangered	Yes	Late fall run
Steelhead, Lower Columbia River ESU	Threatened	Sensitive–Critical	Yes	Winter runs
Chinook, Lower Columbia River ESU	Threatened	Sensitive–Critical	Yes	Fall and spring runs
Coastal cutthroat trout, SW WA/Columbia River ESU	Species of Concern	Sensitive–Vulnerable	Yes	
Pacific lamprey	Species of Concern	Sensitive–Vulnerable	Yes	Clear Creek and its tributaries may also have Western brook lamprey, but Pacific are documented on the site
Northern red-legged frog	Species of Concern	Sensitive–Vulnerable	Yes	

APPENDIX B-2 | KEY ECOLOGICAL ATTRIBUTES

Key ecological attributes (KEAs) are aspects of a conservation target's biology or ecology that, if missing or altered, would lead to the loss of that target over time (The Nature Conservancy 2007). KEAs define the conservation target's viability. They are the biological or ecological components that most clearly define or characterize the conservation target, limit its distribution or determine its variation over space and time. They are the most critical components of biological composition, structure, interactions and processes, and landscape configuration that sustain a target's viability or ecological integrity. For each KEA, one or more indicators were selected to assess the health of the KEA.

Indicators are measurable entities related to the condition of the KEA (The Nature Conservancy 2007). A good indicator should be:

- **Biologically relevant:** The indicator should represent an accurate assessment of target health.
- **Sensitive to anthropogenic stress:** The indicator should be reflective of changes in stress.
- **Measurable:** The indicator should be capable of being measured using standard procedures.
- **Cost-effective:** The indicator should be inexpensive to measure using standard procedures.
- **Anticipatory:** The indicator should indicate degradation before serious harm has occurred.
- **Socially relevant:** The indicator's value should be easily recognizable by stakeholders.

KEA indicators were categorized by type: size, condition or landscape context:

- **Size:** A measure of the area or abundance of the conservation target's occurrence.
- **Condition:** A measure of the biological composition, structure and biotic interactions that characterize the occurrence.
- **Landscape context:** An assessment of the target's environment including ecological processes and regimes that maintain the target occurrence such as flooding, fire regimes and many other kinds of natural disturbance, and connectivity such as species targets having access to habitats and resources or the ability to respond to environmental change through dispersal or migration.

The status of an indicator will vary over time either within an acceptable range of variation that sustains the conservation target or beyond a critical threshold that threatens the viability of the conservation target. The range is described as very good, good, fair or poor. The very good and good ratings mean that the indicator is functioning within its acceptable range of variation. Fair and poor ratings mean an indicator is outside its acceptable range of variation. When information was lacking to define all four categories then only a subset of the four categories was defined.

Definitions for the four categorizes follow those used by The Nature Conservancy:

- **Very Good**: The indicator is functioning within an ecologically desirable status, requiring little human intervention for maintenance within the natural range of variation (i.e., is as close to "natural" as possible and has little chance of being degraded by some random event).
- **Good:** The indicator is functioning within its range of acceptable variation, although it may require some human intervention for maintenance.

- **Fair:** The indicator lies outside of its range of acceptable variation and requires human intervention for maintenance. If unchecked, the target will be vulnerable to serious degradation.
- **Poor:** Allowing the indicator to remain in this condition for an extended period will make restoration or prevention of extirpation of the target practically impossible (e.g., too complicated, costly and/or uncertain to reverse the alteration).

KEAs and their indicators for the Jonsson Center conservation targets are provided in the following tables.

