# STREAM MORPHOLOGY I:
# BRASS GRANT PROJECT

This is the first of a 3-part series. BRASS thanks the Lake Champlain Basin Program, the NYS Soil & Water Conservation Committee, and Trout Unlimited for funds that enabled BRASS to carry on this project.

What were we doing? Staff of the Boquet River Association, the Au Sable River Association, and summer college interns spent the summer with survey equipment in the two rivers and some of their tributaries. The purpose was to determine the type of reaches (stretches of river) in our watersheds and whether certain ones were stable or unstable.

"Stable" means the reach carries its water and sediment load over time without building up its channel bed (aggrading) of cutting it down (degrading), and at the same time keeps its proportions of width, depth, incline and curves. Stable does not mean stationary.

What is this important? Learning about river types, proportions, and indicators of stability, gives us clues about how we might expect areas of the river to behave in the future. Rivers work hard at maintaining stability. If left alone without human impact or interference, they correct imbalances so they can successfully carry their water and sediment load. But, river valleys are settlement areas with homes, businesses, and transportation corridors. Catastrophic events, road maintenance, bridges, and ways we treat the land cause imbalances. If we are to continue to live near rivers, we need to know how best to help an unstable section become stable once again.

One way is to use the dimensions of a stable section, of the same type of river, as a blueprint for restoration attempts. Looking and working carefully with dimensions is a far cry from dumping loads of rip rap, digging out cobble bars, or even expecting thousands of planted seedlings to survive and hold streambanks together.

What reaches did we pick? What measurements did we get? How was stream type determined? We picked areas with easy access due to the amount of equipment we carried, and where landowners gave us permission. We also tried to pick reaches we thought were stable, and ones we believed might be unstable and prone to flooding. The length of each read had to generally be twenty times the "bankfull" width.

"Bankfull" is when water just begins to flow over a point bar on an inside bend of the river. Bankfull conditions occur on an average every 1.5 years. These flows actually form the character (width, depth, gradient and sinuosity) of the river channel. Floods can change the character of a reach, but they occur much less

frequently. If a reach does not have a meander and point bar, you look for bankfull indicators like the beginning of permanent woody vegetation along the bank, a consistent scour line or slight change in bank slope, a change of particle size in bank materials, or stain lines if there is bedrock present. There were many unstable areas of the Boquet we couldn't survey because there were not good bankfull indicators.

Once we placed flags at bankfull indicators along the reach, we measured elevations of the deepest part of the river, the rest of the channel bottom, the water surface, top of bank, and area of the active flood-prone width. This is considered to be the 50-year flood elevation and is two times the depth measurement from the channel bottom to the bankfull indicator. We also measured the length of the reach and distances between riffles, runs, pools and glides.

With measurement data, we used information from professional geomorphologists to determine stream type. There are roughly seven different stream types, with sub-types according to the material making up the channel bed (boulders, cobbles, gravel, sand, silt and clay).

"A" streams are steep with cascades and a step/pool sequence, like the North and South Forks of the Boquet coming off the Dix Mountain range. "B's," "D's" and "G's" have a moderate slope of 2-4%. Downstream of Split Rock Falls to New Russia is a good example of a swift "B" stream, or the Boquet along Steele Woods Road. "D" streams differ by being multi-channeled and braided; and a "G" is narrow, deep, and incised into the earth like a gully. Streams with little slope are generally "C" streams (like along agricultural areas in Wadhams where there are broad flood plains, meanders and old ox bows) or are "E's" (like the narrow and deep area of Spruce Mill Brook as it heads east of the Northway with its broad meadow valley) or are the shallow "F" with very high unstable banks and winding nature.

