Youth and Ecological Restoration Program
Ecological Inventory of the Upper Headwaters of the South Millard Creek tributary

Prepared By

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We gratefully acknowledge the visits of Chip Ross a Director of MPWS (Photograph 1), and Dr. Will Marsh a Landscape Architect – Geo-morphologist (Photograph 2). Both Chip and Will inspired us with their visions of the landscape and their questions.

I INTRODUCTION

A Background

This report documents information collected during the 9th, 10th and 11th of July 2012, ecological inventory in the headwaters of Millard Creek with the Youth and Ecological Restoration Program (YER). This project was completed within the same forest as a project in 2011, so the information presented here will be in addition to the 2011 report with some repetition of supporting background information.

YER provides work experience, training and support for youth under the age of nineteen (YER 2012). Through studying local watersheds with community members youth gain a sense of worth, belonging and place. The focus of YER, Phase I is to work one on one with youth conducting ecological restoration activities with a variety of environmental organizations; YER, Phase II has two youth and two adults concentrating on a specific project to further develop teamwork, research techniques and communication skills.

The four ecological inventory contributors were YER coordinator, Wendy Kotilla; Registered Professional Biologist, Ian Moul; and two youth participants, Quinn Burgess and Chris Mattila (Photograph 3). This is a citizen science project with a goal of using scientific methods in ways that are interesting to the youth, helping them gain a more in-depth understanding of what makes up a functioning ecosystem, while documenting meaningful information for MPWS.

YER has conducted previous work within the Millard and Piercy watersheds and at the present study site. YER, Phase I work includes: invasive species removal, planting native plant species, water quality monitoring, monitoring downstream fish migration, conducting adult spawner counts and fish population estimates. YER, Phase II projects were carried out in 2008 and 2011 to monitor the productivity of fish rearing habitat in the Millard Creek side channel, as well as the 2011 ecological study in this same headwater forest.

B Purpose of Study

The purpose of this study is twofold:

1) To further the understanding of background habitat inventory of this study site as a baseline living laboratory for the upper portion of the Millard Watershed. This site is particularly interesting as it is the transition point where shallow subsurface water flow (called interflow), within the depth of the roots of trees, breaks out and becomes flowing stream channels. With ongoing land development upstream, this site will likely be an early indicator of changes in local hydrology.
2) To develop a methodology for an educational experience that is scientifically sound yet is interesting, hands on and understandable by youth that may or may not have experience working, or even spending time in the natural world.

C Location

The study site is located along Minto Road in the upper headwaters of Millard Creek, in Electoral Area A of the Comox Valley Regional District (Map 1). The study site is made up of two properties, one owned by Wendy Kotilla at 4327 Minto Road is 1 acre and the second, owned by Sue Minchin at 4333 Minto Road is 10 acres (Map 2). Access to the study site was through Wendy Kotilla's property along a series of trails. The site is not open to the public.

II METHODS

Before beginning the field study, the methods and results of last year's work: **Youth and Ecological Restoration Program Ecological Inventory of the Upper Headwaters of the South Millard Creek Tributary** were reviewed and adjusted to better suit the purpose of the program. The ecosystem inventory method used in this study was an abbreviated reconnaissance form of the Biogeoclimatic Ecosystem Classification described in MOELP (1998) and Green and Klinka (1994). The use and function of global positioning (GPS) devices and laser rangefinders was demonstrated but kept to a minimum. It was decided that hands on measuring by the youth was more engaging than the use of electronic instruments. To avoid trigonometry and still teach the use of handheld compasses we made measurements based on magnetic north. Fixed points were measured with a Trimble GeoXH GPS and differentially corrected using the CANSEL base station in Courtenay. Water quality indicators were measured using a HANNA Instruments HI98129 pH/EC/TDS/Temperature with Only One Tester, and an OxyGuard Handy Beta Portable DO Meter H01B.

The ecological inventory and mapping was divided into three field study exercises:
Exercise One was the mapping of a section of watercourse near Study Plot One (see Map 2 and Photographs 4 and 5). Using the south-west corner point of Study Plot One as a fixed point a tape was laid out along the magnetic north axis, 30m to the south and 10m to the north. At five metre intervals the boundaries of open water and saturated soil were measured and plotted on graph paper (Map 3). Using the plotted points as a guide, the boundaries of open water and saturated soil were sketched onto the map.

