CITY OF
BAINBRIDGE ISLAND

Environmental Technical Adivsory Committee
Regular Meeting
Thursday, MARCH 16, 2017
3:00 PM – 5:00 PM
City Hall
Council Conference Room
280 Madison Avenue North
Bainbridge Island, WA 98110

AGENDA

1. **CALL TO ORDER / ROLL CALL / ACCEPT OR MODIFY AGENDA / CONFLICT OF INTEREST DISCLOSURE 3:00 PM**

   Chair: Frank Gremse

   Members: Michael Bonoff, Charlie Kratzer, Jason Flowers, Karl Shearer, Dylan Frazer

2. **LIAISON REPORT OUT** – Councilmember Roth

3. **REVIEW SUZUKI PROPERTY ECOLOGICAL ASSESSMENT DRAFT REPORT** – All

4. **DISCUSSION OF THE CLIMATE ACTION PLAN** – All

5. **COMMENTS FROM THE PUBLIC** – All

6. **ACCEPTANCE OF MEETING NOTES – FEBRUARY 16, 2017** – ETAC Members

7. **MISCELLANEOUS ITEMS** – All

8. **ADJOURNMENT**
   5:00 PM

For special accommodations, please contact Roz Lassoff,
206-780-8624 or at rlassoff@bainbridgewa.gov

Draft

SUZUKI PROPERTY ECOLOGICAL ASSESSMENT

Bainbridge Island, Washington

Prepared for

City of Bainbridge Island

March 2017

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Acronyms and Abbreviations

BIMC	Bainbridge Island Municipal Code
CARA	Critical Aquifer Recharge Area
City	City of Bainbridge Island
Ecology	Washington State Department of Ecology
EPA	Environmental Protection Agency
ESA	Environmental Science Associates
ETAC	Environmental Technical Advisory Committee
GPS	global positioning system
HMP	Habitat Management Plan
LID	low impact development
NRCS	National Resources Conservation Service
NWI	National Wetlands Inventory
OPG	Olympic Property Group
PHS	Priority Habitats and Species
RFP	Request for Proposals
USFWS	United States Fish and Wildlife Service
USGS	U.S. Geological Survey
VTA	visual tree assessment
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington State Department of Natural Resources

1. INTRODUCTION

At the request of the City of Bainbridge Island (City), Environmental Science Associates (ESA) conducted an ecological assessment of the Suzuki Property (the "property"), an undeveloped City-owned parcel. The purpose of this assessment is to characterize the baseline ecological conditions of the property in order to inform the design of a proposed residential development. As described in ESA's scope of work, the primary elements of this ecological assessment include a forest survey (conducted by ESA's subconsultant Tree Solutions, Inc.), an aquifer recharge and soil infiltration study, and characterization of the habitat features on the property, including a pond, wildlife corridor, stream, and forest habitat. The methods and findings of the ecological assessment are described in this report, along with a set of management recommendations for avoiding and minimizing potential impacts to habitat factures and ecological functions.

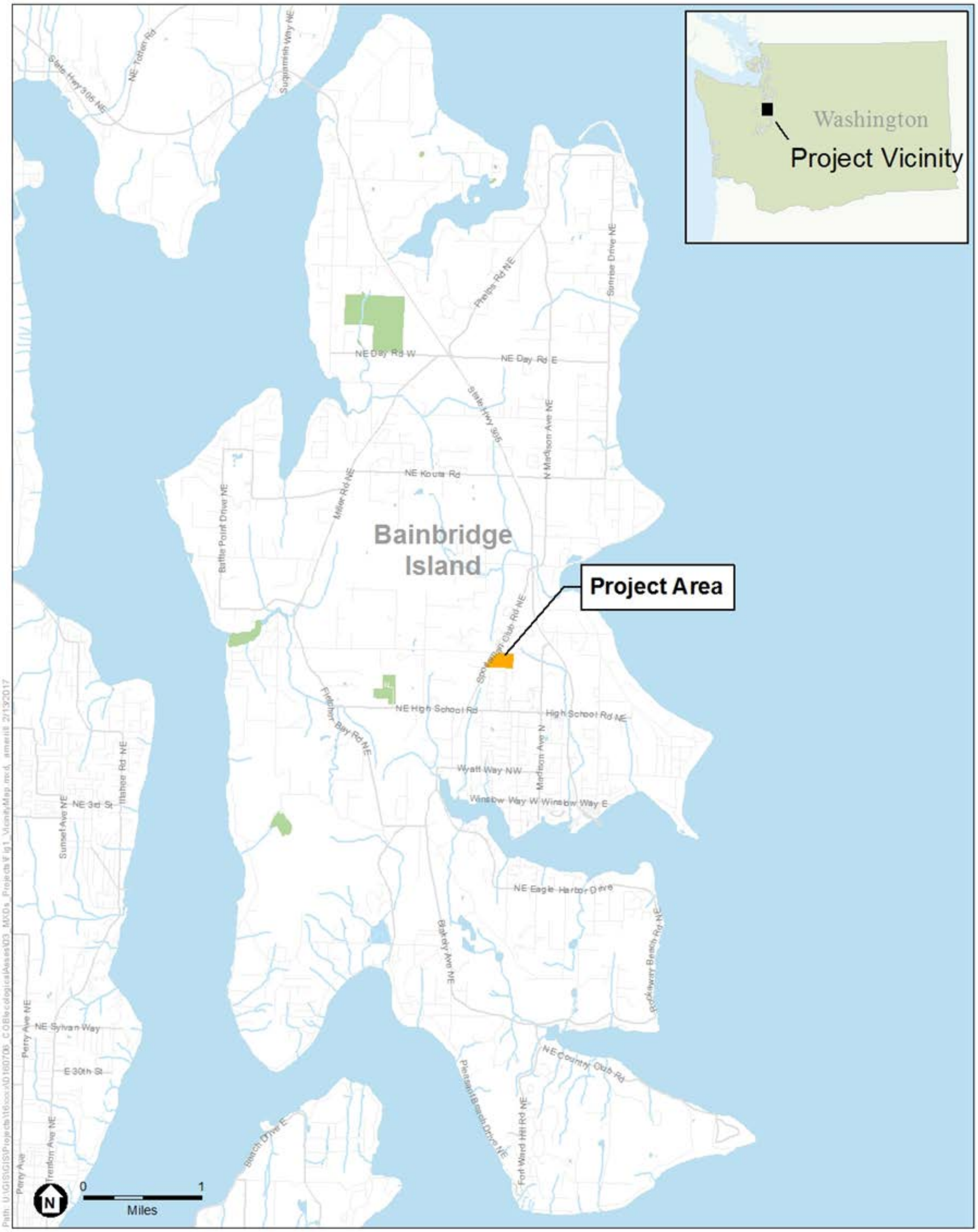
1.1 Site Description

The Suzuki Property is 13.83 acres in area, and located at the southeast corner of NE New Brooklyn Road and Sportsman Club Road NE (Figure 1). The property is bordered by NE New Brooklyn Road to the north, a gravel road and school bus facility to the east, a residential subdivision to the south, and Sportsman Club Road NE to the west. The NE New Brooklyn Road frontage has been improved with a sidewalk, and a trail on the property parallels Sportsman Club Road NE.

The property is undeveloped and entirely wooded, with the exception of a pond along the south boundary. Topography on the property is generally flat or gently rolling, with moderate slopes in the west portion toward Sportsman Club Road NE.

1.2 Proposed Development

The City purchased the Suzuki Property in 2000 and originally intended to construct a combined police-courthouse building on the site and a "decant facility" to dispose of sludge collected from street sweeping and storm-drain cleaning operations. Due in part to neighborhood opposition to the proposed projects, the development of the facilities did not occur and the property remained undeveloped.



SOURCES: ESA, 2016

Figure 1
Suzuki Property Vicinity Map

In November 2014, the City held a community workshop to solicit community input on whether and how the property should be sold, and how it should be used. Workshop participants urged the City Council to develop the property in a way that benefits the community (Bainbridge Island, 2015). In June 2015, the Suzuki Ad Hoc Committee recommended that the City Council prepare a Request for Proposals (RFP) for the development of the property, with a goal of selling the property to a developer who would design and construct a project compatible with the surrounding residential uses that would also enhance and benefit the neighborhood and community. The RFP was issued in September 2015. The development priorities listed in the RFP included a varied housing mix (e.g., homes and apartments), permanent affordability, green and sustainable construction, and open space and community gardens.

The City received four RFP submissions, and in March 2016 the City Council selected the Olympic Property Group (OPG) proposal. The development concept presented in the OPG proposal is called the "Suzuki Farm," and includes affordable housing, a community center, community gardens and orchards, open space preservation, and trails (Figure 2). The proposed concept shows the development concentrated in the northeast portion of the property, while preserving the remainder of the property as open space. Under the concept, the existing pond would be enlarged for stormwater detention, and an additional stormwater detention pond would be constructed near the southwest corner.[1]

Another outcome of the public process for the Suzuki Property was the identified need for an assessment of the property that characterizes the ecological conditions of the property prior to additional site design efforts (Bainbridge Island, 2016). As a result, the City Council requested a recommendation from the City Environmental Technical Advisory Committee (ETAC) regarding the scope and contents of a potential study. ETAC subsequently held several meetings, walked the property, and invited public input in developing their recommendation. After consideration, ETAC recommended that the following significant ecological features of the property be identified, described, and evaluated as part of an ecological assessment (Bainbridge Island, 2016): (1) grove of "old trees" in the southeast section of the property, (2) aquifer recharge potential, (3) human-made pond, (4) stream, and (5) riparian pathway/wildlife corridor.

[1] The site plan shown in Figure 2 is conceptual and developed without City input as part of the RFP process; therefore, the actual development plan may differ significantly from the concept.

SOURCE: Olympic Property Group and Davis Studio Architecture + Design, 2016

Figure 2
Olympic Property Group "Suzuki Farm" Development Concept

2. METHODS AND DATA SOURCES

The following sections describe the methods and data sources used to conduct the various components of the ecological assessment.

2.1 Forest Survey

Forest survey methods are described in detail in Appendix A, and summarized here. Forest community types were categorized based on the definitions and methods described in Hall et al. (1995) and Chappell (2004). Tree Solutions, Inc. surveyed forest community type boundaries using global positioning system (GPS), which ESA refined using aerial photo interpretation.

Survey and assessment of individual trees focused on the "old trees" area, which ETAC identified as an area of focus for the ecological assessment (Bainbridge Island, 2016). Tree ages were determined using a micro-resistance recording drill and a manual increment borer. Tree health and structure were evaluated using visual tree assessment (VTA) method, which involves analyzing trees for defects to estimate tree condition and hazard potential. The individual trees that were assessed were marked with aluminum tags.

2.2 Soil Infiltration and Aquifer Recharge

The data sources and methods used to measure soil infiltration rates and estimate aquifer recharge potential on the property are described in detail in Appendix B, and summarized here. Data sources used to conduct these evaluations included the following:

- National Resources Conservation Service (NRCS) Soil Survey data (NRCS, 1980).
- *Conceptual Model and Numerical Simulation of the Groundwater-Flow System of Bainbridge Island, Washington* (USGS, 2011).
- *Review Findings and Recommendations and Critical Aquifer Recharge Area Assessment* (Aspect Consulting, 2015).

Soil infiltration was measured at six different locations on the property, using the methodology detailed in the NRCS Soil Quality Test Kit Guide (1999a). This test involves filling a metal ring placed on the soil surface with water, and recording the time it takes for the water to infiltrate into the soil. Additionally, a subsurface infiltration test was performed at each test site using methods similar to the Environmental Protection Agency (EPA) Falling Head Percolation Test Procedure (1980). This test is often used in the design of low impact development (LID) facilities. For this subsurface test, a 2-foot-deep hole was excavated and filled with approximately 9 inches of water, and the rate of water infiltration was measured. In addition to the infiltration testing, soil characteristics were recorded in each of the six test holes. Based on the soil infiltration tests and a review of the existing information listed above, the aquifer recharge potential of the property was estimated, as well as the overall suitability of the property for the use of LID stormwater management measures.

2.3 Wildlife Habitat, Species, and Corridors

Based on the forest types identified during the forest survey, a scientific literature review was conducted to determine the relative values of the habitats present on the property. An inventory of wildlife species that use the property was also conducted. Data sources used for the inventory include the following:

- Wildlife species observations from a neighboring property owner (Marshall, 2016).
- Wildlife species observation conducted by ESA scientists during a one-day site visit on December 15, 2016.
- Washington Department of Fish and Wildlife (WDFW) Priority Habitats and Species (PHS) data (WDFW, 2017a).

Potential habitat corridors and connections to the property were identified; the primary data sources included a Bainbridge Island wildlife corridor study (Self, 2000) and analysis of aerial photography. The quality and effectiveness of existing wildlife corridor(s) were estimated based on a review of the relevant scientific literature.

2.4 Wetland Identification

A review of existing wetland inventory data and a reconnaissance-level wetland field assessment of the property was conducted. The field assessment consisted of walking the property and observing the presence of wetland features (i.e., hydrophytic plant communities, hydric soil, and wetland hydrology), per the methods defined in *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region* (Corps, 2010). The approximate boundaries of potential wetland features were sketched on an aerial photo. The reconnaissance-level wetland assessment did not include formal delineation of wetland boundaries or establishment of wetland data plots; therefore, likely wetland areas on the property are referred to as “potential wetland areas” in this report.

