Hydrologic Reconnaissance for Stream Stability And Sediment Consequences

Morris Creek, West Virginia

6/1/05

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In Partnership with:

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DEP

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Table of Contents

Summary

A hydrologic reconnaissance for stream stability and sediment consequences took place on Morris Creek on May 23, 2005. This reconnaissance consisted of walking the Morris Creek mainstem (approximately 3 miles) from the Jones Hollow Slip to near the confluence with the Upper Kanawha River near Montgomery, West Virginia. The field partners included: members of the Morris Creek Watershed Association (MCWA), the West Virginia Department of Environmental Protection (WVDEP), the West Virginia Conservation Agency (WVCA), the US Office of Surface Mining (OSM), and Canaan Valley Institute (CVI). The goal was to assess stream-type and stream stability (channel reaches aggrading or degrading) as well as identify potential restoration projects and conceptualize designs. Measurements of the stream channel and floodplain included: bankfull width/depth ratios, slope, sinuosity, a riffle pebble count, and bankfull discharge estimations. GPS and photographic information was also captured. The majority of the Morris Creek Mainstem is a B4/1 stream-type situated in an alluvial fan, colluvial, and incised valley type (Summary Table 1). Areas of channel instability occur when the entrenchment ratio increases (the floodprone area decreases) and the stream moves to an unstable G4 or F4 (entrenched and confined). When considering restoration, the stable form a G is usually a B, and the stable form of an F is usually a B or a C. Due to the extremely high sediment load, a stable B channel would need numerous structures to maintain the W/D important to transport sediment and dissipate flood effects above the bankfull stage. This consideration may make construction costs higher than estimated in this report. The total length of channel instability was estimated at 2,512 feet. The total estimated cost per foot for design, materials, and construction ranged from \$50 - \$100 per linear foot using local materials, equipment, knowledgeable operators and oversight, and volunteer efforts from the watershed organization.

Ryan Gaujot
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Bankfull Width (Wbf) = 19.5 ft

Average Depth (Dbf) = 1.9 ft

Bankfull Cross sectional Area (Abf) = 37.1 ft^2

Width/Depth ratio (Wbf/Dbf) = 10.3

Maximum Depth (Dmax) = 4.5 ft

Width Flood Prone Area (Wfpa) = 40 ft

Entrenchment Ratio (ER) = 2.1

Channel Materials (D50mm) = 30 mm

Water Surface Slope = 0.02

Sinuosity = 1.2

Summary Table 1: Level 2 Morris Creek Stream Classification
Measurements were made in stable representative riffles above the Morris Creek Waterfall as in cover photo.

