Lightner Creek Watershed Evaluation Report

Prepared for:

Lightner Creek Watershed Group

Durango & La Plata County

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INTRODUCTION

An ad-hoc watershed group consisting of the San Juan Citizens Alliance, Trout Unlimited, the City of Durango, La Plata County, the Colorado Division of Wildlife, and the San Juan Public Lands Center is interesting in determining the cause(s) of excessive sedimentation that has accumulated in Lightner Creek at its confluence with the Animas River. Observations suggest this excessive sedimentation is a more recent phenomenon.

The watershed group is interested in evaluating the sedimentation problem using a three phase approach. The first phase is a broad brush evaluation of the watershed in order to identify likely source areas. The second phase consists of identifying the cause(s) at each source area along with potential corrective measures. Phase three consists of implementation of corrective measures. This Report and supporting documentation corresponds primarily to the first phase of this process. However, some information pertaining to components of the second phase are also presented below.

It should be noted that it was Basin Hydrology's understanding that the focus of the study was to identify the sources and causes of sedimentation, not turbidity, at the mouth of Lightner Creek. During subsequent discussions with watershed members and a newspaper article, it became apparent that high turbidity levels were also a concern. Although potential turbidity sources are difficult to determine during the fall low-flow season (when this study's field work was performed), the sediment sources identified here-in, along with a proposed water quality monitoring scheme, can be used to identify likely sources or areas that are creating high turbidity levels.

The majority of the field work for this Report was performed in October 2009 with some work performed in November 2009.

The Appendix contains:

- 11" x 17" maps
- Channel Stability and Stream Classification Summary forms, and
- photographs documenting encountered field conditions.

STUDY AREA DESCRIPTION

Watershed

The Lightner Creek watershed encompasses 63.7 $miles^2$. Its highest elevations lie on the east slope of the La Plata Mountains at an elevation of ~ 11,500 feet. The watershed discharges to the Animas River at an elevation of ~ 6,500 feet. For the purposes of this study, the watershed was subdivided into three major sub watersheds. They consist of Upper Lightner Creek, Wildcat Canyon and Lower Lightner Creek. The Lower Lightner Creek watershed was further divided into three subwatersheds consisting of the Tech Center Watershed, Perins Canyon Watershed and the balance of the Lower Lightner Creek watershed. Boundaries of these watersheds are shown on the Lightner Creek Watershed map. The size of each watershed is presented below.

Watershed	Area (mi^2)	% of Total
Upper Lightner Creek	52.1	82
Wildcat Canyon	8.9	14
Lower Lightner Creek	2.7	4
Perins Canyon	*0.7*	*26**
Tech Center	*0.2*	*7**
Lower Lightner Creek	*1.8*	*67**
Total Lightner Creek	**63.7**	

***** *Percent of Lower Lightner Creek watershed*

Soils

Soils within the watershed area are generally a mix of residuum, alluvium and alluvial fans derived from interbedded sandstones and shales as defined by the Archuleta-Goldvale-Hesperus general soil map unit (Soil Survey of La Plata County Area, Colorado). Within the general soil map units are detailed soil map units. Characteristics of the detailed soil maps units pertinent to this study are provided below. The Soils Map: Lower Lightner Creek Watershed in the Appendix shows the distribution of the detailed soils map units in Lower Lightner Creek. The only locations with Badland and Zyme clay loam soils, which contain high percentages of shale, lie within the Lower Lightner Creek watershed. Since the Archuleta – Sanchez Complex is also derived from sandstone and shale residuum, it has the potential to contribute shale and other fines to watercourses. It is distributed throughout the entire watershed with a large area lying on the north side of Lightner Creek along the eastern edge of the Upper Lightner Creek watershed (e.g., Dry Fork area). It also occurs south of Lightner Creek within the upper watershed and in Wildcat Canyon in the form of linear bands.

Soil Map Unit	Texture	% Passing 200 Sieve	Erodibility
Archuleta – Sanchez Complex	loam – clay loam	50 – 65	Moderate
Badland	Mancos Shale	~ 90+	High+
Haploborolls-Rubble Complex	cobbly loam	35-65	Moderate
Pescar Fine sandy loam	fine sandy loam	25-50	Slight
Zyme clay loam	clay loam	70-95	High

Highlights from the above information are the high percentages of fines and the erodibility of the Badland and Zyme soils. Components of the Archuleta – Sanchez Complex soil also contain soils of similar character as the Zyme clay loam hence the potential for this map unit to have high percentages of fines and a high erodibility. In general, soils that have derived from sandstone sources are medium textured whereas soils derived from shale sources are fine textured. Therefore, locations that have a significant amount of soil derived from shale are capable of contributing both coarse and fine grained materials to Lightner Creek.

METHODS & MATERIALS

This section summarizes the various methods and materials used to document erosional source areas within the Lightner Creek watershed.

Particle Sizes & Geologic Type

Since the primary purpose of this study is to determine the sources and causes of sedimentation present at the mouth of Lightner Creek, it is necessary to first identify the size composition and the geologic type(s) of sediments being deposited at that location. The composition of materials was determined using standard sediment particle size analyses and a visual inspection to determine its geologic makeup.

To determine size composition, sediments were collected from the delta from an area approximately 12" in diameter and 5"-6" deep. Materials were sifted in the field through a series of wire sediment sieves ranging in size from 64mm to 2mm. Particle sizes that passed through the 2mm were taken to Green Analytical Labs and screened using sieve sizes from 1mm to 0.074mm (#200 screen). Results from the screening process are presented in the Findings section. Except for the large rounded cobbles (which are from the Animas River and not Lightner Creek), the majority of the depositional material is two dimensional (flat) shale particles (see Photo 1 & 2).

The same particle size analysis was performed in Perins Canyon (at the transition from single family to multifamily residential) and in the "Tech Center" watershed above the City's sedimentation basin, since these two watershed's surfacial geology is dominated by shale. These three Sediment Evaluation Sites are shown on the Watershed Evaluation Maps.

Sediment Transport

To document the mechanisms of sediment transport of particle sizes present at the mouth of Lightner Creek, a channel cross section and longitudinal profile were surveyed approximately 150' upstream of the Dog Park bridge. The channel cross section and profile were used to determine the stage (water elevation) versus discharge relationship of Lightner Creek at that location. This location was selected as it is near the mouth, is presumably on City-owned property and is considered to be fairly representative of the lower Lightner Creek's channel morphology. This cross section and profile were also used to determine the stage at which a given particle size that can be moved (stage versus particle size relationship). These plots are presented and discussed further in the Findings section.

Channel Stability, Bank Erosion & Contributing Watersheds

The second step was to inspect Lightner Creek beginning at the Animas River. Inspections included:

- examining overall channel stability,
- identifying areas of bank instability and their associated geologic materials,
- evaluating geologic composition within the channel bed (including pool and backwater areas) and flood plain areas,
- inspecting Lightner Creek immediately downstream and upstream of inflow sources,
- inspecting watersheds that discharge into Lightner Creek (where accessible), and
- photographic documentation.

Inspections of Lightner Creek were performed by wading the channel from the mouth upstream to where it crosses Highway 160 at Rosemary Lane. Upstream of Rosemary Lane to Wildcat Canyon, channel inspections occurred by frequently accessing the channel from Highway. Behind the Exxon Station and Nissan Dealer, the channel was inspected by walking the channel's north bank.

Channel stability was determined in the field using the Pfankuch channel stability methodology. This methodology focuses on the geomorphic, vegetative and erosional characteristics of the upper and lower channel banks. The methodology also evaluates the channel bed composition, scour and deposition characteristics and mobility relative to channel stability. In addition, the Rosgen stream type was determined for each stream evaluation site. The Pfankuch channel stability rating and Rosgen stream classification system combine to create stability ratings of Good, Fair or Poor. Channel Stability and Stream Classification Summary Forms for each evaluation site are contained in the Appendix and each evaluation site is shown on the Watershed Evaluation Maps. Results are presented in the Findings section.

While inspecting the channel and completing the forms, a shovel was used to dig into the channel substrate and into flood plain features to determine the size and composition of materials present. This provided a good insight as to the types of materials being transported through that particular reach on a fairly routine basis. Where a discharge point into Lightner Creek occurs, inspections above and below that point were performed to document what materials (shale, sandstone, etc.) were being discharged into Lightner Creek and to document if there was a perceptible change in sediment amounts and types as a result of that discharge point.

Inspections continued upstream until the geologic materials (shale) present at the mouth were no longer observed in the channel or in flood plain areas in any significant amount. For this study, channel and erosional source inspections terminated at the Wildcat Canyon confluence based on the lack of shale material present in the Lightner Creek channel or flood plains at that location.

Based on inflows to Lightner Creek, watersheds that could easily be accessed were also inspected relative to channel stability, erosional source areas and geologic composition. The two primary watersheds inspected were the Tech Center and the lower half of Perins Canyon. Other small watersheds north of Highway 160 (e.g., watersheds discharging at Animas Storage, Bob's Truck Repair and the CDOT facility) were not inspected despite their potential to contribute shale materials to Lightner Creek.

Aerial Photography

High resolution (15cm) color aerial photography is used in some of the maps presented in the Appendix. Despite the imagery being approximately eight years old, it is a good resource for identifying land uses, some erosional features, discharge points, etc.

Soils Maps

Soil mapping units developed from the Natural Resources Conservation Service for the Lightner Creek watershed downstream of Wildcat Canyon were reviewed for type of parent material, soil textures and erosion potential. Soil mapping units for the lower Lightner Creek are shown on the Soils Map in the Appendix. A brief discussion of the soils of particular interest is presented in the Findings section.

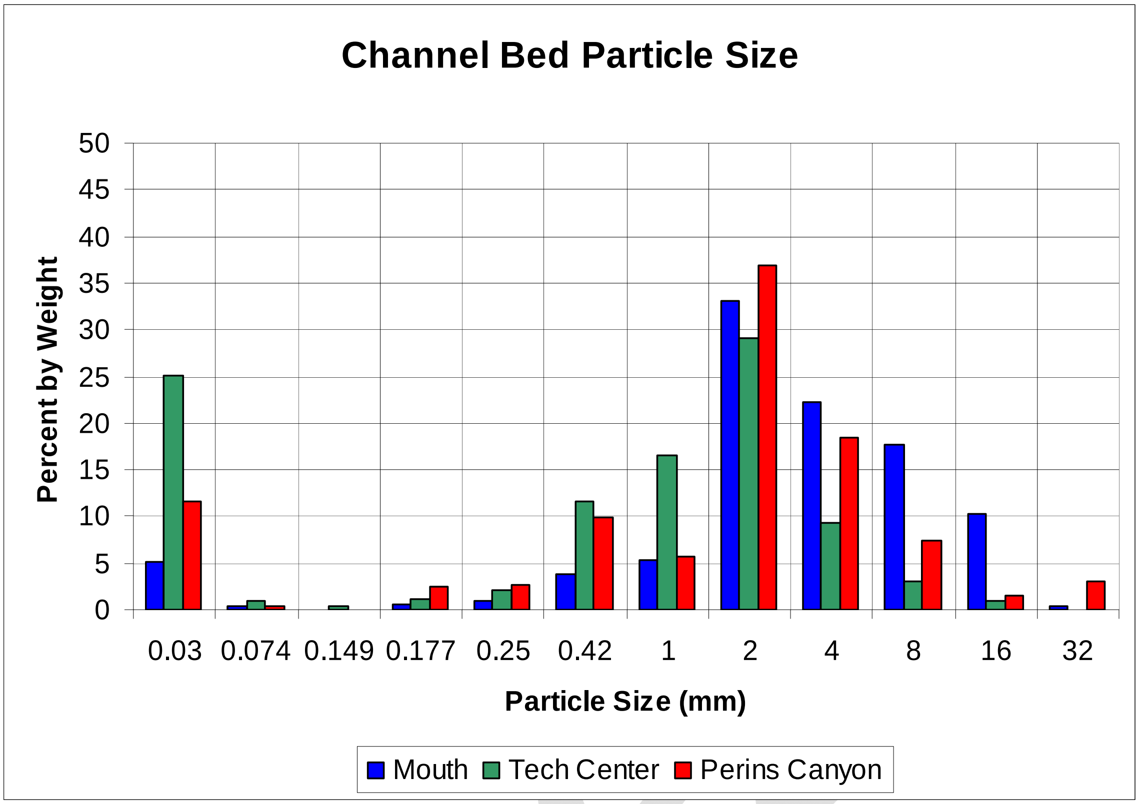
FINDINGS

This section summarizes the results of the particle size analyses, the sediment transport potential of Lightner Creek, soils, and the channel stability evaluations. It also identifies and prioritizes significant sediment source areas.

Particle Sizes & Geologic Type

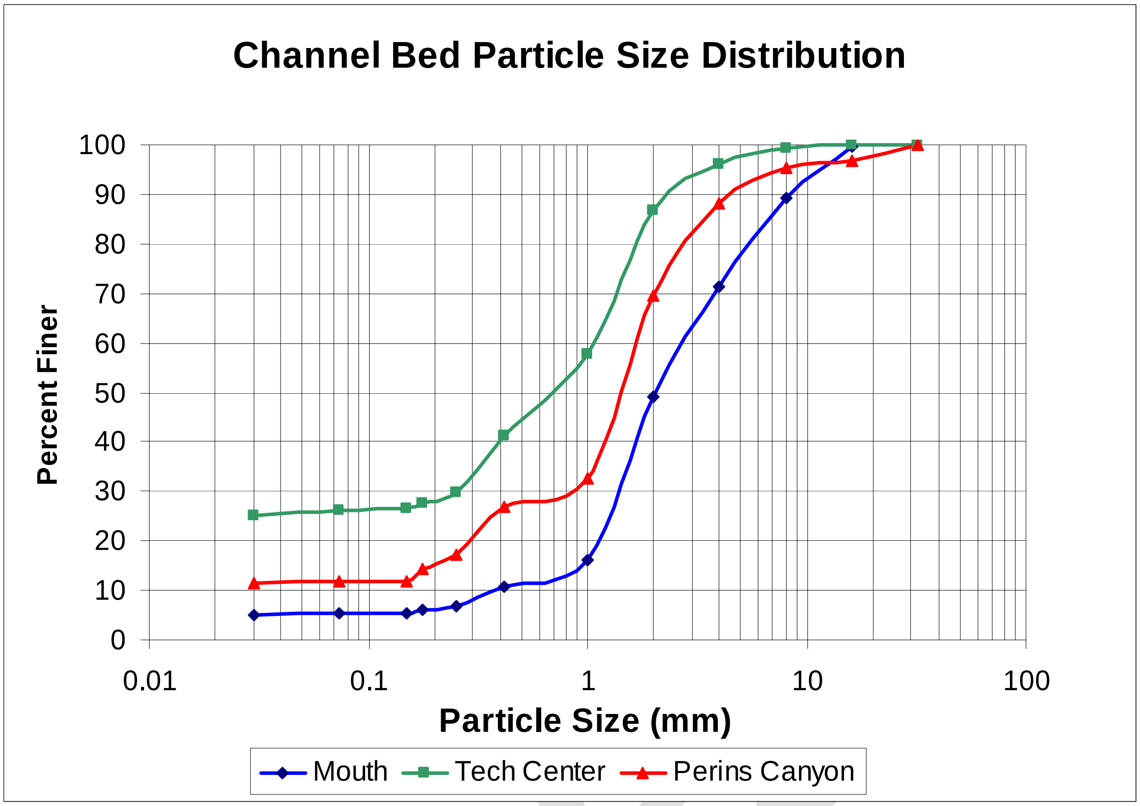
Results of the channel bed particle size analyses performed at the mouth of Lightner Creek, above the City's sedimentation basin in the upper Tech Center watershed and in lower Perins Canyon are presented in the following two charts.