Data sources consulted for the wetland identification included the following:

- City of Bainbridge Island Critical Areas Data (Bainbridge Island, 2017).
- National Wetlands Inventory (NWI) Wetlands Mapper (USFWS, 2017).
- NRCS Soil Survey (NRCS, 1980).

Wetland functions and the relative value of the potential wetland areas identified on the property were estimated using the methods described in Hruby (2014).

2.5 Stream Identification

The methods for assessing streams on the property included a field assessment in conjunction with a review of publically available data resources that indicate the presence of streams, including potential fish use and/or presence. The field assessment consisted of walking the property and identifying any channelized features. Any such observed features were analyzed for presence of bed and bank, type and distribution of channel vegetation and substrate, and hydrology sources/flow rates.

Data sources consulted for this evaluation included the following:

- City critical areas data (Bainbridge Island, 2017).
- WDFW PHS data (WDFW, 2017a).
- WDFW SalmonScape interactive mapping tool (WDFW, 2017b).
- Washington State Department of Natural Resources (WDNR) stream typing data (WDNR, 2017).

3. FINDINGS

The following sections describe the results and findings of the Suzuki Property ecological assessment.

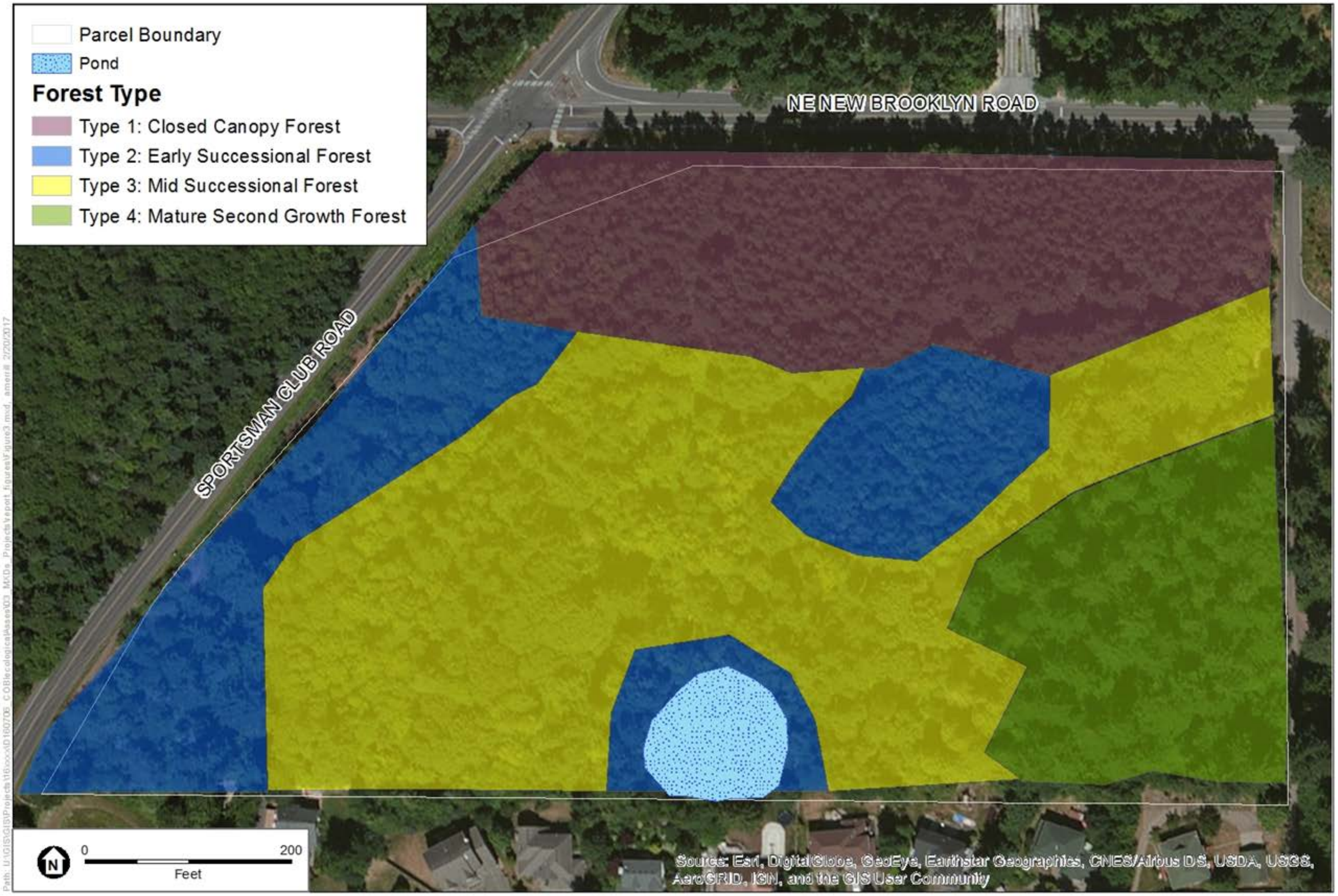
3.1 Forest Survey

Four forest types were identified on the property, as shown in Figure 3 and summarized below. See the Forest Survey Report (Appendix A) for additional details on these forest types and the data table of individually surveyed trees.

Type 1: Closed Canopy Forest

The closed canopy forest zone is approximately 3.9 acres in area, and is located along the north boundary of the property. This zone consists primarily of young Douglas fir trees. Based on the relatively small size of the trees, the homogenous canopy structure, and the absence of snags and coarse woody debris (e.g., downed trees and logs), it appears that this section of the property was historically cleared and later planted with Douglas fir (likely in the late 20th century). The trees are dense with very few gaps in the canopy, which limits understory sapling and shrub vegetation. The understory vegetation that is present consists of trailing blackberry, swordfern, salal, salmonberry, and evergreen huckleberry.

Closed Canopy Forest Zone



SOURCES: Tree Solutions, Inc., 2017; ESA, 2016

Figure 3
Forest Zones on the Suzuki Property

Type 2: Early-Successional Forest

Three areas of early-successional forest are found on the property: a patch near the center of the property, an area around the pond perimeter, and another area along the western property boundary. The total coverage of this forest zone on the property is approximately 2.9 acres. Trees observed in this forest zone include red alder, bigleaf maple, bitter cherry, and Pacific madrone. The dominant tree species in this zone is red alder, a relatively short-lived and fast-growing tree. Some scattered conifer trees (primarily western red cedar and Douglas fir) are present in this zone, but they appear to be outcompeted by the fast-growing alder and understory shrubs. Dominant understory vegetation in this zone consists of salmonberry, swordfern, and Pacific willow, with invasive Himalayan blackberry observed in some areas, particularly where sunlight is available. Some areas, particularly where canopy gaps are present, contain very dense coverage of understory shrubs. The early-successional forest zone contains a generally low density of snags and coarse woody debris.

Early Successional Forest Zone

Type 3: Mid-Successional Forest

The mid-successional forest zone is the predominant forest type on the property; it covers an area of approximately 4.8 acres. This forest type consists of a multi-tiered forest that contains the co-dominant confers (western red cedar and Douglas fir) and some western hemlock. There is a moderate amount of canopy gaps in this forest type, which allows for sapling regeneration (primarily western red cedar). The forest appears to be transitioning from a mainly deciduous forest stand to a coniferous forest. Based on the tree coring results, trees in this area range in age between 63 and 67 years old. The dominant tree species include western red cedar, bigleaf maple, Douglas fir, red alder, and western hemlock. Dominant understory vegetation includes vine maple, evergreen huckleberry, red huckleberry, salal, swordfern, and trailing blackberry. The mid-successional forest zone contains a generally low density of snags, and a moderate density of coarse woody debris.

Mid-Successional Forest Zone

Type 4: Mature Second-Growth Forest

The southeast portion of the property is comprised of a mature second-growth forest, which covers approximately 1.9 acres. Forest characteristics include moderate to large-diameter conifer trees and a multi-layered canopy with shade-tolerant shrub species. Tree species observed in this zone are Douglas fir, western red cedar, bigleaf maple, western hemlock, and bitter cherry. Dominant understory species include vine maple, evergreen huckleberry, red huckleberry, salal, swordfern, Oregon grape, and trailing blackberry. A moderate volume of coarse woody debris is present on the forest floor, but no standing snags were observed.

Based on the tree coring results, trees in this forest zone range in age between 81 and 144 years old. As indicated by the stumps throughout the property, which show evidence of logging by both crosscut saw and chainsaws, this area was likely logged in multiple events. Based on historical records of logging, the first major logging event likely occurred in the 1870s.

Mature Second-Growth Forest Zone

3.2 Soil Infiltration and Aquifer Recharge

The soil infiltration testing was performed on February 9, 2017, immediately following a period of relatively high precipitation. Soil surface infiltration rates ranged from 9.3 to 21.8 inches per hour, and subsurface rates ranged from 0.7 to 4.5 inches per hour at five of the six test sites.[2] Restrictive hardpan layers were encountered between a depth of 24 to 32 inches in the test pits, which likely limited subsurface infiltration. The higher infiltration rates measured in the surface tests are likely due to soil irregularities that can result in better infiltration, such as roots, insect/worm burrows, and organic material. In general, the subsurface infiltration tests revealed the more limiting infiltration capability of the deeper soils.

Overall, the infiltration rates measured in the subsurface tests indicated a low to moderate infiltration capacity of the soils on the property, which is consistent with the hydrologic Soil Group C classification listed in the NRCS Web Soil Survey (2017). Given that Bainbridge Island is made up of mainly Hydrologic Groups A, B, and C, infiltration at the Suzuki Property is likely low to average in comparison with the rest of the island.

Most of Bainbridge Island, including the Suzuki Property, is classified as a Critical Aquifer Recharge Area (CARA) for shallow aquifers (Aspect Consulting, 2015; USGS, 2011). The shallowest aquifer with the highest potential to be affected by development on the property is the Vashon advance aquifer (the property is not classified as a CARA for deep aquifers). Based on the low to moderate infiltration rates measured on site and the presence of better draining soils within the mapped CARA outside of the Suzuki

[2] Due to high groundwater, the surface infiltration test at Test Site 2 was aborted when the test failed to show measurable infiltration after 40 minutes, and the subsurface infiltration test was not performed. This test site is in the immediate vicinity of a potential wetland area (see Section 3.3.2).

Property, the site likely has a low to moderate impact on aquifer recharge in comparison to the rest of the island.

See the Soil Infiltration and Aquifer Recharge Report (Appendix B) for additional information.

3.3 Wildlife Habitat and Species

3.3.1 Forest Habitat

Of the four forest types identified on the property, the closed canopy forest zone (Type 1) has the least overall habitat value. The forest consists of a dense, even-aged stand of Douglas fir with a high degree of canopy closure and a sparse understory, which provides comparatively poor quality wildlife habitat compared to more species- and structurally diverse forest types (McComb et al., 1993). The lack of canopy openness restricts wildlife access, reduces visibility for spotting prey, and decreases ground temperatures, all of which negatively impact wildlife habitat quality (Carey, 1996; North et al., 1999). A low diversity of vertical structure and canopy variability, along with minimal understory vegetation, provides few niches for wildlife and prey species, which lowers the overall wildlife species diversity and population levels (Hays & Hagar, 2002; Wilson & Puettmann, 2007). Coarse woody debris and standing snags are largely absent from this forest zone, further limiting habitat quality.

In comparison, the mature second-growth forest zone (Type 4) has the highest overall habitat value of the four forest types on the property. The diversity of tree species, ages, heights, and canopy openness provide niches for a variety of wildlife and prey species (Carey, 1996; Carey et al., 1999; Wilson & Puettmann, 2007). The presence of understory deciduous trees and shrubs is especially important, as they provide berries, seeds, small mammal cover, habitat structure, as well as browsing material for larger mammals (Martin & McComb, 2002; Wender et al., 2004). Additionally, compared to the closed canopy forest zone, coarse woody debris is abundant in this forest habitat. Coarse woody debris is an important component of healthy forest ecosystems, as it provide sites for nests, dens, and burrows; hiding cover for predators and protective cover for their prey; organic material for insects; and other habitat functions (Stevens, 1997). The mature second-growth forest zone meets the WDFW (2008) criteria to be considered a “mature forest,” which is a state-designated priority habitat type.

The mid-successional forest zone (Type 3) has moderate habitat value, compared to the closed canopy forest (Type 1) and the mature second-growth (Type 4) forest zones. The mid-successional forest zone shares several attributes with the mature second-growth forest zone (Type 4), such as similar dominant tree and understory species. However, course woody debris abundance, plant species diversity, diversity of vertical structure, and level of canopy openness is lower compared to the mature second-growth forest zone, but is significantly higher than what was observed in the closed canopy forest zone.

The remaining forest type on the property (early-successional forest [Type 2]) also has comparatively moderate habitat value. As described in Section 3.1, the early-successional forest zones on the property are dominated by red alder. Various species of birds, mammals, amphibians, and invertebrates depend on red alder; for example, the leaves of red alder support a high number of invertebrates, which serve as the main food source of many songbird species (Jensen et al., 1995). These zones also contain a dense understory of native shrubs, particularly where canopy gaps are present. Habitat limitations of the early-successional forest zones include low levels of coarse woody debris and snags, the presence of invasive species (primarily Himalayan blackberry) in some locations, and a lower diversity of vertical structure and canopy variability, compared to the mature second-growth forest zone.

3.3.2 Pond and Wetland Habitat

As shown in Figure 3, an approximately 0.5-acre human-created pond is located on the south property boundary. The pond is surrounded by an earthen berm, and is likely maintained by a high groundwater table and/or a clay lining at the bottom of the pond. A Douglas fir tree rooted within the berm was determined to be between 71 and 76 years old (see Appendix A for details), indicating that the pond was likely constructed in the mid-20th century.