Exercise Two was a 20m by 20m study plot measured on the ground and marked with flagging tape (Study Plot 3 on Map 2; Map 4). The plot was subdivided into four quadrants. Trails and watercourses crossing the study plot were plotted on graph paper maps. All trees were identified by species, plotted on graph paper maps and measured for diameter at breast height. Plant species within each quadrant were inventoried and scored based on relative abundance in each of the forest layers of: Moss/Lichen; Herb; Shrub; and Tree. We assigned quantities of vegetation based on looking at the quadrants and the various plants (Appendix 1), and worked together to determine relative percentages of vegetation through mutual discussion that resulted in a general consensus of what we were seeing.

Exercise Three was mapping a section of open watercourse to add to information collected in 2011 (labelled as 'New plot of watercourse route' in Map 2). From the fixed point of a red alder tree (located by GPS), two sections of watercourse were measured by hip-chain and compass bearing.

During the three field study exercises selected features were photographed and documented with the goal being a general overview of the study site and its characteristics. Flora and fauna were noted when encountered, though not systematically catalogued. As this is private land, much effort was made to stay on trails and not disturb the vegetation.

Following the field exercises, the collected data was compiled and digital maps were produced by Ian Moul. The sketch map of the water courses from Exercise One and Two was imported into ArcMap 10 and geo-referenced based on the known fixed points of each study plot. The realignment of a section of water course based on Exercise Three was calculated based on the measured fixed point. The coordinates of trees in Study Plot Three were calculated using the fixed south-east corner.

III RESULTS and DISCUSSION

This project was completed between the 9th and 13th of July, a time approaching the driest point in the year. While the major watercourses on this site were previously ditched and have flowing water year-round, the exercises carried out at Study Plots One and Three (Map 2), documented the summer extent of surface flow and the evidence of subsurface water at two areas of the site. With future plans for residential development in the upper areas of the watershed, upstream of this site, the extent of surface and subsurface flow at this site becomes an important indicator of the heath of the watershed. In recent years much effort has been made to develop standards whereby the flow of rainwater from roofs and impervious surfaces in residential developments can best mimic the natural flow of water into the ground and through the landscape (CAVI 2012; van der Gulik and Finnie 2008). This site, at the break-out point of subsurface water flow, is an excellent location to monitor potential impacts on watercourses from upstream developments, as well as the effectiveness of rainwater management.

The watercourses mapped at this site, while they may or may not be inhabited by fish, provide water, food and nutrients to known fish bearing waters immediately down-stream. Under the terms of both the Provincial Riparian Area Regulation (RAR 2011) and the Forest Practices Code (FPC 1995), these areas are considered as fish habitat. Any adjustments to the hydrology of watercourses, which include the alteration of bridges, culverts, and building dams, must be carried out under prescriptions developed by a Qualified Environmental Professional.

Water Quality Measurements:

Water quality measurements were taken in two locations. Both sites were shady and the change in air temperature is a reflection on the differing times of day. The water temperatures recorded fall near the top of range that is considered as “cold” (5 - 13°C) and optimal for freshwater fish (Taccogna and Munro 1995). While fish are not known to be in this area of the Millard Creek headwaters, a reasonable goal is to keep water temperature as low as possible as it flows into fish bearing waters further downstream.

Table 1: Water quality measurements at two locations in Millard Creek headwaters

	Study Plot One	Stream/ trail crossing (location of Exercise 3)
Date	9 July 2012	11 July 2012
Time of day	10:30	14:15
Air Temperature	15.4°C	20.0 °C
Water Temperature	12.0°C	12.5 °C
Dissolved Oxygen	22%	56%
pH	8.10	7.24
Total Dissolved Solids	73 ppm	72 ppm

Aquatic life is dependent on dissolved oxygen. Dissolved oxygen is linked to both water temperature and conditions in which the water is flowing. Cold, deep and turbulent water tends to have more dissolved oxygen. Healthy streams are saturated with oxygen (90 to 110% saturation) during most of the year (Taccogna and Munro 1995). The low level of dissolved oxygen at Study Plot One is likely a reflection on how the water had virtually no flow and was very shallow, less than 3cm deep. In flowing water, at the nearby stream and trail crossing, double the dissolved oxygen was documented.