Table 1: Key ecological attributes for riparian forest

CATEGORY	KEA	INDICATOR	---------- INDICATOR RATING ---------- POOR	FAIR	GOOD	VERY GOOD	CURRENT RATING	DFC* FOR THIS SCP	LONG TERM DFC	COMMENTS
Size	Riparian forest width	Avg. width of riparian forest	<15 m (50 ft) each side of stream	15-30 m (50-100 ft) each side of stream	30-61 m (100-200 ft) each side of stream	>61 m (200 ft) each side of stream	Good	Good	Very Good	Total width, both sides of stream. Estimate using GIS. Riparian forest width positively correlates with water and wildlife habitat quality, including biodiversity corridors. Width includes both sides of the stream or one side for larger rivers (effective wildlife movement corridor). Title 13 Class I riparian, which accounts for 5 primary ecological functions, is typically within 30-61 m (100-200 ft) on either side of the stream; steep slopes are encompassed in the wider distances. Optimum width won't always be achievable – e.g., could interact with other priority habitats such as prairie. (Environmental Law Institute 2003; Metro's *Technical Report for Fish and Wildlife* Habitat, 2005; Hennings and Soll 2010; Shandas and Alberti 2009; Cole and Hennings 2006)
Condition	Vegetative structure: shrub layer	% native shrub cover	<10% cover	10-25% cover	25-50% cover	>50% cover	Good	Very Good	Very Good	Estimate via site walk. Indicator categories based on data from local study at 54 riparian study sites. Abundance and species richness of many bird and mammal species is associated with native shrub cover and woody vegetation volume. Puget Sound studies suggest that the fragmentation of upland vegetation and the total amount of riparian vegetation explain the greatest amount of variability in riparian bird communities. (Carey and Johnson 1995; Hennings 2001; Hagar 2003; Shandas and Alberti 2009; Hagar 2011)
Condition	Vegetative structure: tree layer	% native tree canopy cover	<20% cover	20-30% cover	30-40% cover	40% or more	Good	Very Good	Very Good	Estimate via site walk. Based on data from local study at 54 riparian study sites. In these sites, the best mix of native tree and shrub cover occurred when both were in the 40-60% range. Tree cover in this tended to support healthy shrub communities and helped control European starlings. Note that some species, such as yellow-breasted chat, rely on native shrub habitat rather than forest, therefore if specific species are involved separate KEAs should be developed. (Hennings 2001)
Condition	Native herbaceous layer richness	# native species of grasses, herbs, forbs and ferns, at least half of which are riparian-associated, per 0.4 ha (1 ac)	<5 species	5-12 species	12-18 species	>18 species	Fair	Good	Good	Estimate via site walk. Species numbers based on field experience of Marsha Holt-Kingsley and Lori Hennings; currently using species list from McCain and Christy 2005, Technical Paper R6-NR-ECOL-TP-01-05.
Condition	Native tree and shrub richness	# native tree and shrub species per 0.4 ha (1 ac)	<5 species	5-10 species	10-15 species	>15 species	Good	Good	Very Good	Estimate via site walk. Some studies show that native wildlife species diversity (particularly Neotropical migratory songbirds) is associated with native deciduous shrub diversity. (Muir et al. 2002; Hagar 2003; Hagar 2011)
Condition	Standing and downed dead trees	Average # snags and large wood (> 50 cm, or 20 in, DBH) per 0.4 ha (1 ac)	< 5 snags and <5% down wood	5-11 snags and 5-10% down wood	12-18 snags and 10-20% down wood with moderate variety of size and age classes	> 18 snags and >20% cover down wood in a good variety of size and age classes	Poor	Poor	Good	Estimate via site walk. Rankings distilled from multiple references and particularly from *Habitat Conservation for Landbirds in Lowlands and Valleys of Western Oregon and Washington* (Altman and Alexander 2012) and DecAID results for species' use of dead wood in Westside Lowland Conifer-hardwood forests.