Human-Created Pond

The pond is permanently flooded and approximately 10 feet deep, with a seasonal variation of 3 to 4 feet (Bainbridge Island, 2016). Vegetation in the pond includes duckweed, water parsley, and yellow-flag iris. Despite the fact that the pond is a human-made feature, it provides habitat for a variety of species that rely on open water habitat for all or a portion of their life cycle, such as amphibians and many insects (Sheldon et al., 2005). Other species, such as deer and herons, use open water areas for obtaining some life requirements (e.g., sources of prey and drinking water). The close proximity and uninterrupted connection between the pond and the adjacent forest habitat support both the overall wildlife populations and biodiversity on the property.

Along with the pond, three potential wetland areas were identified on the property, which are shown in Figure 4 and described below. Wetlands provide many valuable environmental functions, such as water quality improvement, flood water storage, and habitat for plants and animals (Sheldon et al., 2005). The ability of a wetland to provide these functions is dependent upon a variety of factors, such as the wetland’s topography and position in the landscape, water regime, proximity to adjacent habitats, and vegetative composition.

SOURCE: ESA, 2016

Figure 4
Potential Wetland Areas on the Suzuki Property

Potential Wetland Area 1

Potential Wetland Area 1 is a depressional feature near the center of the property. The dominant vegetation in the area is red alder trees, with some scattered western red cedar trees. The understory is dominated by salmonberry, with patches of salal, swordfern, and trailing blackberry, primarily on the fringes of the wetland area.

During the December 15, 2016 site visit, shallow ponded water was observed in the middle of the potential wetland area. The area is isolated (i.e., there is no obvious surface water outlet). During and shortly after rain events, the area reportedly contains standing water up to 6 inches deep (C. Kratzer, personal communication, December 15, 2016). No standing water is present during drier periods; surface water infiltrates into the soil fairly rapidly after rain events.

Potential Wetland Area 1

Potential Wetland Area 2

Potential Wetland Area 2 is a linear swale feature in the east-central portion of the property. The area slopes to the west and drains into the ditch along Sportsman Club Road NE (see Section 3.3.5). The dominant vegetation in the area is primarily red alder trees with an understory of salmonberry, with some scattered patches of swordfern, trailing blackberry, and red elderberry along the potential wetland area boundary. During the December 15, 2016 site visit, areas of soil saturation and water seeping from the hillside were observed.

Potential Wetland Area 2

Potential Wetland Area 3

Potential Wetland Area 3 is a depressional feature near the southwest corner of the property. The area drains south into the ditch along Sportsman Club Road NE (see Section 3.3.5). The dominant vegetation in the area is primarily red alder trees and mature willows, with an understory of salmonberry and soft rush. During the December 15, 2016 site visit, ponding was observed in the area, and water was observed flowing out of the area into the adjacent ditch.

It appears that a portion of the wetland is seasonally flooded (meaning that the observed ponding persists for at least two consecutive months out of the year). As opposed to the other two potential wetland areas identified on the property, Potential Wetland Area 3 may provide breeding habitat for amphibians.

Potential Wetland Area 3

3.3.3 Wildlife Species

Many different wildlife species have been observed on the property, including a variety of songbirds, waterfowl, and raptors; frogs, salamanders, and newts; painted turtle, Douglas squirrel, coyote, river otter, and white-tail deer. Many of these species, particularly the river otters, painted turtles, and amphibians, were observed within or in close proximity to the pond. The resident of a house located directly south of the pond on Commodore Lane NW has collected wildlife observation data of the pond vicinity for several years; these data are presented in Appendix C. During a one-day field visit on December 15, 2016, ESA biologists also recorded species observations, which are presented in Appendix C.

A sample of wildlife observed in the pond (clockwise from upper left): painted turtle, river otther, great blue heron, and wood duck (Photos courtesy L. Marshall)

The WDFW PHS database (2017a) does not include species data for the property. However, of the observed wildlife species on the property, seven species are listed as priority species by WDFW (Table 1).

TABLE 1
WDFW-LISTED PRIORITY SPECIES OBSERVED ON THE SUZUKI PROPERTY

Species	Listing Criteria
Pileated woodpecker	#1: State-Listed Species[1] *(Sensitive)*
Bald eagle	#1: State-Listed Species[1] *(Candidate)*
Great blue heron	#2: Vulnerable Aggregations[2]
Wood duck	#3: Species of Recreational, Commercial, and/or Tribal Importance[3]
Common goldeneye	#3: Species of Recreational, Commercial, and/or Tribal Importance[3]
Bufflehead	#3: Species of Recreational, Commercial, and/or Tribal Importance[3]
Hooded merganser	#3: Species of Recreational, Commercial, and/or Tribal Importance[3]

[1] State-listed species are native fish and wildlife species legally designated as Endangered, Threatened, or Sensitive (Washington Administrative Code [WAC] 232-12-011). State Candidate species are fish and wildlife species that will be reviewed by WDFW for possible listing as Endangered, Threatened, or Sensitive according to the process and criteria defined in WAC 232-12-297.

[2] Vulnerable aggregations include species or groups of animals susceptible to significant population declines, within a specific area or statewide, by virtue of their inclination to aggregate.

[3] Native and non-native fish and wildlife species of recreational or commercial importance, and recognized species used for tribal ceremonial and subsistence purposes, whose biological or ecological characteristics make them vulnerable to decline in Washington or that are dependent on habitats that are highly vulnerable or are in limited availability.

Pileated woodpeckers generally nest in snag cavities or in the dead branches of live trees, usually 15 to 80 feet above ground (Audubon Society, 2017). Pileated woodpecker nests may be present on the property, although none have been observed to date. If present, the nests would like occur in the mid-successional forest zone (Type 3) or the mature second-growth forest zone (Type 4). WDFW PHS data (2017a) show the nearest documented pileated woodpecker nesting habitat is located approximately 2 miles northwest of the property, near the corner of NE Tolo Road and NE Nelson Hill Road.

There are no bald eagle nests or great blue heron rookeries on the property, although these species have been observed using the property for roosting and/or foraging. WDFW PHS data (2017a) show the nearest bald eagle nest located near Murden Cove, approximately 0.75 mile northeast of the property. WDFW data also show the presence of a great blue heron breeding area 0.5 mile east of the property, adjacent to Highway 305.

Wood duck, common goldeneye, bufflehead, and hood merganser are all cavity-nesting ducks, meaning that they require natural cavities or nest boxes to raise their young. Suitable nesting cavities are generally located near water (Seattle Audubon Society, 2017). Nesting sites may be present on the property, although none have been observed to date. WDFW PHS data (2017a) do not show the presence of cavity-nesting duck breeding areas within 2 miles of the property.

3.3.4 Habitat Corridors and Connections

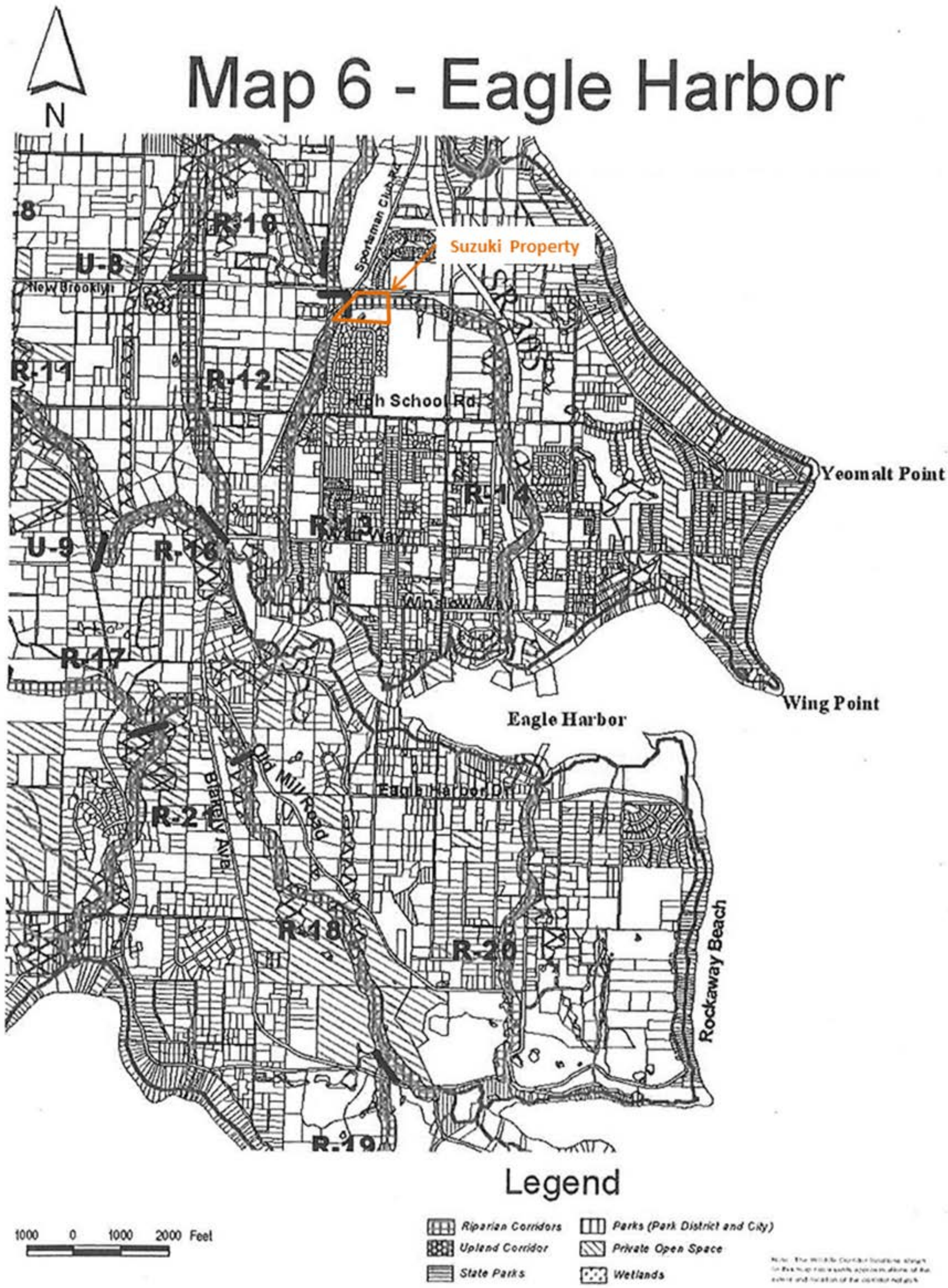
Land development generally results in habitat fragmentation, which is a significant threat to wildlife populations and species (Gilbert-Norton et al., 2009). The dominant effect of habitat fragmentation is a decline in wildlife population density and species richness. In a fragmented landscape, remnant areas of relatively undisturbed habitat are referred to as “habitat patches.” As the Suzuki Property is surrounded on all four sides by development (arterial roads to the north and west, a gravel road to the east, and a residential subdivision and stormwater detention pond to the south), the entire property can be consisted a habitat patch.

In developing landscapes, the primary option for increasing wildlife migration between habitat patches is the creation of landscape corridors, which are thin strips of habitat that connect isolated patches of habitat (Gilbert-Norton et al., 2009; Christie & Knowles, 2015). Corridors can be effective at maintaining or slowing the decline of wildlife population density and species richness. Corridor effectiveness depends on a variety of factors, such as life cycle needs of the target species, corridor width, length, and level of fragmentation within the corridor (e.g., a road crossing) (NRCS, 1999b). The minimum effective corridor width is generally recognized to be approximately 300 feet (USDA, 2008).

The Suzuki Property is identified as part of a "riparian corridor"[3] in the *Bainbridge Island Wildlife Corridor Network* study (Figure 5) (Self, 2000). This corridor, identified as "Link R-14," is described as connecting riparian habitat along Stream 0321 (Drainage to Murden Cove) with riparian habitat along Streams 0325 and 0324 in the North Eagle Harbor watershed. The study was developed by a City summer intern, and the corridor mapping conducted at a relatively coarse scale using aerial photo interpretation.

The mapped corridor crosses developed areas and is interrupted in several locations in the vicinity of the property. To the east, the mapped corridor is bisected by Madison Avenue North approximately 1,000 feet from the property. Just to the southwest of the property, the mapped corridor is narrowed to a width of less than 200 feet between Sportsman Club Road NE and a residential subdivision on Capstan Drive NE, and the mapped corridor crosses High School Road NE approximately 2,000 feet south of the property. These disturbances, particularly the roads, severely limit the effectiveness of the corridor. However, given the recorded observations of river otter in the Suzuki Property pond, flightless species have the potential to migrate from off-site riparian areas to the property.

[3] The term "riparian corridor" in the study includes both riparian (stream) corridors, as well as upland areas that link riparian areas.



