FINAL PROJECT MEMORANDUM

TO: WRIA 54 WIT

FROM: THE LANDS COUNCIL

SUBJECT: WRIA 54 DEEP COULEE CREEK WATERSHED RESTORATION PROJECT 2014 UPDATE

DATE: 6/30/2014

CC: SPOKANE COUNTY WATER RESOURCES

INTRODUCTION

This memorandum describes the work completed and presents data collected for the WRIA 54 Deep Coulee Creek Watershed Restoration Project (project) between July 1, 2013 and June 30, 2014. The project is funded by Washington Department of Ecology (Ecology) and is administered by Spokane County Water Resources under Professional Service Agreement Contract number P7390.

This project began on July 1, 2013. Work completed between July 1, 2013 and June 30, 2014 includes the following:

- Topical herbivory repellants applied during winter and physical repellants managed year round.
- Some planting on along Coulee Creek in fall 2013 and spring 2014.
- Native willow whips and poles collected from healthy population along Deep Creek in winter of 2014. Some cuttings were planted on Coulee Creek in spring '14 and some were taken to a plant nursery for further propagation and future use.
- Spokane County Correctional Facility's work crews joined TLC staff for watering, invasive removal, and herbivory repellant application for 4 full days in the fall and spring.
- Photo points taken and tree vigor monitored, along with vegetative composition and canopy cover measurements taken at monitoring site on Coulee Creek.
- Upland vegetation from 2012 and 2013 watered regularly through June 2014. Competing vegetation surrounding the plants, such as reed canary grass, was trimmed or removed.

See Appendix I for site maps and monitoring results.

IMPLEMENTATION ACTIONS

Re-Vegetation Actions

In fall '13 approximately 50 upland plants that had died after previous restoration efforts were replaced with new stock and watered deeply over the fall. An additional 500 willow poles (7-8' tall) and willow cuttings were planted along the greenline at both Coulee Creek sites. Willow varieties used include a mix of pacific, bebb, coyote, and drummond (*Salix lucida, bebbiana, exigua, and drummondiana* respectively).

Maintenance

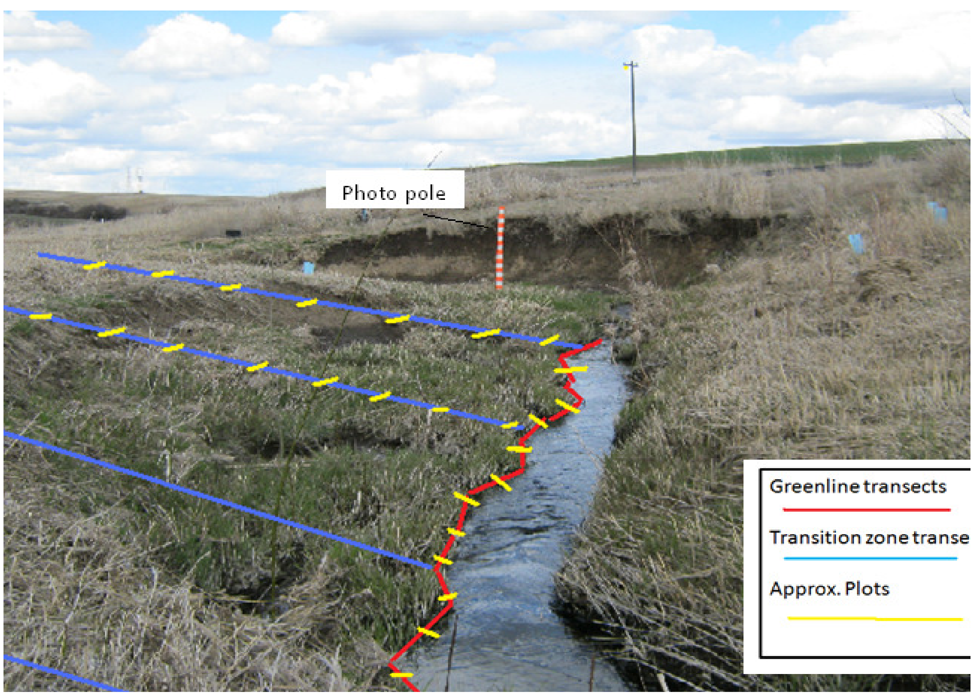
Following planting activities neem oil, an organic repellant, was applied to plants in order to reduce herbivory. Neem oil was reduced to a winter prescription, as it appears to scorch leaves during the summer and surrounding months. During the winter neem oil was applied to the base stem of plants to prevent rodent girdling. Previously applied tree tubes were managed so that in instances where plants had outgrown the tubes or tubes had not been properly installed and plants were over-heated, tubes were removed and saved for future restoration efforts. Tubes that had been knocked askew from flooding or wind were straightened, though plants nearest the floodplain had not received tree tubes in order to avoid being knocked over and injuring the plant during high flow.