The Channel Bed Particle Size chart quantifies the percentage of each particle size class at each sample site. Common to all three sites is the relatively small size of materials present. At the Tech Center site, ~ 25% of the material is smaller than 0.074mm. Very fine sand size particles are in the 0.1mm to 0.05mm range, silt is in the 0.05 to 0.002mm range and clay is finer than 0.002mm. It is likely that the majority of the material passing through the 0.074mm screen is silt and clay. These size particles are easily transported and remain in suspension for long periods once mobilized, contributing to turbidity.



The Channel Bed Particle Size Distribution chart shows the distribution of particle size classes based on their accumulated occurrence. The largest particle sizes measured were 32mm for both the Mouth and Perins Canyon. In general, the Mouth has the largest particle sizes, with Perins Canyon intermediate and the Tech Center the smallest particle sizes. The mean particle sizes are approximately 2mm, 1.5mm and 0.7mm for the Mouth, Perins Canyon and Tech Center sites, respectively. Despite numeric differences, these are all relatively small particle sizes. The Mouth site has the coarsest material, which is to be expected as there is little opportunity for fines to settle out due to the scouring affects of the Animas River during non-low flow conditions.

Particle size analyses were not performed at eroding banks comprised of shale along the Lightner Creek channel. Based on the relatively small size particles observed at those sites, it is likely that all the exposed shale areas in an alluvial setting have similar particle sizes to those measured at the three sites.



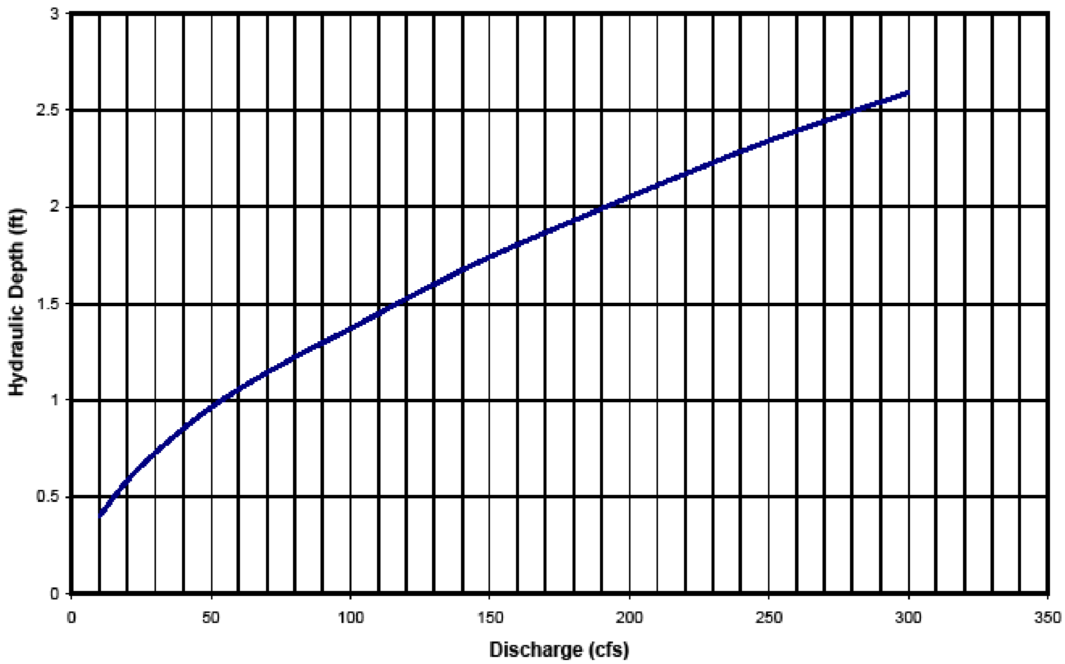
The Mouth site contains few particles (<5%) that are not of shale composition. The Tech Center and Perins Canyon sites are approximately 99% shale materials. Since the overwhelming majority of sediment being deposited at the mouth of Lightner Creek is shale, and this depositional area is reportedly a relatively recent phenomenon, this study put more emphasis on identify eroding banks and other highly erodible source areas that are comprised of shale. However, non-shale sediment source areas were also identified and mapped.

Based on all identified sediment source areas (point and non-point) between the mouth and Wildcat Canyon, the majority of these sites are comprised of shale materials.

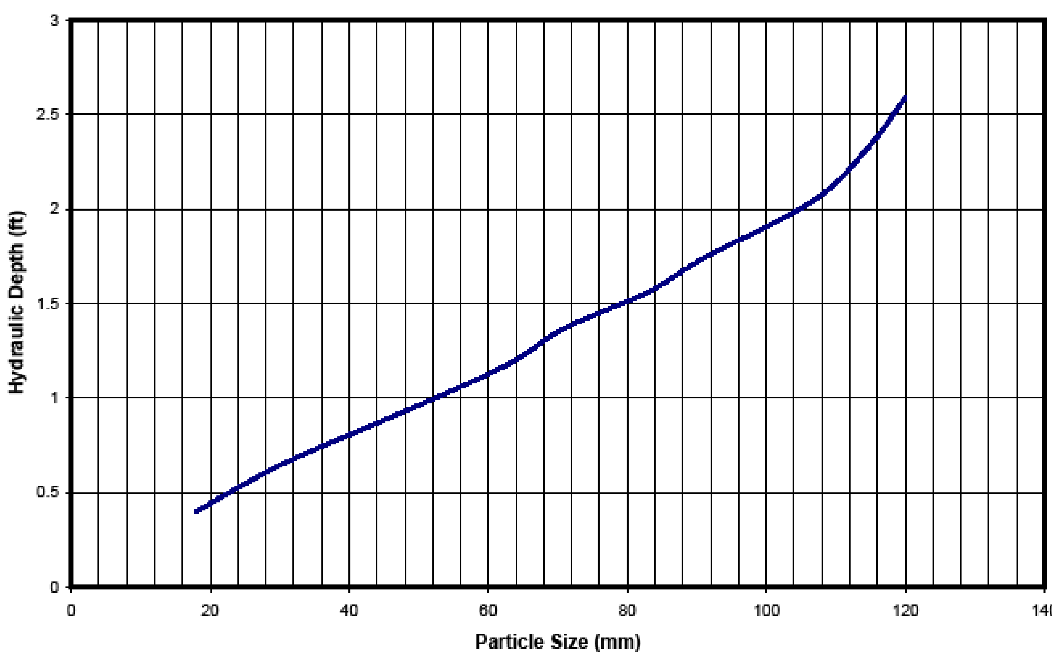
Sediment Transport

The channel cross section and longitudinal profile surveyed ~ 150' upstream of the Dog Park bridge were used to generate stage versus discharge and discharge versus moveable particle size relationships. These relationships are presented below. The bankfull discharge (*the flow that occurs, on average, every two out of three years*) is estimated to be ~ 200 cfs, corresponding to a depth of ~ 2.0' (see Hydraulic Depth versus Discharge plot below). The stage (hydraulic depth) versus discharge relationship provides some basic information on the hydraulic capacity of Lightner Creek for low to moderate flows. This relationship was then used to develop the stage (hydraulic depth) versus moveable particle size relationship. The mean slope at the Dog Park site is ~ 1.7%.

Lightner Creek - Hydraulic Depth vs Discharge



Lightner Creek - Hydraulic Depth vs Moveable Particle Size



The Hydraulic Depth versus Moveable Particle Size plot shows the size of particles predicted to move during a specific stage. Channel bed shear stress was calculated for various stages and converted to moveable particle size using the Shields Diagram.

Based on the above chart and the particle size distributions for all three sediment evaluation sites, it is clear that all the measured particle sizes are potentially moved during even relatively low discharge rates. This indicates that sediments discharging from the Tech Center and Perins Canyon watersheds or other source areas with similar particle distributions along Lower Lightner Creek are easily transported towards, if not to, the mouth of Lightner Creek during even modest runoff events. Assuming the bankfull discharge of ~ 200 cfs, large volumes of fine grain materials can be transported along the Lightner Creek channel and into the Animas River. Considering that ~ 25% of the sediments measured at the Tech Center site and ~ 12% of the sediments at the Perins Canyon site are silt size and finer, these two watersheds could be a significant source of fine textured sediments that are deposited at the mouth of Lightner Creek and also of silt and clay sediments that remain in suspension beyond the mouth of Lightner Creek. Not all of the sediments originating from these two source areas, or any other source area, necessarily make it to the Animas River in a given runoff event. Some settle out in back water areas, pools and in overbank areas. Sediments in these areas can easily be remobilized during subsequent runoff events.

Channel Stability, Bank Erosion & Contributing Watersheds

Nine sites were evaluated using the Channel Stability and Stream Classification Summary forms between the Dog Park bridge and the Wildcat Canyon-Lightner Creek confluence. Seven sites lie along Lightner Creek and one each in the Tech Center and Perins Canyon watersheds. These locations are shown on the various Watershed Evaluation Maps. The site name on the Maps corresponds with the name on the top of each Channel Stability and Stream Classification Summary form (in the Appendix). The number(s) of photographs corresponding to each evaluation site are noted at the bottom of each evaluation form.

The following table summarizes the overall findings at each evaluation site. It should be noted that the Location names used herein are strictly for geographical reference purposes only.

<u>Channel Stability Evaluation and Stream Classification Evaluation Summary</u>

Location	Sediment Supply	Stream Bed Stability	Stability Rating	Stream Type
Dog Park	High	Stable	Good	B3
Camper World	Very High	Stable	Poor	B3
Tech Center	High-Very High	Stable	Fair	B3
Upper Tech Center	Extreme	Aggrading	Poor	B5
Jiffy Lube	Extreme	Stable	Poor	B1/B5
Perins Canyon	Very High	Stable	Fair	B4
Lower Perins Canyon	Extreme	Aggrading	Poor	B5
Nissan Dealer	Very High	Stable	Poor	B3
Wildcat Canyon	Low-Moderate	Stable	Fair	B3

In general, the main stem of Lightner Creek between the Animas River and Wildcat Canyon has a low to moderate sediment supply due either to good vegetative cover or because the lower banks have been stabilized with rock. This reach is also considered to have a stable channel bed (e.g., it is not aggrading, downcutting or experiencing significant lateral migration). The B stream type implies the channel is relatively steep and has a very limited flood plain width relative to the overall channel width. The numbers following the B indicate dominant channel bed particle sizes (1 is bedrock, 3 is cobble, 4 is gravel, 5 is sand).

With the exception of the Dog Park and Wildcat Canyon sites, the locations listed above are sites in which a significant sediment source was identified. All listed locations lie along Lightner Creek except for Upper Tech Center (which is above the City's sedimentation basin) and Lowers Perins Canyon (which is the upstream end of the multifamily housing area). The Upper Tech Center and Lower Perins Canyon sites represent non-point sources (i.e., the watershed itself) while sites at Camper World, Jiffy Lube, Perins Canyon, and Nissan Dealer represent point sources due to bank instability issues. Each site is discussed below.

<u>Dog Park:</u> This reach's banks are stabilized with rock and therefore have low erosion potential during moderate to high runoff. The high sediment source rating is a result of the watershed above this point and not from local bank erosion. There are minimal shale deposits in this reach due to the lack of back water areas. Some shale deposits are present in flood plain areas (see Photos 3 and 4).

<u>Camper World:</u> Overly steep upper and lower channel banks along this reach provide little opportunity for soil-stabilizing vegetation to become established. Although most of this reach's banks appear to be comprised of non-shale fill material, most are not raw or

actively eroding. However, there are small areas that provide a sediment source during non-low flow events and intense rainfall events (see photos 5 and 6). The box culvert driveway immediately south of Highway 160 is filled with shale sediments as a result of upstream sources, a reduction in channel gradient, and an increase in channel width (see Photo 7).

<u>Tech Center:</u> This site was selected to document conditions in Lightner Creek immediately downstream of the Tech Center channel discharge point. There is a noticeable increase in shale present in the channel from the west end of Camper World to the Tech Center channel outfall. Back water areas and bar features contain moderate to large amounts of shale, especially immediately downstream of the Tech Center channel/Highway 160 box culvert (see Photos 8 -14). The sediment supply is considered to be extreme due to contributions from the Tech Center watershed (discussed further in Upper Tech Center). This indicates the Tech Center is a significant contributor of shale materials to Lightner Creek.

<u>Upper Tech Center:</u> The Upper Tech Center evaluation site is located above the City's sedimentation basin (see Photos 51 & 52). The sediment supply is considered to be extreme and simply the result of natural hillslope processes on highly erosive geologic materials (shale). The sedimentation basin appears to be a somewhat recent addition to the watershed. The inlet box contains a low and a high elevation inlet. An emergency spillway is also present. The basin's purpose appears to trap sediment and allow runoff water to enter a piped storm drain system at the downstream of a large concrete inlet box. A storm drain pipe extends from the inlet box southward for several hundred feet and discharges into a rock lined open channel between the lanes of Tech Center Drive (see Photo 47). This channel flows into a box culvert under Highway 160 and discharges into Lightner Creek just east of Jiffy Lube.

There are two problems with the present configuration of the sedimentation basin. The most significant is that there is a relatively large diameter opening at the bottom of the basin. The second issue is the apparent lack of grade control at the upstream end of the basin itself (see Photos 48 - 50). When runoff enters the basin, it is likely carrying high concentrations of shale sediments. Water and sediment immediately flow to this low elevation opening at the bottom of the basin and into the storm drain system. Once the outlet is overwhelmed with water and sediment, the low elevation inlet becomes buried and water either seeps through the sediments and into the low elevation opening or it builds up until it flows into the high elevation drop inlet structure.

The lack of grade control at the upstream end of the basin creates an overly steep slope on fine grained, highly erodible materials. This combination easily allows headcutting to occur which generates additional sediments into the basin, and potentially into the storm drain system and Lightner Creek.

Due to the high conveyance efficiency of this storm drain system and the open channel along Tech Center Drive, all but a few of the sediments that enter the system will be discharged to Lightner Creek.

Based on observations within the rest of the Tech Center development and its storm drain system, it appears this portion of the Tech Center watershed contributes relatively insignificant amounts of sediments to Lightner Creek. Based on the above observations, the Upper Tech Center watershed appears to be a significant contributor of shale material to Lightner Creek.

Jiffy Lube: Immediately upstream of the Tech Center watershed outfall, a significant but short term reduction in shale materials within Lightner Creek occurs (see Photo 15). Directly south of the Jiffy Lube commercial area is a large steep slope that forms the south bank of Lightner Creek. The eastern end of this slope is comprised of glacial materials (sandstone, etc.) while the balance of the slope is exposed shale bedrock (see Photos 16-22). This site is considered the largest, single point source area of eroding bank and shale along Lightner Creek. It is ~ 300 feet long and the slope is up to ~ 70 feet tall. Much of the Lightner Creek channel bed is shale bedrock through this reach although pool and back water areas are filled with loose shale materials. Good bank vegetation exists on the north channel bank. As seen in Photographs 18 and 21, the material is not very cohesive and is highly erodible. During moderate to high flows, the sediment production from this area is likely very high as a result of loose materials on the channel bed and from the base of the slope.

Although a reduction in shale occurs immediately upstream of this site, the flood plain areas, and to a lesser degree the channel, still contain large amounts of shale fragments (see Photos 23 & 24). This phenomenon continues to the next channel evaluation site (Perins Canyon). Upstream of Highway160 (at Rosemary Lane) to Perins Canyon, the channel is stable with good vegetation. There is opportunity for sediment storage in this reach during overbank events due to good vegetation and some flood plain feature development.

Perins Canyon: This site is located on Lightner Creek just downstream from the Perins Canyon watershed outfall culvert. A 3 foot high by 150 foot long bar comprised of mostly shale material has formed along the south bank of Lightner Creek bank opposite the Perins Canyon culvert. This material can easily be mobilized during moderate to high flows from either Lightner Creek or Perins Creek. This feature is likely a moderate to large sediment source (see Photos 25-27). Downstream of this site, the channel appears to be slightly steeper and as a result, there is less shale material in the channel, except in pools and backwater areas. Flood plain soils contain large amounts of shale materials.