SOURCE: Best, 2000

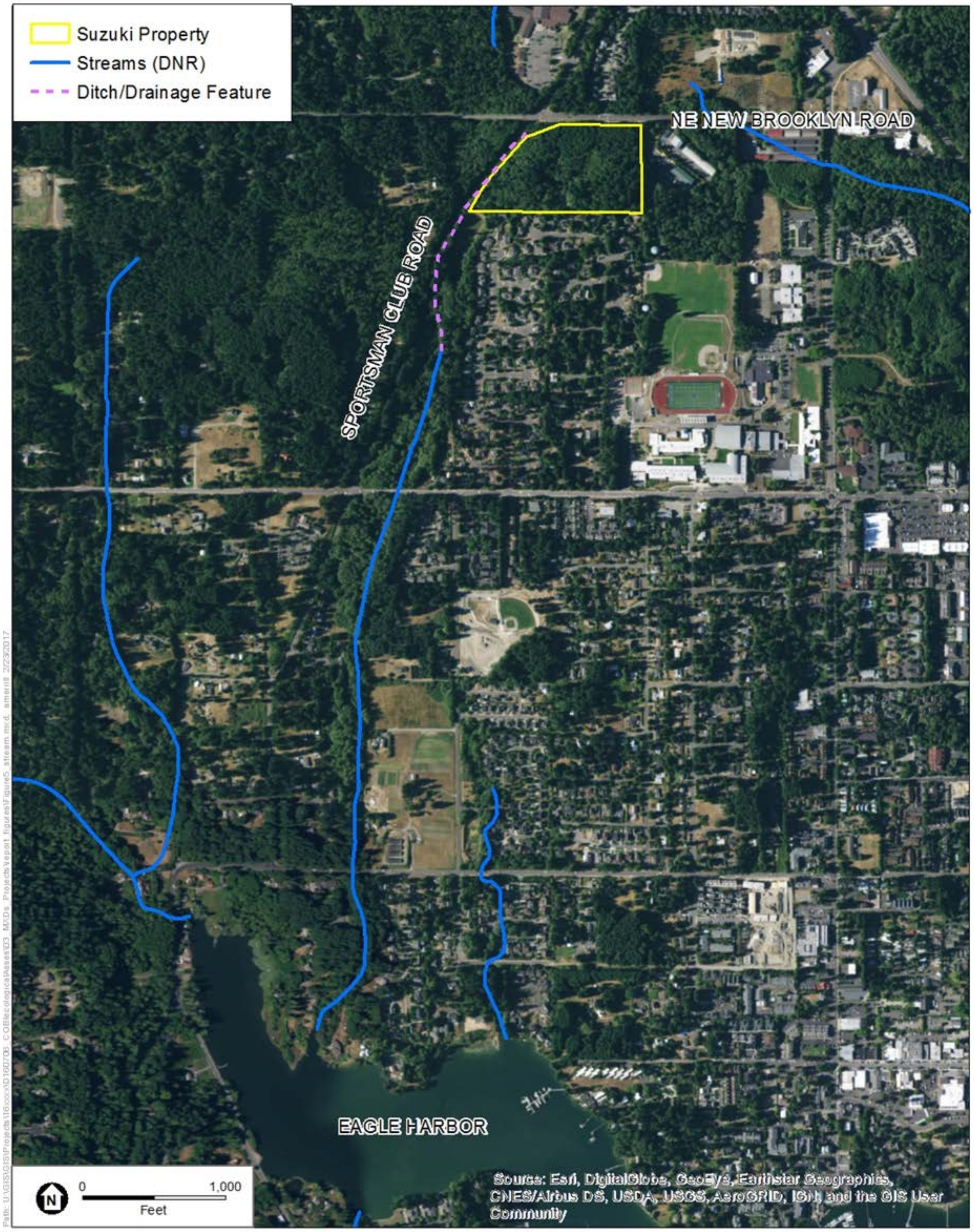
Figure 5
Eagle Harbor Vicinity Habitat Corridor Map

3.3.5 Stream Identification

Several data sources indicate the presence of a stream near the west property boundary, adjacent to Sportsman Club Road NE. However, these data sources differ in both the extent of the stream features and its fish-bearing status. WDNR (2017) data show a Type F (fish-bearing) stream originating approximately 1,000 feet south of the property and draining into Eagle Harbor (Figure 6). City critical areas mapping shows the stream as originating farther north, approximately 200 feet southeast of the intersection of Sportsman Club Road NE and NE New Brooklyn Road directly adjacent to the property (Bainbridge Island, 2017). The City data show the stream mapped as Type Ns (non-fish bearing seasonal) from its origin to a point approximately 400 feet downstream, where it is then mapped as a Type F stream. The Type F stream extends for approximately 200 feet into the southeast boundary of the property. The remaining downstream reach of the stream follows a similar path as the WDNR mapping.

The SalmonScape database (WDFW, 2017b) also identifies an ephemeral, non-fish-bearing stream in the general project vicinity. These data show the stream originating approximately 1,000 feet south of the property. The remaining downstream reach of the stream is mapped by WDFW as following a similar path as the WDNR and City mapping.

During the December 15, 2016 field investigation, a single channelized drainage feature was observed just west of the property boundary, adjacent to Sportsman Club Road NE (Figure 6). For most of its length along the western property boundary, the drainage feature is between 1 and 2 feet wide. Approximately 150 north of the southern property boundary, a 12-inch diameter culvert conveys the drainage into Potential Wetland Area 3 (Figure 4). The wetland extends to the southern boundary of the property, where it drains through another culvert under an unpaved access road and into what appears to be a second wetland located south of the property. Any flow appears to continue downstream to the southwest, as indicated by the WDNR stream mapping (Figure 6). During the site visit, the drainage feature was dry upstream of Potential Wetland Area 3. Water was observed flowing south from the wetland area, just south of the property.



SOURCES: WDNR, 2017, ESA 2017

Figure 6
Streams/Drainage Features in the Suzuki Property Vicinity

In the immediate vicinity of the property, the drainage feature appears to be a human-created ditch with the primary purpose of intercepting and conveying stormwater runoff from Sportsman Club Road NE. The channel is heavily vegetated with blackberry, rushes, grasses, and forbs forming a thick mat of vegetation within the bottom and sides of the channel. Patches of swordfern, an upland plant, also extend adjacent and into the channel. The substrate within the ditch is predominantly compacted organic soil and root material, with little natural cobble or gravel observed (some irregular and small patches of angular quarry spalls were observed).

Drainage ditch west of the Suzuki Property

Based on the observed channel, habitat, and hydrology within the drainage feature, it appears that the portion of the drainage feature in the immediate vicinity of the property should not be considered a stream, but rather a manmade stormwater conveyance feature. Drainage appears to come primarily from roadway stormwater runoff, and no suitable habitat for fish species is present within the homogenous, linear channel. Downstream of the property, it is likely that the contributing basin area is large enough to create and maintain a stream channel, but these conditions do not occur in the immediate vicinity of the property.

4. MANAGEMENT RECOMMENDATIONS

The most effective strategy for maintaining ecological functions in a developing area is to retain large, connected patches of native vegetation and limit development footprints. This strategy, typically referred to as development “clustering,” is consistent with the stated goals in the “Suzuki Farm” development concept (OPG and Davis Studio Architecture + Design, 2016), which include preserving open space and enhancing habitat for Bainbridge Island species.

Overall, based on our site investigation and a review of the relevant ecological data and scientific literature, we recommend focusing the development footprint on the north portion of the property. This portion of the property, identified in this study as the closed canopy forest (Type 1) zone (Figure 3), has the least overall ecological value compared to the remaining habitats of the property. We recommend preserving the mature second-growth forest (Type 4) zone in its entirety, as this area, along with the pond, as they are the most ecologically valuable areas of the property. We also recommend that the early successional forest (Type 2) and mid-successional forest (Type 3) zones be retained as much as possible, particularly the portions that provide connections between the mature second-growth Forest and the pond, as well as off-site habitats. Ideally, the retained open space on the property would be one large, connected block of habitat, instead of creating multiple patches with interrupted connections.

Specific management recommendations for the different ecological features on the property are described below.

4.1 Tree Protection

Prior to creating a site development plan, it is important to look at the forest holistically to determine groves or stands of trees that will be retained. This includes assessing species tolerance to construction impacts, such as soil compaction, root loss, and exposure to changing forest conditions resulting from adjacent tree removal. On the property, trees that are more open-grown with higher live crown ratios (measured as the length of live tree canopy compared to total tree height) are more likely to tolerate new exposure that results from the removal of adjacent trees. Conversely, trees with lower live crown ratios are more susceptible to windthrow if adjacent trees are removed.

Other tree protection management recommendations include the following:

- Install tree protection fencing around the critical root zones of retained trees, and avoid disturbances (such as parking, materials storage, or dumping) within the tree protection area.
- Minimize soil disturbance adjacent to tree protection areas, and use alternative methods (such as hand excavation) to protect roots.
- Minimize root pruning.

- Retain and protect the existing duff layer and understory near retained trees.

For further tree protection details, see the Forest Survey Report (Appendix A).

4.2 Soil Infiltration and Aquifer Recharge

As stated in Section 3.2, the property is within a designated CARA. Based on a review of existing information and the results of the soil infiltration testing, the property likely has a low to moderate impact on groundwater recharge, in comparison to the rest of Bainbridge Island. However, considering that groundwater is the sole source of drinking water on the island, utilizing stormwater management strategies that maintain the quantity and quality of aquifer recharge is important, even in areas with more limited groundwater recharge potential. Therefore, we recommend the use of LID stormwater management techniques for the proposed development.

LID stormwater management techniques remove pollutants from stormwater runoff and reduce impact to the natural hydrologic cycle by infiltrating stormwater on-site through localized facilities, such as rain gardens and bioswales. LID stormwater management benefits aquifer recharge by maintaining the quantity of water infiltration that would occur naturally on an undeveloped site. The suitability of LID facilities is determined by the subsurface infiltration rates and the depth to seasonal high groundwater.

The average subsurface infiltration rate measured on the property was 2.2 inches per hour, which is suitable for some types and sizes of LID infiltration facilities. However, the high groundwater levels on the property may limit the opportunity for infiltration of stormwater. The Western Washington Stormwater Management Manual (Ecology, 2012) states that the bottom of infiltration facilities should be at least 5 feet above seasonal high groundwater. The recommended separation of stormwater infiltration facilities and groundwater is intended to protect groundwater from contamination from pollutants.

Several LID stormwater management techniques are effective in areas with limited soil infiltration capacity and high groundwater tables; these techniques include the following:

- Limiting impervious surface coverage across the development site.
- Installing “green roofs,” i.e., a building that is partially or completely covered with vegetation and a growing medium, planted over a waterproofing membrane.
- Utilizing impervious pavement for roads, driveways, sidewalks, and other hardscapes.
- Using rain barrels/cisterns to “harvest” rainwater that can be used for irrigation or other non-potable water uses.
- Using lined, vegetated stormwater planters to treat stormwater prior to discharging to a separate infiltration facility.

Prior to site design efforts, we recommend that additional field investigation be performed to better understand the extent of perched groundwater beneath the site, in order to select and design LID stormwater facilities that are appropriate for the site-specific conditions of the property.

4.3 Wildlife Habitat

Other than retaining existing native vegetation, there are several methods for minimizing the impacts of development on wildlife habitat. These methods include the following:

- Locate development and uses that create noise, such as playgrounds, away from habitat areas.
- Minimize light pollution and maintain naturally dark habitat by minimizing outdoor lighting, orienting lighting away from habitat areas.
- Create "buffer zones" of native vegetation between development and existing high-quality habitat areas (such as the mature second-growth forest).
- Limit and/or exclude domestic animal access to habitat areas.
- Use native plantings for residential landscaping, particularly plants that create forage and habitat for bird and insect species.

Once constructed, a major amenity for residents of the proposed development will be opportunity to enjoy the wildlife habitat that is literally "in their backyard." Human use of the habitat areas would significantly increase relative to existing conditions. This increase could have a serious detrimental effect on the wildlife and habitat on the property, as increased human use can result in trampling of vegetation, soil compaction, disturbance of wildlife breeding activity, and other negative effects. Fortunately, there are several effective measures to mitigate the impacts of increased human use, including the following:

- Restrict human use to established paths, to avoid disturbance to the majority of the habitat areas.
- Develop educational materials, such as educational signage, to inform residents and visitors on how to enjoy and view wildlife and open space while minimizing disturbance.
- Establish a volunteer program to conduct outreach efforts, lead wildlife enhancement projects, and monitor potential wildlife-disturbing activities (such as littering and the creation of informal paths).

Along with minimizing human impacts to habitat areas, opportunities to enhance habitat quality on the property include the following:

- Remove invasive species (e.g., Himalayan blackberry and English ivy).
- Establish native plantings to increase plant species diversity and vertical structure in the retained forest areas.
- Install bat houses and bird nest boxes.
- Increase habitat structure by installing brush piles and snags throughout the property, particularly in areas where course woody debris density is low. The materials needed to create these habitat

structures (tree trunks, brush, and root wads) can be salvaged from trees that are removed during site development.

As the property provides habitat for state-listed priority species, the Bainbridge Island Municipal Code (BIMC) requires the submission of a Habitat Management Plan (HMP) prior to site development. Per BIMC Section 16.20.130.C, the HMP must include measures to retain and protect the wildlife habitat and consider effects of land use intensity, buffers, setbacks, impervious surfaces, erosion control, and retention of native vegetation.

4.3.1 Pond

As stated in Section 3.3.2, the human-created pond on the property provides habitat for a variety of species that rely on open water habitat for all or a portion of their life cycle. The “Suzuki Farm” development concept shown in the OPG and Davis Studio Architecture + Design proposal (2016) describes enlarging the pond for stormwater detention purposes, as well as constructing a play/gathering space directly adjacent to the proposed enlarged pond (Figure 2).

We recommend avoiding disturbance to the pond, given its importance as a habitat feature on the property. Additionally, we recommend maintaining a protective buffer of existing native vegetation around the pond. Ideally, the pond buffer would be a component of the habitat corridor across the southern portion of the site (see Section 4.3.3 below).