Upland plants were watered by hand on average twice per month (excluding winter months) until June 30, 2014, though wet weather in June made the workload light. During fall 2013 and spring 2014 further maintenance actions included trimming and digging vegetation, mostly reed canary grass, which surrounded any of the planted material. On four occasions work crews from Spokane County Correctional Facility joined The Lands Council (TLC) staff members to accomplish general maintenance work.

Monitoring

Vegetation composition monitoring was performed as a baseline at the largest Coulee Creek site to compare against ultimate stream habitat goals gauged by vegetation communities. The primary monitoring practices included "greenline" monitoring and "transition zone" monitoring. TLC also monitored plant survivorship and initial overstory canopy cover. These same monitoring measurements will be taken in 5 years and again in 10 years to record changes and note how habitat goals are advancing over time.

Figure 1: Depiction of Vegetation Monitoring Design



TLC has adapted vegetation monitoring for our purposes and limitations from other credible projects. The following reports were used to develop monitoring protocol tailored to TLC's resources:

> "Protocol for Monitoring Effectiveness of Riparian Planting Projects"
> http://www.rco.wa.gov/documents/monitoring/MC-3_Riparian_Planting_Projects.pdf
> "Riparian Planting Guide for Lincoln County"
> http://www.co.lincoln.wa.us/Planning/wria43/miscdocs/riparianplantingguide.pdf
> "Multiple Indicator Monitoring of Stream Channels and Streamside Vegetation"
> http://www.blm.gov/nstc/library/pdf/MIM.pdf

The greenline vegetation monitoring method involves running a baseline measuring tape along the first zone (or line) of vegetation at low flow times when the stream level has receded from this zone, often the same as "bank-full" stage. Vegetation species composition is then measured along this line at systematically chosen points using line-intercept or cover-class techniques. The line-intercept technique measures and records plant species composition, based on how frequently biomass of each individual species crosses the plot line, and in what proportion to other species. Cover-class measurements calculate what percentage of biomass within a plot frame is attributed to each species. Greenline monitoring is used to capture any vegetation community changes which would indicate hydrologic conditions and ecosystem status changes.

Transition zone vegetation monitoring is used along with greenline sampling to record the extent of and rate of change in vegetation along the gradient from stream to upland zones (from greenline to approx. 100m upland or obstruction). Adding this dimension allows us to quantify not just how vegetation communities are changing in structure, but also the extent they, and the ecological factors they indicate, are expanding in time and space. This method involves running 100m measuring tapes as transect lines from designated points on a baseline (same as greenline) transect, at a bearing chosen at random, extending away from the stream. Numerous plots are chosen at systematic intervals along the transect. Cover class methodology is used at each plot for species composition.

