Morphology and Sedimentology of Panther Creek, Montgomery County Preserve

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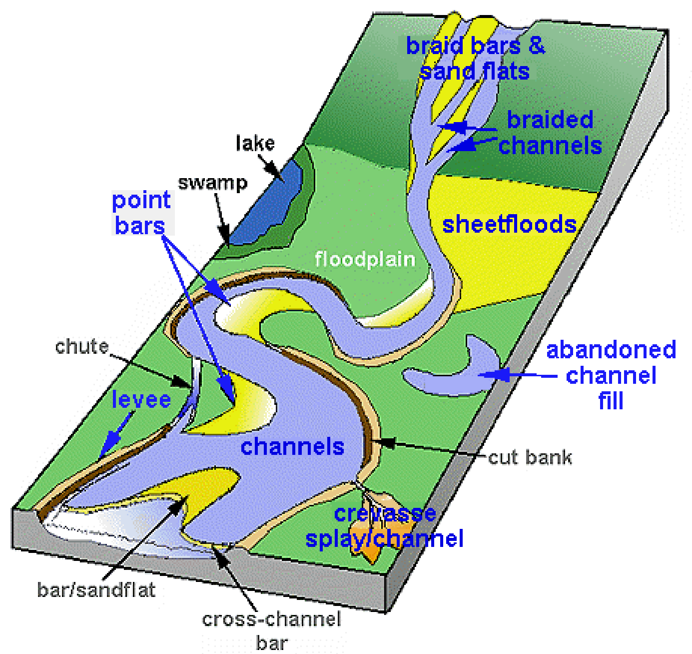
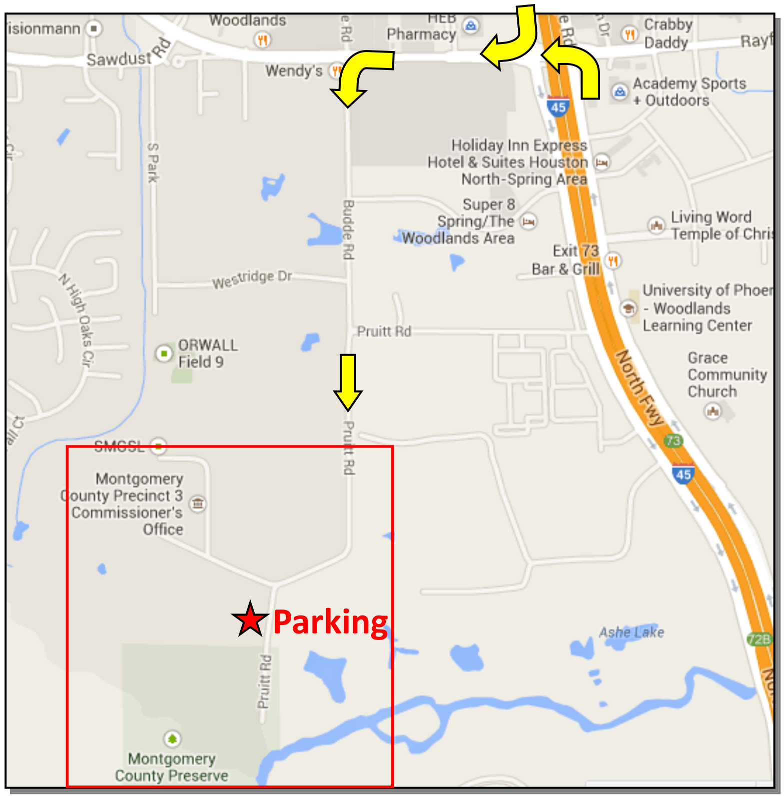


October, 2016

Location

Sites along Panther Creek where it merges with Spring Creek in the Montgomery County Preserve, south of The Woodlands, Texas provide an excellent location to view numerous features of a meandering stream system.