4.3.2 Wetlands

Wetlands provide valuable ecological functions (e.g., floodwater storage, water quality improvement, and wildlife habitat), and are regulated at the federal, state, and local levels. The BIMC (Section 16.20.160) assigns protective buffer widths to wetlands; widths range between 25 and 250 feet depending on wetland category, as determined using the *Washington State Wetland Rating System for Western Washington* (Hruby, 2014). The BIMC permits impacts to wetlands for some specific uses when no reasonable alternative location is available, such as utility installation and dock construction. But in general, impacts to wetlands and their buffers are only allowed when they are determined to be “necessary and unavoidable” by the City (BIMC Section 16.20.100). Any impacts to wetlands or their buffers must be mitigated for per BIMC Section 16.20.160.H.

Prior to site design, wetlands on the property should be formally delineated, categorized, and documented in a critical areas study (BIMC Section 16.20.090).

4.3.3 Habitat Corridors and Connections

We recommend that the habitat corridor across the south portion of the property, as described in the *Bainbridge Island Wildlife Corridor Network* study (Self, 2000), be retained. Despite the fact that the mapped corridor is interrupted and narrows to the east and west of the property, the documented presence of river otter in the pond indicates that flightless species have the potential to migrate to the property from off-site habitat areas. Retaining this corridor would also connect three of the most high-quality habitat areas on the site: Potential Wetland Area 3, the pond, and the mature second-growth forest (Type 4) forest zone. In accordance with the scientific literature, we recommend a corridor width of 300 feet or greater.

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Appendix A
Forest Survey Report

Project No. TS - 5753

Arborist Report

TO:	Environmental Science Associates and City of Bainbridge Island
SITE:	Suzuki Property; Parcel #222502-4-006-2005
RE:	Forest & Old Tree Assessment
DATE:	February 16, 2017
PROJECT ARBORISTS:	Katie Hogan ISA Certified Arborist #PN-8078A ISA Qualified Tree Risk Assessor Scott Baker, Registered Consulting Arborist #414 ISA Board Certified Master Arborist #PN-0670B ISA Qualified Tree Risk Assessor
REVIEWED BY:	J. Casey Clapp ISA Certified Arborist #PN-7475A ISA Qualified Tree Risk Assessor

Contents

Attachments

Summary

The 13.83 acre site, known as the Suzuki Property, consists of four distinct forest cover types. These forest types were determined by assessing the species composition throughout the property, using our knowledge of tree species and forest structure, and sampling seven (7) trees to determine age.

The small tree size and homogenous stand structure of the northern section of the property indicates that it was planted, likely sometime around the late 20th century. This resulted in minimal species diversity and forest canopy gaps, and is therefore categorized as a closed canopy forest.

There were several areas throughout the site dominated by riparian species and small deciduous trees, likely due to the changes in topography and subsequent movement of water throughout the property. These areas comprised of fast growing, short lived species that are commonly referred to as early-successional species which can adapt to poor soil conditions after disturbances. Due to this, these areas are categorized as early-successional forest.

The majority of the site is covered with a maturing forest that has a diverse species composition, including both deciduous and coniferous trees. This forest type had gaps within the canopy structure that allowed understory tree regeneration. This structure is commonly seen as a transition phase when a forest is progressing from a deciduous-dominated landscape to a mainly coniferous forest. This is referred to as a mid-successional forest type.

The final forest type comprises of the southeastern portion of the site and includes the oldest trees on site, referred to as a mature, second-growth forest. This was a conifer-dominated landscape that had a moderate amount of downed logs and mature sized trees. There were several old stumps that appeared to be from one of the previous logging events throughout this area. Using an increment borer and micro-resistance drill, we determined the age range of the trees in the mature second-growth forest type to be between 63 and 144 years old.

Based on the development concept for the property, the northern section of the property may be the focal point for development. The majority of this area consists of young, closed canopy forest with a small portion of early-successional forest and mid-successional forest. Depending on the final dimensions of the development, it is possible that the southern portion will encroach within the mature second-growth forest. When developing plans for the site, tree protection measures should be discussed throughout the design process to determine how to best preserve trees. Trees should be retained in clusters and groves as much as possible to minimize susceptibility to windthrow. Once more detailed plans become available, tree retention can be further assessed.

Assignment & Scope of Report

This report outlines the site inspection by Katie Hogan and Scott Baker, of Tree Solutions Inc., on January 19, 2017. We were asked to visit the site and provide an assessment to characterize the forest types of the subject property. We were asked to provide a formal report including approximate tree age and categorization of forest types. Environmental Science Associates requested these services to gain detailed information on the existing vegetative conditions of the property.

<u>Limits of Assignment</u>

Unless stated otherwise: 1) information contained in this report covers only those trees that were examined and reflects the condition of those trees at the time of inspection; and 2) the inspection is limited to visual examination of the subject trees without dissection, excavation, probing, climbing, or coring unless explicitly specified. There is no warranty or guarantee, expressed or implied, that problems or deficiencies of the subject trees may not arise in the future.

Methods

We evaluated tree health and structure utilizing **visual tree assessment (VTA)** methods. The basis behind VTA is the identification of symptoms, which the tree produces in reaction to a weak spot or area of mechanical stress. A tree reacts to mechanical and physiological stresses by growing more vigorously to re-enforce weak areas, while depriving less stressed parts (Mattheck & Breloer, 1994). An understanding of the uniform stress allows us to make informed judgments about the condition of a tree.

We took diameter measurements for each tree at standard height (DSH), typically located at 54 inches above average grade. Bark thickness was measured using a sharp probe and a ruler in the field, and using data collected by the micro-resistance recording drill. We used a steel soil probe to test soil depths and compaction. We used a Garmin GPS device to locate the trees and delineate the forest types.

We used a **micro-resistance drill** to determine the age of the trees. The micro-resistance recording drill measures the amount of resistance presented to the drilling needle as it is driven into the wood, perpendicular to the annual rings. The drilling needle is driven into the wood at a constant rate, up to one-half meter deep, and can detect the most minute changes in wood density. The data is recorded as a graphic resistance profile using a vertical scale that represents wood density. Annual growth rings can be counted using the data from the drill as the early and late wood layers on each ring show up due to the changes in wood composition over each year.

We also used a manual **increment borer** to determine the age of the trees. An increment borer is a specialized tool used to extract wood tissue from a living tree revealing the annual growth rings and other wood characteristics.

Observations

The Site and History

The subject site is a 13.83 acre undeveloped parcel located within the City of Bainbridge Island. The vegetation composition varies throughout the site. The varied forest types on the site are indicative of post-disturbance regeneration. In this case, the land was previously logged likely in several events creating a patchwork of various plant composition and forest structure. The changes in topography throughout the site has influenced how water moves and pools, creating suitable growing conditions for both coniferous trees and deciduous riparian species. We observed standing water in the southern portion of the property and a ditch along the western property edge. A man made pond is located near the south property line. There is a moderate volume of invasive species along the north and western portions of the site including, Himalayan blackberry (*Rubus bifrons*), Scotch broom (*Cytisus scoparius*), English holly (*Ilex aquifolium*), and invasive ivy (*Hedera* spp.). Overall the forest health appeared to be stable. We did not observe signs or symptoms of advanced root disease and found minimal windthrown trees.

Based on the plant composition we categorized the site into four distinct forest cover types. These cover types were derived from the methods used in the publications Definitions and codes for seral status of vegetation and Upland Plant Associations of the Puget Trough Ecoregion (Hall et al., 1995 and Chappell, 2004). Below are the cover types and their definitions:

Type 1: Closed Canopy Forest; early-successional forest, stem inclusion phase, dominated by Douglas-fir
Type 2: Early-successional Forest; riparian forest, understory re-initiation phase, dominated by red alder and bigleaf maple
Type 3: Mid-successional Forest (trees <80 years); mid-successional, stem inclusion phase, dominated by Douglas-fir
Type 4: Mature Second-growth Forest (trees 80-144 years); mid-to-late successional, understory rei-initiation phase, dominated by Douglas-fir and western redcedar

Type 1: Closed Canopy Forest - 171,222 square feet

This zone consisted predominantly of young, second generation Douglas-fir (*Pseudotsuga menziesii)* trees. There were very few gaps in the canopy which resulted in minimal understory sapling and shrub regeneration. Based on the small size of the trees, the homogenous canopy structure, and the absence of downed woody debris, we believe this section of the site was planted. Based on information provided to us on site, this area was previously an open field used for growing strawberries in the early 20th century. We observed pooling water along the north end of the property just west of the bus stop that was spilling over onto the sidewalk.

The species composition for the closed canopy forest cover type included:

Trees

Douglas-fir (*Pseudotsuga menziesii*)

Shrubs and Forbs

Trailing blackberry (*Rubus ursinus*)
Sword fern (*Polystichum munitum*)
Salal (*Gaultheria shallon*)
Salmon berry (*Rubus spectabilis*)
Evergreen huckleberry (*Vaccinium ovatum*)

Type 2: Early-successional Forest - 126,517 square feet

This forest type consisted of mainly small deciduous trees and shrubs that were less than 40 feet tall. The dominant tree species was red alder (*Alnus rubra*), a relatively short-lived and fast-growing tree. The species composition present throughout the Type 2 areas corresponded with site conditions that have consistently wet soils throughout most of the year. Red alder is an early pioneer species that can establish in poor soil conditions due to its ability to fix atmospheric nitrogen. There were some scattered conifer trees throughout these areas, but they appeared to be outcompeted by the fast-growing alders and understory shrubs. Some areas were very dense with understory shrubs. Invasive Himalayan blackberry was encroaching throughout most of the riparian areas on site especially where sunlight was available.

The species composition for this forest cover type included:

<u>Trees</u>
Red alder (*Alnus rubra*)
Bigleaf maple (*Acer macrophyllum*)
Bitter cherry (*Prunus emarginata*)
Pacific madrone (*Arbutus* menziesii)

<u>Shrubs and Forbs</u>
Salmon berry (*Rubus spectabilis*)
Sword fern (*Polystichum munitum*)
Pacific willow (*Salix lucida*)

Type 3: Mid-successional Forest (trees <80 years) - 209,713 square feet

Mid-successional forests were the dominant forest type throughout the property. This consisted of a multi-tiered forest that contained both deciduous and coniferous trees. There were dispersed gaps in the forest canopy that facilitated a heterogeneous forest structure. These gaps allowed for a moderate volume of coniferous sapling regeneration, mostly western redcedar. The forest appeared to be transitioning from a mainly deciduous forest stand to a coniferous forest.

The species composition for this forest cover type included:

<u>Trees</u>
Western redcedar (*Thuja plicata*)
Bigleaf maple (*Acer macrophyllum*)
Douglas-fir (*Pseudotsuga menziesii*)
Red alder (*Alnus rubra*)
Western hemlock (*Tsuga heterophylla*)

<u>Shrubs and Forbs</u>
Vine maple (*Acer circinatum*)
Evergreen huckleberry (*Vaccinium ovatum*)
Red huckleberry (*Vaccinium parvifolium*)
Salal (*Gaultheria shallon*).
Sword fern (*Polystichum munitum*)
Trailing blackberry (*Rubus ursinus*)

Type 4: Mature Second-growth Forest (trees 80-150 years) - 83,483 square feet

The southeastern portion of the site comprised of a mature second-growth forest. Forest characteristics included moderate to large diameter conifer trees, a moderate volume of coarse woody debris, and a multi-layered canopy with shade tolerant shrub species. There was a low volume of invasive species throughout the Type 4 area. We did not observe any standing snags throughout this area or trees with old-growth canopy form, such as large diameter branches, rounded crowns, dead tops, or large epicormic branch structures.

We found several large diameter western redcedar and Douglas-fir stumps with springboard notches and chainsaw cuts, indicating this area was previously logged. It is likely that logging occurred in more than one event. We base this on our observation of springboard notches in the large stumps, which were used before chainsaws came into use. It is recorded that the area surrounding Eagle Harbor was cleared in the 1870s.

The species composition for this forest cover type included:

<u>Trees</u>
Douglas-fir (*Pseudotsuga menziesii*)
Western redcedar (*Thuja plicata*)
Bigleaf maple (*Acer macrophyllum*)
Western hemlock (*Tsuga heterophylla*)
Bitter cherry (*Prunus emarginata*)
<u>Shrubs and Forbs</u>
Vine maple (*Acer circinatum*)
Evergreen huckleberry (*Vaccinium ovatum*)
Red huckleberry (*Vaccinium parvifolium*)
Salal (*Gaultheria shallon*)
Sword fern (*Polystichum munitum*)
Oregon grape (*Mahonia* spp.)
Trailing blackberry (*Rubus ursinus*)

Testing and Discussion

We determined tree age from partial core samples using the following formula (Altman et al., 2006):

$$AGE = [N + ((GR - PCL - MBW)/MRWn) + Y]$$

Where N is the number of visible rings on the partial core, GR is the tree radius in inches at the testing height, PCL is the core or drill test length, MBW is the average bark thickness in inches, MRWn is the average ring width in inches, and Y is the estimated years before the tree reached the testing height (typically less than 54 inches above average grade).

We determined the growth factors for variable Y to be between 5 and 10 years for Douglas-fir and 10 to 15 years for western redcedar. This is based on our knowledge of the species and their average growth rates. Western redcedar trees are typically slower growing trees, with annual growth rates of 6 inches or less per year. Douglas-fir are typically faster growing species that can grow well over 12 inches per year.