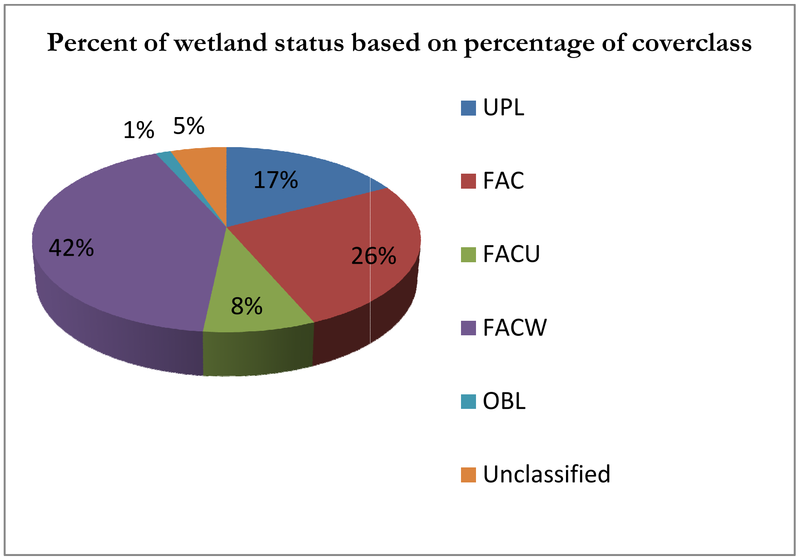
During baseline monitoring we expect to see more non-native plants and upland plant communities in the riparian zone. A higher percentage of native and wetland plants vs. upland and transition species is the desired outcome of these restoration efforts. Additional monitoring included plant survivorship and canopy cover measurements.

Plant survivorship and vigor monitoring was used to measure the success of our reforestation efforts. This entails mapping or tagging a representative sample of trees after planting and recording certain metrics that indicate vigor such as diameter, height, and herbivory rate. The same trees are visited at a minimal 5 and 10 year intervals to record changes. The 10^{th} year measures results against our goals of tree cover and overall restored riparian forest ecosystem structure. The second method (usually in congruence with the method above) entails measuring overstory canopy changes in connection with the tree plantings. This method involves taking reading with a densiometer at designated points within the sampling area, with which to extrapolate as a representation of the entire restoration zone. When possible, these sampling points are taken within all or some of plots in the transition zone vegetation monitoring process to increase feasibility.

Photo points were taken with a 2 meter, striped photo pole visible in each photo to show scale. These pictures can be seen in Appendix I.

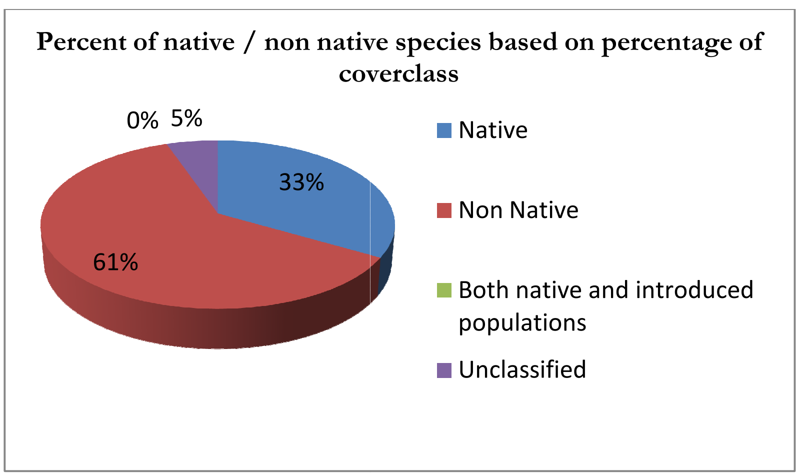
Below are combined results from the greenline and transition zone vegetation monitoring at our sampling site on Coulee Creek. Further monitoring data on plant survivorship, plant vigor, and canopy cover can be found in Appendix I

Graph 1: Baseline Monitoring Results by Wetland Status



UPL is upland, FAC is facultative, FACU is facultative upland, FACW is facultative wetland, OBL is obligate wetland

Graph 2: Baseline Monitoring Results by Native Status



DISCUSSION

The Lands Council has been applying various restoration prescriptions to Deep and Coulee Creeks since 2011. We consider this an excellent area to learn about best management practices for our region, as the results of each prescription have been thoroughly monitored. The most successful techniques will be used as the basis for future TLC riparian restoration efforts.