CATEGORY	KEA	INDICATOR	---------- INDICATOR RATING ---------- POOR	FAIR	GOOD	VERY GOOD	CURRENT RATING	DFC* FOR THIS SCP	LONG TERM DFC	COMMENTS
Condition	Floodwater access to the floodplain	Degree of connection between stream/ floodplain during high water events	Extensively disconnected by channel incision, dikes, tide gates, elevated culverts, etc.	Moderately disconnected by channel incision, dikes, tide gates, elevated culverts, etc.	Minimally disconnected by channel incision, dikes, tide gates, elevated culverts, etc.	Completely connected (backwater sloughs, channels)	Fair to Very Good	Good to Very Good	Very Good	Measure based on field walk, aerials. Adapted from Washington DNR's *Ecological Integrity Assessment for North Pacific Lowland Riparian Forest and Shrubland*, "Hydrologic Connectivity (Riverine)." Added channel incision. Not appropriate for higher gradient streams. (Rocchio 2011)
Landscape context	Offsite riparian habitat condition	% rating at least "fair" for both width and gaps (see above), within 2.5 km (1.6 mi) up- and down-stream of property.	0-25%	25-50%	50-75%	75-100%	Good	Good	Good	Measure using aerial photos for 2.5 km (1.6 mi) stream length, up- and downstream. Several studies suggest the importance of riparian buffer contiguity to water quality, fish and benthic organisms. A 2006 study in and near Damascus, OR found that benthic biotic integrity was significantly correlated with % forested area for 1,500 m (1,640 ft) upstream at 50, 100, and 200 m (55, 109, and 219 ft) wide. Ontario researchers found that the combination of % of forested stream bank and forest width within 2.5 km (1.6 mi) upstream of a site accounted for 90% of the observed variation in water temperatures. (Barton et al. 1985; Wang et al. 2001; Cole and Hennings 2006; Freeman et al. 2007; Olson et al. 2007)

**Desired future condition.

** This KEA may not be appropriate where native turtles are present, because nesting turtles require some open habitat. Patches of bare ground may accommodate turtles and are important to native ground-nesting bees.

Table 2: Key ecological attributes for upland forests

CATEGORY	KEA	INDICATOR	---------- INDICATOR RATING ----------				CURRENT RATING	DFC* FOR THIS SCP	LONG TERM DFC	COMMENTS
			POOR	FAIR	GOOD	VERY GOOD				
Size	Forested habitat patch size	Patch size (includes native shrub patches or natural clearings)	< 12 ha (30 ac)	12-40 ha (30-100 ac)	40-61 ha (100-150 ac)	>61 ha (150 ac)	Poor	Fair	Fair	Calculate by delineating forest patch in GIS. If more than one patch present, rank based on a composite. In the Puget Sound, most native forest birds were present in patches ≥ 42 ha (104 ac). Local studies suggest a lowest threshold for birds and mammals of about 12 ha (30 ac) (Environmental Law Institute 2003; Donnelly and Marzluff 2004; Soll and Hennings 2010).
Condition	Native tree and shrub richness	Number of native tree and shrub species per ac	<5 species per 0.4 ha (1 ac)	5-8 species 0.4 ha (1 ac)	8-12 species per 0.4 ha (1 ac)	>12 species per 0.4 ha (1 ac)	Good	Good	Very Good	Estimate overall via site walk. Native wildlife species diversity is associated with native vegetation. A diversity of shrubs is more likely to provide food and shelter for species over the seasons. Shrub diversity is particularly important to pollinators and songbirds. (Hagar 2003; Hennings 2006; Burghardt et al. 2009).
Condition	Vegetative structure: native tree and shrub layer	% native tree and shrub canopy cover (combined)	<25% cover	25-50% cover	50-75% cover	>75% cover	Good	Good to Very Good	Very Good	Estimate overall via site walk. Native bird species richness is associated with the amount of native shrub cover. (Hagar 2003; Hennings 2006). Numbers based on data analysis from local studies at 54 riparian study sites (Hennings 2001). Native shrub cover was as high as ~60%, with highest native shrub cover in the 50-60% tree canopy cover range.
Condition	Mature trees	Number and size (dbh) of species such as Douglas fir, western red cedar, western hemlock and grand fir	Mature trees lacking	<3 per ac with dbh >24 in	3-5 per ac with dbh >24 in	>5 per ac with dbh >24 in	Good	Good	Good	Recruitment of native trees necessary for long-term health of upland forests. Saplings are < 2m tall. Based on PIF (2000) biological objective for WV large-canopy trees in riparian deciduous woodland.
Condition	Standing and downed dead trees	Average # snags and large wood (> 50 cm, or 20 in, DBH) per acre	< 5 snags and <5% down wood	5-11 snags and 5-10% down wood	12-18 snags and 10-20% down wood with moderate variety of size and age classes	>18 snags and >20% cover down wood in a good variety of size and age classes	Fair	Fair	Good	Etimate via site walk. Rankings distilled from multiple references and particularly from *Habitat Conservation for Landbirds in Lowlands and Valleys of Western Oregon and Washington* (Altman and Alexander 2012) and DecAID results for species' use of dead wood in Westside Lowland Conifer-hardwood forests.
Landscape context	Edge condition	% of edge bordered by natural habitats and/or managed for conservation	Patch surrounded by non-natural habitats (0-25% natural habitat)	25%+ of patch bordered by natural habitats	50-75% of patch bordered by natural habitats or managed for conservation	75-100% of patch bordered by natural habitats or managed for conservation	Good	Good	Very Good	Assess via aerial photographs. The intactness of the edge can be important to biotic and abiotic aspects of the site. Derived from *Ecological integrity assessment: North Pacific dry Douglas-fir forest and woodland* (Crawford/WDNR 2011).

