Stream Classification of the Mora River in The Wind River Ranch near Watros, New Mexico

Loraine Garcia and Jason Martinez,

Supervisors: Dr. Edward Martinez and Dr. Craig Conley

New Mexico Highlands University, Las Vegas, New Mexico

Abstract:

During the third week of April 2010, the New Mexico Highlands University (NMHU) Surface Hydrology and Watershed Management students, as supervised by, Dr. Craig Conley and Dr. Edward Martinez, studied the Mora River watershed by measuring flows and stream morphology characteristics. Largely, the Mora River watershed is located on the eastern slopes of the Sangre de Cristo Mountains in northeastern , New Mexico and is approximately 1,476-mi². The Mora River flows eastward into the plains of New Mexico and drains into the Canadian and Arkansas rivers. Recharge to the Mora River watershed occurs by means of surface waters. Agricultural activities such as livestock watering and irrigation are primary uses for the waters and drinking water typically is gained via groundwater. During the 2-day study, present-day conditional status evaluation of the river took place. The Mora River reach, after analysis, appeared to be recovering from disturbance. Natural ecologic recovery of the river determination involved measuring cross sectional profiles, longitudinal profiles, and recording parameters such as natural meanders and point bar development along the stream reach.

Introduction:

The Mora River on the Wind River Ranch (WRR) has a watershed area of approximately 458 mi². It was determined, based on the Rosgen stream classification system, that the existing stream in the study area was an F5. An F5 is a flat bottom meandering stream which has been incised. The stream bottom was mainly made up of sand and cobble and had a shallow slope. The vegetation outlining the stream boundary was sparse, and varied down the channel length.

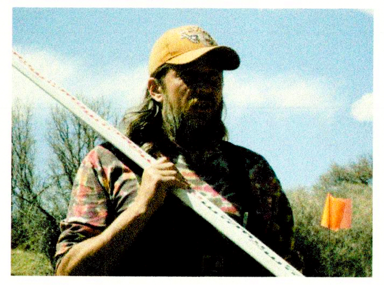
Mora River has a history of anthropogenicity. Rapid morphological changes within the last hundred years such as cattle production formed arroyos around the timeframe of the 1890s. Subsequent erosion has degraded the soil's ability to hold water. Cumulatively, physical, biological, and chemical impacts caused by such phenomena are those that reduce the health of the land. Therefore, investigation towards current riparian health as well as morphological health are those that were investigated by the Surface Hydrology and Watershed Management courses.

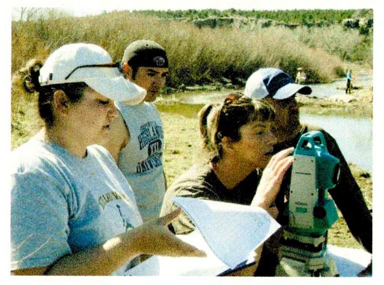
Purpose of Study:

The main objective of the study was to conduct a river assessment of the Mora River, located within the Wind River Ranch (WRR). The Wind River Ranch is located north of Las Vegas, New Mexico and maintains an area of 4,500 acres in south-central Mora County.

What is the problem facing the Mora River research site?

The Mora River research site has historically been subjected to deliberate changes in the stream morphology. In many areas along the Mora River research site, deliberate alterations have been made to the natural river system that have resulted in the rivers' current state. Historical cultural impacts such as water impoundments, inactive/ active dirt roads, abandoned wagon roads, culverts, stream crossings, floodplain encroachment, and loss of wetlands have altered the natural drainage patterns of the streams hydrology. Both cultural and agricultural features currently on the Wind River Ranch landscape, and within the study area, tend to intercept, divert, concentrate, and accelerate the surface waters of the Mora River in places that geologically and historically never received water.





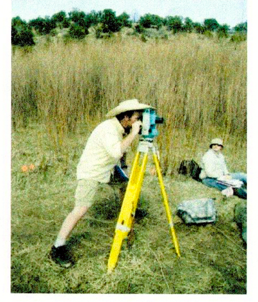
Methods:

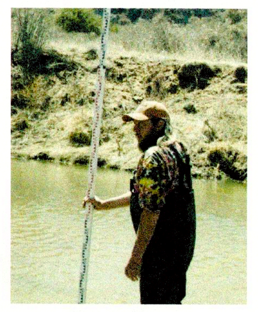
Cross Sectional Area:

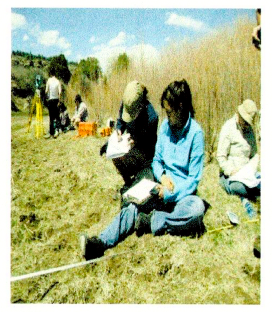
Measuring channel cross sections required a minimum of 3-people. Materials used were composed of the auto-level, measuring rod, transect tape, and recording materials. Major components of the channel cross section measurement were the endpoints taken via GPS and photos. Key points of the stream bank were marked where the cross section was taken for each individual reach being surveyed. Measurements were taken across the stream channel from identified bankfull from each side of the river. Significant breaks in the channel, outside channel include floodplain, bankfull elevation, and stream terraces were measured. Ideal placement for the conduction of the cross section took place on riffle section, point bars or locations with a clear floodplain, presence of one or more terraces, or on channel section representative of stream. Once in water, regular intervals were measured every 1-ft along the measurement tape, along with the water level. Measurements were taken until the right-endpoint was reached. All measurements and data were recorded on field-handouts. Photos were taken downstream and upstream of the river.

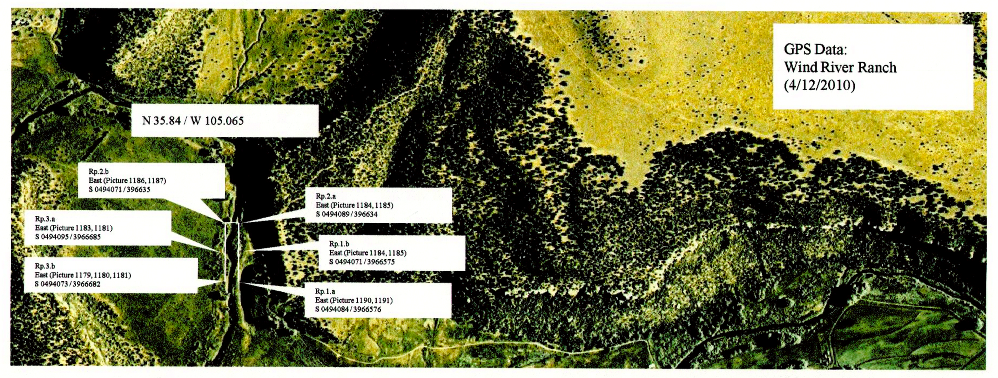
Longitudinal Profile:

The defining, observing, and recording the longitudinal profiles required a minimum of 3-people. Notable items required were the total station, inventory scribe and prepared data-sheets, waterproof trousers, and total station staff for measuring thalweg along the stream reach. The channel reach was defined according to the proposed upstream and downstream limits of the survey. The longitudinal profile was prepared by flagging the proposed channel reach (300-ft) for key features such as pools, riffles, and runs. The beginning, middle, and end of a riffle sections were captured, along with all pools within the stream observation site. The total station was set up so most of the observation site was visible. The level was placed midstream and above all features to be surveyed. Measurements were taken along the thalweg (deepest part of the channel), along with water surface and channel bottom. Elevations and slopes of the terraces were recorded via GPS technology.







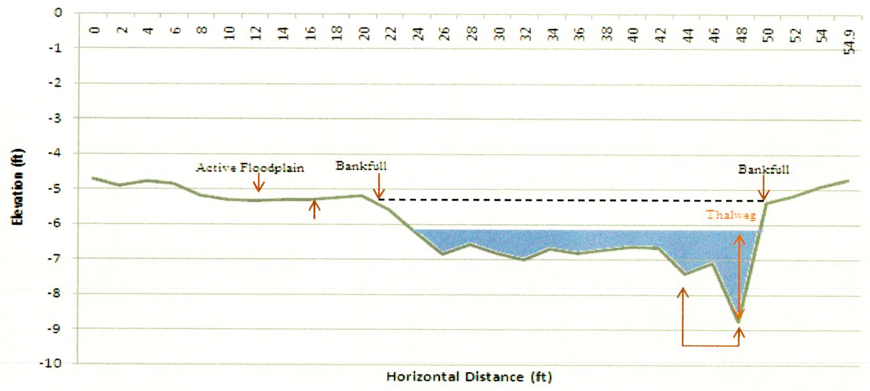


Greenline:

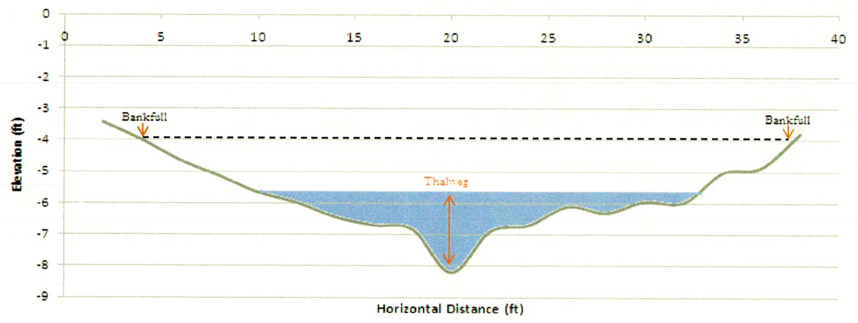
The greenline monitoring method is composed of three data collection procedures designed to generate a compatible data set. Greenline composition, riparian cross-section composition, and woody species density were the data objectives. Materials needed to collect data include data collection sheets, camera, six fence posts with post hammer, GPS or compass, flagging, calculator, 6-ft rod (1). Placement of flagging on the greenline form the first cross-sectional transect and the starting point of the greenline transect. Using a GPS, the coordinates of each post of the cross-sectional transect were recorded. As a future reference, witness posts were located in upland vegetation to prevent them from being washed out and to allow for a potential increase in the width of the riparian zone. We then traversed the greenline upstream from the initial flagging, placing flagging at, 100, 200, 300, and 363-ft. We then crossed the stream and traversed the greenline back down the opposite bank 363-ft. Flagging was placed to mark the end of the greenline transect. These markers helped the observers to keep track of the location within the transect and provide valuable reference points for the photographs.

Results:

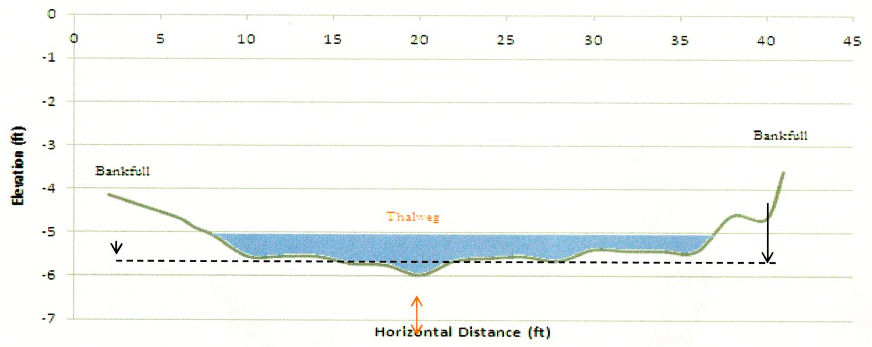
Cross Sectional View

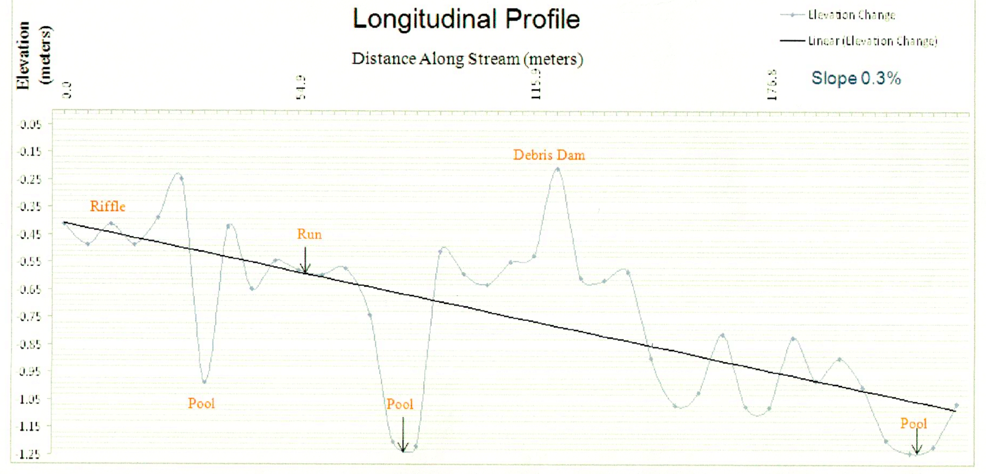


Cross Sectional View



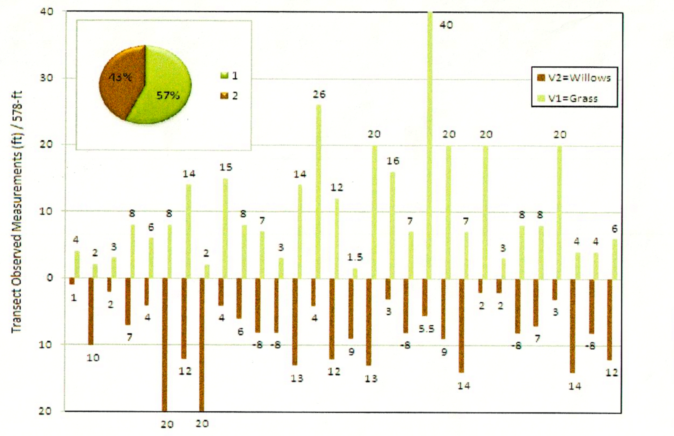
Cross Sectional View

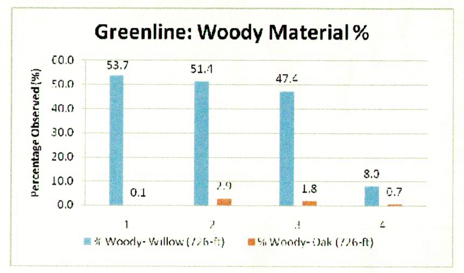




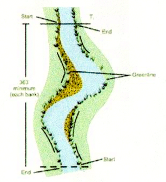
	Rosgen Channel Type	
Parameter	*Exisiting*	*Design Channel*
Rosgen Channel Type	G5	C5
Watershed Area (mi^2)	458	458
Bankfull Cross Section Area (ft^2)	23.66	26.55
Bankfull Width (ft)	24	26.55
Bankfull Mean Depth (ft)	0.986	0.891
Width/Depth Ratio	24.34	29.79
Width of Flood Prone Area (ft)	52.33	56.21
Entrenchment Ratio	2.18	2.43
Meander Length (ft)	288	318.6
Channel Length (ft)	740	777.38
Valley Length (ft)	708	708
Sinuosity	1.05	1.22
Slope (%)	0.3	0.2
# of Meanders	1	2
Bankfull Shear Stress (lbs/ft^3)	0.184	0.111
Size of Particle Moved (mm)	12	8

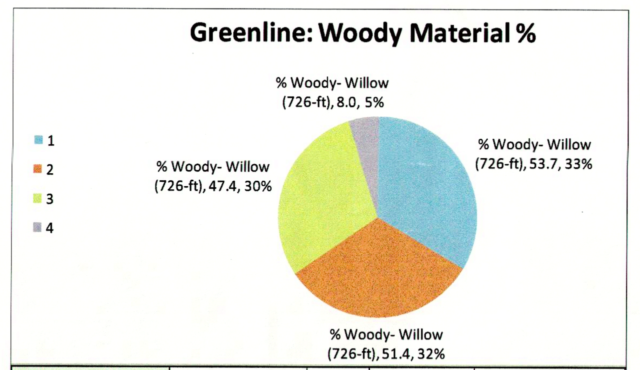
Results:





Woody Species Classification	
1	Seedling
2	Young
3	Mature <50% dead
4	Mature >50% dead





GREENLINE - Woody Material				
	% Woody- Willow (726-ft)			
	Seedling	Young	Mature <50%Dead	Mature >50%Dead/ Clubbed
Transect - Feet Observed	390	373	344	58
Percentage (%)	53.7	51.4	47.4	8.0
	% Woody- Oak (726-ft)			
	Seedling	Young	Mature <50%Dead	Mature >50%Dead/ Clubbed
Transect - Feet Observed	1	21	13	5
Percentage (%)	0.1	2.9	1.8	0.7

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Conclusion:

Surface Hydrology Conclusion:

The area of the Mora River studied was found to be behaving like a much smaller stream, than what it was thought to be behaving like. The Mora River is thought to behave this way because there are so many diversions up and down stream from the study location. The problem is that much of water is being allocated for agricultural uses. However, the river does have the capability of becoming a C5 stream, which was set as the desired goal. With minor emplacements of restoration structures , the river in this area will start to meander and form a larger, healthier floodplain. The goals to restore this area of the river would be to decrease the slope, in order to slow the incision of the channel. The next step would be to insert a single baffle and a single weir, to induce meandering and dissipate the water energy in the area. The addition of this structures would only speed up the process of the meandering, something that the stream is already trying to do by itself.

Watershed Management Conclusion:

Two conclusions were formed after conducting the greenline, which include: vegetation cross section composition transect, and the woody material percentage. The woody species calculation concluded that most of the woody species in the area was a seedling, young, or mature with <50% dead. Only 5% of the woody vegetation in the area was mature with >50% dead. Vegetation cross sectional composition results implied that the major vegetation along the transect was made up of 57% grass, and the rest of the transect was composed of willow (43%).

References:

- Zeedyk, B., Clothier, V. 2009. *Let The Water Do The Work: Induced Meandering an Evolving Method for Restoring Incised Channels.* The Quivera Coalition.

Acknowledgments:

- ➢Wind River Ranch
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- ➢The Watershed Management Class at NMHU