Since 2012 approximately 4,000 plants, including potted riparian stock, sedges, and willow whips, cuttings, and poles have been planted along sites on Deep and Coulee Creeks. Of these 4,000, approximately 3,000 are whips and another 500 are poles. After three years, whips see an average survival rate of 20% and poles see an average survival rate of 40%, while potted stock averages 70% survival after one year, and 45%

survival after three. While these survival rates seem low, we have come to expect a 20% survival rate for all whips and cuttings, and still favor this method due to its efficiency. The biggest advantage to using whips is the ease of planting: one person can plant 500 or more in a day, compared to only about 50 per day of potted nursery stock. Using whips also uses fewer resources; it takes less energy and resources to harvest a cutting than to grow something in a nursery, and it takes less to transport these to the restoration site than it would to load up 1-2 gallon potted stock. Due to where they're planted, cuttings also don't need regular watering, but merely herbivory protection at the base so rodents won't girdle them and for surrounding reed canary grass (RCG) to be trimmed.

As in the previous years, all sites were prone to significant ungulate and rodent browsing pressure and shading from RCG. Neem oil was applied base of plants to prevent rodent girdling, and to plant parts protruding from tree tubes. Neem oil was used primarily in the late fall in winter due to apparent leaf scorch that can occur in warmer weather. In the spring of '13, many plants had been severely damaged by rodent girdling. The neem oil appears to be an effective technique to combat this when applied to the base of plants; plants viewed in spring '14 did not appear to suffer from rodent girdling. Due to the fact the neem oil is not a viable herbivory repellant in the summer months, tubes were used as primary herbivory repellants, and larger-scale exclosures will be used in the future.

While the winter of 2013-2014 had a few cold snaps that caused significant mortality, the project is still achieving minimal survivorship goals, especially among upland plantings. Many upland plants that were damaged from cold or herbivory are growing back from the roots.

Figure 2: Example of Damaged Plant Growing from Roots

Mortality was also offset by clonal recruiting from coyote willow and suckering from other species such as aspen and cottonwood that exhibit clonal recruitment abilities. These root expansion properties have great implications for stream habitat restoration success. Riparian species planted slightly upland of the greenline will send clonal shoots which can establish in the unstable substrate near the stream, in the RCG zone, and will eventual shade-out the shallow-rooting grasses. Willows planted in 2012 are also producing seed which will help recruit more native trees to the riparian zone. Clonal recruitment and seed-bearing stock will create a perpetual riparian reforestation as the system reinforces itself as seen in reference sites along Deep Creek. This is in combination with natural disturbance and apart from synthetic disturbance.

Figures 3 & 4: Examples of Clonal Coyote Willow Recruitment

RECOMMENDATIONS

Following the 2012 – 2014 seasons' riparian restoration procedure, combined with input from collaborating programs, TLC has developed the following recommendations toward future projects and adaptive management:

- Larger, more mature planting materials provide environmental benefits quickly for little investment and should be used- especially if height can exceed browse zone and RCG height
- Planting more mature stock also reduces need for protecting from top browse, and more complex root systems are more resilient to root disturbance (i.e. frost, ground rodents)
- Planting more extensively during each restoration season helps to distribute herbivory amongst greater number of plants, reducing mortality
- Cuttings should be planted in-stream and remain partially submerged throughout the year to avoid rodent herbivory and reduce RCG shading
- Ideally, RCG should be completely removed surrounding new plantings until the plantings become established
- Neem oil applied to the base of plant stems will help reduce rodent herbivory in the winter
- Building exclosures to fence in multiple trees could be a good strategy to combat herbivory in the summer when neem oil is not as viable.
- Plants should receive water at least once a month during dry seasons, though once a week is ideal, for a minimum of one year after planting to maximize survival rates
- Whips and poles should receive a multiplier of 0.25 toward mortality estimates while potted willow, aspen, and cottonwood should receive a multiplier of 5 due to perpetual clonal recruitment and root establishment