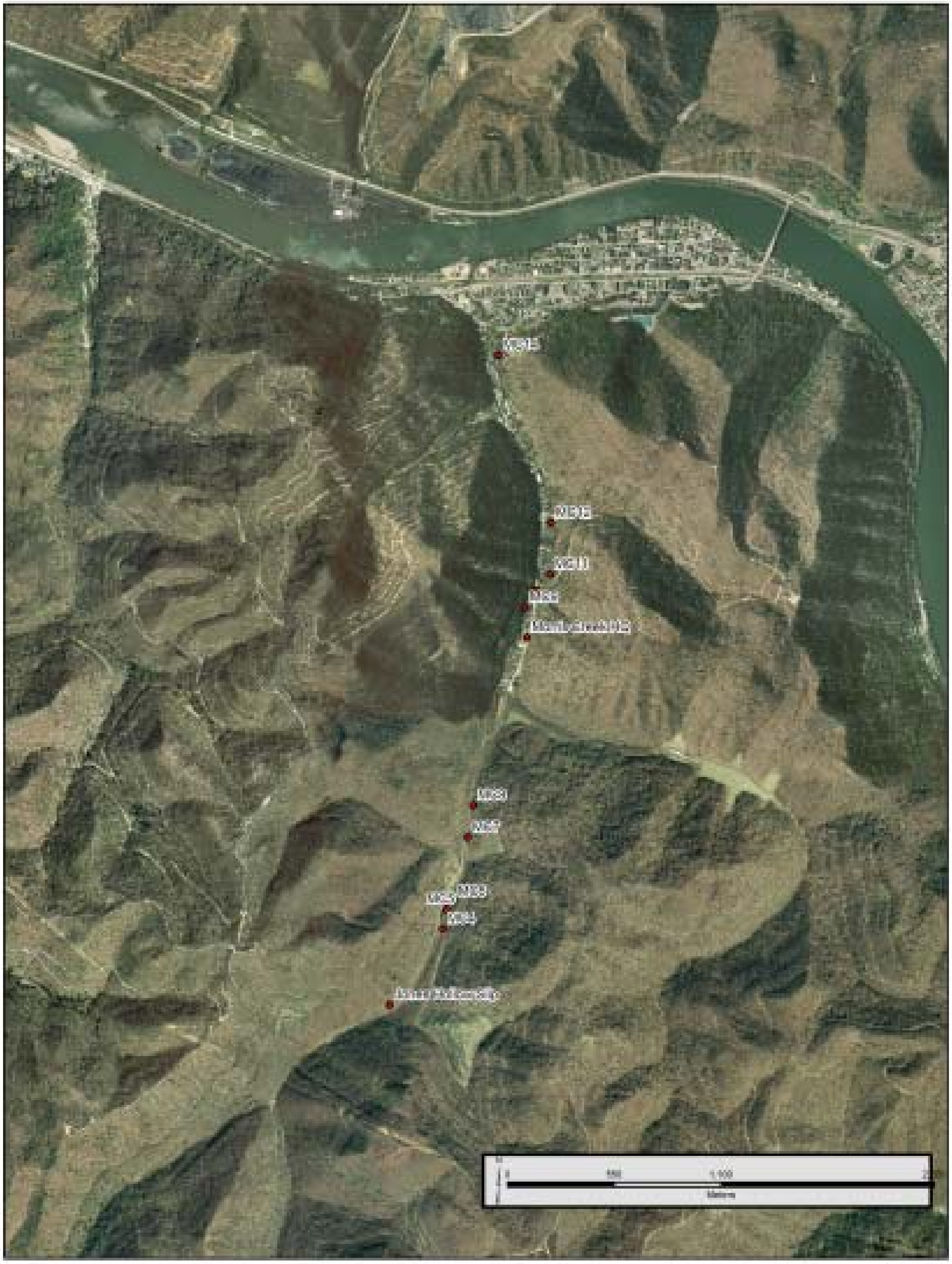

Figure 1: An aerial photograph of the Morris Creek Sediment Project Sites. The City of Montgomery is located near the confluence with the Kanawha River flowing northwest. The primary data source is the WV State Addressing and Mapping Board (2003).

MC#1

This location is near the mouth of Gibson Hollow. Near the tributary confluence, a small pond impounds water from flowing to the mainstem of Morris Creek.

Restoration goals would include better sediment transport and hydrologic connectivity. This could be accomplished through channel relocations and better channel crossings that work for the frequent bankfull flow. The impoundment is approximately 80 x 30 ft.

MC#2 (no photo)

This location is near the mouth of Magazine Hollow (Youngs Branch). Similar to MC#1, impounded side ponds are capturing slope runoff. These ponds need better connectivity (flow and sediment) to the mainstem. Caution should be made to design the appropriate crossing; this area is adjacent to a main haul road that will be in use.

Jones Hollow

This location is estimated to be one the main sediment contributing problems in the basin. Channel realignment, well above the top of the slip, has caused accelerated erosion and mass wasting of bedrock and coal refuse creating a modified drainage network. Restoration would include reestablishing the flow of water and sediment into the 'old' existing channel above the slip to the west (out of photo). A significant 'plug' would need to be built in order to keep flow from reentering the slip seen below.

A reference riffle above the Jones Hollow Slip gave:

Wbf = 21.0 ft
Dbf = 1.7 – 2.0 ft

MC#2b

A dry, eroded culvert was observed just below Jones Hollow slip at river left.

A reference riffle in the MC#2b culvert area gave:

Wbf = 14.4 ft
Dbf = 2.1 ft

MC#3

Streambank erosion (107 ft) of low priority was observed at river left below a dry culvert. The eroded bank looks like refuse and road fill. There is an excellent floodplain at river right. One or two j-hook structures with a bankfull bench at river left could enhance the stability of the reach.

At 2X's maximum bankfull depth (in a riffle), the stream is still contained within an incised channel. The floodprone area is small (<30ft) resulting in an entrenchment ratio (ER) of 1.5 – 2.0. When entrenchment ratio decreases, stream stability dramatically decreases especially during a big flood. Thus, Morris Creek is an entrenched B channel, with unstable reaches that are G and F channels. The stable form of a G channel is a B.