The pH scale measures the relative acidity or alkalinity of any substance. The scale ranges from very strong acid, at pH 0, to very strong base, at pH 14 (Taccogna and Munro 1995). Pure water has a neutral pH of 7. Most aquatic organisms are sensitive to small pH changes and prefer a pH of 6.0 to 8.5. Streams that drain soils with high mineral content are usually alkaline, whereas streams that drain coniferous forests are usually acidic. The pH measured at both sites falls within the acceptable range.

Total Dissolved Solid (TDS) is a measurement of inorganic salts, organic matter and other dissolved materials in water (Wikipedia 2012). The concentration and composition of TDS in natural waters is determined by the geology of the drainage, atmospheric precipitation, and the water balance (evaporation-precipitation). The most common chemical constituents are calcium, phosphates, nitrates, sodium, potassium and chloride associated with runoff of agricultural fertilizers. Total dissolved solids can cause toxicity through increases in salinity, changes in the ionic composition of the water and toxicity of individual ions (Weber-Scannell and Duffy 2007). Changes in the ionic composition of water can exclude some species while promoting population growth of others (Weber-Scannell and Duffy 2007). TDS is usually a measure of salts; the TDS of rainwater is <10ppm, and for freshwater rivers TDS ranges from

100 to 1,000ppm (Waterwatch 2012). The TDS reading of <100ppm measured in the Millard Creek headwaters, would be considered as "soft" water and does not suggest a concern over runoffs from agricultural lands upstream of the site.

<u>Habitat Inventory – Study Plot Three</u>:
Study Plot 3 (Maps 2, 3, and 4 and Photographs 6, 7 and 8) was chosen as an area that is slightly wetter than Study Plots One and Two that were inventoried in 2011. The dominant tree type was red alder, of a size that suggests these trees with begin to die out in the coming 20 years and likely be replaced by the second most common tree, the western red cedar. The most plentiful plant in the shrub layer is salmonberry; in the herb layer it is skunk cabbage. The site association/ plant community best describing the study plot is Western redcedar – Sitka Spruce – Skunkcabbage (CWHxm1/12) (MOELP 1998), which is Blue Listed or vulnerable in BC (CDC 2012). That Sitka spruce not being found in the study plot does not exclude it from this plant community; Sitka spruce are found in the same forest within 100m to the north-east.

On the second afternoon of the project we were joined by Dr. Will Marsh. Dr. Marsh spoke about the formative processes that shape the landscape, how the sun drives the cycles of rain and water flow. He spoke of trees and how they hold moisture and pass it back to the sky. He looked at the study site and described its history of original forest, the clearing for agriculture and the regeneration that is seen today. He also spoke of the need to belong to a landscape and feel it in our souls before we know the need to protect it. He spoke of how change is inevitable both naturally and shaped by the human hand. Dr. Marsh noted the importance of having study sites like this forest to document changes in the landscape over time.

The fourth day of this five day program was devoted to preparing the youth participants to deliver a public tour of the study site. The tour aspect of this work is very important as it allows the youth participants to demonstrate what they have learned, put into their own words. The tour, on day five, was advertised in local papers and participants ranged widely in how much they understand biology and ecology. One of the successes in this program may be gauged by the youth participant's ability to express their interest of the local ecology during the tour.

As a small, but intact ecosystem this study site provides natural habitat for many terrestrial species that live in the forest, as well as a wildlife corridor and upstream habitat for aquatic species. This study site is a maturing second growth forest whose soils would be classed as '*Subhygric*' (MOELP 1998) - receiving input from both precipitation and from seepage, and where water is removed slowly enough to keep the soil wet for a significant part of the growing season.

Here the groundwater lies close to the surface, which is important to maintain for the health of the downstream watershed.

Considering the dual objectives of conducting an inventory of the study site and involving youth participants to learn more about the natural world, this project was a success. The two youth learned how to do a forest inventory by naming and mapping its contents; they effectively passed on the knowledge they gained to the nine tour members.

IV RECOMMENDATIONS

As this study site is at the point where shallow subsurface waters break out and begin the open flowing water of upper Millard Creek it is an ideal site for ongoing monitoring. Monitoring groundwater levels prior to upslope development would provide a database to document any possible changes. Relatively inexpensive electronic data-loggers, such as the HOBO™ supplied by Onset™, require little maintenance and provide ongoing scientifically sound data.