Appendix I

Figure 5: Site Locations within WRIA 54

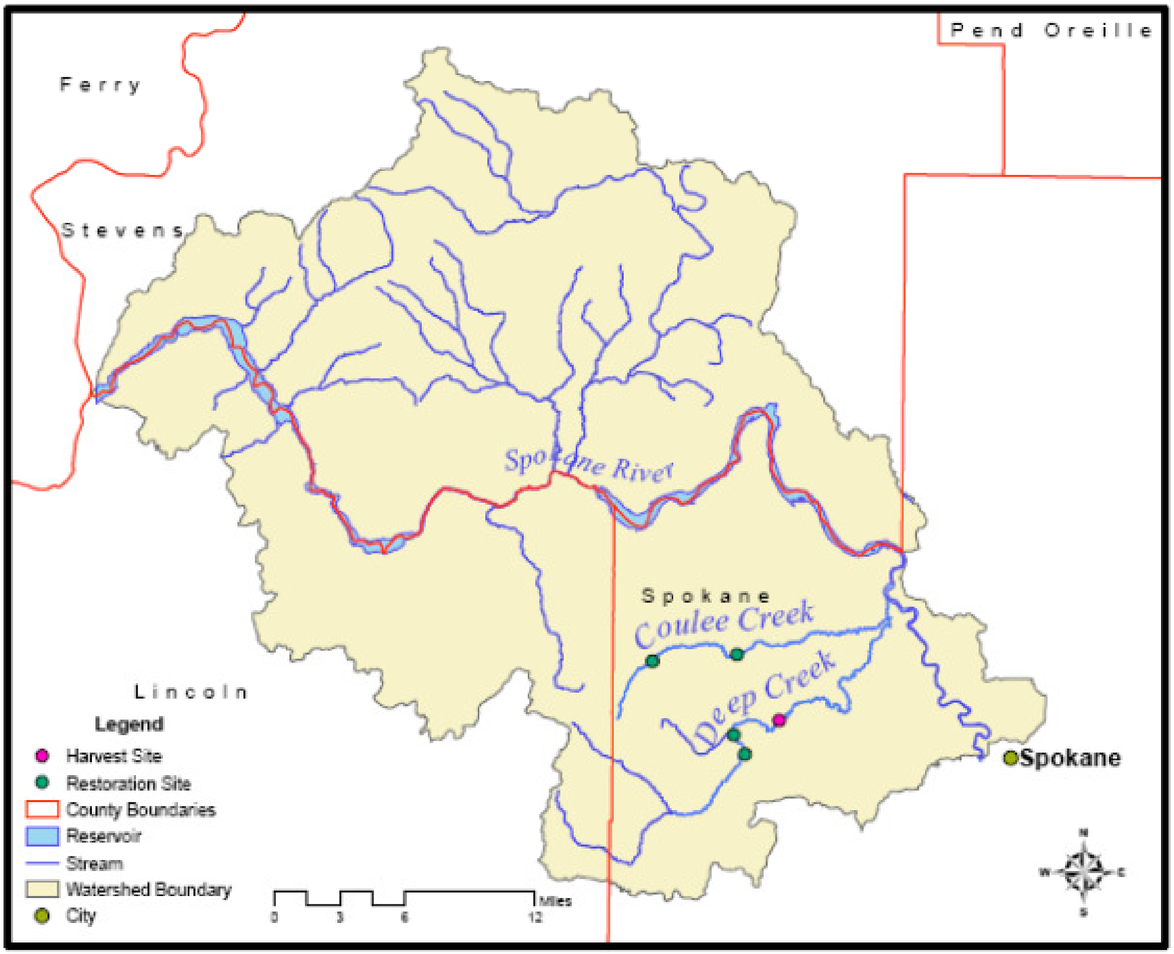


Figure 6: Depiction of Monitoring Practices at Coulee Creek Monitoring Site

- Planting and monitoring boundaries (yellow line)
- Baseline transect: greenline vegetation monitoring and stream assessment reach (blue line)
- Radial transects for vegetation monitoring (purple line)
- Shrub and vegetation layer assessment points (red line)
- Photo points (orange dot)