Sinuosity = 1.1 – 1.2

MC#4

At this location an apparent change in W/D for the mainstem due to the development a long central bar. A culvert bridge impounds the bankfull flow and facilitates aggredation in the upstream reach. This sections measures 300 feet of instability due to a bridge grade control in slope and flood-prone width. Restoration could include channel realignment using two structures and retrofit two ‘squashed’ bankfull culverts at the bridge.

A riffle in this area gave:

Wbf = 31.0 ft
Dbf = 1.2 ft

MC#5

At this location, a meander-chute-cut-off has resulted due to aggredation and central bar deposition. This aggredation has also influenced the erosion of the left bank. Within this reach, the stream wants to build in some pattern (sinuosity). Restoration could include channel pattern reshaping, 1- 3 structures with a floodplain bench and vegetation plan. Riparian vegetation is low through this section. The total length of instability is 76 ft.

Riffle Pebble Count

Figure 2 illustrates a Riffle Pebble 100 Count for Morris Creek showing the D50 as 30mm (course gravel) particle size. Particle size from this pebble count is underestimated due to sampling more 'bankfull' particles skewing the distribution to include more sand and silt. Future pebble counts need to be accomplished upstream and downstream of this pebble count location for velocity and sediment entrainment calculations.

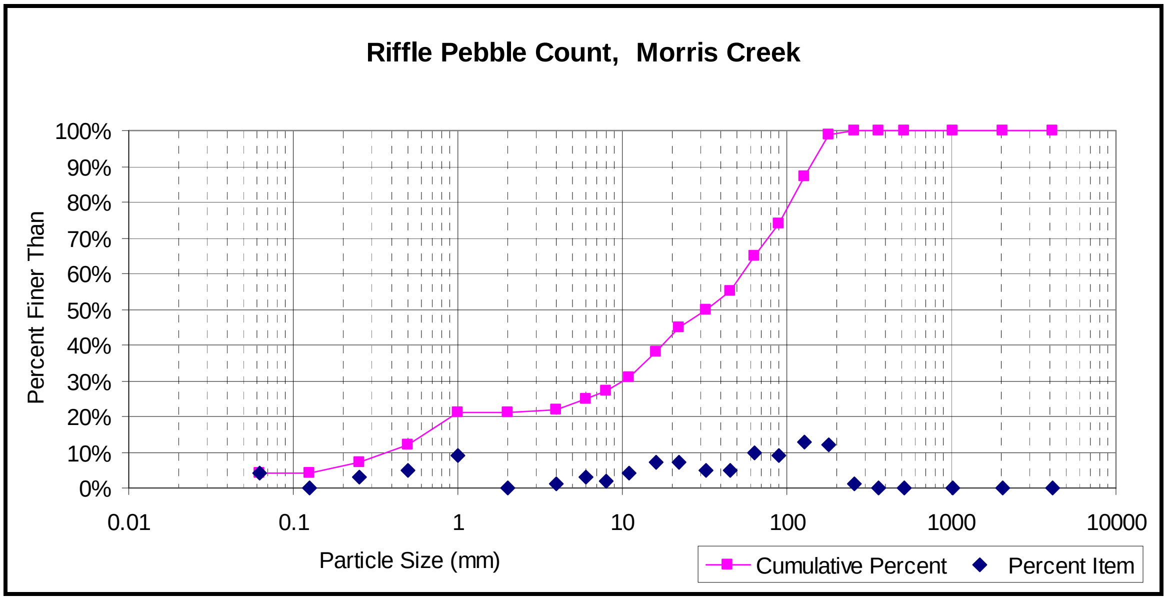

Figure 2: A riffle pebble count for Morris Creek just above the Waterfall.

MC#6 (no photo)

At this location 93 feet of aggrading stream channel has migrated above the Morris Creek waterfall. This is near the location of the channel reroute proposed in the 2005 Acid Mine Drainage Abatement Projects for the Upper Mainstem Site. The ~20.0 ft waterfall acts as a ‘natural’ grade control on pattern, slope, dimension, and sediment transport. Restoration and stream realignment projects should incorporate and/or mimic this feature into the design of the new stream channel reroute.

It is noted that there is a bedrock substrate below the AMD Upper Mainstem site #1. There is also a reach with old rip-rap along the left bank.

A reference riffle in this area gave:

Wbf = 16.5 ft
Dbf = 2.0 ft

MC#7

At this location, a landslide slip has occurred at river right. The total length of the site is 40 ft. The top of the slip could be pulled back and hydro seeded. There is a 'natural' log-vein just above the slip (keep in place for restoration).