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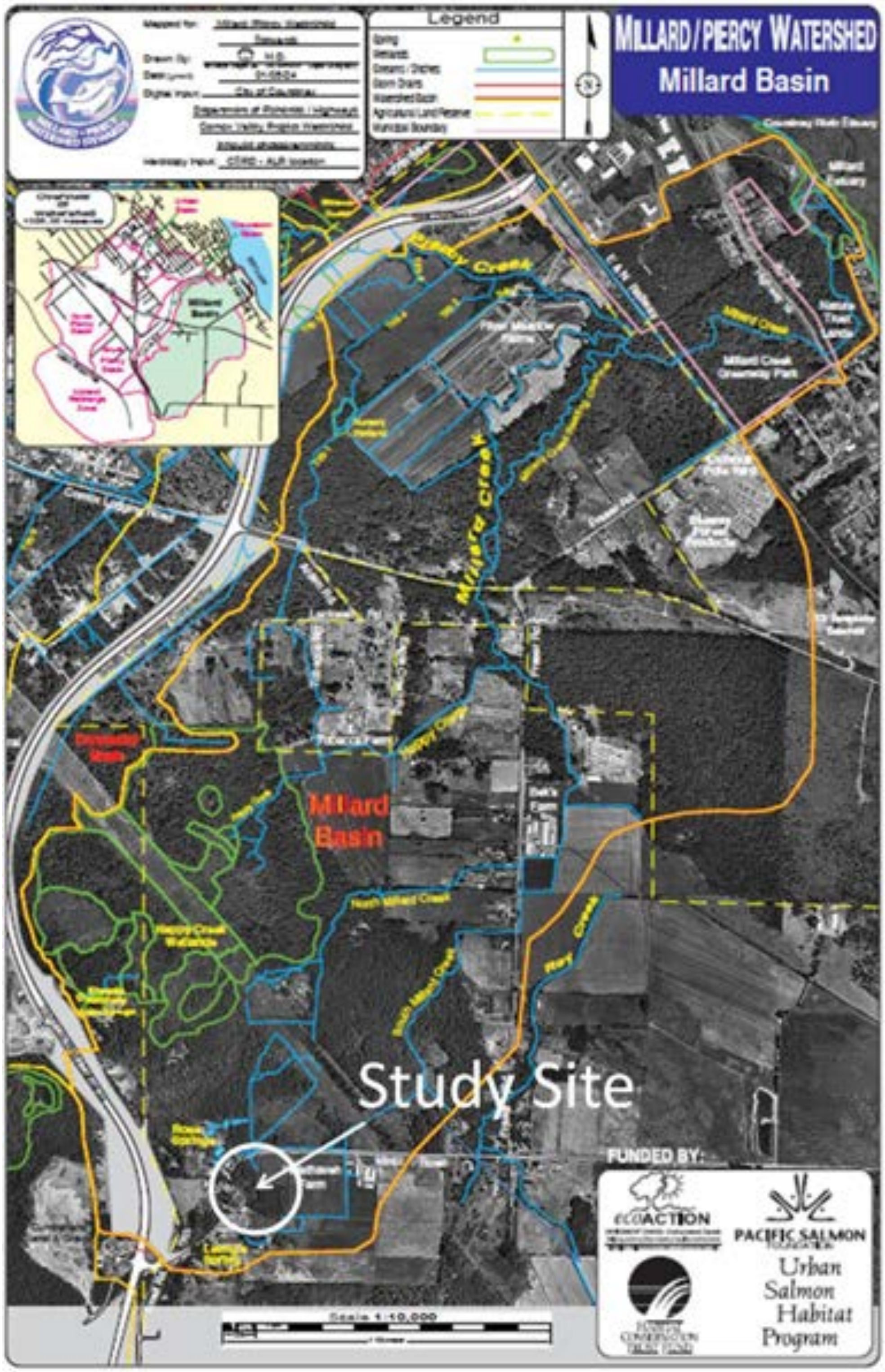