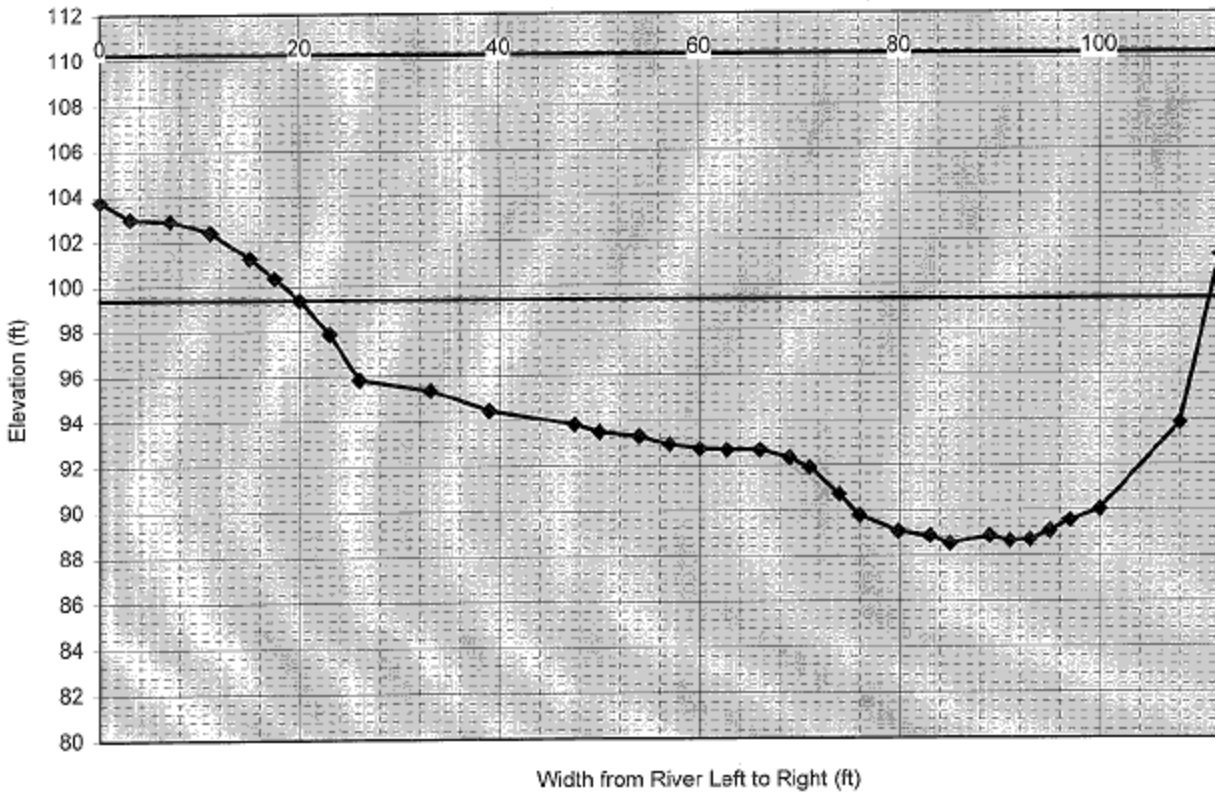
How did we judge whether a reach was stable or unstable? As we surveyed we also assessed the channel bed, banks, and vegetation for signs that professionals have noted as being indicators of either channel or streambank instability. We looked at the stream bed for scouring or deposition, whether there were bars or islands in the channel and if their width was greater than half the stream width. We looked for cut faces on bars, cut-offs and flood chutes, and unusually steep riffles. Then we examined the streambanks for erosion, type and diversity of vegetation, composition of the banks, leaning trees or exposed tree roots, the ratio of the bank height to the bankfull height, and the bank angle. These are some of the indicators that have been assigned values for various stream types, and total values provide a judgment about stability. So what were the results?

Results - #1. First, let's look at an area of theBoquet River behind the old, stone railraod station house in Essex along Route 22, opposite the County Home. Several years ago, a flood caused extensive erosion along the western streambank, rose

