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WRI Internship Summer 2016

July 26, 2016

My Internship as a Hydrologist

For this summer internship I spent time as a Hydrologist Surveying streams in the Mendocino National Forest. This was done through the U.S. Forest Service and I was able to work with the Forest Hydrologist. He introduced us to the Project we were going to be apart of, which was named the Four Beetles Project. This Project was started to help manage Forest Health due to disease and insects which have been impacting tree mortality. The project consisted of different fields of work including the Hydrologists, Botanist, Fish Biologist, and Archaeologists. As one of the Hydrology interns I was introduced to Stream Stability Surveys which I would be working on for my time here.

The Stream Stability Surveys which I was introduced to was a combination of the Rosgen Stream Classification and Pfankuch Channel Stability Rating. These surveys are done on second to fourth order streams. Streams are classified as 1st order when it is the head of the perennial stream, 2nd order starts at the confluence of two 1st order streams and so on.The Pfankuch Channel Stability Evaluation is a set of procedures used to organize evaluations in order to provide information about the capacity of the streams being able to recover or adjust from changes in flow or amount of moving sediment. This type of survey is based on judgements of the stream broken down into different categories. Each Category has different items that we needed to look at which are supposed to answer three questions; What magnitudes of hydraulic forces at work detach and transport various organic and inorganic bank and channel components? How resistant are these components to the recent stream flow exerted on them? What is the capacity to adjust and recover from potential changes in flow?(Pfankuch ,2)

With the Pfankuch we looked at three parts of the stream; the upper bank, lower bank, and the channel bottom. The upper bank is the area where the normal high water line meets with the slope of the mountain side. This area is mostly inhabited by non-aquatic plants/animals. The information we would gather from the upper bank included the bank slope gradient, whether or not there was mass wasting, if there was debris jams, and the amount of vegetation on banks. We measured the bank slope gradient by standing at the edge of the stream and using a clinometer, which is an instrument used to measure angles of slope. With Mass Wasting we would look at whether there had been or whether there was potential for the detachment of soil or sediment which could affect stream flow. This can range from little or none to frequent which has sediment interacting yearlong from the banks with the stream. The size of sediment can be as small as gravel to as large as boulders. When looking at debris jam we would judge whether it was small twigs or larger size material. The smaller the material would mean the stream was more stable because with heavy amounts of flow that material would be moved and not cause an obstruction to the flow. The amount of vegetation can tell us how stable the banks can be. Trees and scrub have deeper roots which allow more stability and also reduce velocity of flood flows.

When looking at the lower bank, the intermittently submerged portion of channel from normal high waterline to the water's edge, we measure the channel capacity, looked at the bank rock content, obstructions or flow deflectors, cutting, and depositing happening in the stream. With the channel capacity we gave an ocular estimate of the width to depth ratio which gives us an idea of how well the stream can handle high amounts of flow. When we look at the bank rock content we are looking at if we see larger sized boulders, which are more stable because they resist erosion from flow, or if we see smaller sized gravel ,which erode into the stream easier. Obstructions to flow and flow deflectors can cause instability to streams by increasing the severity of channel damage when they break.(Pfankuch) They can also cause channel migrations and heavy cutting/deposition can occur. Large rocks and logs that are firmly embedded however can also be good by changing the velocity of the flow and can also deflect the flow from an unstable area. Cutting and Deposition are two signs that will show that large amounts of flow are causing instability to the stream. Cutting can be seen as erosion, almost a vertical wall, and can cause root exposure leading up to overhangs into streams.(Pfankuch, 16) Deposition can be seen as sand or gravel which creates new banks from erosion happening upstream.

The last part of the stream which we look at is the channel bottom or the submerged portion of the channel. The characteristics we looked at are the rocks angularity, brightness, consolidation, percent of size distribution, amount of scouring/depositing and aquatic vegetation. With rock angularity the sharper the rock would give us a more stable stream because they are less likely to be tumbling then a rounded rock and are also packed better. The rocks brightness also gives us the idea of whether there is a lot of tumbling. The brighter the surface tells us there is a lot of movement because the banging of rocks keeps them polished or clean from algae or moss. If there is consolidation, particle packing, it shows a stable stream because the rocks are tightly packed which causes the bed to be resistant to movement from high flow. The percent of stable material is based off of the variety of sizes of the rock. The more stable material would be bedrock boulders and large cobble(5” or greater), the least stable material would be seen as silt, sand, gravel, or small cobble(less than 5”). To help with figuring this out we were given a small category on our survey sheet which we would give rough estimates of what percent of the stream these different sizes occupied. Scouring is seen as uneven bottom channel cutting. The last thing we look at is the aquatic vegetation. Algae and moss show stability because they would not be able to stay in high flow areas.

All these categories gave us the information we needed to rate streams by the stability. We used a modification comparing the Pfankuch ratings to the Rosgen Score in order to give us a Good, Fair, or Unstable Rating. The Rosgen score varied with the different stream types. The stream types vary and are differentiated by different characteristics like slope, width to depth ratio, sinuosity, and entrenchment ratio. There are nine different major stream types; AA, A, B, C, D, DA, E, F, G. I mostly dealt with surveying AA, A, and B. After we decided what kind of stream it was we assigned a number alongside the letter. This number gives us an idea of what size sediment is mostly seen. 1 being bedrock, 2-boulder, 3-cobble, 4-gravel, 5-sand, and 6-silt.

All the information we gathered is now going to be put into a data sheet which will help determine the Threshold of Concern for these streams. Stream stability ratings define the percent of watershed which can be occupied by disturbed areas, determining the TOC.(Vandame, 2) TOC is found by identifying the stream stability rating, acreage of watershed, and acreage of active landslides occurring. The TOC is an estimated level of disturbance that statistically affects the physical or biological conditions of a hydrological system. TOC coefficients are assigned to watersheds using this information, the more stable a stream is the higher the coefficient will be.(Vandame, 2) This coefficient leads to telling us an amount of disturbance these watersheds are going through and how well they are able to handle it.

Table 4A – Stream Stability / TOC Coefficient Crosswalk Mendocino NF		
Pfankuch Stability Rating	Descriptor	TOC Coefficient
0 – 13	High Excellent	0.16
14 - 26	Med Excellent	0.15
27 – 39	Low Excellent	0.14
40 – 52	High Good	0.14
53 – 65	Med Good	0.13
66 – 78	Low Good	0.12
79 – 91	High Fair	0.12
92 – 104	Med Fair	0.11
105 – 117	Low Fair	0.10
118 – 130	High Poor	0.10
131 – 148	Med Poor	0.09
149 – 156	Low Poor	0.08

This internship allowed me to experience a perspective of the field of work I am pursuing. It has also expanded my knowledge in not only from what I learned for the Hydrological view but also in a sense of a geological view. While working with the Forest Service I have increased my confidence in working independently, with others, and also in an office environment. This opportunity has also increased my interest in pursuing a lifelong career with the Forest service. I am very happy I was given the opportunity to experience this and would like to thank the CSUSB Water Resources Institute.

Works Cited

Vandame, Mike 2009 Mendocino National Forest ERA Process USDA unpublished document as required by Region 5

Pfankuch, D. J. 1975. Stream reach inventory and channel stability evaluation. U.S. Department of Agriculture Forest Service. Region 1. Missoula, Montana.