Figure 7: Photo Point, Coulee Creek Monitoring Site, 2012a

Photo taken 17 April 2012

Figure 8: Photo Point, Coulee Creek Monitoring Site, 2013a

Photo taken 25 June 2013

Figure 9: Photo Point, Coulee Creek Monitoring Site, 2014a

Photo taken 25 June 2014

Figure 10: Photo Point, Coulee Creek Monitoring Site, 2012b

Photo taken 17 April 2012

Figure 11: Photo Point, Coulee Creek Monitoring Site, 2013b

Photo taken 25 June 2013

Figure 12: Photo Point, Coulee Creek Monitoring Site, 2014b

Photo taken 25 June 2014

Figure 13: Photo Point, Coulee Creek Monitoring Site, 2012c

Photo taken 17 April 2012

Figure 14: Photo Point, Coulee Creek Monitoring Site, 2013c

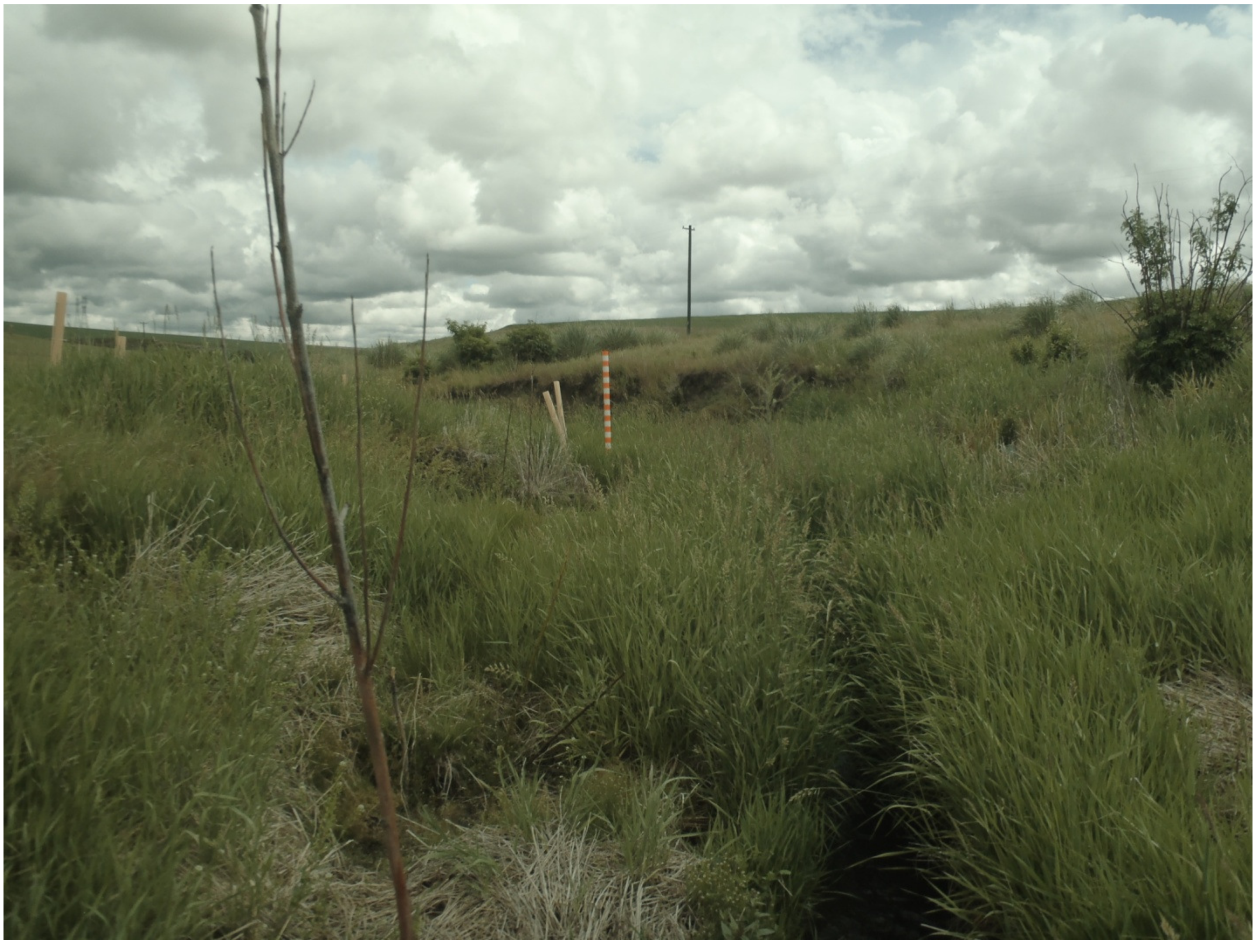


Photo taken 25 June 2013

Figure 15: Photo Point, Coulee Creek Monitoring Site, 2014c

Photo taken 25 June 2014

Table 1: Baseline Overstory Canopy Cover Data

Joel/Anna to 200m, Joel/Mollie 200m-400m, 240° from North	Canopy Coverage % (Every 5m)									
Transect Distance (meters)	0m	5m	10m	15m	20m	25m	30m	35m	40m	45m	50m
0.11	0	0	0	0	0	0	0	0		road	
20.11	0	0	0	0	0	0	0	0	0	0	road
40.11	0	0	0	0	0	0	0	0	0	0	road
60.11	0	0	0	0	0	0	0	0	0	0	0
80.11	0	0	0	0	0	0	0	0	0	0	0
100.11	0	0	0	0	0	0	0	0	0	0	0
120.11	0	0	0	0	0	0	0	0	0	0	0
140.11	0	0	0	0	0	0	0	0	0	0	0
160.11	0	0	0	0	0	0	0	0	0	0	0
180.11	19.8	0	0	0	0	0	0	0	0	0	0
200.11	0	0	0	0	0	0	0	0	0	0	0
220.11	0	0	0	0	0	0	0	0	0	0	0
240.11	0	0	0	0	0	0	0	0	0	0	0
260.11	1	0	0	0	0	0	0	0	0	0	0
280.11	0	0	0	0	0	0	0	0	0	0	0
300.11	0	0	0	0	0	0	7.3	9.4	0	0	0
320.11	0	0	0	0	0	crosses stream					
340.11		crosses stream immediately									
360.11	2.1	0	0	0	0	0	0	0	0	0	0
380.11	0	0	0	0	0	0	0	0	0	0	0