MC#8

This would be a high priority restoration location just above the AMD Lower Mainstem site. Stream bank erosion for 146 ft at river left leads into a small landslide at river right. This erosion and mass wasting is due to channel confinement to an unstable G stream-type with a low floodprone width (<30ft). During a big flood, shear stress would be very high through this reach. Restoration could include channel pattern realignment, 2 -3 structures, a bankfull bench, and a vegetated terrace. A terrace could be built just below 2x's maximum bankfull depth to reduce stream velocity during very large flood events. The excellent vegetation in the reach should be included as materials in the final restoration designs to help keep restoration costs low.

The small landslide:

Just below MC#8 there is a riprap road section for ~200 ft at river left. This could be linked to the upstream erosion, or a tight, nick point in the stream valley.

Bridge near Morris Creek Gate

At this bridge location there is erosion on both wing walls through the bridge. The bridge confines the floodprone area creating an unstable F stream type (Wbf =30, Wfpa = 40). The W/D ratio in this area is 14. Restoration would include channel realignment; structures maintain W/D and dissipate energy near the bridge and route sediment through the bridge at bankfull flows and during large floods.


05 23 2005 12:11


05.23.2005 13:09

Behind Eddy Grey’s house a riffle gave:

Wbf = 26.0 ft
Dbf = 1.6 – 2.1 ft

MC#9

This location has a landslide at river left. There is 'confining' residential encroachment up to the active stream channel. The entrenchment ratio is <1. The encroachment at river right accelerates the water through the channel by working with the bedrock at river left. There is a long eroded stream bank toe at river left below the residential encroachment. This location is just above the most upstream WV Highways Bridge. The total length of instability is 55 ft.

MC#10

This location is the most upstream WV Highways Bridge. This bridge spans the active floodplain allowing for the channels ability to route sediment at bankfull flows. Less frequent large floods could cause back water and erosion of bridge wing walls during the event. This design could be a model for future bridge construction in the watershed. Care should be taken to design bridges to drain the floodplain during large floods.

MC#11

This is a location of residential channel encroachment. W/D ratio increases to 14 through this reach resulting in a confined F stream type. Restoration would include 140 ft of channel and floodplain realignment with reestablishment if riparian vegetation. A vegetated terrace may also be a solution to assist during very large floods. Sycamore and willow were observed in the area.

MC#12

This location is residential encroachment at river left just above private bridge. W/D ratio is < 12, and the stream is a confined G. The total length of instability is 75 ft. The channel needs to be reconnected to a floodplain or bankfull bench. Two structures could also help realign channel and dissipate energy through the bridge below. A vegetated terrace may also assist in this reach for the large floods.

This bridge works for now, but should not be imitated for the long term. This bridge is showing signs of erosion, particularly around the wing wall foundations. This bridge does not dissipate energy at bankfull, nor would it handle the energy or transport the sediment during a big flood event.

Black Snake Hollow

The confluence of Black Snake Hollow with Morris Creek is heavily eroded due to alluvial and colluvial processes (mass wasting). Stream bank erosion occurs on the river left downstream of the confluence. This would be a very difficult sediment source to stabilize.

Aggredation below:

The channel is too wide through this reach to route sediment (Wbf = 38, Dbf = 1.5). The channel geometry in this reach results in low bankfull velocities, deposition of sediment, and erosion downstream river left.


05 23 2006 14 23


05 23 2006 14 23

This bridge works for now, but should not be imitated. This bridge is showing signs of erosion, particularly around the wing wall foundations. This bridge does not dissipate energy at bankfull, nor would it handle the energy or transport the sediment during a big flood event.

MC#13

This is a recently rip-rap section at river right of approximately 100 ft. This rock was put in place to armor the right bank from erosion and channel migration towards residential structures. The rip rap armor confines the stream channel at 2x's maximum depth resulting in an F stream type. This section should be combined with MC#14 below.

MC#14

This is a high priority location that has been apparently over-widened due to dredging and streamside burming of the Morris Creek mainstem channel. The section is extremely wide and shallow, resulting in lower flow velocities at bankfull. The reach needs a lower W/D to route sediment with higher stream velocity. Reestablishment of pattern using 2 – 4 structures should help dissipate energy and route flows during floods. The burms would have to be set back to provide for more floodprone area. A section of the Sanitary Sewer runs through this reach making channel work more difficult driving up design and construction costs. Some sewers are upwelling.