*Desired future condition.

Table 3: Key ecological attributes for native fish habitat (instream)

CATEGORY	KEA	INDICATOR	---------- INDICATOR RATING ---------- POOR	FAIR	GOOD	VERY GOOD	CURRENT RATING STATUS	DFC* FOR THIS SCP	LONG TERM DFC	COMMENTS
Condition	Complexity of Habitat	# of different stream habitat units per 305 m (1,000 foot) reach	Less than 2 habitat units	Between 2-5 habitat units	Between 5-10 habitat units	Greater than 10 habitat units	Fair to good	Good	Very Good	The number of different habitat units indicates the complexity of the stream reach. Complex stream reaches provide high quality habitat for all life stages of native fish. Habitat units may include glides, riffles, runs, pools, step pools, alcoves, side channels, etc. (Independent Multidisciplinary Science Team, 2002, *Recovery of Wild Salmonids in Western Oregon Lowlands*).
Condition	Key pieces and # of pieces of large wood in wetted areas of the stream and adjacent streambank	# key pieces and large wood per 305 m (1,000 ft) reach	<10 large wood pieces and 0-1 key pieces	10-20 large wood pieces and 2-5 key pieces	20-40 large wood pieces and 6-10 key pieces	>40 large wood pieces and >10 key pieces	Poor	Good to Very Good	Very Good	Large wood is defined as logs greater than 46 cm (18 inch) diameter and 6 m (20 ft) in length. Note that optimum diameter and length depends on bankfull width; see DSL/ODFW's 2010 *Guide to Placement of Wood, Boulders and Gravel for Habitat Restoration*. Key pieces resist downstream transport as well as anchor and retain other pieces of large wood.
Condition	Substrate in wetted areas of stream	% area of fines and gravel substrate per 305 m (1,000 ft) reach	Fines >30% and gravel <10% of area	Fines 20-30% and gravel 10-20% of area	Fines 10-20% and gravel 20-35% of area	Fines <10% and gravel >35% of area	Good	Good	Good	Visually assess for a stream reach of interest or for entire stream on site. If preferred, measure quantitatively using cross-sections ODFW methods. Fines are defined as sand, silt or organics. Gravels are defined as particles that range in size from a small pea to roughly baseball sized substrate. Derived from *2000 Reference Site Selection and Survey Results, Report No. OPSW-ODFW-2001-6*, Oregon Plan for Salmon and Watersheds, 2000.
Landscape context	Fish passage	Fish able to move to and from mainstem and tributaries	Complete blockage	Blocked more than half the year	Blocked less than half the year	Passage open year-round	Very Good	Very Good	Very Good	All fish passage barriers have been removed from Clear Creek by project partners.

*Desired future condition.