We used data collected from core or drill samples to estimate the approximate ages of the remainder of the trees assessed. This data was applied to trees that were not physically sampled based on species, size, and site conditions (i.e. dense canopy, open grown, steep, flat). See Table 1 below and attached Table of Trees for more details.

The trees we tested were identified by the local citizens who are interested in the planning process for the site. They had produced estimates of tree age and had marked trees on the site. We tagged all of these trees with our own tag and numbering system. We also assessed four additional trees that appeared to be good candidates for aging and exhibited similar characteristics.

Type 3: Mid-successional Forest

We performed testing on two trees in the Type 3 area, trees 2 and 15. Tree 2 was a 32.7 inch diameter Douglas-fir tree located at the edge of the pond. From our core sample, we determined the age of this tree to be between 71 and 76 years old. Tree 15 was a 21.5 inch diameter Douglas-fir tree located in the northeastern portion of the site. Using a micro-resistance drill, we determined the age of this tree to be between 70 to 75 years old. The difference in trunk diameter between the two trees of similar age is likely the result of growing conditions. Tree 2 is perched on the edge of a pond with minimal competition from surrounding trees. Increased sunlight and water availability likely contributed to the faster growth rate. This difference in growth rate was apparent from our ring analysis. The average annual ring width for tree 2 was 0.22 inches versus 0.16 inches for tree 15.

The age range of trees in the mid-successional forest type was determined to be 63 to 76 years old.

Type 4: Mature Second Growth Forest

We performed tests on five trees in the Type 4 area, trees 4, 5, 6, 7, and 8. From our sampling, we determined the oldest tree to be tree 5, a 48.0 inch diameter Douglas-fir tree, with an age between 139 and 144 years. Upon initial inspection of the tree, we noted that the crown was beginning to round out and that there were several large diameter branches. These attributes are common in older trees. Tree 5 was located along a unmaintained foot trail and was the most dominant tree in this area.

Tree 9 was a 21.9 inch diameter Douglas-fir tree that we cored and drilled. Because of the small size, we were able to reach the pith (center) of the tree with the increment borer. This tree had the smallest annual growth increments, averaging 0.12 inches wide. We determined the tree's age to be between 103 and 108 years old. This tree was located in a fairly dense canopy area with limited light exposure.

The age range of trees within the mature second growth forest was determined to be between 81 to 144 years old. Based on historical records of logging, the major logging event likely occurred around the 1870s. The majority of the trees existing today most likely did not exist at that time. As indicated by the stumps present throughout the property, we believe this land was logged in multiple events. Several stumps had springboard notches, signifying they were removed with a crosscut saw, while others had chainsaw cuts. It is unlikely a crosscut saw would have been used if chainsaws were available. This leads us to believe there was more than one logging event.

There is no clear record of when this pond was constructed but we assume it would have been within the last 75-100 years based on surrounding development. Our tree age calculations support this estimate.

Table 1. Tree Age Table

Tree No.	Common Name	Botanical Name	Diameter (inches)	Health	Age (years)	Notes
1	Douglas-fir	*Pseudotsuga menziesii*	~30.0	Good	65-70	Age estimated from core sample results for Tree 1
2	Douglas-fir	*Pseudotsuga menziesii*	32.7	Good	71-76	
3	Douglas-fir	*Pseudotsuga menziesii*	36.0	Good	88-93	Age estimated from core sample results for Tree 7
4	Western redcedar	*Thuja plicata*	35.4	Good	83-88	
5	Douglas-fir	*Pseudotsuga menziesii*	48.0	Good	139-144	
6	Douglas-fir	*Pseudotsuga menziesii*	47.4	Good	106-111	
7	Douglas-fir	*Pseudotsuga menziesii*	34.1	Good	84-89	
8	Douglas-fir	*Pseudotsuga menziesii*	36.5	Good	83-88	Age estimated from core sample results for Tree 7
9	Douglas-fir	*Pseudotsuga menziesii*	24.9	Good	103-108	
10	Douglas-fir	*Pseudotsuga menziesii*	37.3	Good	113-118	Age estimated from drill test results for Tree 6
11	Western redcedar	*Thuja plicata*	34.8	Good	84-89	Age estimated from core sample results for Tree 4
12	Western redcedar	*Thuja plicata*	35.9	Good	87-92	Age estimated from core sample results for Tree 4
13	Douglas-fir	*Pseudotsuga menziesii*	40.0	Good	122-127	Age estimated from drill test results for Tree 6
14	Western redcedar	*Thuja plicata*	25.2	Good	63-68	Age estimated from core sample results for Tree 4
15	Douglas-fir	*Pseudotsuga menziesii*	21.5	Good	70-75	
16	Douglas-fir	*Pseudotsuga menziesii*	23.5	Good	67-72	Age estimated from drill test results for Tree 15

Tree Management Recommendations

When considering development strategies for this property, it is important to look at the forest holistically to determine groves or stands of trees that will be most suitable for retention. This includes looking at species tolerance to construction pressures such as soil compaction or fill, root loss, and exposure to changing forest conditions resulting from adjacent tree removals.

Live crown ratio (LCR) is a common indicator of trees that may be more suitable to withstand new exposure after adjacent trees are removed. LCR is measured as the length of live canopy compared to the total tree height. Trees that are more open grown or were on site prior to successional vegetation typically have higher live crown ratios because sunlight was available to lower parts of the trunk. Denser forests that do not have multiple tiers of vegetation at varying heights typically have trees with low live crown ratios and smaller crowns overall. Smaller crown size to overall height can reduce the ability of a tree to dampen wind forces which can in turn increase their susceptibility to windthrow.

For this site, trees that are more open-grown with higher live crown ratios are more likely to tolerate new exposure that results from adjacent tree removals. This should be taken into consideration when determining whether a tree would have a long safe and useful life expectancy after development has occurred. Wherever possible, clusters of trees should be preserved rather than individual trees. Isolated trees that are desired to be retained should be evaluated on a case-by-case basis to determine whether they would be predisposed to windthrow.

When assessing the amount of area around retained trees that should be protected, there are multiple metrics that are commonly used. One of the most common is the trees' drip line, or extent of radial canopy area. However, in dense forested sites canopies are often more compact due to competition for light resources and do not accurately represent the critical root zone of a tree. The critical root zone (CRZ) is the area around a tree where most of the large structural roots are likely present.

Another metric is outlined in the Best Management Practices: Managing Trees During Construction developed by the International Society of Arboriculture. This method considers both the relative age of the tree and species tolerance to construction pressures. This is based on the knowledge that younger, healthier trees are typically more resilient to disturbances and that the ability for trees to sustain construction damages varies greatly between individual tree species. The categories can be found below in Table 2.

Table 2. Tree Protection Zone Guidelines

Species tolerance	Tree age	TPZ factor*
High	Young	6
	Mature	8
	Overmature	12
Medium	Young	8
	Mature	12
	Overmature	15
Low	Young	12
	Mature	15
	Overmature	18

*Tree Protection Zone (TPZ) factor is the multiplication factor that is applied to individual tree diameter to determine the radial TPZ in feet. Diameter at Standard Height (DSH) x TPZ Factor = TPZ radius in feet.

The tree species captured in this assessment (Douglas-fir and western redcedar) typically have a low to high tolerance to construction pressures. The ability for a tree to withstand construction damages is typically greatly influenced by the quality of existing site conditions, especially soil conditions. Most of the trees throughout the site would be considered young to mature.

Example: Tree 5 measured 48.0 inches DSH, is a mature tree, and has a high tolerance to construction pressures. DSH X TPZ Factor = TPZ or, 48 X 8 = 32 radial feet.

In many cases, the TPZ can be reduced in one direction and expanded in another to accommodate development requirements. This decision should be determined by a Certified Arborist after assessing site conditions and proposed grading in detail. As more detailed tree retention plans become available, tree protection zones can be determined on an individual tree basis.

For a site like this, it is important to take into consideration how grading will influence changes to soil profiles and hydrology throughout the site. Grading can drastically alter growing conditions for trees and may result in a shorter life expectancy. Other considerations to take into account during the design phase include locations of construction access and parking, utility installation, soil storage, temporary construction buildings, material staging, and the area needed for aerial equipment such as cranes.

It is crucial that tree protection is established throughout all phases of the development process. Recommended tree protection measures are outlined in the specification below.

Tree Protection Specifications

- **Tree Protection Fencing:** All trees planned for retention or on neighboring properties that overhang the site shall be protected for the entire duration of the construction project. Tree protection fencing shall consist of high visibility mesh or chain link fencing installed at the extent of the tree protection area. Where trees are being retained as a group the fencing should encompass the entire area.
- **Soil Protection:** No parking, materials storage, or dumping (including excavated soils) are allowed within the tree protection area. Any heavy machinery should remain outside of the protection area unless soils are protected from the load. Acceptable methods of soil protection include apply 18 inches of wood chip mulch, applying 1 inch plywood over 3 to 4 inches of wood chip mulch, or use of Alturna mats (or equivalent product).
- **Excavation:** Excavation done at or within the tree protection area should be carefully planned to minimize disturbance. Where feasible consider using alternative methods such as pneumatic excavation which uses pressurized air to blow soil away from the root system, directional drilling to bore utility lines, or hand excavation to expose roots. Excavation done with machinery (backhoe) in proximity of trees should be performed slowly with flat front buckets, removing small amounts of soil at a time with one person on the ground spotting for roots. When roots are encountered, excavation should stop and roots should be cleanly pruned as needed so they are not ripped or torn.
- **Root Pruning:** Root pruning should be limited to the extent possible. All roots shall be pruned with a sharp saw making clean cuts. Avoid fracturing and breaking roots with excavation equipment. Root cuts shall be immediately covered with soil or mulch and kept moist.
- **Duff/Mulch:** Retain and protect as much of the existing duff and understory as possible. Retained trees in areas where there are exposed soils shall have 4 to 6 inches of wood chips applied to help prevent water evaporation and compaction. Keep mulch 1 foot away from the base of the tree.
- **Irrigation:** Retained trees may require supplemental water if construction occurs during summer drought periods.
- **Pruning:** Any pruning required for construction and safety clearance in accordance with a pruning specification provided by the project arborist in accordance with American National Standards Institute ANSI A300 Standard Practices for Pruning. Use of an arborist with an International Society of Arboriculture Certification to perform pruning is strongly advised.

Glossary

ANSI A300: American National Standards Institute (ANSI) standards for tree care
codominant stems: stems or branches of nearly equal diameter, often weakly attached (Matheny *et al.* 1998)
cracks: defects in trees that, if severe, may pose a risk of tree or branch failure (Lilly 2001)
crown: the aboveground portions of a tree (Lilly 2001)
DBH or DSH: diameter at breast or standard height; the diameter of the trunk measured 54 inches (4.5 feet) above grade (Matheny *et al.* 1998)
deciduous: tree or other plant that loses its leaves sometime during the year and stays leafless generally during the cold season (Lilly 2001)
evergreen: tree or plant that keeps its needles or leaves year round; this means for more than one growing season (Lilly 2001)
ISA: International Society of Arboriculture
included bark: bark that becomes embedded in a crotch between branch and trunk or between codominant stems and causes a weak structure (Lilly 2001)
increment borer: specialized tool used to extract wood tissue from a living tree revealing the annual growth rings and other wood characteristics
landscape function: the environmental, aesthetic, or architectural functions that a plant can have (Lilly 2001)
lateral: secondary or subordinate branch (Lilly 2001)
live crown ratio: length of live tree crown compared to total tree trunk length
owner/manager: the person or entity responsible for tree management or the controlling authority that regulates tree management (ISA 2013)
pathogen: causal agent of disease (Lilly 2001)
phototropic growth: growth toward light source or stimulant (Harris *et al.*1999)
micro-resistance drill: a drilling instrument used to determine the density of wood by measuring the amount of resistance presented to the drilling needle as it is driven into the wood. The drilling resistance profiles show clearly where compression wood, annual rings, rot in various stages and other defects have been encountered by the drilling needle
retain and monitor: the recommendation to keep a tree and conduct follow-up assessments after a stated inspection interval (ISA 2013)
snag: a tree left partially standing for the primary purpose of providing habitat for wildlife
soil structure: the arrangement of soil particles (Lilly 2001)
structural defects: flaws, decay, or other faults in the trunk, branches, or root collar of a tree, whichmay lead to failure (Lilly 2001)
windthrow: the failure of a whole tree from the base or roots due the wind load
Visual Tree Assessment (VTA): method of evaluating structural defects and stability in trees by noting the pattern of growth. Developed by Claus Mattheck (Harris, *et al* 1999)

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Appendix A - Assumptions & Limiting Conditions

1. Consultant assumes that any legal description provided to Consultant is correct and that title to property is good and marketable. Consultant assumes no responsibility for legal matters. Consultant assumes all property appraised or evaluated is free and clear, and is under responsible ownership and competent management.

2. Consultant assumes that the property and its use do not violate applicable codes, ordinances, statutes or regulations.

3. Although Consultant has taken care to obtain all information from reliable sources and to verify the data insofar as possible, Consultant does not guarantee and is not responsible for the accuracy of information provided by others.

4. Client may not require Consultant to testify or attend court by reason of any report unless mutually satisfactory contractual arrangements are made, including payment of an additional fee for such Services as described in the Consulting Arborist Agreement.

5. Unless otherwise required by law, possession of this report does not imply right of publication or use for any purpose by any person other than the person to whom it is addressed, without the prior express written consent of the Consultant.

6. Unless otherwise required by law, no part of this report shall be conveyed by any person, including the Client, the public through advertising, public relations, news, sales or other media without the Consultant's prior express written consent.