A dredged section riffle shows:

Wbf = 37.0 ft
Dbf = 1.2 ft

These measurements show a very different stream type (C or D) from what was been observed through most of the Morris Creek mainstem (B - G).

Results

Table is a restoration estimate. This estimate and report should be used to help guide budgeting for projects, highlight considerations for restorations designs, and to evaluate contractor expertise. The logistical and unforeseen problems could drastically change cost estimates.

Morris Creek	3/23/2005					
Location	Instability	Length Instability (ft)	Restoration Measures	Annual Sediment Consequences	Estimated Cost (Design, Materials, & Construction)	Restoration Cost $/Foot Estimated Range
MC#1	Impoundment, ponding,	80	Reestablish bankfull flow and sediment connectivity to Morris Creek Mainstem	low	$40	$3,200
MC#2	Impoundment, ponding,	80	Reestablish bankfull flow and sediment connectivity with Morris Creek Mainstem	low	$40	$3,200
Jones Hollow	Mass Wasting, channel realignment, refuse, stream crossing, vegetation problems	1000	Construct new channel realignment, develop crossing to transport flows and sediment, develop vegetation plan	high	$80	$80,000
MC#2b	Eroded Culvert	30	Create new channel/drainage crossing with energy dissipaters	low	$40	$1,200
MC#3	Stream Bank Erosion	107	Channel realignment, 3 structures, bankfull bench, increase floodprone width	low	$50	$5,350
MC#4	Aggredation, pattern and slope problems due to bridge grade control on stream pattern and slope	300	Channel realignment, 4 structures, bankfull bench, bridge retrofit	moderate	$80	$24,000
MC#5	Aggredation, pattern, slope, and vegetation problems	76	Channel realignment, 3 structures, bankfull bench, increase floodprone width	low	$40	$3,040
MC#6	Aggredation, channel migration, and stream bank erosion	93	Reestablish W/D ratio needed to acquire velocities that can transport the sediment load. Channel realignment, 2-3 structures.	low	$50	$4,650
MC#7	Landslide	40	Pull back escarpment of the landslide from above	low	$40	$1,600
MC#8	Confined channel with streambank erosion. Entrenchment ratio is < 1.5	146	Realign channel pattern, increase floodprone width, use structures to maintain W/D important for transporting and dissipating flood effects at bankfull stage or above.	high	$70	$10,220
Bridge Near Morris Creek Gate	Poor eroded condition, Cannot dissipate energy above bankfull flows.	150	Replace bridge with appropriate design to transport sediment and dissipate flood effects	moderate	$100	$15,000
MC#9	Landslide and residential encroachment confines channel and decreases Entrenchment ratio (ER) increasing velocity and shear stress through the reach.	55	Work with landowner to provide to increase floodprone width. Use several structures (4) to build a stable B channel with correct W/D ratio.	moderate	$100	$5,500
MC#11	Residential Encroachment, change in W/D ration, channel and floodplain disconnection.	140	Reestablish W/D ration needed to acquire velocities that can transport the sediment load. Reconnect the channel to the floodplain at bankfull stage. Channel realignment for correct pattern using 2-3 structures.	moderate	$100	$14,000
MC#12	Residential encroachment confines channel and decreases Entrenchment ratio (ER) increasing velocity and shear stress through the reach.	75	Work with landowner to provide to increase floodprone width. Use several structures (4) to build a stable B channel with correct W/D ratio.	moderate	$100	$7,500
Black Snake Hollow	Alluvial and colluvial processes with stream bank erosion. This area may produce a large amount of sediment and should be considered for any sediment reduction project in Morris Creek	500	Very difficult to slow or stop colluvial processes. Restore stream channel to transport the sediment load. Reduce sediment sources in the headwaters of Black Snake Hollow. A large area below this confluence needs channel reshaping, several structures, and appropriate W/ D ratio.	moderate	$100	$50,000
MC#13	Rip-rap, channel floodplain disconnection, stream bank erosion	100	Reestablish W/D ratio needed to acquire velocities that can transport the sediment load. Reconnect the channel to the floodplain at bankfull stage. Channel realignment for correct pattern using 2-3 structures. Work with landowner to provide to increase floodprone width.	moderate	$70	$7,000
MC#14	Dredging, over-widening, burming, aggredation	600	Build appropriate W/D, pattern, and profile using 4 - 5 structures. Work with landowner to provide to increase floodprone width. Setback burm, residential setbacks, reestablish riparian vegetation, develop transportation route.	high	$70	$42,000
		3572				**$277,460**

Other Photos