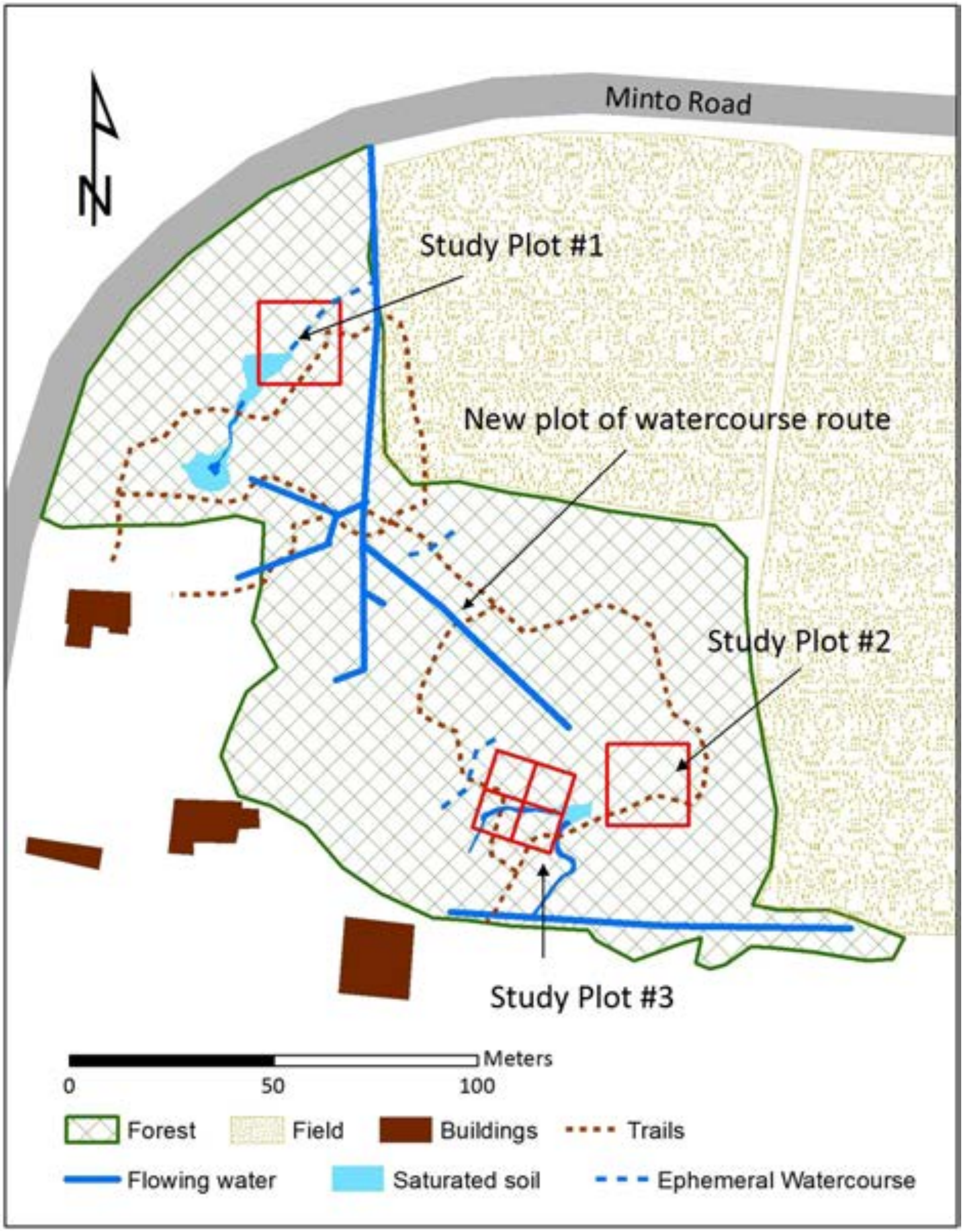
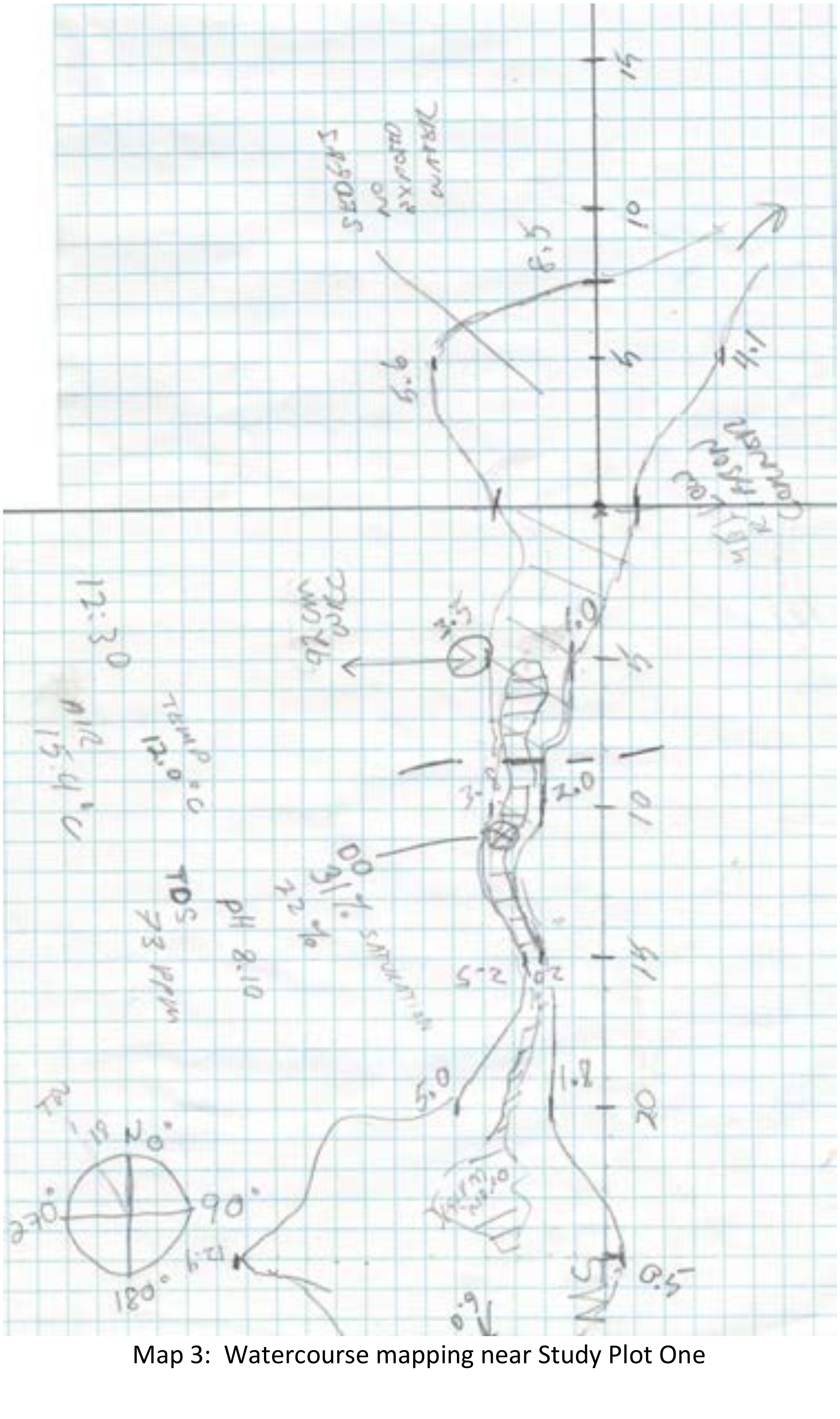