The prominent bar at the Perins Canyon culvert along with the fact that no other feature of this size exists on Lightner Creek provides strong evidence that Perins Canyon watershed is a significant source of shale materials. Immediately upstream of the Perins Canyon Road bridge, there is a noticeable reduction in shale material within Lightner Creek itself but adjoining flood plain areas still contain noticeable amounts of shale.

Lower Perins Canyon: The Lower Perins Canyon site was chosen to characterize the relatively undisturbed condition of the Perins Canyon channel (Photo 54). Between this site and Lightner Creek, the channel has been altered to accommodate roads and multifamily housing (Photo 53). Above this site to the end of the road, there are low density single family residences within the valley bottom. Land use modifications associated these residences include culverts for driveways and channel encroachments to accommodate garages, storage areas, etc. (Photos 55-58). The end of the road is at the dashed sub watershed boundary shown on the Watershed Evaluation: Perins Canyon & Tech Center map. Although access was not pursued above the end of the road, it is assumed the upper watershed is in its natural condition and dominated by steep shale slopes.

The channel evaluation site consists of almost all shale material. Shale is at least 90% to 95% of the material visible in the channel, on flood plains, on terraces and, on hillsides. Considering 1) shale covers the vast majority of the watershed,

2) development lies within the valley bottom close to the channel, 3) those developments have altered the shape of the channel along with reductions in flood plain areas, and 4) the watershed is relatively large (~ 448 acres), it is clear why the Perins Canyon watershed is a significant source of sediment, particularly shale, to Lightner Creek.

An estimated 80%+ of Perins Canyon watershed is undisturbed and erosion within the watershed is simply very high to extreme due to natural processes. Therefore it is likely that a high percentage of sediment volumes discharging from the watershed are a result of natural processes. However, land use modifications have increased that sediment yield to some degree. It is unlikely that correcting or eliminating those land use modification impacts will result in a significant decrease in sediment delivery to Lightner Creek.

<u>Perins Canyon to Nissan Dealer:</u> (no channel evaluation forms completed) Between Perins Canyon Road and Bob's Truck Repair, the channel contains minimal shale material but is present in some back water areas (Photos 28-30). However, some flood plains within this reach contain moderate to large amounts of shale material (Photo 31). There are two small inflow channels that originate in shale dominated watersheds to the north. One channel exists on the east side of Animas Storage and the other is on the west side of Bob's Truck Repair (see Watershed Evaluation maps).

Buck Skillen provided a photograph (Photo 33, taken in March 2009) showing the drainage at Bob's Truck Repair with a significant accumulation of sediment that appears to be shale. Photo 32, taken in October 2009 at the same location, shows no perceptible evidence of sediment originating from this source. This is probably because high flows in Lightner Creek removed all but the coarsest of materials. Access to the watersheds on the north side of these two drainages was not pursued in order to assess present-day land use modifications and soils. Project aerial photography indicates that significant regrading has occurred directly north of these businesses but it is unclear if any drainage and erosion control improvements have been made.

<u>Nissan Dealer:</u> From the Exxon Station to the Nissan Dealer, Lightner Creek lies on the south side of Highway 160. Its south bank is formed by another steep slope similar to the one at the Jiffy Lube site. Although the channel evaluation site was performed south of the Nissan Dealer, its results are generally applicable to the two other sites south of the Exxon Station. The eroding bank behind the Nissan Dealer is comprised of glacial materials and not shale. The other two sites just downstream are comprised of shale. The Nissan Dealer site is ~ 350' long, the next downstream site is ~ 130' long and the one directly south of the Exxon Station is ~ 250' long. These three sites are relatively small in size but appear to be a significant sediment source for Lightner Creek.

<u>Nissan Dealer to Wildcat Canyon:</u> (no channel evaluation forms completed) Just upstream of the Nissan Dealer site, a small box culvert under Highway 160 drains the Colorado Department of Transportation (CDOT) facility and the ~ 250 acre watershed area north of the facility. Inspections at this culvert indicate shale is the dominate material discharging from the culvert (Photo 39). Although shale deposits were evident in Lightner Creek at the culvert outlet, the amount of sediment discharging from the culvert appears to be minor based on the lack of shale materials observed in the area of

the Nissan Dealer site. It is assumed that CDOT has implemented some level of drainage and erosion control but this could be verified as access to the CDOT facility or its watershed was not pursued. <u>This site is the farthest upstream location in which shale materials are encountered.</u>

Channel inspections where Lightner Creek crosses from the north to the south side of Highway 160, at Lightner Creek Village, found little evidence of shale material (Photo 40) despite digging into bars and flood plain areas. If present, it represented less than 5% of the material present and was very small. The material at this location was slightly coarser than channel bed materials found in downstream reaches suggesting a change in dominant geologic composition and-or channel gradient.

From this location upstream to Wildcat Canyon, Lightner Creek lies on the north side of Highway 160. Despite having relatively steep upper and lower channel banks, there is good vegetative cover (willows) and some rock lining to protect the banks from significant erosion.

<u>Wildcat Canyon:</u> The channel evaluation site, located ~ 150' downstream from the Wildcat Canyon-Highway 160 box culvert shows good vegetative cover on the banks with a moderate amounts of very fine, brown sediments and organic detritus on the channel bed (Photos 41-42). No shale material was found despite digging into flood plain areas. Soils within the flood plain areas were brown (Photos 43 & 46). By contrast, soils within flood plains containing even moderate amounts of shale are much grayer in color. This characteristic, along with the lack of shale within the channel itself, are used to conclude that the most significant sources of coarse shale sediments lie downstream of the Lightner Creek-Wildcat Canyon confluence. For this reason, no additional sampling was performed upstream of this site.

Fines present within the box culvert draining Wildcat Canyon and the amount of highway "sands" along the shoulder and on the slopes of the grouted rock face abutting the box culvert suggest these two sources could be the primary contributors of fines show in Photos 41 and 42. However, no evidence was encountered that suggests either source is a large contributor of sediments. No depositional features were present in the channel except immediately adjacent to the box culvert.

<u>Lightner Creek above Wildcat Canyon:</u> (no channel evaluation forms completed) The Lightner Creek channel was waded from County Road 207 downstream to Wildcat Liquors approximately two months prior to this investigation for a separate project. As a result of that inspection, no significant areas of bank erosion or channel instability were encountered. The reach has good vegetative growth along the channel and good flood plain features to accommodate overbank flows (and sediment). No signs of shale were encountered during the inspection. This finding supports observations at Wildcat Canyon that the primary shale sources for Lightner Creek lie downstream of the Wildcat Canyon-Lightner Creek confluence.

Sediment Source Summary

The following provides a summary of each channel evaluation site and identified sediment source area. The table indicates the cause(s) of sediment based on 1) channel instability or channel modification, 2) hill slope instability, 3) land use modifications and-or 4) naturally high sediment yield watershed. Each site's source area is provided, along with material type (shale or non-shale), and perceived sediment yield rating (Low, Moderate or High).

Sediment Source Summary Table

Location	Cause(s) of Sediment: Channel Instability-Modific.	Hill Slope Instabil.	Land Modific.	High Sediment Watershed	Source Area	Material Type	Sediment Yield
Camper World			X		300 ft	non-shale	Low
Upper Tech Center				X	300 ft	shale	High
Jiffy Lube Hill Slope		X			300 ft	shale	High
Perins Canyon Watershed				X	448 ac	shale	High
Perins Canyon channel bar				X	150 ft	shale	Mod.
Bob's Trucking Watershed	-		X ?	X ?	37 ac	shale	Mod.?
Exxon-Nissan Hill Slope	X ?	X			680'	shale/non-shale	High
CDOT Watershed			X ?	X ?	253 ac	shale/non-shale	Mod.?

CONCLUSIONS

The primary purpose of this first phase of the Lightner Creek watershed evaluation was to determine sediment source areas that have lead to the depositional feature in Lightner Creek at its confluence with the Animas River. Since the majority of this sediment was shale and of measurable size (i.e., not silt and clay), the focus was to locate source areas contributing these sediments. Based on particle size analyses conducted for this study, the identified source areas may also be a significant source of silts and clays, which can remain in suspension (causing turbidity) well beyond the Lightner Creek – Animas River confluence.

Sediment particle sizes and their geologic type that are deposited at the mouth of Lightner Creek were documented for this study. The materials being deposited are mostly shale and are relatively small (mean size of 2mm). Since the Tech Center and Perins Canyon are dominated by shale, sediment particle sizes within the channels of these two watersheds were also documented. The channel cross section analysis performed near the Dog Park bridge documents Lightner Creek's stage versus discharges and stage versus moveable particle size relationships. Based on these relationships and the size of particles measured at the three sediment evaluation sites, Lightner Creek is capable of moving all the sizes measured, and larger.

Channel inspections progressing upstream from the Animas River to Wildcat Canyon (and beyond) determined that there are significant shale source areas within the lower Lightner Creek watershed. Two significant source areas are considered to be non-point (i.e., watersheds) and five are considered to be point source (i.e., eroding banks) along Lightner Creek. Three smaller, potential non-point source areas (Animas Storage, Bob's Truck Repair and CDOT) were identified but since access to these watersheds was not pursued, it is unclear what their contributions are.

Source Area Sediment Production Rankings

Based on field observations performed in October and November 2009 by Basin Hydrology and considering the size of the source areas, the following sites and watershed areas are ranked 1 through 5 with 1 contributing the largest amount of sediment, 2 the second largest contributor, etc. Sites discussed above but not listed below are considered to be relatively insignificant sources of sediments.

1. Perins Canyon watershed
2. Tech Center watershed (above sedimentation basin)
3. Jiffy Lube hill slope
4. Exxon Station – Nissan Dealer hill slopes
5. CDOT watershed
6. In-channel bar at Perins Canyon culvert
7. Bob's Truck Repair watershed

Source Area Stabilization Prescriptions

For each of the above source areas, measures for reducing sediment are provided. Some measures can be implemented immediately while others will require additional steps such as obtaining property access, site surveys, design, and U.S. Army Corps of Engineers permitting.

<u>Perins Canyon:</u> Options for reducing the sediment load from Perins Canyon will be difficult due to the size and geologic composition of the watershed. Measures could include:

- Identify which properties have land use modifications that are creating or exacerbating erosion and drainage problems,
- Work with landowners to implement corrective measures through financial assistance and-or code enforcement,
- Obtain land in the very downstream portion of the watershed in which a sedimentation basin can be constructed AND maintained. This will require land acquisition, site design and a <u>*perpetual obligation*</u> to remove sediments on a <u>*routine basis*</u>.

<u>Tech Center:</u> (City sedimentation basin) Modification of the existing sedimentation is required to improve its sediment retention capabilities. These include:

- Connect a vertical stand pipe to the low elevation outlet that extends up to an elevation near the elevation of the drop inlet. A few, thin slots could be cut into the stand pipe to facilitate slow drainage of water.
- Alternatively, simply plug the low elevation drain hole on the uphill side of the outlet structure.

- Install a large rock or concrete grade control structure system around the inlet side of the sediment basin to prevent headcutting.

Jiffy Lube Hill Slope: Due to the height of this eroding hill slope, the only practical solution is to protect toe of the hill from being eroding during moderate to high flows. Stabilizations measures would include:

- Constructing a stacked rock wall ~ 4'-5' high along toe of the hill slope for the length of the unstable bank,

- Excavate into the shale bedrock to construct a flood plain-bankfull bench feature that could be topsoiled and planted with willows and other wetland-riparian vegetation to provide a buffer between the channel and the slope.

Exxon Station – Nissan Dealer Hill Slopes: Similar to the Jiffy Lube site, the height of the eroding hill slope reduces the potential for stabilization measures. Implementation of measures presented at the Jiffy Lube site would also be suitable for this site.

CDOT Watershed: Until is known that this watershed is a significant source of sediment, and what type of drainage or sedimentation control facilities are present (or absent), no stabilization prescriptions can be provided. The next step for this site is to obtain permission to access the area and document conditions and existing control measures. Once these conditions are known, then stabilization recommendations can be proposed.

In-Channel Bar at Perins Canyon Culvert:

- Excavate the sediment bar present in the channel.

Bob's Truck Repair Watershed: Until is known that this watershed is a significant source of sediment, and what type of drainage or sedimentation control facilities are present (or absent), no stabilization prescriptions can be provided. The next step for this site is to obtain permission to access the area and document conditions and existing control measures. Once these conditions are known, then stabilization recommendations can be proposed.

Source Area Rankings – Priority for Stabilization

Using the above source area sediment production rankings and potential source area stabilization prescriptions, the following site priority rankings for implementing stabilization measures is proposed. Rankings are based on their potential stabilization design and construction costs, effectiveness of stabilization, simplicity of stabilization implementation, and site access. The ***HIGH*** or ***MEDIUM*** ranking following each site corresponds with the color coding for each area shown on the Sediment Source Priorities & Proposed Sampling Sites map.

1. Remove In-channel bar at Perins Canyon culvert. (***HIGH***)
2. Modify the City's sedimentation basin inlet structure. (***HIGH***)
3. Evaluate options for reducing (capturing) sediments from Perins Canyon. (***HIGH***)
4. Jiffy Lube hill slope. (***HIGH***)
5. Exxon Station – Nissan Dealer hill slopes. (***MEDIUM***)

6. Evaluate watershed conditions at CDOT and Bob's Truck Repair. Development a stabilization plan, as needed. (***MEDIUM***)

RECOMMENDATIONS

Prior to implementing any of the above stabilization measures (except perhaps the first two times), it is recommended that the following water quality program be implemented during the 2010 spring snowmelt and summer monsoon runoff seasons. The purpose of this monitoring program is to document turbidity sources in Lightner Creek. The study completed to-date focused primarily on coarse sediment sources. The proposed 2010 monitoring plan could identify source areas that are contributing significantly to turbidity levels but are not a significant source of coarse sediments. Once information from this monitoring program is evaluated, there may be the need to perform additional field surveys to determine specific source areas and causes of observed turbidity levels. Those findings may result in a modification of the above Priority for Stabilization list.

Proposed Water Quality Monitoring

The following is a list of the proposed sampling sites. The Sediment Source Priorities & Proposed Sampling Sites map shows the location of each proposed sample site, except for those upstream of the Highway 160 – County Road 207 (Lightner Creek Road) intersection.

- Lightner Creek at the Animas River
- Lightner Creek below Tech Center outfall culvert
- Tech Center Channel North of Highway 160 culvert
- Lightner Creek at Highway 160 at Rosemay Lane
- Perins Canyon outfall culvert
- Lightner Creek above Perins Canyon outfall culvert (below Bob's Truck Repair)
- Lightner Creek below Exxon Station (above Bob's Truck Repair)
- Lightner Creek above CDOT culvert (Lightner Creek Village?)
- Lightner Creek below Wildcat Canyon-Highway 160 culvert
- Lightner Creek above Wildcat Canyon-Highway 160 culvert
- Lightner Creek at 1st bridge on CR 207 north of Highway 160
- Dry Fork at CR 207
- Lightner Creek above Dry Fork along CR 207 (sample site TBD)
- Lightner Creek near old fish hatchery along CR 207 (sample site TBD)

At each established sample site, a grab sample would be obtained. A photograph of the site emphasizing the turbidity-clarity of the water at the time of collection should also be taken. Sample location, date, time, photograph number and the person collecting the sample should be recorded. The sample site and date should be recorded on the jars. Samples should be taken every 5-7 days during the snowmelt runoff period and all sample sites should be sampled as close together in time as is feasible. The date a tributary dries up, or a sample can no longer be obtained, should also be noted including a photograph of the channel bed at the established sample site.

Sampling during the monsoon season is more difficult to plan for but ideally, sampling would occur after rainfall durations or intensities generate runoff in the more ephemeral channels. The same sample areas and sampling techniques would be used during monsoon sampling as during the snowmelt sampling period.