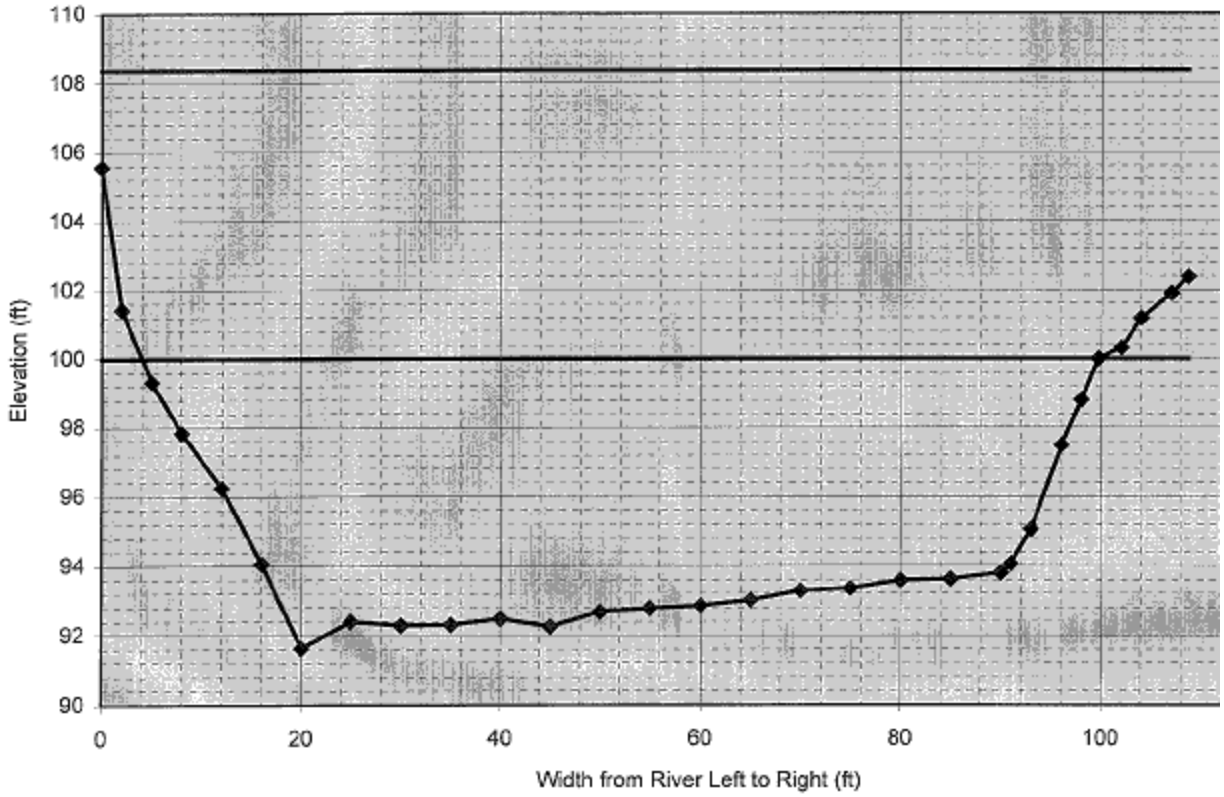
high up onto the flood plain and into a nearby home, and cut off the drive exit to Route 22. The current home owners are worried about bank stability, and have planted hundreds of seedlings in an effort to establish vegetation again. Several years ago, BRASS included this reach in a request of funds for erosion control. But, what could we do? Upstream and downstream banks weren't stable enough for a log crib. Should we dump rip rap? If we did, wouldn't the outside, downstream meander bend erode huge sections out of a cornfield across the river? We held the grant funds and waited for survey results.

This is a broad valley with little gradient, what should be a typical "C" stream. Years ago it used to meander across the plain because you can see the old ox-bows on the other side of the railroad tracks. The railroad cut off the floodplain and forced an artificial straightening of the river. The Boquet has a hard time transporting its sediment load through this section; in other words this reach is aggrading. The channel bed is totally sand so there are no riffles and the be stays nearly a perfect trapezoid until the bend downstream of the house which has a pool on the outside where the velocity is greatest. With eroding banks and no roughness of vegetation or channel bed stones, there is little to dissipate the energy of water during bankfull events or during floods. The current owners have reason to worry, not just about the stability of the bank, but the elevation of the house in terms of the flood prone area.