APPENDIX B-3 | THREATS AND SOURCES

INTRODUCTION

A stress is the "impairment or degradation of the size, condition and landscape context of a conservation target, and results in reduced viability of the target," (The Nature Conservancy 2007) or, in other words, a degraded key ecological attribute (KEA) that is outside its acceptable range of variation. Stresses may also reduce the viability of nested conservation targets such as grassland birds. A source of stress is an extraneous factor, either human (e.g., policies, land use) or biological (e.g., non-native species) that infringes upon a habitat or species target in a way that results in stress. Put together, stresses and their sources constitute a threat.

Analysis of threats to conservation targets at Clear Creek North Natural Area involves three parts:

- Identify stresses and apply stress-rating criteria.
- Identify sources of stress, rank and assign threat-to-system rank.
- Assign overall threat rank.

BACKGROUND ON METHODS

Identify stresses and apply stress-rating criteria

In identifying stresses, we applied the concept that a stress is any alteration of a KEA that can result or has resulted in a KEA declining below a "good" rating. For each conservation target, KEA indicators with ratings of "poor" or "fair" were analyzed by asking the question "*What types of destruction, degradation or impairment are responsible for the 'poor' or 'fair' rating?"* We also considered those KEA indicators with "good" and "very good" ratings but likely to degrade to "poor" or "fair" if no management actions are taken.

Stresses are ranked according to two criteria: **severity** and **scope** of the anticipated damage.

Severity

The level of damage to the conservation target that can reasonably be expected within 10 years under current circumstances (i.e., given the continuation of the existing situation).

- **Very high:** The threat is likely to destroy or eliminate the conservation target over some portion of the target's occurrence at the site.
- **High:** The threat is likely to seriously degrade the conservation target over some portion of the target's occurrence at the site.
- **Medium:** The threat is likely to moderately degrade the conservation target over some portion of the target's occurrence at the site.
- **Low:** The threat is likely to only slightly impair the conservation target over some portion of the target's occurrence at the site.

Scope

The geographic extent of impact on the conservation target at the site that can reasonably be expected within 10 years under current circumstances (i.e., given the continuation of the existing situation).

- **Very high:** The threat is likely to be widespread or pervasive in its scope and affect the conservation target throughout the target's occurrences at the site.
- **High:** The threat is likely to be widespread in its scope and affect the conservation target at many of its locations at the site.
- **Medium:** The threat is likely to be localized in its scope and affect the conservation target at some of the target's locations at the site.
- **Low:** The threat is likely to be very localized in its scope and affect the conservation target at a limited portion of the target's location at the site.

Once severity and scope ratings are determined, they are combined to develop a stress ranking using the following stress ranking table (The Nature Conservancy 2007).

Table 1: Stress ranking

	SCOPE			
SEVERITY	**VERY HIGH**	**HIGH**	**MEDIUM**	**LOW**
Very high	Very high	High	Medium	Low
High	High	High	Medium	Low
Medium	Medium	Medium	Medium	Low
Low	Low	Low	Low	Low

Identify sources of stress and apply threat to system rank

Sources of stresses are the proximate cause of the stress. A source of stress may be either human activities or biological (e.g., non-native species). Sources of the stress are rated in terms of **contribution** and **irreversibility** as defined below:

CONTRIBUTION

The expected contribution of the source, acting alone, under current circumstances (i.e., given the continuation of the existing management/conservation situation).

- **Very high:** The source is a very large contributor of the particular stress.
- **High:** The source is a large contributor of the particular stress.
- **Medium:** The source is a moderate contributor of the particular stress.
- **Low:** The source is a low contributor of the particular stress.

IRREVERSIBILITY

The degree to which the effects of a source of stress can be restored.

- **Very high:** The source produces a stress that is irreversible (e.g., wetlands converted to a shopping center).
- **High:** The source produces a stress that is reversible, but not practically affordable (e.g., wetland converted to agriculture).
- **Medium:** The source produces a stress that is reversible with a reasonable commitment of resources (e.g., ditching and draining of wetland).
- **Low:** The source produces a stress that is easily reversible at relatively low cost (e.g., off-road vehicles trespassing in wetland).

The contribution and irreversibility of each source across all the stresses to each conservation target is ranked using Table 5, resulting in a source of stress rank for each contribution/ irreversibility combination.