Ideally, the sample will sit undisturbed long enough (~ 3-5 days) to allow the sediments to settle to the bottom of the jar. The depth of sediment in each jar will be determined and recorded. Alternatively, the sample could be dried and the weight of each sample determined. Whatever the method, the goal is to provide a relative index of the amount of sediments present at each sample site during the course of the runoff season.

The color of sediment in each sample can also be evaluated. Sediments from various samples can be examined under a microscope to determine their geologic make-up. This information can be used to help identify the source area by geologic type. This same examination may also be used to evaluate the relative distribution of shale and non-shale particles within the samples.

The Next Step

The following is a list of activities that should be completed in order to complete the first phase of the Lightner Creek watershed evaluation.

- Collect water quality data in 2010, through at least the snowmelt season and summarize the findings,
- Perform additional field evaluations in the summer of 2010 to determine the source(s) and cause(s) of high turbidity (if warranted based on 2010 water quality data),
- Evaluate Bob's Truck Repair and CDOT watersheds to document sediment sources and existing control measures (or the lack thereof), and
- Update this Report and its Recommendations to include the above findings.

By updating this Report with the findings from the water quality sampling and the watershed evaluations, the existing baseline conditions of the watershed will be documented. With this information, the watershed group can determine how to proceed with the second phase.

The second phase would include the development of alternatives, costs, construction plans, permits, etc. for recommendations identified in the final Phase 1 Report. Activities that could be considered now may include:

- construction plans for modifying the City's sediment basin,
- field surveys, alternatives and plans for addressing the Jiffy Lube site,
- identifying specific adverse land use issues in the lower Perins Creek watershed that can be addressed through stabilization measures or code enforcement, and
- alternatives, negotiations and surveys to determine the feasibility of a sediment basin in lower Perins Canyon near Lightner Creek.

Lightner Creek Watershed Assessment
Photographic Documentation
(October 25-27, 2009)

Photo 1. Lightner Creek at Animas River (sediment particle size analysis site).

Photo 2. Depositional material in Lightner Creek at the Animas River.

Photo 3. Downstream view of channel cross section site and channel stability evaluation site (~ 150' upstream of Dog Park Bridge).

Photo 4. Channel bed at channel cross section site contains no significant amounts of shale materials.

Camper World Reach

Photo 5. Upstream view at Camper World channel stability evaluation site.

Photo 6. Upstream view, just upstream of Camper World evaluation site.

Photo 7. Depositional material (shale) in box culvert at Camper World entrance.

Downstream of Tech Center/Highway 160 Culvert

Photo 8. Upstream view of channel ~ 100' downstream of Tech Center culvert at channel stability evaluation site.

Photo 9. Typical bar material - shale (dominated by medium gravels and finer).

Photo 10. Typical “slack water” channel bed material - shale (fine gravels and sands).

Tech Center Outfall at Highway 160 Culvert

Photo 11. Lightner Creek at Tech Center culvert outfall structure.

Photo 12. Lightner Creek channel bed at culvert outfall structure (predominately shale).

Photo 13. Depositional area at culvert outlet (predominately shale).

Photo 14. Close up of depositional material at culvert outlet.

Tech Center Outfall to Rosemary Lane/Highway 160 Culvert

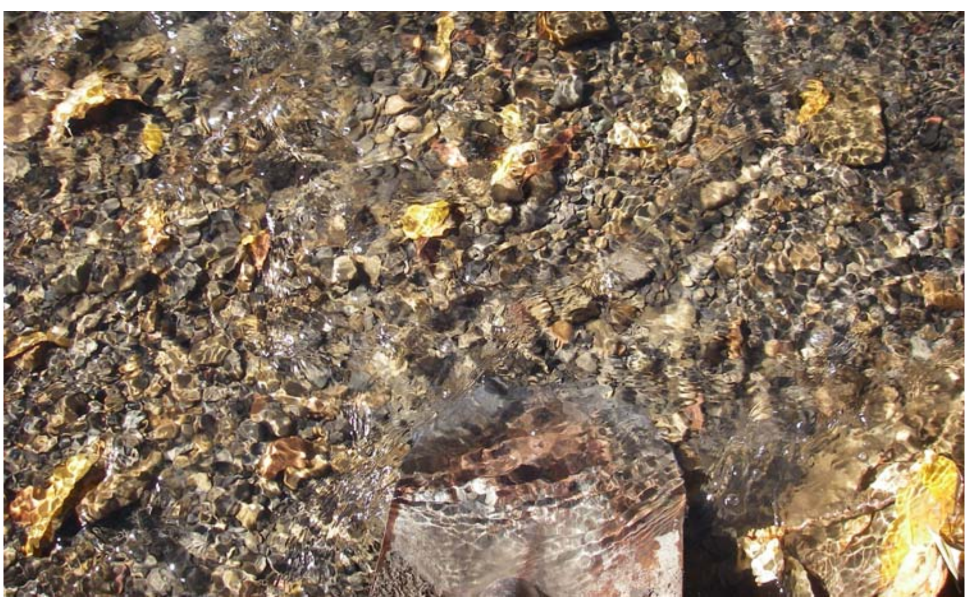


Photo 15. Channel bed ~ 100' upstream of Tech Center outfall (~30-40% reduction in shale material).


Photo 16. Upstream view of channel & eroding bank south of Jiffy Lube.


Photo 17. Upstream view of eroding colluvium bank south of Jiffy Lube.


Photo 18. Close up of eroding colluvium bank south of Jiffy Lube.


Photo 19. Large eroding shale slope immediately upstream of colluvium bank.


Photo 20. Channel at upstream end of large eroding shale slope (channel stability evaluation site).

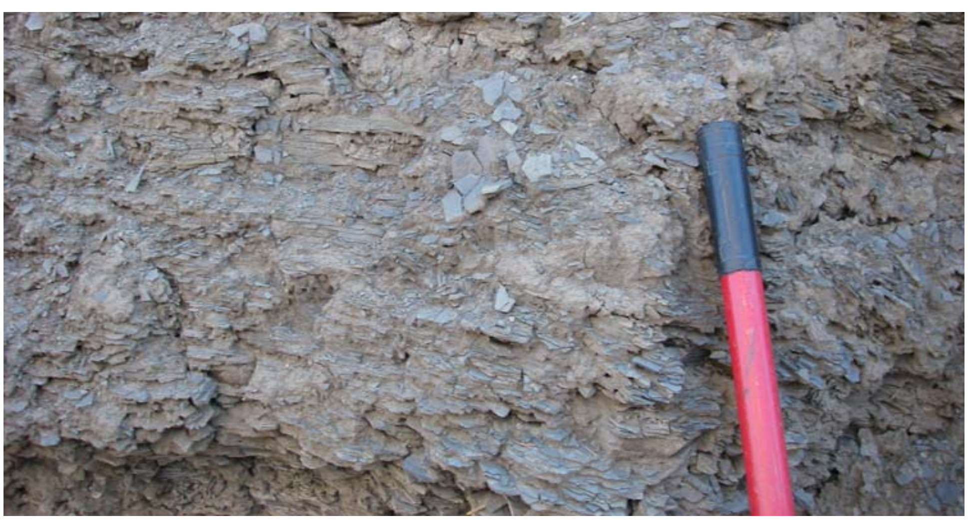


Photo 21. Close up of eroding shale slope south of Jiffy Lube.

Photo 22. Channel bed composition (shale), where not bedrock, along shale slope.

Photo 23. Upstream view of stable reach downstream of Hwy. 160 culvert at Rosemary Lane.

Photo 24. Bar materials (predominately shale) at Photo 23.

Perins Canyon at Highway 160

Photo 25. Downstream view of Lightner Creek ~ 300’ downstream of Perins Canyon at channel stability evaluation site.

Photo 26. Downstream view of Lightner Creek at Perins Canyon outfall culvert.

Photo 27. Composition (shale) of depositional features at Perins Canyon culvert.

Perins Canyon Upstream to Bob's Truck Repair/Hwy 160 Culvert

Photo 28. Upstream view ~ 100' upstream of Perins Canyon Road.

Photo 29. Bar composition ~ 100' upstream of Perins Canyon Road contains significantly less surfacial shale material.

Photo 30. Downstream view ~ 70' downstream of Bob's Truck Repair access bridge.

Photo 31. Bar composition (predominately shale) at Photo 30 at Photo 30.

Photo 32. Downstream end of Hwy 160 culvert. Confluence of Lightner Creek and small ephemeral channel along the west side of Bob's Truck Repair property.

Photo 33. Same photo location as Photo 32 except this photo was taken on March 4, 2009. Note large shale deposition area present here but missing in Photo 32.

Bob's Truck Repair/Hwy 160 Culvert to Wildcat Canyon

Photo 34. Upstream view of stable channel reach south of the Exxon station.

Photo 35. Upstream view of a steep shale slope south of the Exxon station.

Photo 36. Downstream view of channel at channel stability evaluation site, south of Nissan dealer.

Photo 37. Downstream view of south eroding colluvium bank at channel stability evaluation site, south of Nissan dealer.

Photo 38. Bar south of Nissan dealer containing ~ 20% shale material. This site is above shale source areas identified in Photos 35 but below Photo 39.

Photo 39. Lightner Creek at the downstream end of the Hwy 160/CDOT maintenance yard culvert contains predominately shale material.

Photo 40. Depositional material at Lightner Creek Village/Hwy 160 culvert outlet contains no apparent shale material.

Photo 41. Downstream view at channel stability evaluation site (~ 150' downstream of Wildcat Canyon - Lightner Creek confluence).

Photo 42. Channel bed with lots of fines at Wildcat Canyon – Lightner Creek confluence channel stability evaluation site.

Photo 43. Flood plain materials (non-shale) at Wildcat Canyon – Lightner Creek confluence channel stability evaluation site.

Photo 44. Depositional material at outlet of Wildcat Canyon/Hwy 160 culvert (no shale material apparent).

Photo 45. Upstream view of Wildcat Canyon/Hwy 160 culvert outlet (lots of fines with no shale material apparent).


Photo 46. Brown flood plain materials (sand & sandstone) at Wildcat Canyon/Hwy 160 culvert.


Photo 47. Upstream view of armored Tech Center channel along Tech Center Drive.


Photo 48. Downstream view of City sedimentation basin with low-elevation culvert outlet, high-elevation large capacity outlet and overflow spillway.


Photo 49. Upstream view from City sedimentation basin outlet structure.

Photo 50. Upstream view from sedimentation basin showing road and slope sediment sources areas.

Photo 51. Downstream view of channel stability evaluation and particle size analysis site ~ 300’ upstream of City sedimentation basin.

Photo 52. Upstream view at channel stability evaluation and particle size analysis site.
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Photo 53. Upstream view of constructed channel with grade control structures ~ 300' upstream from Lightner Creek confluence (opposite Westwood Apartments).

Photo 54. Upstream view of Perins Canyon channel at downstream end of single family residential area and at channel stability and sediment size analysis site. At least 95% shale composition.

Photo 55. Point-source for erosion due to headcutting (probably due to drainage modifications).

Photo 56. Downstream view below driveway culvert showing highly incised channel due to excavation and berming activities (> 95% shale).

Photo 57. Downstream view showing highly incised channel due to excavation and berming activities (> 95% shale).

Photo 58. Upstream view showing highly incised channel due to excavation and berming activities (> 95% shale).

– DOG PARK –

CHANNEL STABILITY (PFANKUCH) EVALUATION AND STREAM CLASSIFICATION SUMMARY (LEVEL III)

Reach Location Lightner Ck ~ 300' ABV. MOUTH Date 10/27/09 Observers TMO

Stream Type B3c

Category			EXCELLENT	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient <30%	2
	2	Mass Wasting	No evidence of past or future mass wasting.	3
	3	Debris Jam Potential	Essentially absent from immediate channel area.	2
	4	Vegetative Bank Protection	90%+ plant density. Vigor and variety suggest a deep dense soil binding root mass.	3
LOWER BANKS	5	Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1
	6	Bank Rock Content	65%+ with large angular boulders. 12"+ common.	2
	7	Obstructions to Flow	Rocks and logs firmly imbedded. Flow pattern without cutting or deposition. Stable bed.	2
	8	Cutting	Little or none. Infreq. raw banks less than 6".	4
	9	Deposition	Little or no enlargement of channel or pt. bars.	4
BOTTOM	10	Rock Angularity	Sharp edges and corners. Plane surfaces rough.	1
	11	Brightness	Surfaces dull, dark or stained. Gen. not bright.	1
	12	Consolidation of Particles	Assorted sizes tightly packed or overlapping.	2
	13	Bottom Size Distribution	No size change evident. Stable mater. 80-100%	4
	14	Scouring and Deposition	<5% of bottom affected by scour or deposition.	6
	15	Aquatic Vegetation	Abundant Growth moss-like, dark green perennial. In swift water too.	1
			TOTAL	

Category			GOOD	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient 30-40%	4
	2	Mass Wasting	Infrequent. Mostly healed over. Low future potential.	6
	3	Debris Jam Potential	Present, but mostly small twigs and limbs.	4
	4	Vegetative Bank Protection	70-90% density. Fewer species or less vigor suggest less dense or deep root mass.	6
LOWER BANKS	5	Channel Capacity	Adequate. Bank overflows rare. W/D ratio 8-15	2
	6	Bank Rock Content	40-65%. Mostly small boulders to cobbles 6-12"	4
	7	Obstructions to Flow	Some present causing erosive cross currents and minor pool filling. Obstructions newer and less firm.	~~4~~ 3
	8	Cutting	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12"	6
	9	Deposition	Some new bar increase, mostly from coarse gravel.	8
BOTTOM	10	Rock Angularity	Rounded corners and edges, surfaces smooth, flat.	2
	11	Brightness	Mostly dull, but may have <35% bright surfaces.	2
	12	Consolidation of Particles	Moderately packed with some overlapping.	4
	13	Bottom Size Distribution	Distribution shift light. Stable material 50-80%.	8
	14	Scouring and Deposition	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12
	15	Aquatic Vegetation	Common. Algae forms in low velocity and pool areas. Moss here too.	2
			TOTAL	

Category			FAIR	
UPPER BANKS	1	Landform Slope	Bank slope gradient 40-60%	6
	2	Mass Wasting	Frequent or large, causing sediment nearly year long.	9
	3	Debris Jam Potential	Moderate to heavy amounts, mostly larger sizes.	6
	4	Vegetative Bank Protection	<50-70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9
LOWER BANKS	5	Channel Capacity	Barely contains present peaks. Occasional overbank floods. W/D ratio 15 to 25.	3
	6	Bank Rock Content	20-40% with most in the 3-6" diameter class.	6
	7	Obstructions to Flow	Moder. frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6
	8	Cutting	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	12
	9	Deposition	Moder. deposition of new gravel and course sand on old and some new bars.	12
BOTTOM	10	Rock Angularity	Corners and edges well rounded in two dimensions.	3
	11	Brightness	Mixture dull and bright, ie 35-65% mixture range.	3
	12	Consolidation of Particles	Mostly loose assortment with no apparent overlap.	~~6~~ 5
	13	Bottom Size Distribution	Moder. change in sizes. Stable materials 20-50%	~~12~~ 10
	14	Scouring and Deposition	30-50% affected. Deposits & scour at obstructions, constrictions, and bends. Some filling of pools.	18
	15	Aquatic Vegetation	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3
			TOTAL	

FIELD PHOTOS 7042-45

REPORT PHOTOS 3-4

CHANNEL STABILITY (PFANKUCH) EVALUATION AND STREAM CLASSIFICATION SUMMARY (LEVEL III)