400.11	0	0	0	0	0	0	0	0	0	0	0

Table 2: Baseline Tree Vigor Data

Species	Id Number	Plant Date	Diameter (mm)	Height (in)	Height (cm)	Height (m)	Climate/Vigor Notes	Treatment Date	Data Collectors
	189		6	28.6	72.64	0.73	starting closest to road [north bank] moving sw along stream, assumed recently dead	30-May-13	MP, HS
RIHU	190		4	13.3	33.78	0.34		30-May-13	MP, HS
	191		4	15.5	39.37	0.39	assumed recently dead	30-May-13	MP, HS
	192		13	74	187.96	1.88	possibly dead	30-May-13	MP, HS
	193		9	59.8	151.89	1.52	assumed recently dead	30-May-13	MP, HS
	194		10	38.2	97.03	0.97	vigorous	30-May-13	MP, HS
COSE	195		7	26.4	67.06	0.67	mostly dead	30-May-13	MP, HS
COSE	196		6	40.3	102.36	1.02	doing well	30-May-13	MP, HS
	197		7	37.5	95.25	0.95		30-May-13	MP, HS
	198		8	38.6	98.04	0.98		30-May-13	MP, HS
	199		6	35.6	90.42	0.90		30-May-13	MP, HS
	200		11	74	187.96	1.88		30-May-13	MP, HS
	201		8	60.8	154.43	1.54		30-May-13	MP, HS
POTR	202		13	65.5	166.37	1.66		30-May-13	MP, HS
	203		6	24.2	61.47	0.61		30-May-13	MP, HS
	204		6	28	71.12	0.71		30-May-13	MP, HS
	205		7	23.5	59.69	0.60	stressed	30-May-13	MP, HS
	206		7	56	142.24	1.42		30-May-13	MP, HS
PIPO	207	2012	6	11.9	30.23	0.30		30-May-13	MP, HS
	208		10	62.5	158.75	1.59		30-May-13	MP, HS
	209		5	26.5	67.31	0.67		30-May-13	MP, HS
POTR	210		7	28	71.12	0.71	stressed	30-May-13	MP, HS
POTRE	211		8	54.8	139.19	1.39		30-May-13	MP, HS
POTRE	212		8	53.3	135.38	1.35		30-May-13	MP, HS
COSE	213		15	21.5	54.61	0.55	measured before split	30-May-13	MP, HS
PIPO	214		7	11.8	29.97	0.30		30-May-13	MP, HS
	215		4	16	40.64	0.41	recently dead	30-May-13	MP, HS
PIPO	216		6	11	27.94	0.28		30-May-13	MP, HS

