# Memo

**To:** Whom it may Concern

**From:** SCRP Team

**Date:** 10/7/13

**Subject:** Vegetative Analysis of Schultz Creek Project Site

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Riparian vegetation is an important habitat and functional component of an riparian ecosystem, and also serves as an indirect link to the process of bank and soil stabilization. Riparian area plant community structure and composition were measured using methods based on the Southern Colorado Plateau Network Riparian Monitoring Protocol (SCPN) of the National Park Service (NPS) Standard Operating Procedure (SOP) #6, Nested Plot Sampling Methods. Regulations for the vegetative analysis were provided in the SOP #8. The SOP method obtains frequency and cover estimates of herbaceous, shrub and grass species within cover class categories and tree seedling density using nested plot sampling. The plots must be evenly spaced along the transect with nesting of the 1 $m^2$, 5 $m^2$, and 10 $m^2$ plots at a given plot location (SOP #8, 2007). A total of 8, 10$m^2$ quadrant plots were established along the channel from the culvert opening to the end of the reference reach, as seen in Figure 1 below.


Figure 1: Vegetation Monitoring Site Locations

Vegetation was identified by species and whether or not the species was native or invasive. A list of species identified is provided in Table 1, below.

Table 1: Plant Identification

| Plant Species | Plant Type | Native or Invasive |
|---|---|---|
| Coyote Willow | Shrub | Native |
| Pinus Ponderosa | Tree | Native |
| Humulus lupulus (hops) | Herb | Native |
| Artemisia dracunculus | Herb | Native |
| Bromus inermis | Grass | Native |
| Erigeron divergens | Herb | Native |
| Verba macdouglii (mint) | Herb | Native |
| Helianthus annuus | Herb | Native |
| Conyza candasinus | Grass | Native |
| Linaria Dalamtica | Herb | Invasive |
| Verbascum (mullen) | Herb | Native |
| Bouteloua gracils | Herb | Native |
| Bromus porteri | Herb | Native |
| Chenopodium | Herb | Native |
| Amarathus powellii | Herb | Native |
| Kochia Scoparia | Herb | Native |
| Ambrogia acanthicarpa | Herb | Native |
| Thalictrum fendlerii | Herb | Native |
| Vitis Arizonica | Herb | Native |
| Sisymbirum altissimum | Herb | Invasive |
| Artemisia Ludoviciana | Herb | Native |
| Panicum bulbossum | Grass | Native |
| Marrubium vulgare | Herb | Invasive |
| Hordeum jubatium | Herb | Invasive |
| Muhlendergia Montana | Herb | Native |
| Helenium hoopsii | Herb | Native |

A greater amount of vegetation was observed closer to the culvert due to the disturbance of Highway 180. An indication of disturbance was observed in the increase of Artemisia dracunculus, Helianthus annuus, Verbascum (mullen), Marrubium vulgare, and Hordeum jubatium.

The vegetative analysis performed was based on species abundance, or foliar coverage, in which the mean species cover was based on the cover class midpoints. The cover class midpoints were determined using Table 2 below, based on the percent of concentration of a species within the 8 quadrants.

Table 2: Cover Class Midpoint from SOP #6

| Cover Class | Range of Coverage | Midpoint of Range |
|---|---|---|
| 1 | 0-5% | 2.5% |
| 2 | 5-25% | 15.5% |
| 3 | 25-50% | 37.5% |
| 4 | 50-75% | 62.5% |
| 5 | 75-95% | 85% |
| 6 | 95-100% | 97.5% |

From Table 2, the cover class midpoint range was determined and used in Equation 1, as seen below, to determine the total coverage of the species.

$\% = (1/n) \Sigma c_i$ *(Equation 1)*

The percent of coverage is determined by dividing the sum of $c_i$ per quadrant by $n$ as seen above in Equation 1. The variable $c_i$ represents the cover class midpoint range for every quadrant. The variable $n$ represents the number of quadrants on the plot, which was established to be 8. The species abundance was calculated for each species, shown in Table 3.

Table 3: Species Abundance

| Type of Vegetation | Coverage Class Midpoint Range (%) | Species Abundance (%) | Sites with Significant variation |
|---|---|---|---|
| Grass | 154 | 19.25 | 1, 2, 3, 5, 6 |
| Herb | 81 | 10.125 | 1, 2, 3, 6 |
| Shrub | 115 | 14.375 | 1, 2, 3, 6 |
| Tree | 46 | 5.75 | 3, 4, 6, 7 |
| Bareground | 141 | 17.625 | 1, 3, 5, 6, 8 |

From Table 3, grass is shown to be the most abundant with 19.25% coverage, followed by bare ground with a coverage of 17.63%. Trees had the least coverage with an abundance of 5.75%. From the observed data, the majority of the channel bed contains vegetation. By using the abundance of the species within the quadrants, soil stabilization can be estimated. The presence of more native species allows the Riparian ecosystem to thrive. This data is assumed for seasonal periods with vegetation present.

Another aspect of the Vegetative analysis was to determine the effectiveness of coyote willows for bank stabilization. In order to decrease the amount of erosion undercutting the parking lot, coyote willows will be planted on the bank sides to stabilize the soil with their roots. The tensile strength of the coyote willow root system was calculated to determine the strength of bond between the soil and the roots. The tensile strength of a single root was determined using Equation 2 below.

$T_{ri} = aD^{-b}$ *(Equation 2)*

From Equation 2; D is the diameter of the root, *a* is the relationship constant and b is the scaling exponent. The diameter of the root was determined to be 5.7mm. The *a* was provided to be 34.5 and b was provided to be 1.02 (Encyclopedia of Agrophysics 635). After all variables were input, the tensile strength of a root was determined to be 5.84 kPa. Once one root's tensile strength was determined, the tensile strength for the entire root system was calculated using Equation 3.

$T_r = \Sigma_{i=1}^{n} T_{ri} \frac{A_{ri}}{A_s}$ *(Equation 3)*

As seen in Equation 3, the sum of the tensile strengths of the roots determines the total tensile strength of the root structure. The area of the roots, $A_{ri}$, was determined by multiplying the width (2m) by the depth (.92m) of the root system to get a total of $1.84m^2$. The cross sectional area of the soil, $A_s$, was determined to be $4m^2$. The total number of roots in the system was determined to be 6. The total tensile strength of the root system was determined to be 16.12kPa. The tensile strength of coyote willows is effective for the use of a bank stabilizer to prevent erosion. One thing to monitor is the reproduction of coyote willows to ensure none grow in the channel bed. Coyote willows reproduce by sprouting shoots from the roots, so it is very easy for them to reproduce sporadically, as seen in Figure 2 below.

Figure 2: Coyote Willow: left bank, channel bed, and right bank

The coyote willows on the left bank, seen on the left in Figure 2, are a great example of how they stabilize the bank. However, the coyote willows in the channel are a poor example of bank stabilization because they have shifted to the center of the channel from the bank eroding and sliding. The area does not suggest new sprouts grew there because the willows are the same relative size as the ones on the bank. Maintenance on coyote willows must be maintained to prevent sprouts from growing in the channel bed.