	Category	POOR	
UPPER BANKS	1 Landform Slope	Bank Slope Gradient 60%+	8
	2 Mass Wasting	Frequent or large causing sediment nearly year long or imminent danger of same.	12
	3 Debris Jam Potential	Moder. to heavy amounts, predom. larger sizes.	8
	4 Vegetative Bank Protection	<50% density, fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
LOWER BANKS	5 Channel Capacity	Inadequate. Overbank flows common. W/D ratio >25	4
	6 Bank Rock Content	<20% rock fragments of gravel sizes, 1-3" or less.	8
	7 Obstructions to Flow	Sediment traps full, channel migration occurring.	
	8 Cutting	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9 Deposition	Extensive deposits of predom. fine particles. Accelerated bar development.	16
BOTTOM	10 Rock Angularity	Well rounded in all dimensions, surfaces smooth.	4
	11 Brightness	Predom. bright, 65%+ exposed or scoured surfaces.	4
	12 Consolidation of Particles	No packing evident. Loose assortment easily moved.	8
	13 Bottom Size Distribution	Marked distribution change. Stable materials 0-20%.	16
	14 Scouring and Deposition	More than 50% of the bottom in a state of flux or change nearly year long.	24
	15 Aquatic Vegetation	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
		TOTAL	

Bkf Stream Width 17 x avg. depth 1.35 x mean velocity ______ = Q ______ cfs

Gauge Ht ______ Reach Gradient 0.017 Ft/Ft Stream Order ______ Sinuosity Ratio ______

Width bkf 17 Depth bkf 1.35 W/D Ratio 13 Discharge (Q_{bkf}) ______

Drainage Area ______ Valley Gradient ______ Stream Length ______ Valley Length ______

Sinuosity ______ Entrenchment Ratio ______ Length Meander (Lm) ______ Belt Width ______

Sediment Supply
Extreme ______
Very High ✓
High ✓
Moderate ______
Low ______

Stream Bed Stability
Aggrading ______
Degrading ✓
Stable ✓

Width/Depth Ratio Condition
Normal ✓
High ______
Very High ______

Stream Type: B3c

TOTAL SCORE for Reach E 7 + G 25 + F 21 + P 4 = 57 Pfankuch Rating

Remarks ______

from table: GOOD Reach Condition

CONVERSION OF STABILITY RATING TO REACH CONDITION BY STREAM TYPE*

Stream Type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6
GOOD	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60
FAIR	44-47	44-47	91-129	96-132	96-142	81-110	46-58	46-58	61-78	65-84	69-88	61-78
POOR	48+	48+	130+	133+	143+	111+	59+	59+	79+	85+	89+	79+
Stream Type	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**D3**	**D4**	**D5**	**D6**		
GOOD	38-50	38-50	60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98		
FAIR	51-61	51-61	86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125		
POOR	62+	62+	106+	111+	111+	106+	133+	133+	133+	126+		
Stream Type	**DA3**	**DA4**	**DA5**	**DA6**	**E3**	**E4**	**E5**	**E6**				
GOOD	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63				
FAIR	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86				
POOR	87+	87+	87+	87+	87+	97+	97+	87+				
Stream Type	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	**G1**	**G2**	**G3**	**G4**	**G5**	**G6**
GOOD	60-85	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107
FAIR	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120
POOR	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+

Generalized relations ... need additional Level IV data to expand data base for validation.

— CAMPERWORLD —

CHANNEL STABILITY (PFANKUCH) EVALUATION
AND STREAM CLASSIFICATION SUMMARY (LEVEL III)

LIGHTNER CRK

Reach Location E. End of Camper World Date 10/25/09 Observers TMO

Stream Type B3

		Category	EXCELLENT	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient <30%	2
	2	Mass Wasting	No evidence of past or future mass wasting.	3
	3	Debris Jam Potential	Essentially absent from immediate channel area.	2
	4	Vegetative Bank Protection	90%+ plant density. Vigor and variety suggest a deep dense soil binding root mass.	3
LOWER BANKS	5	Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1
	6	Bank Rock Content	65%+ with large angular boulders. 12"+ common.	2
	7	Obstructions to Flow	Rocks and logs firmly imbedded. Flow pattern without cutting or deposition. Stable bed.	2
	8	Cutting	Little or none. Infreq. raw banks less than 6".	4
	9	Deposition	Little or no enlargement of channel or pt. bars.	4
BOTTOM	10	Rock Angularity	Sharp edges and corners. Plane surfaces rough.	1
	11	Brightness	Surfaces dull, dark or stained. Gen. not bright.	1
	12	Consolidation of Particles	Assorted sizes tightly packed or overlapping.	2
	13	Bottom Size Distribution	No size change evident. Stable mater. 80-100%	4
	14	Scouring and Deposition	<5% of bottom affected by scour or deposition.	6
	15	Aquatic Vegetation	Abundant Growth moss-like, dark green perennial. In swift water too.	1
			TOTAL	

		Category	GOOD	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient 30-40%	4
	2	Mass Wasting	Infrequent. Mostly healed over. Low future potential.	6
	3	Debris Jam Potential	Present, but mostly small twigs and limbs.	4
	4	Vegetative Bank Protection	70-90% density. Fewer species or less vigor suggest less dense or deep root mass.	6
LOWER BANKS	5	Channel Capacity	Adequate. Bank overflows rare. W/D ratio 8-15	2
	6	Bank Rock Content	40-65%. Mostly small boulders to cobbles 6-12"	4
	7	Obstructions to Flow	Some present causing erosive cross currents and minor pool. filling. Obstructions newer and less firm.	~~4~~ 3
	8	Cutting	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12"	~~6~~ 5
	9	Deposition	Some new bar increase, mostly from coarse gravel.	8
BOTTOM	10	Rock Angularity	Rounded corners and edges, surfaces smooth, flat.	2
	11	Brightness	Mostly dull, but may have <35% bright surfaces.	2
	12	Consolidation of Particles	Moderately packed with some overlapping.	4
	13	Bottom Size Distribution	Distribution shift light. Stable material 50-80%.	8
	14	Scouring and Deposition	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12
	15	Aquatic Vegetation	Common. Algae forms in low velocity and pool areas. Moss here too.	2
			TOTAL	

		Category	FAIR	
UPPER BANKS	1	Landform Slope	Bank slope gradient 40-60%	6
	2	Mass Wasting	Frequent or large, causing sediment nearly year long.	~~8~~ 8
	3	Debris Jam Potential	Moderate to heavy amounts, mostly larger sizes.	~~6~~ 5
	4	Vegetative Bank Protection	<50-70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9
LOWER BANKS	5	Channel Capacity	Barely contains present peaks. Occasional overbank floods. W/D ratio 15 to 25.	3
	6	Bank Rock Content	20-40% with most in the 3-6" diameter class.	6
	7	Obstructions to Flow	Moder. frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6
	8	Cutting	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	12
	9	Deposition	Moder. deposition of new gravel and course sand on old and some new bars.	~~12~~ 10
BOTTOM	10	Rock Angularity	Corners and edges well rounded in two dimensions.	3
	11	Brightness	Mixture dull and bright, ie 35-65% mixture range.	3
	12	Consolidation of Particles	Mostly loose assortment with no apparent overlap.	6
	13	Bottom Size Distribution	Moder. change in sizes. Stable materials 20-50%	12
	14	Scouring and Deposition	30-50% affected. Deposits & scour at obstructions, constrictions, and bends. Some filling of pools.	18
	15	Aquatic Vegetation	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3
			TOTAL	

FIELD PHOTO 6941→6944
REPORT PHOTOS 5-7

SHALE DEPOSITS COMMON IN CHANNEL & ON BARS. SOUTH BANK COMPOSED OF SHALE, OVERLY STEEP, LOW VEG. COVER & SUSCEPTIBLE TO EROSION DURING Q'S ABOVE BANKFULL.

CHANNEL STABILITY (PFANKUCH) EVALUATION AND STREAM CLASSIFICATION SUMMARY (LEVEL III)

	Category	POOR	
UPPER BANKS	1 Landform Slope	Bank Slope Gradient 60%+	8
	2 Mass Wasting	Frequent or large causing sediment nearly year long or imminent danger of same.	12
	3 Debris Jam Potential	Moder. to heavy amounts, predom. larger sizes.	8
	4 Vegetative Bank Protection	<50% density, fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
LOWER BANKS	5 Channel Capacity	Inadequate. Overbank flows common. W/D ratio >25	4
	6 Bank Rock Content	<20% rock fragments of gravel sizes, 1-3" or less.	8
	7 Obstructions to Flow	Sediment traps full, channel migration occurring.	
	8 Cutting	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9 Deposition	Extensive deposits of predom. fine particles. Accelerated bar development.	16
BOTTOM	10 Rock Angularity	Well rounded in all dimensions, surfaces smooth.	4
	11 Brightness	Predom. bright, 65%+ exposed or scoured surfaces.	4
	12 Consolidation of Particles	No packing evident. Loose assortment easily moved.	8
	13 Bottom Size Distribution	Marked distribution change. Stable materials 0-20%.	16
	14 Scouring and Deposition	More than 50% of the bottom in a state of flux or change nearly year long.	24
	15 Aquatic Vegetation	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
		TOTAL	

Stream Width ______ x avg. depth ______ x mean velocity ______ = Q ______ cfs

Gauge Ht ______ Reach Gradient ______ Stream Order ______ Sinuosity Ratio ______

Width bkf ______ Depth bkf ______ W/D Ratio ______ Discharge (Q_{bkf}) ______

Drainage Area ______ Valley Gradient ______ Stream Length ______ Valley Length ______

Sinuosity ______ Entrenchment Ratio ______ Length Meander (Lm) ______ Belt Width ______

Sediment Supply	Stream Bed Stability	Width/Depth Ratio Condition
Extreme ______	Aggrading ______	Normal ✓
Very High ✓	Degrading ______	High ______
High ______	Stable ✓	Very High ______
Moderate ______		
Low ______		

Stream Type: B3

TOTAL SCORE for Reach E 1 = G 34 + F 38 + P 16 = 89 Pfankuch Rating

Remarks ______

from table: Poor Reach Condition

CONVERSION OF STABILITY RATING TO REACH CONDITION BY STREAM TYPE*

Stream Type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6
GOOD	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60
FAIR	44-47	44-47	91-129	96-132	96-142	81-110	46-58	46-58	61-78	65-84	69-88	61-78
POOR	48+	48+	130+	133+	143+	111+	59+	59+	79+	85+	89+	79+

Stream Type	C1	C2	C3	C4	C5	C6	D3	D4	D5	D6
GOOD	38-50	38-50	60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98
FAIR	51-61	51-61	86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125
POOR	62+	62+	106+	111+	111+	106+	133+	133+	133+	126+

Stream Type	DA3	DA4	DA5	DA6	E3	E4	E5	E6
GOOD	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63
FAIR	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86
POOR	87+	87+	87+	87+	87+	97+	97+	87+

Stream Type	F1	F2	F3	F4	F5	F6	G1	G2	G3	G4	G5	G6
GOOD	60-85	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107
FAIR	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120
POOR	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+

Generalized relations ... need additional Level IV data to expand data base for validation.

— TECH CENTER —

CHANNEL STABILITY (PFANKUCH) EVALUATION AND STREAM CLASSIFICATION SUMMARY (LEVEL III)

Reach Location LIGHTNER CK BELOW TECH CENTER Date 11/3/09 Observers

Stream Type B3

Category			EXCELLENT	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient <30%	2
	2	Mass Wasting	No evidence of past or future mass wasting.	3
	3	Debris Jam Potential	Essentially absent from immediate channel area.	2
	4	Vegetative Bank Protection	90%+ plant density. Vigor and variety suggest a deep dense soil binding root mass.	3
LOWER BANKS	5	Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1
	6	Bank Rock Content	65%+ with large angular boulders. 12"+ common.	2
	7	Obstructions to Flow	Rocks and logs firmly imbedded. Flow pattern without cutting or deposition. Stable bed.	2
	8	Cutting	Little or none. Infreq. raw banks less than 6".	4
	9	Deposition	Little or no enlargement of channel or pt. bars.	4
BOTTOM	10	Rock Angularity	Sharp edges and corners. Plane surfaces rough.	1
	11	Brightness	Surfaces dull, dark or stained. Gen. not bright.	1
	12	Consolidation of Particles	Assorted sizes tightly packed or overlapping.	2
	13	Bottom Size Distribution	No size change evident. Stable mater. 80-100%	4
	14	Scouring and Deposition	<5% of bottom affected by scour or deposition.	6
	15	Aquatic Vegetation	Abundant Growth moss-like, dark green perennial. In swift water too.	1
			TOTAL	

Category			GOOD	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient 30-40%	4
	2	Mass Wasting	Infrequent. Mostly healed over. Low future potential.	6
	3	Debris Jam Potential	Present, but mostly small twigs and limbs.	4
	4	Vegetative Bank Protection	70-90% density. Fewer species or less vigor suggest less dense or deep root mass.	6
LOWER BANKS	5	Channel Capacity	Adequate. Bank overflows rare. W/D ratio 8-15	2
	6	Bank Rock Content	40-65%. Mostly small boulders to cobbles 6-12"	4
	7	Obstructions to Flow	Some present causing erosive cross currents and minor pool. filling. Obstructions newer and less firm.	~~4~~ 3
	8	Cutting	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12"	6
	9	Deposition	Some new bar increase, mostly from coarse gravel.	8
BOTTOM	10	Rock Angularity	Rounded corners and edges, surfaces smooth, flat.	2
	11	Brightness	Mostly dull, but may have <35% bright surfaces.	2
	12	Consolidation of Particles	Moderately packed with some overlapping.	4
	13	Bottom Size Distribution	Distribution shift light. Stable material 50-80%.	8
	14	Scouring and Deposition	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12
	15	Aquatic Vegetation	Common. Algae forms in low velocity and pool areas. Moss here too.	2
			TOTAL	

Category			FAIR	
UPPER BANKS	1	Landform Slope	Bank slope gradient 40-60%	6
	2	Mass Wasting	Frequent or large, causing sediment nearly year long.	9
	3	Debris Jam Potential	Moderate to heavy amounts, mostly larger sizes.	6
	4	Vegetative Bank Protection	<50-70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9
LOWER BANKS	5	Channel Capacity	Barely contains present peaks. Occasional overbank floods. W/D ratio 15 to 25.	3
	6	Bank Rock Content	20-40% with most in the 3-6" diameter class.	6
	7	Obstructions to Flow	Moder. frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6
	8	Cutting	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	12
	9	Deposition	Moder. deposition of new gravel and course sand on old and some new bars.	12
BOTTOM	10	Rock Angularity	Corners and edges well rounded in two dimensions.	3
	11	Brightness	Mixture dull and bright, ie 35-65% mixture range.	3
	12	Consolidation of Particles	Mostly loose assortment with no apparent overlap.	6
	13	Bottom Size Distribution	Moder. change in sizes. Stable materials 20-50%	12
	14	Scouring and Deposition	30-50% affected. Deposits & scour at obstructions, constrictions, and bends. Some filling of pools.	18
	15	Aquatic Vegetation	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3
			TOTAL	

FIELD PHOTOS 6949 → 6954

REPORT PHOTOS 8 - 10

CHANNEL STABILITY (PFANKUCH) EVALUATION AND STREAM CLASSIFICATION SUMMARY (LEVEL III)

	Category	POOR	
UPPER BANKS	1 Landform Slope	Bank Slope Gradient 60%+	8
	2 Mass Wasting	Frequent or large causing sediment nearly year long or imminent danger of same.	12
	3 Debris Jam Potential	Moder. to heavy amounts, predom. larger sizes.	8
	4 Vegetative Bank Protection	<50% density, fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
LOWER BANKS	5 Channel Capacity	Inadequate. Overbank flows common. W/D ratio >25	4
	6 Bank Rock Content	<20% rock fragments of gravel sizes, 1-3" or less.	8
	7 Obstructions to Flow	Sediment traps full, channel migration occurring.	
	8 Cutting	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9 Deposition	Extensive deposits of predom. fine particles. Accelerated bar development.	16
BOTTOM	10 Rock Angularity	Well rounded in all dimensions, surfaces smooth.	4
	11 Brightness	Predom. bright, 65%+ exposed or scoured surfaces.	4
	12 Consolidation of Particles	No packing evident. Loose assortment easily moved.	8
	13 Bottom Size Distribution	Marked distribution change. Stable materials 0-20%.	16
	14 Scouring and Deposition	More than 50% of the bottom in a state of flux or change nearly year long.	24
	15 Aquatic Vegetation	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
		TOTAL	