Table 2: Source ranking

	CONTRIBUTION			
IRREVERSIBILITY	**VERY HIGH**	**HIGH**	**MEDIUM**	**LOW**
Very high	Very high	High	High	Medium
High	Very high	High	Medium	Medium
Medium	High	Medium	Medium	Low
Low	High	Medium	Low	Low

In a similar fashion stress and source rankings are combined to develop a threat ranking specific to that conservation target (Table 6).

Table 3: Threat ranking

	CONTRIBUTION			
STRESS	**VERY HIGH**	**HIGH**	**MEDIUM**	**LOW**
Very high	Very high	Very high	High	Medium
High	High	High	Medium	Low
Medium	Medium	Medium	Low	Low
Low	Low	Low	Low	low

THREAT-TO-SYSTEM RANK

A threat-to-system rank is a summary ranking for all threats associated with a particular source of stress to a conservation target. Where multiple threats related to the same source of stress occurred, the threat-to-system rank is adjusted by using the "3-5-7" rule as follows:

- Three high rankings equal a very high.
- Five medium rankings equal a high.
- Seven low rankings equal a medium.

Table 7 illustrates the threat-to-system ranking.

Table 4: Conservation target A

	STRESS 1	STRESS 2	STRESS 3	THREAT TO SYSTEM RANK
Stress rank	High	Medium	Medium	
Source A rank	High	Medium	N/A	High*
Source B rank	Low	N/A	Medium	Medium**

N/A = Not applicable: stress/source combination does not affect conservation target
**, ** - See Table4*

OVERALL THREAT RANK

The last step in the process is to summarize threats across the system and apply an overall threat rank to each threat (source/stress combination). Overall threat ranks are determined by combining threat-to-system ranks across all system/targets affected by that threat. For each threat, DEA will combine the threat-to-system ranks across all conservation targets into an overall threat rank of very high, high, medium or low as determined by the "2 Prime" rule which is as follows:

- Two very high threat rankings yield an overall threat rank of very high.
- One very high or two high threat rankings yield an overall threat rank of high.
- One high or two medium threat rankings yield an overall threat rank of medium.
- Less than two medium threat rankings yield an overall threat rank of low.

The overall threat rank represents the degree to which a particular source causes stress to the conservation target.

Table 5: Overall threat rank

	TARGET 1	TARGET 2	TARGET 3	OVERALL THREAT RANK
Threat A	*High**	Very high	High	High
Threat B	*Medium***	Medium	High	Medium
Threat C	N/A	Medium	Low	Low

**, ** from Tables 5,6*

Threats and source analysis for the Jonsson Center Natural Area

Threats for the Jonsson Center Natural Area conservation targets are listed in Tables 7-8 below.

Table 6: Riparian forest

STRESS	STRESS RANK	SOURCE	SOURCE RANK	THREAT RANK	COMMENTS
Increased competition from invasive species	High	Extensive non-native grasses, broadleaf weeds; limited invasive woody vegetation	High	High	Non-native broadleaf weeds include black-berry, Scots broom, ivy, thistle, and foxglove. Tied to native vegetation and structure KEAs.
Lack of down and standing dead wood	Medium	Previous forest management practices and altered hydrology	Medium	Low	Due to previous forest management practices and altered hydrology (see related stress), which can erode streambanks and near-stream plants and remove sources of dead wood. Tied to dead wood KEAs.
Altered hydrology	Medium	Primarily logging, development in upstream portions of the watershed	Medium	Low	Widespread altered hydrology leads to stream bank erosion, riparian vegetation loss, channel damage, loss of gravel and cobble substrate and overall habitat simplification.
Human disturbance	Medium	Facility use, vehicular activity	Low	Low	Light activity by staff operating the facilities.