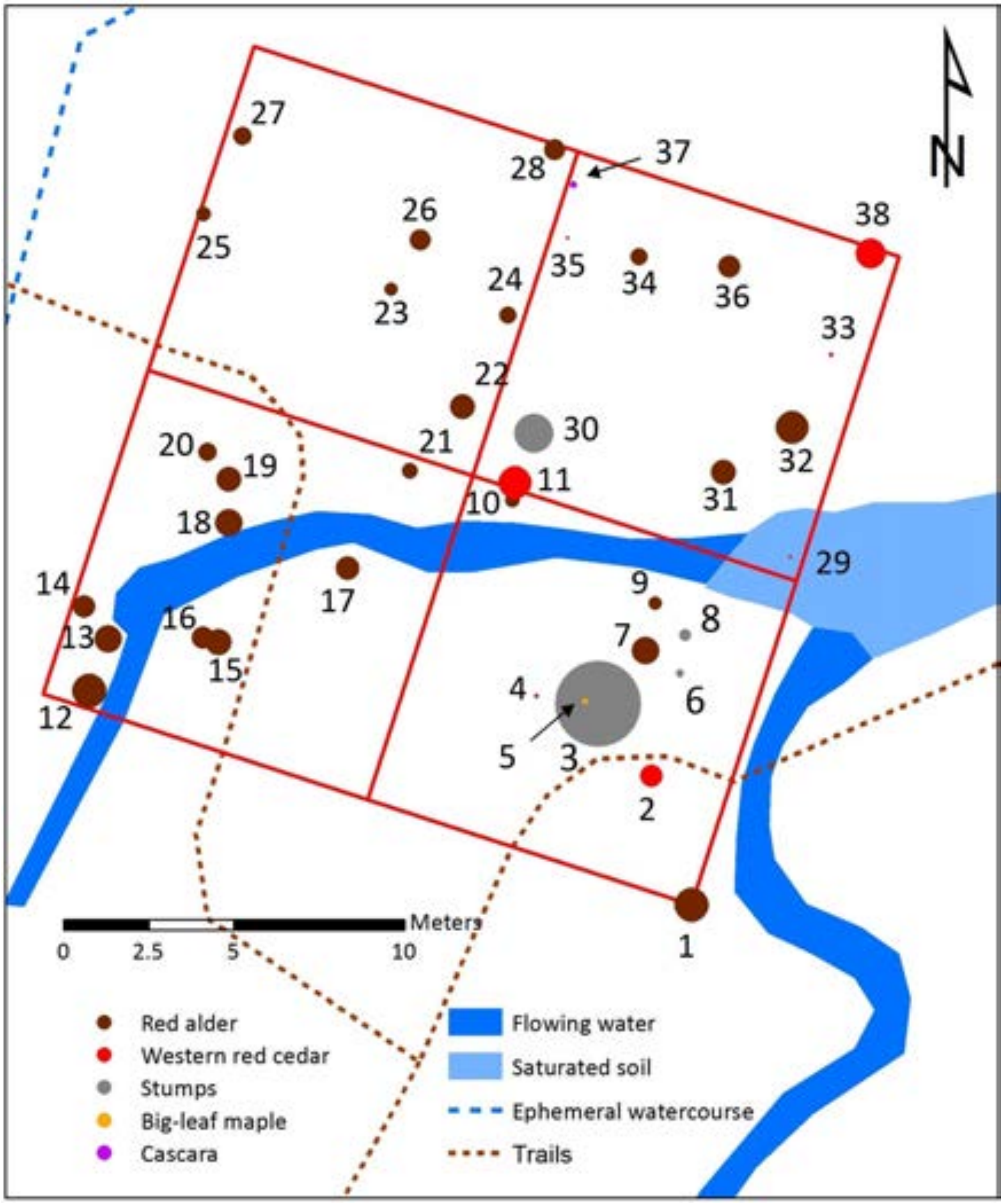
Map 1: The South Millard Creek Headwaters Study Site in relation to the Millard Creek Watershed