Stream Width 17 x avg. depth 1.5 x mean velocity ______ = Q ______ cfs

Gauge Ht ______ Reach Gradient ______ Stream Order ______ Sinuosity Ratio ______

Width bkf 17 Depth bkf 1.5 W/D Ratio ______ Discharge (Q_{bkf}) ______

Drainage Area ______ Valley Gradient ______ Stream Length ______ Valley Length ______

Sinuosity ______ Entrenchment Ratio ______ Length Meander (Lm) ______ Belt Width ______

Sediment Supply
Extreme ✓
Very High ✓
High ✓
Moderate ______
Low ______

Stream Bed Stability
Aggrading ______
Degrading ✓
Stable ______

Width/Depth Ratio Condition
Normal ✓
High ✓
Very High ______

Stream Type: B3

Pfankuch Rating: 78

TOTAL SCORE for Reach E____ = G____ + F____ + P____ =

Remarks ______

from table — Reach Condition: FAIR

CONVERSION OF STABILITY RATING TO REACH CONDITION BY STREAM TYPE*

Stream Type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6
GOOD	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60
FAIR	44-47	44-47	91-129	96-132	96-142	81-110	46-58	46-58	61-78	65-84	69-88	61-78
POOR	48+	48+	130+	133+	143+	111+	59+	59+	79+	85+	89+	79+
Stream Type	C1	C2	C3	C4	C5	C6	D3	D4	D5	D6		
GOOD	38-50	38-50	60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98		
FAIR	51-61	51-61	86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125		
POOR	62+	62+	106+	111+	111+	106+	133+	133+	133+	126+		
Stream Type	DA3	DA4	DA5	DA6	E3	E4	E5	E6				
GOOD	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63				
FAIR	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86				
POOR	87+	87+	87+	87+	87+	97+	97+	87+				
Stream Type	F1	F2	F3	F4	F5	F6	G1	G2	G3	G4	G5	G6
GOOD	60-85	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107
FAIR	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120
POOR	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+

**Generalized relations ... need additional Level IV data to expand data base for validation.*

— UPPER TECH CENTER —

CHANNEL STABILITY (PFANKUCH) EVALUATION AND STREAM CLASSIFICATION SUMMARY (LEVEL III)

Reach Location TECH CENTER ABV. SEDIMENT BASIN Date 10/27/09 Observers YMO

Stream Type B5 ("UNDISTURBED" CHANNEL)

		Category	EXCELLENT	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient <30%	2
	2	Mass Wasting	No evidence of past or future mass wasting.	3
	3	Debris Jam Potential	Essentially absent from immediate channel area.	2
	4	Vegetative Bank Protection	90%+ plant density. Vigor and variety suggest a deep dense soil binding root mass.	3
LOWER BANKS	5	Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1
	6	Bank Rock Content	65%+ with large angular boulders. 12"+ common.	2
	7	Obstructions to Flow	Rocks and logs firmly imbedded. Flow pattern without cutting or deposition. Stable bed.	2
	8	Cutting	Little or none. Infreq. raw banks less than 6".	4
	9	Deposition	Little or no enlargement of channel or pt. bars.	4
BOTTOM	10	Rock Angularity	Sharp edges and corners. Plane surfaces rough.	1
	11	Brightness	Surfaces dull, dark or stained. Gen. not bright.	1
	12	Consolidation of Particles	Assorted sizes tightly packed or overlapping.	2
	13	Bottom Size Distribution	No size change evident. Stable mater. 80-100%	4
	14	Scouring and Deposition	<5% of bottom affected by scour or deposition.	6
	15	Aquatic Vegetation	Abundant Growth moss-like, dark green perennial. In swift water too.	1
			TOTAL	

		Category	GOOD	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient 30-40%	4
	2	Mass Wasting	Infrequent. Mostly healed over. Low future potential.	6
	3	Debris Jam Potential	Present, but mostly small twigs and limbs.	4
	4	Vegetative Bank Protection	70-90% density. Fewer species or less vigor suggest less dense or deep root mass.	6
LOWER BANKS	5	Channel Capacity	Adequate. Bank overflows rare. W/D ratio 8-15	2
	6	Bank Rock Content	40-65%. Mostly small boulders to cobbles 6-12"	4
	7	Obstructions to Flow	Some present causing erosive cross currents and minor pool filling. Obstructions newer and less firm.	4
	8	Cutting	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12"	6
	9	Deposition	Some new bar increase, mostly from coarse gravel.	8
BOTTOM	10	Rock Angularity	Rounded corners and edges, surfaces smooth, flat.	2
	11	Brightness	Mostly dull, but may have <35% bright surfaces.	2
	12	Consolidation of Particles	Moderately packed with some overlapping.	4
	13	Bottom Size Distribution	Distribution shift light. Stable material 50-80%.	8
	14	Scouring and Deposition	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12
	15	Aquatic Vegetation	Common. Algae forms in low velocity and pool areas. Moss here too.	2
			TOTAL	

		Category	FAIR	
UPPER BANKS	1	Landform Slope	Bank slope gradient 40-60%	6
	2	Mass Wasting	Frequent or large, causing sediment nearly year long.	9
	3	Debris Jam Potential	Moderate to heavy amounts, mostly larger sizes.	6
	4	Vegetative Bank Protection	<50-70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9
LOWER BANKS	5	Channel Capacity	Barely contains present peaks. Occasional overbank floods. W/D ratio 15 to 25.	3
	6	Bank Rock Content	20-40% with most in the 3-6" diameter class.	6
	7	Obstructions to Flow	Moder. frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6
	8	Cutting	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	12
	9	Deposition	Moder. deposition of new gravel and course sand on old and some new bars.	12
BOTTOM	10	Rock Angularity	Corners and edges well rounded in two dimensions.	3
	11	Brightness	Mixture dull and bright, ie 35-65% mixture range.	3
	12	Consolidation of Particles	Mostly loose assortment with no apparent overlap.	6
	13	Bottom Size Distribution	Moder. change in sizes. Stable materials 20-50%	12
	14	Scouring and Deposition	30-50% affected. Deposits & scour at obstructions, constrictions, and bends. Some filling of pools.	18
	15	Aquatic Vegetation	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3
			TOTAL	

FIELD PHOTOS 7026→29

REPORT PHOTOS: 47-52

CHANNEL STABILITY (PFANKUCH) EVALUATION AND STREAM CLASSIFICATION SUMMARY (LEVEL III)

	Category		POOR	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient 60%+	8
	2	Mass Wasting	Frequent or large causing sediment nearly year long or imminent danger of same.	12
	3	Debris Jam Potential	Moder. to heavy amounts, predom. larger sizes.	8
	4	Vegetative Bank Protection	<50% density, fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
LOWER BANKS	5	Channel Capacity	Inadequate. Overbank flows common. W/D ratio >25	4
	6	Bank Rock Content	<20% rock fragments of gravel sizes, 1-3" or less.	8
	7	Obstructions to Flow	Sediment traps full, channel migration occurring.	8
	8	Cutting	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9	Deposition	Extensive deposits of predom. fine particles. Accelerated bar development.	16
BOTTOM	10	Rock Angularity	Well rounded in all dimensions, surfaces smooth.	4
	11	Brightness	Predom. bright, 65%+ exposed or scoured surfaces.	4
	12	Consolidation of Particles	No packing evident. Loose assortment easily moved.	8
	13	Bottom Size Distribution	Marked distribution change. Stable materials 0-20%.	16
	14	Scouring and Deposition	More than 50% of the bottom in a state of flux or change nearly year long.	24
	15	Aquatic Vegetation	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
			TOTAL	

BKF Stream Width 8' x avg. depth 1' x mean velocity ______ = Q ______ cfs

Gauge Ht ______ Reach Gradient ~2% Stream Order ______ Sinuosity Ratio ______

Width bkf ______ Depth bkf ______ W/D Ratio 8 Discharge (Q_{bkf}) ______

Drainage Area ______ Valley Gradient ______ Stream Length ______ Valley Length ______

Sinuosity ______ Entrenchment Ratio ______ Length Meander (Lm) ______ Belt Width ______

Sediment Supply		Stream Bed Stability		Width/Depth Ratio Condition	
Extreme	✓	Aggrading	✓	Normal	
Very High		Degrading		High	✓
High		Stable		Very High	✓
Moderate					
Low					

Stream Type: B5

TOTAL SCORE for Reach E 1 = G 6 + F 0 + P 136 = 143 Pfankuch Rating

from table: POOR Reach Condition

Remarks #10 - DUE TO ANGULAR SHALE MATERIAL
W/D RATIO INCREASES TO >25 ~50' d/s & CONTINUES d/s
TO SEDIMENT BASIN

CONVERSION OF STABILITY RATING TO REACH CONDITION BY STREAM TYPE*

Stream Type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6
GOOD	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60
FAIR	44-47	44-47	91-129	96-132	96-142	81-110	46-58	46-58	61-78	65-84	69-88	61-78
POOR	48+	48+	130+	133+	143+	111+	59+	59+	79+	85+	89+	79+

Stream Type	C1	C2	C3	C4	C5	C6	D3	D4	D5	D6
GOOD	38-50	38-50	60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98
FAIR	51-61	51-61	86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125
POOR	62+	62+	106+	111+	111+	106+	133+	133+	133+	126+

Stream Type	DA3	DA4	DA5	DA6	E3	E4	E5	E6
GOOD	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63
FAIR	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86
POOR	87+	87+	87+	87+	87+	97+	97+	87+

Stream Type	F1	F2	F3	F4	F5	F6	G1	G2	G3	G4	G5	G6
GOOD	60-85	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107
FAIR	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120
POOR	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+

Generalized relations ... need additional Level IV data to expand data base for validation.

— JIFFY LUBE —

CHANNEL STABILITY (PFANKUCH) EVALUATION AND STREAM CLASSIFICATION SUMMARY (LEVEL III)

Reach Location Lightner Ck @ Jiffy Lube Date 10/27/09 Observers YMO

Stream Type B1 (Bedrock)

Category			EXCELLENT	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient <30%	2
	2	Mass Wasting	No evidence of past or future mass wasting.	3
	3	Debris Jam Potential	Essentially absent from immediate channel area.	2
	4	Vegetative Bank Protection	90%+ plant density. Vigor and variety suggest a deep dense soil binding root mass.	3
LOWER BANKS	5	Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1
	6	Bank Rock Content	65%+ with large angular boulders. 12"+ common.	2
	7	Obstructions to Flow	Rocks and logs firmly imbedded. Flow pattern without cutting or deposition. Stable bed.	2
	8	Cutting	Little or none. Infreq. raw banks less than 6".	4
	9	Deposition	Little or no enlargement of channel or pt. bars.	4
BOTTOM	10	Rock Angularity	Sharp edges and corners. Plane surfaces rough.	1
	11	Brightness	Surfaces dull, dark or stained. Gen. not bright.	1
	12	Consolidation of Particles	Assorted sizes tightly packed or overlapping.	2
	13	Bottom Size Distribution	No size change evident. Stable mater. 80-100%	4
	14	Scouring and Deposition	<5% of bottom affected by scour or deposition.	6
	15	Aquatic Vegetation	Abundant Growth moss-like, dark green perennial. In swift water too.	1
			TOTAL	

MOSTLY BEDROCK

Category			GOOD	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient 30-40%	4
	2	Mass Wasting	Infrequent. Mostly healed over. Low future potential.	6
	3	Debris Jam Potential	Present, but mostly small twigs and limbs.	4
	4	Vegetative Bank Protection	70-90% density. Fewer species or less vigor suggest less dense or deep root mass.	6
LOWER BANKS	5	Channel Capacity	Adequate. Bank overflows rare. W/D ratio 8-15	2
	6	Bank Rock Content	40-65%. Mostly small boulders to cobbles 6-12"	4
	7	Obstructions to Flow	Some present causing erosive cross currents and minor pool filling. Obstructions newer and less firm.	4
	8	Cutting	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12"	6
	9	Deposition	Some new bar increase, mostly from coarse gravel.	8
BOTTOM	10	Rock Angularity	Rounded corners and edges, surfaces smooth, flat.	2
	11	Brightness	Mostly dull, but may have <35% bright surfaces.	2
	12	Consolidation of Particles	Moderately packed with some overlapping.	4
	13	Bottom Size Distribution	Distribution shift light. Stable material 50-80%.	8
	14	Scouring and Deposition	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12
	15	Aquatic Vegetation	Common. Algae forms in low velocity and pool areas. Moss here too.	2
			TOTAL	

Category			FAIR	
UPPER BANKS	1	Landform Slope	Bank slope gradient 40-60%	6
	2	Mass Wasting	Frequent or large, causing sediment nearly year long.	9
	3	Debris Jam Potential	Moderate to heavy amounts, mostly larger sizes.	6
	4	Vegetative Bank Protection	<50-70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9
LOWER BANKS	5	Channel Capacity	Barely contains present peaks. Occasional overbank floods. W/D ratio 15 to 25.	3
	6	Bank Rock Content	20-40% with most in the 3-6" diameter class.	6
	7	Obstructions to Flow	Moder. frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6
	8	Cutting	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	12
	9	Deposition	Moder. deposition of new gravel and course sand on old and some new bars.	12
BOTTOM	10	Rock Angularity	Corners and edges well rounded in two dimensions.	3
	11	Brightness	Mixture dull and bright, ie 35-65% mixture range.	3
	12	Consolidation of Particles	Mostly loose assortment with no apparent overlap.	6
	13	Bottom Size Distribution	Moder. change in sizes. Stable materials 20-50%	12
	14	Scouring and Deposition	30-50% affected. Deposits & scour at obstructions, constrictions, and bends. Some filling of pools.	18
	15	Aquatic Vegetation	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3
			TOTAL	

FIELD PHOTOS 6964 → 69

REPORT PHOTOS - 19 - 22

CHANNEL STABILITY (PFANKUCH) EVALUATION AND STREAM CLASSIFICATION SUMMARY (LEVEL III)

	Category		POOR	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient 60%+	8
	2	Mass Wasting	Frequent or large causing sediment nearly year long or imminent danger of same.	12
	3	Debris Jam Potential	Moder. to heavy amounts, predom. larger sizes.	8
	4	Vegetative Bank Protection	<50% density, fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
LOWER BANKS	5	Channel Capacity	Inadequate. Overbank flows common. W/D ratio >25	4
	6	Bank Rock Content	<20% rock fragments of gravel sizes, 1-3" or less.	8
	7	Obstructions to Flow	Sediment traps full, channel migration occurring.	
	8	Cutting	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9	Deposition	Extensive deposits of predom. fine particles. Accelerated bar development.	16
BOTTOM	10	Rock Angularity	Well rounded in all dimensions, surfaces smooth.	4
	11	Brightness	Predom. bright, 65%+ exposed or scoured surfaces.	4
	12	Consolidation of Particles	No packing evident. Loose assortment easily moved.	8
	13	Bottom Size Distribution	Marked distribution change. Stable materials 0-20%.	16
	14	Scouring and Deposition	More than 50% of the bottom in a state of flux or change nearly year long.	24
	15	Aquatic Vegetation	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
			TOTAL	

Stream Width 14' x avg. depth 1.5' x mean velocity ______ = Q ______ cfs

Gauge Ht ______ Reach Gradient ~2% Stream Order ______ Sinuosity Ratio ______

Width bkf ______ Depth bkf ______ W/D Ratio 9 Discharge (Q_{bkf}) ______

Drainage Area ______ Valley Gradient ______ Stream Length ______ Valley Length ______

Sinuosity ______ Entrenchment Ratio ______ Length Meander (Lm) ______ Belt Width ______