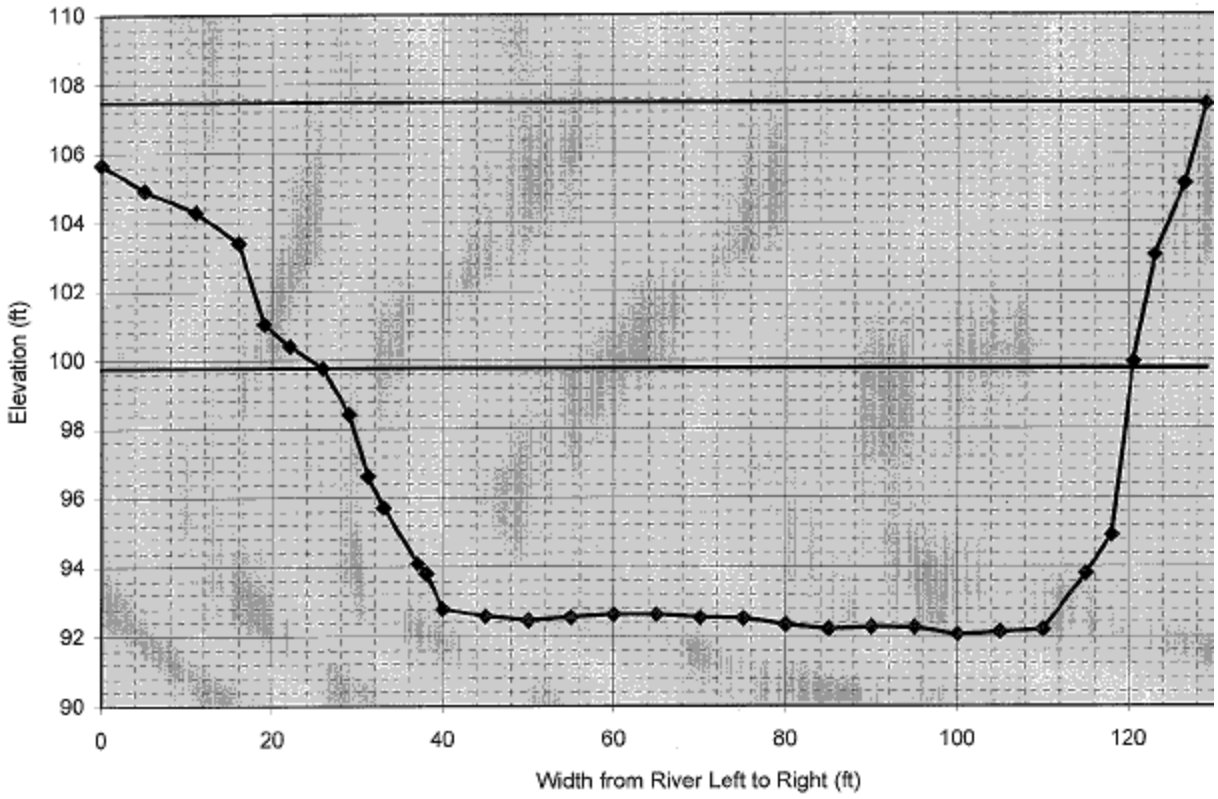
Look at the cross section graph. It represents a slice across the river downstream of the house at the meander bend. You can see how the bed deepens at the outside right (eastern) bend. The house sits upstream and to the left. The dotted line is the channel outline; dots are elevations read with a laser level and stadia rod. The bottom horizontal line is the "bankfull" elevation, where the water level will be every 1.5 years on average. The top horizontal line represents the elevation of the 50-year flood which is nearly 6 feet above the base of the house and top-of-bank.




This is a cross section of an area about 350 feet upstream of the house. Here you see the trapezoidal channel bed.




In another cross section, about 400 additional feet from the one shown above, once again the channel bottom looks like a trapezoid, but look at the left bank.




Notice the change of slope at the "bankfull" mark. This keeps the bank from being so steep, even though it is the same height as the left bank in the second cross-section (almost 14 feet from the bottom of the channel to the top of the bank). Not surprising, there is lush bush vegetation along the left bank with vigorous root growth helping to add roughness against the water's energy and to hold bank soils together. There is no sign of erosion along the left bank for about 400 feet upstream, and upstream cross sections continue to show the same break in slope at the "bankfull" mark.

The survey has given us clues about how to proceed with erosion control, and what warning to give the landowners. The house needs to be moved or elevated to protect occupants from future floods. The width to depth ratio and gradient are within appropriate ranges for a stable "C" stream. Being hindered from developing its normal meander pattern by the railroad bed, the channel will continue to aggrade. Without roughness, the energy of the river will continue to cause bank erosion in susceptible areas. Vegetation along the bank by the house is absolutely necessary, and it appears it will have more chance at successful growth if the current steep embankment is shaped to permit a break in slope at "bankfull" and a more gradual incline to the top of the bank.

Of course, these are measures the landowners must approve before we proceed, but the survey was indeed most helpful.