Table 7: Upland forest

STRESS	STRESS RANK	SOURCE	SOURCE RANK	THREAT RANK	COMMENTS
Increased competition from invasive species	High	Encroachment of non-native invasive species	High	High	Extensive invasive grasses and broadleaf ~~weeds, esp.~~weeds, especially false brome~~ and garlic mustard ,~~ and invasive shrubs such as Himalayan blackberry. Tied to native species KEAs.
Habitat conversion	High	Conversion from natural forest from logging and home site development	High	High	Thinning may be needed. Complete canopy closure stunts trees and prevents development of native herbaceous and shrub layers. Tied to native plant and vegetative structure KEAs.
Lack of downed and standing dead wood	High	Previous forest management practices.	High	High	Snags and down wood are critical habitat elements used by more than 150 species of wildlife in Northwest conifer forests (Hagar 2007). Tied to dead wood KEAs.
Altered fire regime	Medium	Suppression of fire frequency outside natural range of variation	Medium	Low	Increased risk of stand-replacing fires in Douglas-fir forest, where a build up of fuels would increase risk of a high intensity fire. Tied to all KEAs.
Human disturbance	Medium	Facility use, vehicular activity	Low	Low	Light activity by staff operating the facilities.

Table 8: Native fish habitat

STRESS	STRESS RANK	SOURCE	SOURCE RANK	THREAT RANK	COMMENTS
Simplified stream structure, sparse side channel refugia & riffle-pool sequences	High	Altered hydrology, channel morphology due to previous practices and upstream development, deforestation and disturbance	High	High	Salmon require off-channel habitat for rearing. Adult salmon need riffle-pool habitat for spawning, refugia, prey habitat and water oxygenation. Tied to all but fish passage KEAs.
Lack of logs and dead wood in streams	Medium	Previous forest management practices; narrow buffer in some areas	Medium	Low	Large logs provide critical habitat for juvenile fish and form the matrix of large wood jams and structure that provides complexity in the stream. Tied to habitat complexity and large wood KEAs.
Impaired fish passage	Low	Manmade structures that block fish migration including: dams, weirs, culverts	Low	Low	Currently no barriers at the Clear Creek site. Fish passage barriers do exist upstream and should be addressed to improve native fish habitat in the Clear Creek watershed.

APPENDIX B-4 | INVASIVE SPECIES

The table below summarizes a preliminary list of invasive plants requiring control in all or parts of Jonsson Center Natural Area, including focus areas and timing for control. Invasive species, with the exception of Early Detection Rapid Response (EDRR) species, will be controlled as part of restoration projects or ongoing management of habitat areas. Photos of EDRR species for identification are listed below. A list of noxious weeds for Oregon, including descriptions and photos, can be found at: www.oregon.gov/ODA/PLANT/WEEDS/statelist2.shtml.

Table 1: Working list of priority non-native species for control at Jonsson Center Natural Area

GENUS	SPECIES	COMMON NAME	FOCUS AREA FOR DETECTION/CONTROL	CONTROL TIMING
Brachypodium	*sylvaticum*	False Brome	All	Spring/Fall
Campanula	*rapunduloides*	Creeping bellflower	All	Spring/Fall
Cirsium	*arvense*	Canada thistle	Upland forest, site edges	Spring
Clematis	*vitalba*	Old man's beard	Upland forest	Spring/Fall
Crataegus	*monogyna*	Common hawthorn	Upland forest, site edges	Fall
Cytisus	*scoparius*	Scotch broom	Upland forest, site edges	Fall
Dipsacus	*fullonum*	Teasel	All	Spring
Hedera	*Helix*	English Ivy	All	Winter
Ilex	*aquifolium*	Holly	Upland forest	Fall
Lamiastrum	*galeobdolon*	Yellow archangel	Riparian forest	Spring
Pentaglottis	*sempervirens*	Evergreen Bugloss	Upland forest	Spring
Phalaris	*arundinacea*	Reed canarygrass	Riparian forest	Fall
Polygonum	*cuspidatum*	Japanese knotweed	All	Summer
Rubus	*armenianus*	Himalayan blackberry	All	Fall
Solanum	*dulcamara*	Bittersweet nightshade	All	Spring
Vinca	*minor*	Periwinkle	All	Fall/Winter

APPENDIX C | REFERENCES AND ADDITIONAL RESOURCES

REFERENCES AND ADDITIONAL RESOURCES

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