Sediment Supply	Stream Bed Stability	Width/Depth Ratio Condition
Extreme ✓	Aggrading ______	Normal ✓
Very High ______	Degrading ______	High ______
High ______	Stable ✓	Very High ______
Moderate ______		
Low ______		

Stream Type: B1/B5

TOTAL SCORE for Reach E 12 = G 14 + F 24 + P 44 = 94 Pfankuch Rating

from table: POOR Reach Condition

Remarks: CHANNEL BED IS MOSTLY SHALE BEROCK
- High SHEAR PREVENTS ERODED SLOPE MATERIALS FROM STAYING IN THIS REACH

CONVERSION OF STABILITY RATING TO REACH CONDITION BY STREAM TYPE*

Stream Type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6
GOOD	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60
FAIR	44-47	44-47	91-129	96-132	96-142	81-110	46-58	46-58	61-78	65-84	69-88	61-78
POOR	48+	48+	130+	133+	143+	111+	59+	59+	79+	85+	89+	79+

Stream Type	C1	C2	C3	C4	C5	C6	D3	D4	D5	D6
GOOD	38-50	38-50	60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98
FAIR	51-61	51-61	86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125
POOR	62+	62+	106+	111+	111+	106+	133+	133+	133+	126+

Stream Type	DA3	DA4	DA5	DA6	E3	E4	E5	E6
GOOD	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63
FAIR	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86
POOR	87+	87+	87+	87+	87+	97+	97+	87+

Stream Type	F1	F2	F3	F4	F5	F6	G1	G2	G3	G4	G5	G6
GOOD	60-85	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107
FAIR	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120
POOR	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+

**Generalized relations ... need additional Level IV data to expand data base for validation.*

— PERINS CANYON —

CHANNEL STABILITY (PFANKUCH) EVALUATION AND STREAM CLASSIFICATION SUMMARY (LEVEL III)

Reach Location Lightner Ck ~300' d/s Perins Canyon Date 10/26/09 Observers TMO

Stream Type B4

		Category	EXCELLENT	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient <30%	2
	2	Mass Wasting	No evidence of past or future mass wasting.	3
	3	Debris Jam Potential	Essentially absent from immediate channel area.	2
	4	Vegetative Bank Protection	90%+ plant density. Vigor and variety suggest a deep dense soil binding root mass.	3
LOWER BANKS	5	Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1
	6	Bank Rock Content	65%+ with large angular boulders. 12"+ common.	2
	7	Obstructions to Flow	Rocks and logs firmly imbedded. Flow pattern without cutting or deposition. Stable bed.	2
	8	Cutting	Little or none. Infreq. raw banks less than 6".	4
	9	Deposition	Little or no enlargement of channel or pt. bars.	4
BOTTOM	10	Rock Angularity	Sharp edges and corners. Plane surfaces rough.	1
	11	Brightness	Surfaces dull, dark or stained. Gen. not bright.	1
	12	Consolidation of Particles	Assorted sizes tightly packed or overlapping.	2
	13	Bottom Size Distribution	No size change evident. Stable mater. 80-100%	4
	14	Scouring and Deposition	<5% of bottom affected by scour or deposition.	6
	15	Aquatic Vegetation	Abundant Growth moss-like, dark green perennial. In swift water too.	1
			TOTAL	

		Category	GOOD	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient 30-40%	4
	2	Mass Wasting	Infrequent. Mostly healed over. Low future potential.	~~6~~ 8
	3	Debris Jam Potential	Present, but mostly small twigs and limbs.	4
	4	Vegetative Bank Protection	70-90% density. Fewer species or less vigor suggest less dense or deep root mass.	6
LOWER BANKS	5	Channel Capacity	Adequate. Bank overflows rare. W/D ratio 8-15	2
	6	Bank Rock Content	40-65%. Mostly small boulders to cobbles 6-12"	4
	7	Obstructions to Flow	Some present causing erosive cross currents and minor pool. filling. Obstructions newer and less firm.	~~4~~ 3
	8	Cutting	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12"	6
	9	Deposition	Some new bar increase, mostly from coarse gravel.	8
BOTTOM	10	Rock Angularity	Rounded corners and edges, surfaces smooth, flat.	2
	11	Brightness	Mostly dull, but may have <35% bright surfaces.	2
	12	Consolidation of Particles	Moderately packed with some overlapping.	4
	13	Bottom Size Distribution	Distribution shift light. Stable material 50-80%.	8
	14	Scouring and Deposition	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12
	15	Aquatic Vegetation	Common. Algae forms in low velocity and pool areas. Moss here too.	2
			TOTAL	

		Category	FAIR	
UPPER BANKS	1	Landform Slope	Bank slope gradient 40-60%	6
	2	Mass Wasting	Frequent or large, causing sediment nearly year long.	9
	3	Debris Jam Potential	Moderate to heavy amounts, mostly larger sizes.	6
	4	Vegetative Bank Protection	<50-70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9
LOWER BANKS	5	Channel Capacity	Barely contains present peaks. Occasional overbank floods. W/D ratio 15 to 25.	3
	6	Bank Rock Content	20-40% with most in the 3-6" diameter class.	6
	7	Obstructions to Flow	Moder. frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6
	8	Cutting	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	12
	9	Deposition	Moder. deposition of new gravel and course sand on old and some new bars.	~~12~~ 10
BOTTOM	10	Rock Angularity	Corners and edges well rounded in two dimensions.	3
	11	Brightness	Mixture dull and bright, ie 35-65% mixture range.	3
	12	Consolidation of Particles	Mostly loose assortment with no apparent overlap.	6
	13	Bottom Size Distribution	Moder. change in sizes. Stable materials 20-50%	12
	14	Scouring and Deposition	30-50% affected. Deposits & scour at obstructions, constrictions, and bends. Some filling of pools.	18
	15	Aquatic Vegetation	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3
			TOTAL	

FIELD PHOTOS 6994 → 6996
REPORT PHOTO 25.

CHANNEL STABILITY (PFANKUCH) EVALUATION AND STREAM CLASSIFICATION SUMMARY (LEVEL III)

	Category	POOR	
UPPER BANKS	1 Landform Slope	Bank Slope Gradient 60%+	8
	2 Mass Wasting	Frequent or large causing sediment nearly year long or imminent danger of same.	12
	3 Debris Jam Potential	Moder. to heavy amounts, predom. larger sizes.	8
	4 Vegetative Bank Protection	<50% density, fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
LOWER BANKS	5 Channel Capacity	Inadequate. Overbank flows common. W/D ratio >25	4
	6 Bank Rock Content	<20% rock fragments of gravel sizes, 1-3" or less.	8
	7 Obstructions to Flow	Sediment traps full, channel migration occurring.	
	8 Cutting	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9 Deposition	Extensive deposits of predom. fine particles. Accelerated bar development.	16
BOTTOM	10 Rock Angularity	Well rounded in all dimensions, surfaces smooth.	4
	11 Brightness	Predom. bright, 65%+ exposed or scoured surfaces.	4
	12 Consolidation of Particles	No packing evident. Loose assortment easily moved.	8
	13 Bottom Size Distribution	Marked distribution change. Stable materials 0-20%.	16
	14 Scouring and Deposition	More than 50% of the bottom in a state of flux or change nearly year long.	24
	15 Aquatic Vegetation	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
		TOTAL	

BKf

Stream Width 16' x avg. depth 1.5' x mean velocity ______ = Q ______ cfs

Gauge Ht ______ Reach Gradient ______ Stream Order ______ Sinuosity Ratio ______

Width bkf ______ Depth bkf ______ W/D Ratio 11 Discharge (Q_{bkf}) ______

Drainage Area ______ Valley Gradient ______ Stream Length ______ Valley Length ______

Sinuosity ______ Entrenchment Ratio ______ Length Meander (Lm) ______ Belt Width ______

Sediment Supply
- Extreme ______
- Very High ✓
- High ______
- Moderate ______
- Low ______

Stream Bed Stability
- Aggrading ______
- Degrading ✓
- Stable ______

Width/Depth Ratio Condition
- Normal ✓
- High ______
- Very High ______

Stream Type: B4

TOTAL SCORE for Reach E 0 + G 53 + F 22 + P 8 = 83 Pfankuch Rating

Remarks: TYPICAL REACH ALONG HWY 160, LOTS OF SHALE IN FLOOD PLAIN, SS ROCK MORE COMMON ON CHANNEL BED

from table: FAIR Reach Condition

CONVERSION OF STABILITY RATING TO REACH CONDITION BY STREAM TYPE*

Stream Type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6
GOOD	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60
FAIR	44-47	44-47	91-129	96-132	96-142	81-110	46-58	46-58	61-78	65-84	69-88	61-78
POOR	48+	48+	130+	133+	143+	111+	59+	59+	79+	85+	89+	79+
Stream Type	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**D3**	**D4**	**D5**	**D6**		
GOOD	38-50	38-50	60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98		
FAIR	51-61	51-61	86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125		
POOR	62+	62+	106+	111+	111+	106+	133+	133+	133+	126+		
Stream Type	**DA3**	**DA4**	**DA5**	**DA6**	**E3**	**E4**	**E5**	**E6**				
GOOD	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63				
FAIR	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86				
POOR	87+	87+	87+	87+	87+	97+	97+	87+				
Stream Type	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	**G1**	**G2**	**G3**	**G4**	**G5**	**G6**
GOOD	60-85	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107
FAIR	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120
POOR	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+

**Generalized relations ... need additional Level IV data to expand data base for validation.*

— LOWER PERINS CANYON —

CHANNEL STABILITY (PFANKUCH) EVALUATION AND STREAM CLASSIFICATION SUMMARY (LEVEL III)

Reach Location LOWER PERINS CANYON Date 10/27/09 Observers YMO

Stream Type B5

Category			EXCELLENT	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient <30%	2
	2	Mass Wasting	No evidence of past or future mass wasting.	3
	3	Debris Jam Potential	Essentially absent from immediate channel area.	2
	4	Vegetative Bank Protection	90%+ plant density. Vigor and variety suggest a deep dense soil binding root mass.	3
LOWER BANKS	5	Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1
	6	Bank Rock Content	65%+ with large angular boulders. 12"+ common.	2
	7	Obstructions to Flow	Rocks and logs firmly imbedded. Flow pattern without cutting or deposition. Stable bed.	2
	8	Cutting	Little or none. Infreq. raw banks less than 6".	4
	9	Deposition	Little or no enlargement of channel or pt. bars.	4
BOTTOM	10	Rock Angularity	Sharp edges and corners. Plane surfaces rough.	1 MOSTLY SHALE
	11	Brightness	Surfaces dull, dark or stained. Gen. not bright.	1
	12	Consolidation of Particles	Assorted sizes tightly packed or overlapping.	2
	13	Bottom Size Distribution	No size change evident. Stable mater. 80-100%	4
	14	Scouring and Deposition	<5% of bottom affected by scour or deposition.	6
	15	Aquatic Vegetation	Abundant Growth moss-like, dark green perennial. In swift water too.	1
			TOTAL	

Category			GOOD	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient 30-40%	4
	2	Mass Wasting	Infrequent. Mostly healed over. Low future potential.	6
	3	Debris Jam Potential	Present, but mostly small twigs and limbs.	4
	4	Vegetative Bank Protection	70-90% density. Fewer species or less vigor suggest less dense or deep root mass.	6
LOWER BANKS	5	Channel Capacity	Adequate. Bank overflows rare. W/D ratio 8-15	2
	6	Bank Rock Content	40-65%. Mostly small boulders to cobbles 6-12"	4
	7	Obstructions to Flow	Some present causing erosive cross currents and minor pool filling. Obstructions newer and less firm.	4
	8	Cutting	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12"	6
	9	Deposition	Some new bar increase, mostly from coarse gravel.	8
BOTTOM	10	Rock Angularity	Rounded corners and edges, surfaces smooth, flat.	2
	11	Brightness	Mostly dull, but may have <35% bright surfaces.	2
	12	Consolidation of Particles	Moderately packed with some overlapping.	4
	13	Bottom Size Distribution	Distribution shift light. Stable material 50-80%.	8
	14	Scouring and Deposition	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12
	15	Aquatic Vegetation	Common. Algae forms in low velocity and pool areas. Moss here too.	2
			TOTAL	

Category			FAIR	
UPPER BANKS	1	Landform Slope	Bank slope gradient 40-60%	6
	2	Mass Wasting	Frequent or large, causing sediment nearly year long.	9
	3	Debris Jam Potential	Moderate to heavy amounts, mostly larger sizes.	6
	4	Vegetative Bank Protection	<50-70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9
LOWER BANKS	5	Channel Capacity	Barely contains present peaks. Occasional overbank floods. W/D ratio 15 to 25.	3
	6	Bank Rock Content	20-40% with most in the 3-6" diameter class.	6
	7	Obstructions to Flow	Moder. frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6
	8	Cutting	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	12
	9	Deposition	Moder. deposition of new gravel and course sand on old and some new bars.	12
BOTTOM	10	Rock Angularity	Corners and edges well rounded in two dimensions.	3
	11	Brightness	Mixture dull and bright, ie 35-65% mixture range.	3
	12	Consolidation of Particles	Mostly loose assortment with no apparent overlap.	6
	13	Bottom Size Distribution	Moder. change in sizes. Stable materials 20-50%	12
	14	Scouring and Deposition	30-50% affected. Deposits & scour at obstructions, constrictions, and bends. Some filling of pools.	18
	15	Aquatic Vegetation	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3
			TOTAL	

FIELD PHOTOS 7033 → 36
REPORT PHOTOS → 54

CHANNEL STABILITY (PFANKUCH) EVALUATION AND STREAM CLASSIFICATION SUMMARY (LEVEL III)

Category			POOR	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient 60%+	8
	2	Mass Wasting	Frequent or large causing sediment nearly year long or imminent danger of same.	12
	3	Debris Jam Potential	Moder. to heavy amounts, predom. larger sizes.	8
	4	Vegetative Bank Protection	<50% density, fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
LOWER BANKS	5	Channel Capacity	Inadequate. Overbank flows common. W/D ratio >25	4
	6	Bank Rock Content	<20% rock fragments of gravel sizes, 1-3" or less.	8 SHALE
	7	Obstructions to Flow	Sediment traps full, channel migration occurring.	4
	8	Cutting	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9	Deposition	Extensive deposits of predom. fine particles. Accelerated bar development.	16
BOTTOM	10	Rock Angularity	Well rounded in all dimensions, surfaces smooth.	4
	11	Brightness	Predom. bright, 65%+ exposed or scoured surfaces.	4
	12	Consolidation of Particles	No packing evident. Loose assortment easily moved.	8
	13	Bottom Size Distribution	Marked distribution change. Stable materials 0-20%.	16
	14	Scouring and Deposition	More than 50% of the bottom in a state of flux or change nearly year long.	24
	15	Aquatic Vegetation	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
			TOTAL	

BKF Stream Width 11' x avg. depth 1.2' x mean velocity ______ = Q ______ cfs

Gauge Ht ______ Reach Gradient 2-3% Stream Order ______ Sinuosity Ratio ______

Width bkf ______ Depth bkf ______ W/D Ratio 9 Discharge (Q_{bkf}) ______

Drainage Area ______ Valley Gradient ______ Stream Length ______ Valley Length ______

Sinuosity ______ Entrenchment Ratio ______ Length Meander (Lm) ______ Belt Width ______

Sediment Supply
- Extreme ✓
- Very High ______
- High ______
- Moderate ______
- Low ______

Stream Bed Stability
- Aggrading ✓
- Degrading ______
- Stable ______

Width/Depth Ratio Condition
- Normal ______
- High ✓
- Very High ______

Stream Type: B5

TOTAL SCORE for Reach E 1 + G 6 + F 24 + P 104 =

Pfankuch Rating: 104

Remarks ______

from table — Reach Condition: Poor

CONVERSION OF STABILITY RATING TO REACH CONDITION BY STREAM TYPE*

Stream Type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6
GOOD	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60
FAIR	44-47	44-47	91-129	96-132	96-142	81-110	46-58	46-58	61-78	65-84	69-88	61-78
POOR	48+	48+	130+	133+	143+	111+	59+	59+	79+	85+	89+	79+

Stream Type	C1	C2	C3	C4	C5	C6	D3	D4	D5	D6
GOOD	38-50	38-50	60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98
FAIR	51-61	51-61	86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125
POOR	62+	62+	106+	111+	111+	106+	133+	133+	133+	126+

Stream Type	DA3	DA4	DA5	DA6	E3	E4	E5	E6
GOOD	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63
FAIR	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86
POOR	87+	87+	87+	87+	87+	97+	97+	87+

Stream Type	F1	F2	F3	F4	F5	F6	G1	G2	G3	G4	G5	G6
GOOD	60-85	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107
FAIR	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120
POOR	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+

Generalized relations ... need additional Level IV data to expand data base for validation.