7. This report and any values expressed herein represent the opinion of the Consultant, and the Consultant's fee is in no way contingent upon the reporting of a specific value, a stipulated result, the occurrence of a subsequent event or upon any finding to be reported.

8. Sketches, drawings and photographs in this report, being intended as visual aids, are not necessarily to scale and should not be construed as engineering or architectural reports or surveys. The reproduction of any information generated by architects, engineers or other consultants and any sketches, drawings or photographs is for the express purpose of coordination and ease of reference only. Inclusion of such information on any drawings or other documents does not constitute a representation by Consultant as to the sufficiency or accuracy of the information.

9. Unless otherwise agreed, (1) information contained in this report covers only the items examined and reflects the condition of the those items at the time of inspection; and (2) the inspection is limited to visual examination of accessible items without dissection, excavation, probing, climbing, or coring. Consultant makes no warranty or guarantee, express or implied, that the problems or deficiencies of the plans or property in question may not arise in the future.

10. Loss or alteration of any part of this Agreement invalidates the entire report.

Appendix B – Photographs

Photo 1: Looking west along northern property line at Type 1 closed canopy forest.

Photo 2: Invasive ivy climbing on trees in the western portion of the Type 1 area.


Photo 3: Looking north standing near southwestern corner of property showing Type 2 forest cover.


Photo 4: Looking south toward man made pond in Type 2 forest.

Photo 5: Typical ground cover throughout forest Type 2.

Photo 6: Looking north showing typical structure of Type 3 forest cover. Open forest gaps with deciduous and evergreen trees. Note regeneration of small conifer trees.

Photo 7: Another example of canopy structure in Type 3 forest.

Photo 8: Increment coring of Tree 2 just north of the pond. Tree was estimated to be between 71 to 76 years old.

Photo 9: Close up of tree 4 that was cored and estimated to be between 88 and 93 years old.


Photo 10: Base of tree 5, the oldest tree on site aging between 139 to 144 years old.

Photo 11: Canopy of tree 5 showing rounded crown.

Photo 12: Increment coring of tree 9 which exhibited slow annual growth and was estimated to be between 103 to 108 years old.

Photo 13: Fruiting body of decay causing fungi, *Phaeolus schweinitzii,* at the base of tree 9. This fungus is typical of older fir trees and is not a major concern at this time.

Photo 14: Base of tree 13. This tree had low growing branches, likely due to the increased sun exposure from the forest gap to the north. This is the second oldest tree we assessed, aging between 122 to 127 years old.

Photo 15: Photo of old cedar stump with springboard notches. This tree was likely logged in the late 1800s.

Photo 16: Close up of the springboard notch.

Photo 17: Core samples collected showing partial ring counts.

Appendix B
Aquifer Recharge and Soil Infiltration Report

ESA

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memorandum

date February 28, 2017

to Doug Schulze, City of Bainbridge Island

cc Adam Merrill, ESA

from Nathan Robinson, PE

subject Suzuki Property: Soil Infiltration and Aquifer Recharge Investigation

The purpose of this memorandum is to assess the aquifer recharge potential and the feasibility of stormwater infiltration at the Suzuki Property (the "property"), a 13.83-acre undeveloped parcel located just southeast of the corner of Sportsman Club Road NE and NE New Brooklyn Road in the City of Bainbridge Island, Washington. Groundwater is the only source of drinking water for Bainbridge Island, and as such, it is important to protect the island's aquifers from contamination and to maintain natural recharge patterns. This assessment is based on a review of existing documentation of soils and groundwater on Bainbridge Island and a field investigation performed by ESA on February 9, 2017.

Existing Documentation

The United States Department of Agriculture (USDA) Natural Resources Conservation Services (NRCS) maintains the Web Soil Survey, which includes soil data for Bainbridge Island. The NRCS Soil Survey has classified most of the property as Harstine gravelly ashy sandy loam (NRCS 1980). Depth to hardpan layer in Harstine soils is typically 25 to 40 inches. Permeability of Harstine soils is typically moderate to the hardpan and very slow through the hardpan. This soil is classified as Hydrologic Soil Group C. Group C soils generally have low infiltration rates. NRCS Soil Survey maps are attached to this memorandum. The soils across Bainbridge Island are well distributed between Hydrologic Soil Groups A, B, and C.

The United States Geological Survey (USGS) published a detailed report of the groundwater flow system on Bainbridge Island in 2011 (USGS 2011). Additional detail was added in a memorandum prepared by Aspect Consulting in 2015 (Aspect 2015). The report and memorandum identify several aquifers on the island corresponding with permeable geologic layers at varying depths. The shallowest aquifer with the highest potential to be affected by development on the Suzuki property is identified as the Vashon advance aquifer (USGS 2011). Based on maps of the aquifer in the USGS study, the top of this aquifer is approximately 50 feet below ground surface. Most of Bainbridge Island, including the Suzuki property, was classified as Critical Aquifer Recharge Area (CARA) for shallow aquifers (Aspect 2015). The Suzuki property was not classified as a CARA for deep aquifers.

Site Investigation

ESA performed a field investigation, including infiltration testing and soil characterization, on February 9, 2017. Methods and results are described below.

Methods

ESA chose six test locations across the property to obtain a thorough characterization of site soils (Figure 1**)**. At each test location, ESA performed infiltration tests using two different methodologies: a surface test performed at the ground surface, and a subsurface test performed at a depth of approximately 24 to 30 inches below ground surface.

The surface infiltration test was performed according to the methodology out lined in the NRCS Soil Quality Test Kit Guide (1999). This methodology is attached to this memorandum.

The subsurface infiltration test was performed with a method similar to the U.S. Environmental Protection Agency (EPA) Falling Head Percolation Test Procedure (1980). This test is often used in the design of low impact development (LID) facilities and is recommended by the Western Washington Stormwater Management Manual (Ecology 2012). At each site, ESA staff excavated a test hole approximately 9 inches in diameter and 24 to 30 inches in depth. ESA staff filled the test hole with clean water to a depth of approximately 9 inches. ESA staff then measured and recorded the depth of the water surface from a fixed reference point at 10- to 20-minute intervals. The depth to water surface was recorded for a minimum of 1 hour. ESA staff did not presoak the test pits because of heavy rain at the property in the hours prior to and during the tests.

In addition to the infiltration testing, ESA scientists examined the soils encountered in each test hole and noted soil characteristics.

Findings and Discussion

The surface and subsurface infiltration rates measured on site were generally consistent across the property, with the exception of Test Site 2. The results of the infiltration tests are summarized in Table 1 below.

Table 1. Summary of Infiltration Test Results

	Tested Infiltration Rate (in/hr)	
Test Site	**Surface**	**Subsurface**
1	21.8	0.7
2	0	N/A
3	10.6	2.0
4	12.2	1.6
5	9.3	2.0
6	9.7	4.5*

*The subsurface infiltration test performed at Test Site 6 was limited to 45 minutes. Due to the truncated testing time, infiltration at Test Site 6 is likely slower than the reported number.

Test Site 2 is in the immediate vicinity of a potential wetland area, and ESA staff encountered groundwater approximately 4 inches below the ground surface. Due to the high groundwater, the subsurface infiltration rate was not performed. The surface infiltration rate was aborted when the test failed to show measureable infiltration after 40 minutes.

The infiltration rates measured in the surface tests were uniformly higher than the infiltration rates measured in the subsurface tests. Soils at the surface are more likely to contain irregularities that could result in better infiltration such as roots, insect or worm burrows, and organic material. While the surface infiltration tests are useful as a comparison across the property, the subsurface infiltration tests reveal the more limiting infiltration capability of the deeper soils.

The infiltration rates measured in the subsurface tests indicate a low to moderate infiltration capacity in the soils on site. This is consistent with the Hydrologic Soil Group C classification listed in the NRCS Web Soil Survey.

Soils observed during the site visit are consistent with those described in the NRCS soil description. Soil texture was primarily gravelly or very gravelly sandy loam, often with frequent cobble inclusions. Soil structure was typically fine sub-angular blocky, although medium sub-angular blocky and medium granular structures were also observed. Restrictive hardpan layers were frequently encountered between 24 and 32 inches below soil surface.

In addition to the groundwater encountered at Test Site 2, shallow groundwater was also encountered at Test Sites 3, 4, and 5 at depths of approximately 24 inches, and is likely correlated to the recent heavy rains and perched above the hardpan layer.

Aquifer Recharge

The entirety of Bainbridge Island contributes to the recharge of the various aquifers that serve the island. The majority of the island is classified as CARA for shallow aquifers (Aspect 2015). Regions of high infiltration contribute more to groundwater recharge than areas of low infiltration.

The infiltration analysis and soil characterization show little variation across the property. Additionally, the uniformity of the soils suggests that aquifer recharge potential is consistent across the property.

The infiltration tests indicate low to moderate infiltration rates, and the soils are classified as Hydrologic Soil Group C. Given that the island is made up of mainly Hydrologic Groups A, B, and C, infiltration at the Suzuki property is likely low to average in comparison with the rest of the island.

Based on the low to moderate infiltration rates measured on site and the presence of better draining soils within the CARA and outside of the Suzuki property, the property likely has a low to moderate impact on groundwater recharge in comparison to the rest of the island.

Low Impact Development (LID)

LID stormwater management techniques remove pollutants from stormwater runoff and reduce impact to the natural hydrologic cycle by infiltrating stormwater through localized infiltration facilities such as rain gardens or swales. LID stormwater management benefits aquifer recharge by maintaining the quantity of infiltration that occurs naturally on an undeveloped site. The suitability of LID facilities is determined by the subsurface infiltration rates and the depth to seasonal high groundwater.

The average subsurface infiltration rate measured on the property was 2.2 inches per hour and is suitable for some types and sizes of LID infiltration facilities. However, the high groundwater levels on site may limit the opportunity for infiltration of stormwater. Shallow groundwater was encountered in four of the six test locations. The Western Washington Stormwater Management Manual states that the bottoms of infiltration facilities should be at least 5 feet above seasonal high groundwater. Separation of stormwater infiltration facilities and groundwater protects groundwater from contamination by pollutants.

Additional subsurface geotechnical investigations may help determine the location of seasonally high groundwater in the areas of the property where the test holes did not encounter groundwater during our field investigation. A depth to seasonal high groundwater of at least 10 feet below grade would likely provide adequate separation of at least 5 feet for most types of LID facilities.

Where groundwater is shallow, there may be opportunity to infiltrate on site by providing water quality pretreatment prior to infiltration. Lined vegetated stormwater planters (to prevent infiltration) could be used to treat stormwater prior to discharging to a separate infiltration facility.

Based on an infiltration rate of 2.2 inches per hour, the size of LID facilities can be estimated using a 10:1 to 15:1 ratio of impervious area to LID treatment area.

Summary and Recommendations

- The Suzuki Property has a low to moderate contribution to aquifer recharge on Bainbridge Island.
- The aquifer recharge potential is uniform across the Suzuki property.
- Perched groundwater was observed at shallow depths (4 to 24 inches) in several locations on site.
- While measured infiltration rates are suitable for some types of LID, the shallow groundwater limits LID feasibility.
- Prior to development of the site and design of stormwater management, additional field investigation should be performed to better understand the extent of perched groundwater beneath the site.

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Attachments

Figure 1. Test Site Locations

Attachment A. NRCS Web Soil Survey Maps
Attachment B. Methodology for Surface Infiltration Test

Map Scale: 1:2,300 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 30, 60, 120, 180

Feet: 0, 100, 200, 400, 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Kitsap County Area, Washington
Survey Area Data: Version 12, Sep 8, 2016