Map 2: Location of Study Plots within the South Millard Creek Headwaters Study Site



Map 3: Watercourse mapping near Study Plot One



Map 4: Habitat Inventory at Study Plot Three

APPENDIX 1 – Ecosystem Field Form

ECOSYSTEM FIELD FORM Study Site 3	Day: 10	Month: July	Year: 2012
Surveyor(s): Quinn Burgess, Chris Mattila, Wendy Kotilla, and Ian Moul			

SITE DESCRIPTION			
General Location: Forest east of Wendy Kotilla's property at 4327 Minto Road			
SE corner of plot Coordinates	UTM Zone: 10	Easting: 355822.0 Northing: 5500647.5	Horizontal precision: +/- 1.0m
Succession and Structural Stage: Maturing forest of between 60 to 100 years with some young trees. Self thinning where the forest canopy has begun to differentiate into distinct layers			

Substrate (%)	Organic Matter: 60	Rocks: 0	Decomposing wood: 20
	Mineral Soil: 0	Bedrock: 0	Water: 20

Notes: We located two cedars in protective cones. Wendy noted that previous Youth and Ecological Restoration teams have removed English Holly from this area and planted the cedars.
We discussed how plant communities grow from soils based on the amount of available water and the nutrients in the soil. This site appears to be very moist and made up of a thick layer of rich organic soil.

VEGETATION % cover by Layer

Quadrant	Tree	Shrub	Herb	Moss/Lichen	Bare ground
NE	10	20	60	0	10
SE	10	5	65	0	20
SW	10	20	70	0	Trace
NW	10	70	20	0	0
Average	10	29	54	0	7

Summary of Trees

Species	Number of trees	Average DBH (cm)	Range in DBH (cm)
Red alder	25	32.1	19.0 to 49.0
Red cedar	7	20.1	3.0 to 48.0
Cascara	1	8.4	
Big-leaf maple	1	6.8	