– NISSAN DEALER –

CHANNEL STABILITY (PFANKUCH) EVALUATION AND STREAM CLASSIFICATION SUMMARY (LEVEL III)

Reach Location Lightner Ck @ Nissan Dealer Date 10/26/09 Observers YMO

Stream Type B3

		Category	EXCELLENT	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient <30%	2
	2	Mass Wasting	No evidence of past or future mass wasting.	3
	3	Debris Jam Potential	Essentially absent from immediate channel area.	2
	4	Vegetative Bank Protection	90%+ plant density. Vigor and variety suggest a deep dense soil binding root mass.	3
LOWER BANKS	5	Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1
	6	Bank Rock Content	65%+ with large angular boulders. 12"+ common.	2
	7	Obstructions to Flow	Rocks and logs firmly imbedded. Flow pattern without cutting or deposition. Stable bed.	2
	8	Cutting	Little or none. Infreq. raw banks less than 6".	4
	9	Deposition	Little or no enlargement of channel or pt. bars.	4
BOTTOM	10	Rock Angularity	Sharp edges and corners. Plane surfaces rough.	1
	11	Brightness	Surfaces dull, dark or stained. Gen. not bright.	1
	12	Consolidation of Particles	Assorted sizes tightly packed or overlapping.	2
	13	Bottom Size Distribution	No size change evident. Stable mater. 80-100%	4
	14	Scouring and Deposition	<5% of bottom affected by scour or deposition.	6
	15	Aquatic Vegetation	Abundant Growth moss-like, dark green perennial. In swift water too.	1
			TOTAL	

		Category	GOOD	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient 30-40%	4
	2	Mass Wasting	Infrequent. Mostly healed over. Low future potential.	6
	3	Debris Jam Potential	Present, but mostly small twigs and limbs.	4
	4	Vegetative Bank Protection	70-90% density. Fewer species or less vigor suggest less dense or deep root mass.	6
LOWER BANKS	5	Channel Capacity	Adequate. Bank overflows rare. W/D ratio 8-15	2
	6	Bank Rock Content	40-65%. Mostly small boulders to cobbles 6-12"	4
	7	Obstructions to Flow	Some present causing erosive cross currents and minor pool filling. Obstructions newer and less firm.	4
	8	Cutting	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12"	6
	9	Deposition	Some new bar increase, mostly from coarse gravel.	8
BOTTOM	10	Rock Angularity	Rounded corners and edges, surfaces smooth, flat.	2
	11	Brightness	Mostly dull, but may have <35% bright surfaces.	2
	12	Consolidation of Particles	Moderately packed with some overlapping.	4
	13	Bottom Size Distribution	Distribution shift light. Stable material 50-80%.	8
	14	Scouring and Deposition	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12
	15	Aquatic Vegetation	Common. Algae forms in low velocity and pool areas. Moss here too.	2
			TOTAL	

		Category	FAIR	
UPPER BANKS	1	Landform Slope	Bank slope gradient 40-60%	6
	2	Mass Wasting	Frequent or large, causing sediment nearly year long.	9
	3	Debris Jam Potential	Moderate to heavy amounts, mostly larger sizes.	6
	4	Vegetative Bank Protection	<50-70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9
LOWER BANKS	5	Channel Capacity	Barely contains present peaks. Occasional overbank floods. W/D ratio 15 to 25.	3
	6	Bank Rock Content	20-40% with most in the 3-6" diameter class.	6
	7	Obstructions to Flow	Moder. frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6
	8	Cutting	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	12
	9	Deposition	Moder. deposition of new gravel and course sand on old and some new bars.	12
BOTTOM	10	Rock Angularity	Corners and edges well rounded in two dimensions.	3
	11	Brightness	Mixture dull and bright, ie 35-65% mixture range.	3
	12	Consolidation of Particles	Mostly loose assortment with no apparent overlap.	6
	13	Bottom Size Distribution	Moder. change in sizes. Stable materials 20-50%	12
	14	Scouring and Deposition	30-50% affected. Deposits & scour at obstructions, constrictions, and bends. Some filling of pools.	18
	15	Aquatic Vegetation	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3
			TOTAL	

FIELD PHOTOS 7009 → 7011

REPORT PHOTOS → 36-38

CHANNEL STABILITY (PFANKUCH) EVALUATION AND STREAM CLASSIFICATION SUMMARY (LEVEL III)

Category			POOR	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient 60%+	8
	2	Mass Wasting	Frequent or large causing sediment nearly year long or imminent danger of same.	12
	3	Debris Jam Potential	Moder. to heavy amounts, predom. larger sizes.	8
	4	Vegetative Bank Protection	<50% density, fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
LOWER BANKS	5	Channel Capacity	Inadequate. Overbank flows common. W/D ratio >25	4
	6	Bank Rock Content	<20% rock fragments of gravel sizes, 1-3" or less.	8
	7	Obstructions to Flow	Sediment traps full, channel migration occurring.	
	8	Cutting	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9	Deposition	Extensive deposits of predom. fine particles. Accelerated bar development.	16
BOTTOM	10	Rock Angularity	Well rounded in all dimensions, surfaces smooth.	4
	11	Brightness	Predom. bright, 65%+ exposed or scoured surfaces.	4
	12	Consolidation of Particles	No packing evident. Loose assortment easily moved.	8
	13	Bottom Size Distribution	Marked distribution change. Stable materials 0-20%.	16
	14	Scouring and Deposition	More than 50% of the bottom in a state of flux or change nearly year long.	24
	15	Aquatic Vegetation	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
			TOTAL	

BKF Stream Width 18' x avg. depth 1.5 x mean velocity ____ = Q ____ cfs

Gauge Ht ____ Reach Gradient ____ Stream Order ____ Sinuosity Ratio ____

Width bkf ____ Depth bkf ____ W/D Ratio 12 Discharge (Q_{bkf}) ____

Drainage Area ____ Valley Gradient ____ Stream Length ____ Valley Length ____

Sinuosity ____ Entrenchment Ratio ____ Length Meander (Lm) ____ Belt Width ____

Sediment Supply		Stream Bed Stability		Width/Depth Ratio Condition	
Extreme	✓	Aggrading		Normal	✓
Very High	✓	Degrading	✓	High	
High		Stable	✓	Very High	
Moderate					
Low					

Stream Type: B3

TOTAL SCORE for Reach E 0 + G 30 + F 57 + P 16 = 103 Pfankuch Rating

Remarks - NO SHALE - SS COLLUVIUM
- APPEARS OLD FILL ENCROACHED ON CHANNEL HAS LED TO CHANNEL EROSION

from table: POOR Reach Condition

CONVERSION OF STABILITY RATING TO REACH CONDITION BY STREAM TYPE*

Stream Type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6
GOOD	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60
FAIR	44-47	44-47	91-129	96-132	96-142	81-110	46-58	46-58	61-78	65-84	69-88	61-78
POOR	48+	48+	130+	133+	143+	111+	59+	59+	79+	85+	89+	79+

Stream Type	C1	C2	C3	C4	C5	C6	D3	D4	D5	D6
GOOD	38-50	38-50	60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98
FAIR	51-61	51-61	86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125
POOR	62+	62+	106+	111+	111+	106+	133+	133+	133+	126+

Stream Type	DA3	DA4	DA5	DA6	E3	E4	E5	E6
GOOD	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63
FAIR	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86
POOR	87+	87+	87+	87+	87+	97+	97+	87+

Stream Type	F1	F2	F3	F4	F5	F6	G1	G2	G3	G4	G5	G6
GOOD	60-85	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107
FAIR	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120
POOR	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+

Generalized relations ... need additional Level IV data to expand data base for validation.

– WILDCAT CANYON –

CHANNEL STABILITY (PFANKUCH) EVALUATION AND STREAM CLASSIFICATION SUMMARY (LEVEL III)

Reach Location Lightner Ck @ Wildcat Cany. Date 10/26/09 Observers TMO

Stream Type B3

Category			EXCELLENT	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient <30%	2
	2	Mass Wasting	No evidence of past or future mass wasting.	3
	3	Debris Jam Potential	Essentially absent from immediate channel area.	2
	4	Vegetative Bank Protection	90%+ plant density. Vigor and variety suggest a deep dense soil binding root mass.	3
LOWER BANKS	5	Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1
	6	Bank Rock Content	65%+ with large angular boulders. 12"+ common.	2
	7	Obstructions to Flow	Rocks and logs firmly imbedded. Flow pattern without cutting or deposition. Stable bed.	2
	8	Cutting	Little or none. Infreq. raw banks less than 6".	4
	9	Deposition	Little or no enlargement of channel or pt. bars.	4
BOTTOM	10	Rock Angularity	Sharp edges and corners. Plane surfaces rough.	1
	11	Brightness	Surfaces dull, dark or stained. Gen. not bright.	1
	12	Consolidation of Particles	Assorted sizes tightly packed or overlapping.	2
	13	Bottom Size Distribution	No size change evident. Stable mater. 80-100%	4
	14	Scouring and Deposition	<5% of bottom affected by scour or deposition.	6
	15	Aquatic Vegetation	Abundant Growth moss-like, dark green perennial. In swift water too.	1
			TOTAL	

Category			GOOD	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient 30-40%	4
	2	Mass Wasting	Infrequent. Mostly healed over. Low future potential.	6
	3	Debris Jam Potential	Present, but mostly small twigs and limbs.	4
	4	Vegetative Bank Protection	70-90% density. Fewer species or less vigor suggest less dense or deep root mass.	6
LOWER BANKS	5	Channel Capacity	Adequate. Bank overflows rare. W/D ratio 8-15	2
	6	Bank Rock Content	40-65%. Mostly small boulders to cobbles 6-12"	4
	7	Obstructions to Flow	Some present causing erosive cross currents and minor pool. filling. Obstructions newer and less firm.	4
	8	Cutting	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12"	6
	9	Deposition	Some new bar increase, mostly from coarse gravel.	8
BOTTOM	10	Rock Angularity	Rounded corners and edges, surfaces smooth, flat.	2
	11	Brightness	Mostly dull, but may have <35% bright surfaces.	2
	12	Consolidation of Particles	Moderately packed with some overlapping.	4
	13	Bottom Size Distribution	Distribution shift light. Stable material 50-80%	8
	14	Scouring and Deposition	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12
	15	Aquatic Vegetation	Common. Algae forms in low velocity and pool areas. Moss here too.	2
			TOTAL	

Category			FAIR	
UPPER BANKS	1	Landform Slope	Bank slope gradient 40-60%	6
	2	Mass Wasting	Frequent or large, causing sediment nearly year long.	9
	3	Debris Jam Potential	Moderate to heavy amounts, mostly larger sizes.	6
	4	Vegetative Bank Protection	<50-70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9
LOWER BANKS	5	Channel Capacity	Barely contains present peaks. Occasional overbank floods. W/D ratio 15 to 25.	3
	6	Bank Rock Content	20-40% with most in the 3-6" diameter class.	6
	7	Obstructions to Flow	Moder. frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6
	8	Cutting	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	12
	9	Deposition	Moder. deposition of new gravel and course sand on old and some new bars.	12
BOTTOM	10	Rock Angularity	Corners and edges well rounded in two dimensions.	3
	11	Brightness	Mixture dull and bright, ie 35-65% mixture range.	3
	12	Consolidation of Particles	Mostly loose assortment with no apparent overlap.	6
	13	Bottom Size Distribution	Moder. change in sizes. Stable materials 20-50%	12
	14	Scouring and Deposition	30-50% affected. Deposits & scour at obstructions, constrictions, and bends. Some filling of pools.	18
	15	Aquatic Vegetation	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3
			TOTAL	

FIELD PHOTOS 7020-7022
REPORT PHOTOS: 41-46

CHANNEL STABILITY (PFANKUCH) EVALUATION AND STREAM CLASSIFICATION SUMMARY (LEVEL III)

Category			POOR	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient 60%+	8
	2	Mass Wasting	Frequent or large causing sediment nearly year long or imminent danger of same.	12
	3	Debris Jam Potential	Moder. to heavy amounts, predom. larger sizes.	8
	4	Vegetative Bank Protection	<50% density, fewer species and less vigor indicate poor, discontinuous and shallow root mass.	12
LOWER BANKS	5	Channel Capacity	Inadequate. Overbank flows common. W/D ratio >25	4
	6	Bank Rock Content	<20% rock fragments of gravel sizes, 1-3" or less.	8
	7	Obstructions to Flow	Sediment traps full, channel migration occurring.	
	8	Cutting	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9	Deposition	Extensive deposits of predom. fine particles. Accelerated bar development.	16
BOTTOM	10	Rock Angularity	Well rounded in all dimensions, surfaces smooth.	4
	11	Brightness	Predom. bright, 65%+ exposed or scoured surfaces.	4
	12	Consolidation of Particles	No packing evident. Loose assortment easily moved.	8
	13	Bottom Size Distribution	Marked distribution change. Stable materials 0-20%.	16
	14	Scouring and Deposition	More than 50% of the bottom in a state of flux or change nearly year long.	24
	15	Aquatic Vegetation	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
			TOTAL	

BKF Stream Width 17' x avg. depth 1.5' x mean velocity ______ = Q ______ cfs

Gauge Ht ______ Reach Gradient ______ Stream Order ______ Sinuosity Ratio ______

Width bkf ______ Depth bkf ______ W/D Ratio ~11 Discharge (Q_{bkf}) ______

Drainage Area ______ Valley Gradient ______ Stream Length ______ Valley Length ______

Sinuosity ______ Entrenchment Ratio ______ Length Meander (Lm) ______ Belt Width ______

Sediment Supply
Extreme ______
Very High ______
High ______
Moderate ✓
Low ✓

Stream Bed Stability
Aggrading ______
Degrading ______
Stable ✓

Width/Depth Ratio Condition
Normal ✓
High ______
Very High ______

Stream Type: B3

TOTAL SCORE for Reach E 8 + G 56 + F 6 + P 0 = 70 — Pfankuch Rating

Remarks: looks like most of the sediment supply is finer material (i.e., fine sand & finer)

from table: FAIR — Reach Condition

CONVERSION OF STABILITY RATING TO REACH CONDITION BY STREAM TYPE*

Stream Type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6
GOOD	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60
FAIR	44-47	44-47	91-129	96-132	96-142	81-110	46-58	46-58	61-78	65-84	69-88	61-78
POOR	48+	48+	130+	133+	143+	111+	59+	59+	79+	85+	89+	79+

Stream Type	C1	C2	C3	C4	C5	C6	D3	D4	D5	D6
GOOD	38-50	38-50	60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98
FAIR	51-61	51-61	86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125
POOR	62+	62+	106+	111+	111+	106+	133+	133+	133+	126+

Stream Type	DA3	DA4	DA5	DA6	E3	E4	E5	E6
GOOD	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63
FAIR	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86
POOR	87+	87+	87+	87+	87+	97+	97+	87+

Stream Type	F1	F2	F3	F4	F5	F6	G1	G2	G3	G4	G5	G6
GOOD	60-85	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107
FAIR	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120
POOR	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+

**Generalized relations ... need additional Level IV data to expand data base for validation.*