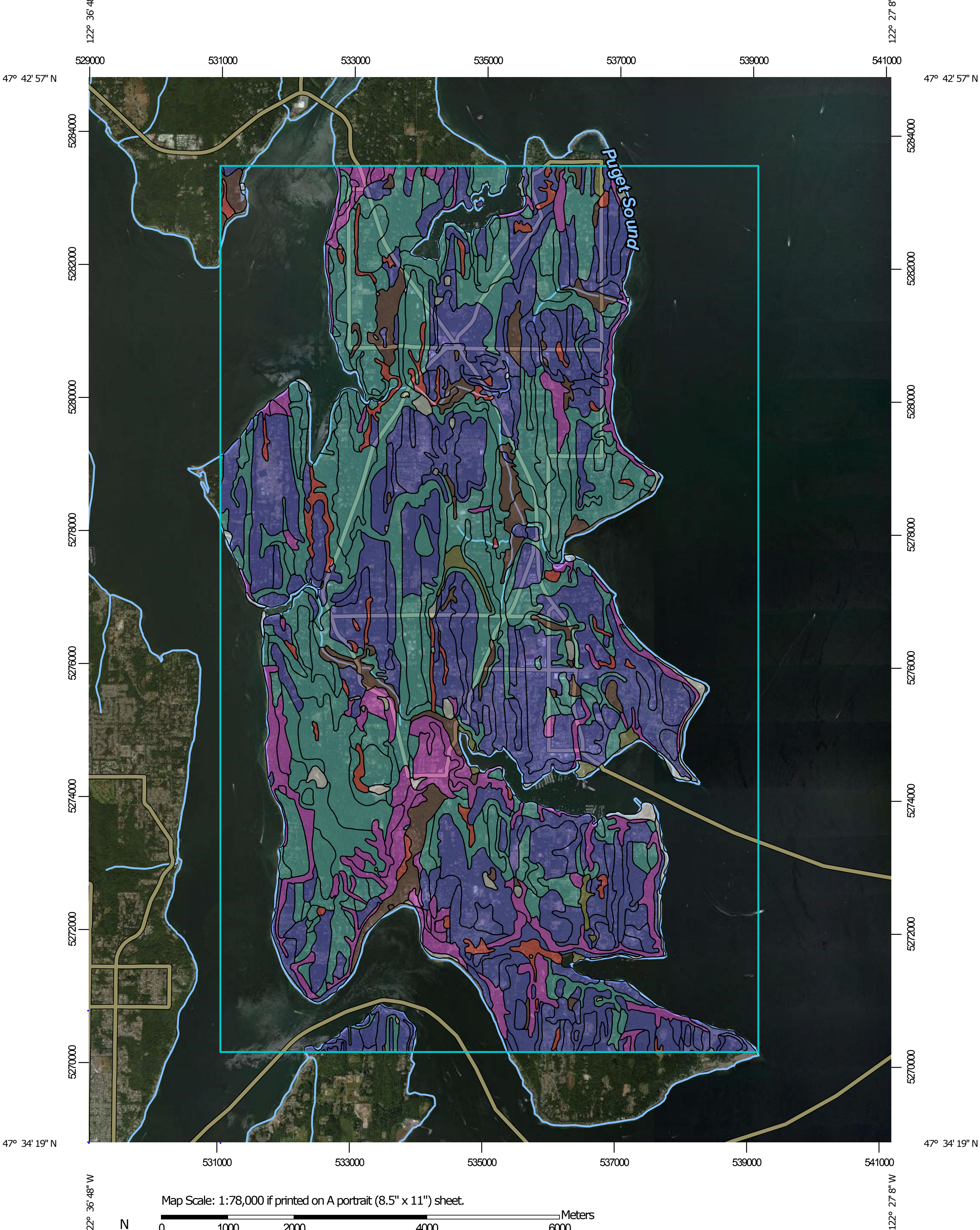
Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 9, 2010—Aug 20, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Kitsap County Area, Washington (WA635)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
14	Harstine gravelly ashy sandy loam, 0 to 6 percent slopes	10.2	37.4%
15	Harstine gravelly ashy sandy loam, 6 to 15 percent slopes	2.1	7.8%
16	Harstine gravelly ashy sandy loam, 15 to 30 percent slopes	10.7	39.0%
17	Harstine gravelly ashy sandy loam, 30 to 45 percent slopes	0.2	0.7%
22	Kapowsin gravelly ashy loam, 0 to 6 percent slopes	3.6	13.2%
23	Kapowsin gravelly ashy loam, 6 to 15 percent slopes	0.5	2.0%
Totals for Area of Interest		**27.4**	**100.0%**



Map Scale: 1:78,000 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 1000, 2000, 4000, 6000

Feet: 0, 3500, 7000, 14000, 21000

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Kitsap County Area, Washington
Survey Area Data: Version 12, Sep 8, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 9, 2010—Aug 20, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Kitsap County Area, Washington (WA635)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Alderwood gravelly sandy loam, 0 to 8 percent slopes	B	68.0	0.3%
2	Alderwood gravelly sandy loam, 8 to 15 percent slopes	B	133.4	0.5%
3	Alderwood gravelly sandy loam, 15 to 30 percent slopes	B	105.7	0.4%
4	Beaches		131.3	0.5%
6	Bellingham silty clay loam	C/D	72.4	0.3%
7	Cathcart silt loam, 2 to 8 percent slopes	B	485.6	1.8%
8	Cathcart silt loam, 8 to 15 percent slopes	B	207.9	0.8%
9	Cathcart silt loam, 15 to 30 percent slopes	B	241.7	0.9%
10	Dystric Xerorthents, 45 to 70 percent slopes	A	832.5	3.1%
14	Harstine gravelly ashy sandy loam, 0 to 6 percent slopes	C	1,943.4	7.2%
15	Harstine gravelly ashy sandy loam, 6 to 15 percent slopes	C	1,647.7	6.1%
16	Harstine gravelly ashy sandy loam, 15 to 30 percent slopes	C	1,991.1	7.4%
17	Harstine gravelly ashy sandy loam, 30 to 45 percent slopes	C	261.4	1.0%
19	Indianola loamy sand, 5 to 15 percent slopes	A	40.0	0.1%
21	Indianola-Kitsap complex, 45 to 70 percent slopes	A	191.6	0.7%
22	Kapowsin gravelly ashy loam, 0 to 6 percent slopes	B	3,797.1	14.2%
23	Kapowsin gravelly ashy loam, 6 to 15 percent slopes	B	1,804.1	6.7%

Hydrologic Soil Group— Summary by Map Unit — Kitsap County Area, Washington (WA635)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
24	Kapowsin variant gravelly clay loam, 0 to 5 percent slopes	D	53.8	0.2%
28	Kitsap silt loam, 2 to 8 percent slopes	C	120.3	0.4%
29	Kitsap silt loam, 8 to 15 percent slopes	C	85.7	0.3%
30	Kitsap silt loam, 15 to 30 percent slopes	C	214.3	0.8%
31	Kitsap silt loam, 30 to 45 percent slopes	C	21.9	0.1%
32	McKenna gravelly loam	D	384.3	1.4%
33	Mukilteo peat	B/D	80.4	0.3%
34	Neilton gravelly loamy sand, 0 to 3 percent slopes	A	32.8	0.1%
35	Neilton gravelly loamy sand, 3 to 15 percent slopes	A	7.4	0.0%
36	Neilton gravelly loamy sand, 15 to 30 percent slopes	A	9.4	0.0%
37	Norma fine sandy loam	B/D	549.0	2.0%
38	Pits		55.7	0.2%
39	Poulsbo gravelly sandy loam, 0 to 6 percent slopes	B/D	45.5	0.2%
44	Ragnar fine sandy loam, 0 to 6 percent slopes	A	216.5	0.8%
45	Ragnar fine sandy loam, 6 to 15 percent slopes	A	190.0	0.7%
46	Ragnar fine sandy loam, 15 to 30 percent slopes	A	122.9	0.5%
48	Schneider very gravelly loam, 45 to 70 percent slopes	B	30.9	0.1%
49	Semiahmoo muck	B/D	62.1	0.2%
50	Shalcar muck	B/D	14.9	0.1%
60	Sinclair very gravelly sandy loam, 8 to 15 percent slopes	B	7.4	0.0%
61	Sinclair very gravelly sandy loam, 15 to 30 percent slopes	B	1.7	0.0%
62	Tacoma silt loam	C/D	45.1	0.2%

Hydrologic Soil Group— Summary by Map Unit — Kitsap County Area, Washington (WA635)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
63	Urban land-Alderwood complex, 0 to 8 percent slopes		22.4	0.1%
64	Water		56.9	0.2%
Totals for Area of Interest			**26,817.9**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

3. Infiltration Test

The infiltration test is generally performed after the **first** respiration measurement. The same 6-inch diameter ring left in place from the soil respiration test can be used for the infiltration test. If soil respiration was not determined, follow the instructions in Step 1 of the soil respiration procedure (Chapter 2) for inserting the 6-inch diameter ring.

Materials needed to measure infiltration:

- **6-inch diameter ring (left in soil from respiration test)**
- **plastic wrap**
- **500 mL plastic bottle or graduated cylinder**
- **distilled water**
- **stopwatch or timer**

> **Did You Know?**
> Infiltration rate is a measure of how fast water enters the soil. Water entering too slowly may lead to ponding on level fields or to erosion from surface runoff on sloping fields.

Considerations: If the soil is saturated, infiltration will not occur. Wait for one or two days to allow for some drying. Also, if the respiration test is not performed, make sure the sampling area is free of residue and weeds or that vegetation is trimmed to the soil surface before inserting the ring.

(1) **Firm Soil**

With the 6-inch diameter ring in place, use your finger to gently firm the soil surface **only** around the **inside edges** of the ring to prevent extra seepage. Minimize disturbance to the rest of the soil surface inside the ring.

(2) **Line Ring with Plastic Wrap**

Line the soil surface inside the ring with a sheet of plastic wrap to completely cover the soil and ring as shown in **Figure 3.1.** This procedure prevents disturbance to the soil surface when adding water.

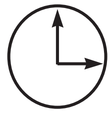
Figure 3.1

(3) **Add Water**

- Fill the plastic bottle or graduated cylinder to the 444 mL mark with distilled water.

- Pour the 444 mL of water (1" of water) into the ring lined with plastic wrap as shown in **Figure 3.1.**

4 Remove Wrap and Record Time



- Remove the plastic wrap by gently pulling it out, leaving the water in the ring **(Figure 3.2)**. N**ote the time.**
- Record the amount of time (in minutes) it takes for the 1" of water to infiltrate the soil. Stop timing when the surface is just glistening.

Figure 3.2

- If the soil surface is uneven inside the ring, count the time until half of the surface is exposed and just glistening **(Figure 3.3)**.
- Enter the amount of time in minutes on the Soil Data worksheet.

Figure 3.3

5 Repeat Infiltration Test

In the same ring, perform Steps 2, 3, & 4 with a second inch of water. On the Soil Data worksheet, enter the number of minutes elapsed for the second infiltration measurement. If soil moisture is at or near field capacity, the second test is not necessary.

[The moisture content of the soil will affect the rate of infiltration; therefore, two infiltration tests are usually performed (if soil is dry). The first inch of water wets the soil, and the second inch gives a better estimate of the infiltration rate of the soil.]

6 Replace Lid

If a second respiration measurement will be performed, set the lid loosely on the ring and leave it covered for preferably 16 to 24 hours (6-hour minimum) before beginning the second test (Chapter 2). (Remove lid and replace it before beginning the second soil respiration measurement).

> **!** **Reminder**: If you still need to perform the second respiration measurement, remember to loosely place the lid back on the ring before leaving the field.

SOURCE: ESA, 2016; ESRI, 2017.

Suzuki Property: Soil Infiltration and Aquifer Recharge Investigation

Figure 1
Test Site Locations

ESA

Appendix C
Wildlife Observation Tables

Wildlife Species Observations, December 15, 2016 (ESA)

Suzuki Property, entire site

BIRDS

Songbirds

Hairy woodpecker
Black-capped chickadee
Chestnut backed chickadee
Red-breasted nuthatch
Common raven
Ruby crowned kinglet
Mallard
American crow

MAMMALS

Douglas squirrel
Black-tailed deer

Wildlife Species Observations, 2006 to 2016 (L. Marshall, 2016)

Vicinity of Suzuki Property, near 18XX Commodore Lane NW

BIRDS

Songbirds

Red-breasted sapsucker
Downy woodpecker
Hairy woodpecker
Pileated woodpecker
Red-shafted flicker
Yellow-shafted flicker
Steller's jay
American crow
European starling
Brown-headed cowbird
Cedar waxwing
American robin
Varied thrush
Hermit thrush
Swainson's thrush
Spotted towhee
Anna's hummingbird
Fox sparrow
Song sparrow
Dark-eyed junco
White-throated sparrow
Gold-crowned sparrow
House sparrow
House finch
Purple finch
American goldfinch
Pine siskin
Black-headed grosbeak
Red crossbill
Western tanager
Western wood peewee
Olive-sided flycatcher
Tree swallow
Violet-green swallow
Townsend's warbler
Wilson's warbler
Orange-crowned warbler
Black-throat grey warbler
Ruby-crowned kinglet
Gold-crowned kinglet
Hutton's vireo
Bushtit
Brown creeper
Wren sp.
Bewick's wren
Red-breasted nuthatch
Chestnut-backed chickadee
Black-capped chickadee
Rock pigeon
Mourning dove
Green-winged teal

Waterfowl

Mallard
Wood duck
Bufflehead
Hooded merganser
Common golden-eye
American wigeon
Canada goose
Glaucous-winged gull
Great blue heron
Green heron
Belted kingfisher

Raptors

Bald eagle
Osprey
Barred owl
Rough-legged hawk
Sharp-shinned hawk
Cooper's hawk
Red-tailed hawk
Merlin

MAMMALS

River otter
Deer
Raccoon
Douglas squirrel
Grey squirrel
Chipmunk
Mice
Rats
Coyote

AMPHIBIANS

Frogs
Salamanders
Newts

REPTILES

Garter snake
Painted turtle

Environmental Technical Adivsory Committee
Regular Meeting
Thursday, February 16, 2017
3:00 PM – 5:00 PM
City Hall
Council Conference Room
280 Madison Avenue North
Bainbridge Island, WA 98110

CITY OF
BAINBRIDGE ISLAND

Minutes

1. **CALL TO ORDER / ROLL CALL / ACCEPT OR MODIFY AGENDA / CONFLICT OF INTEREST DISCLOSURE 3:06 PM**

   Chair: Frank Gremse

   Members: Michael Bonoff, Jason Flowers, Dylan Frazer, Charlie Kratzer, Karl Shearer

2. **LIAISON REPORT OUT** – DISCUSSED THE CURRENT STATE OF THE COMPREHENSIVE PLAN – Councilmember Roth

3. **Presentation on Wyckoff East Harbor Cap Enhancement Project** – Frank Gremse

4. **COMMENTS FROM THE PUBLIC** – No public comment was made.

5. **ACCEPTANCE OF MEETING NOTES – JANUARY 19, 2017** – ETAC Members

6. **ADJOURNMENT 4:40 PM**

Frank Gremse, Chair 3/16/17

For special accommodations, please contact Roz Lassoff, City Clerk
206-780-8624 or at rlassoff@bainbridgewa.gov