APPENDIX 1 – Ecosystem Field Form

SHRUB LAYER		
Quadrant	**Species**	**Percent coverage** *(based on vegetation percent coverage above)*
NE	Salmonberry	15
	Mountain ash	5
	Elderberry	Trace
	Red huckleberry	Trace
	Pacific ninebark	Trace
SE	Salmonberry	Trace
	False azalea	Trace
	Red huckleberry	Trace
SW	Salmonberry	15
	False azalea	5
	Mountain ash	Trace
	Red huckleberry	Trace
NW	Salmonberry	58
	Mountain ash	7
	False azalea	5

HERB LAYER		
Quadrant	**Species**	**Percent coverage** *(based on herb layer percentages above)*
NE	Skunk cabbage	15
	Lady fern	5
	Hellebore	Trace
	False lily of the valley	Trace
SE	Skunk cabbage	35
	Lady fern	10
	False lily of the valley	Trace
SW	Skunk cabbage	45
	Lady fern	5
	sedges	5
	False lily of the valley	Trace
NW	Skunk cabbage	15
	Lady fern	5
	False lily of the valley	Trace

APPENDIX 1 – Ecosystem Field Form

Tree Layer						
ID	Species	DBH (cm)	Quadrant	Easting	Northing	Notes
1	Red Alder	48.2	SE	355822.04	5500647.50	
2	Red Cedar	32.2	SE	355820.85	5500651.28	
3	Cedar	125	SE	355819.30	5500653.39	Stump of veteran tree
4	Red Cedar	6	SE	355817.48	5500653.62	
5	Big-leaf Maple	6.8	SE	355818.91	5500653.48	
6	Dead Alder	10.8	SE	355821.70	5500654.28	
7	Red Alder	39	SE	355820.68	5500654.95	
8	Dead Alder	17	SE	355821.85	5500655.42	
9	Red Alder	19	SE	355820.98	5500656.34	
10	Red Alder	21	SE	355816.78	5500659.38	
11	Red Cedar	48	SE	355816.85	5500659.89	
12	Red Alder	49	SW	355804.37	5500653.77	
13	Red Alder	40	SW	355804.91	5500655.29	
14	Red Alder	31.7	SW	355804.21	5500656.25	
15	Red Alder	38.5	SW	355808.15	5500655.20	
16	Red Alder	32.2	SW	355807.70	5500655.34	
17	Red Alder	33.9	SW	355811.94	5500657.37	
18	Red Alder	40	SW	355808.45	5500658.72	
19	Red Alder	36.6	SW	355808.46	5500659.98	
20	Red Alder	25.5	SW	355807.83	5500660.79	
21	Red Alder	23	SW	355813.78	5500660.24	
22	Red Alder	35	NW	355815.31	5500662.12	
23	Red Alder	19	NW	355813.22	5500665.57	
24	Red Alder	24	NW	355816.65	5500664.80	
25	Red Alder	21	NW	355807.72	5500667.78	
26	Red Alder	30	NW	355814.08	5500667.02	
27	Red Alder	26	NW	355808.87	5500670.06	
28	Red Alder	30	NW	355818.02	5500669.65	
29	Red Cedar	3	NE	355824.93	5500657.70	Protected by cone
30	Cedar	57.6	NE	355817.41	5500661.33	Stump of veteran tree
31	Red Alder	35.5	NE	355822.97	5500660.20	
32	Red Alder	47	NE	355824.98	5500661.50	
33	Red Cedar	6	NE	355826.13	5500663.65	
34	Red Alder	23.9	NE	355820.49	5500666.51	
35	Red Cedar	3	NE	355818.41	5500667.08	Protected by cone
36	Red Alder	32.4	NE	355823.14	5500666.23	
37	Cascara	8.4	NE	355818.58	5500668.64	
38	Red Cedar	42.7	NE	355827.29	5500666.62	

Photograph 1: left to right – Chip Ross, Wendy Kotilla, Quinn Burgess and Chris Mattila

Photograph 2: left to right – Chris Mattila, Quinn Burgess, Ian Moul and Dr. Will Marsh

Photograph 3: left to right – Ian Moul, Wendy Kotilla, Quinn Burgess and Chris Mattila

Photograph 1: Watercourse mapping near Study Plot One, looking downstream to the North-east (the orange ribbon is the SW corner of Study Plot One).

Photograph 2: Watercourse mapping near Study Plot One, looking south-west.

Photograph 3: Study Plot Three, looking north-north-east along the east boundary

Photograph 4: Central portion of Study Plot Three

Photograph 5: Water flow under a path crossing in the south-west quadrant on Study Plot Three.