PIPO	217		4	23.8	60.45	0.60	stressed, very dry	30-May-13	MP, HS
	218		10	30.6	77.72	0.78		30-May-13	MP, HS
PIPO	219		6	11.5	29.21	0.29		30-May-13	MP, HS
PIPO	220		5	15.3	38.86	0.39		30-May-13	MP, HS
PIPO	221		7	14.5	36.83	0.37		30-May-13	MP, HS
POTRE	222		6	44.5	113.03	1.13	numbered trees beginning inland then circled back towards bank	30-May-13	MP, HS
PIPO	223		6	12	30.48	0.30		30-May-13	MP, HS
	224		11	56	142.24	1.42		30-May-13	MP, HS
PIPO	225		6	10.2	25.91	0.26		30-May-13	MP, HS
PIPO	226		6	12	30.48	0.30		30-May-13	MP, HS
PIPO	227		5	11.3	28.70	0.29		30-May-13	MP, HS
PIPO	228		5	8.6	21.84	0.22		30-May-13	MP, HS
PIPO	229		5	9.6	24.38	0.24		30-May-13	MP, HS
COSE	230		3	19.5	49.53	0.50	back alongside stream	30-May-13	MP, HS
RIHU	231		7	26.3	66.80	0.67		30-May-13	MP, HS
	232		8	64.5	163.83	1.64		30-May-13	MP, HS
	233		8	48.5	123.19	1.23		30-May-13	MP, HS
POTR	234		7	50.7	128.78	1.29		30-May-13	MP, HS
POTRE	235		3	15.3	38.86	0.39	tall stem dead, short stem thriving, (live stem)	30-May-13	MP, HS
	236		8	37.4	95.00	0.95	stressed	30-May-13	MP, HS
	237		7	41.1	104.39	1.04		30-May-13	MP, HS
COSE	238		9	42.5	107.95	1.08		30-May-13	MP, HS
	239		8	43.2	109.73	1.10		30-May-13	MP, HS
	240		7	36.5	92.71	0.93		30-May-13	MP, HS
	241		10	39.1	99.31	0.99		30-May-13	MP, HS
	242		9	36.9	93.73	0.94		30-May-13	MP, HS
	243		5	6.6	16.76	0.17	assumed dead with one stem of growth	30-May-13	MP, HS
	244		9	42.2	107.19	1.07		30-May-13	MP, HS
	245		5	19.6	49.78	0.50		30-May-13	MP, HS
	246		3	25	63.50	0.64	assumed dead	30-May-13	MP, HS
	247		8	33.6	85.34	0.85		30-May-13	MP, HS
	248		6	45.8	116.33	1.16		30-May-13	MP, HS
	249		9	58.5	148.59	1.49	across	30-May-13	MP, HS

							stream		
	250		8	61.5	156.21	1.56		30-May-13	MP, HS
	251		10	44	111.76	1.12		30-May-13	MP, HS
	252		7	36.8	93.47	0.93		30-May-13	MP, HS
	253		9	39.6	100.58	1.01		30-May-13	MP, HS
	254		6	25.3	64.26	0.64		30-May-13	MP, HS
	255		9	32	81.28	0.81		30-May-13	MP, HS
	256		8	34	86.36	0.86		30-May-13	MP, HS