Directions – *Off of Interstate 45 take the Rayford/Sawdust exit. Turn West onto Sawdust. Turn South onto Budde Road. Go straight on Budde Road which will turn into Pruitt Road. Keep on Pruitt Road and turn left at the Montgomery County Preserve and Nature Trail entrance sign located at 1118 Pruitt Road and park in the parking area on the right.*



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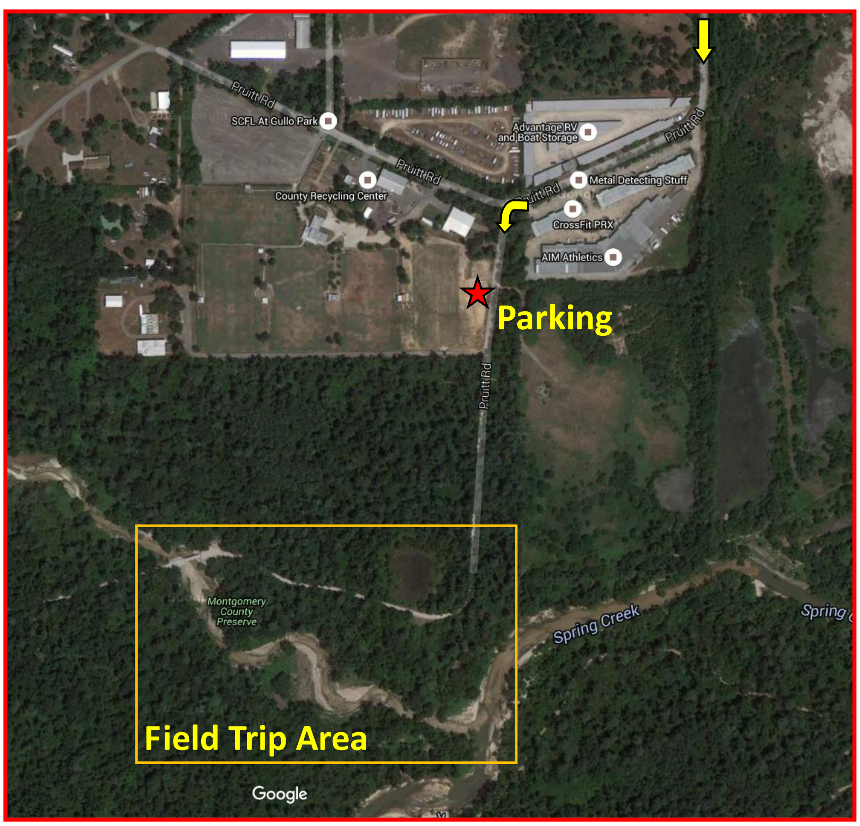


Safety

The distance walked that this field guide covers is a total of ~1.75 kms along a gravel access road and generally well-groomed trails. There are small portions of the trail that can be uneven next to the creeks. Depending upon the time from the last maintenance on the trail and if there have been previous high winds in the area, there may be some vegetation across portions of the trail.

You will be walking through the water in Panther Creek so footwear and clothing that you do not mind getting wet should be worn. Hiking boots are not needed. Tennis shoes, rubber boots, hiking sandals or any other sports shoes will be adequate. If sandals are worn, there is a possibility that sticks or other material could injure feet.

Participants will be walking in Panther Creek itself to see the ongoing sedimentological processes and the resultant deposits. The typical water depth in Panther Creek is just over the ankle, but there may be small areas up to 50cm deep. Currents in Panther Creek are not strong and will not affect the average person's walking stability. Spring Creek on average is slightly deeper (30cm to 1m with slower currents than Panther Creek. The trip will not be walking in Spring Creek. Wet, loosely packed sediments next to and in the creek can quickly liquefy if stepped on resulting in sinking into the sediments potentially up to and beyond knees. If there has been significant rainfall in the area during the previous week(s), water levels and currents can be increased to the point where it may be unsafe to walk in the creek.

As with all outings involving water, caution should be taken to avoid any circumstance that increases the risk of drowning. Drowning can occur in water as shallow as 30mm. ***Appropriate behavior respecting the environment where we will be is the best way to reduce this risk.***

Most of the year, especially during the summer months, it can be hot and sunny in the area. It is highly recommended to bring adequate water, use sunscreen and wear a hat. Insect repellant is also advised.

Poison ivy, poison oak and sumac are in the area. Long pants and long sleeves can be worn if desired to prevent contact with these plants and the urushiol oil that causes a skin rash.

Dangerous spiders and snakes may also be encountered. Staying on the trail and/or in the creek will greatly reduce the risk of encountering any dangerous animal. If one is come upon, stay calm and back away pointing it out to the other field trip participants.

More information on identification of and dealing with potential dangerous animals and plants in the Panther Creek area can be found in the back of the field guide.

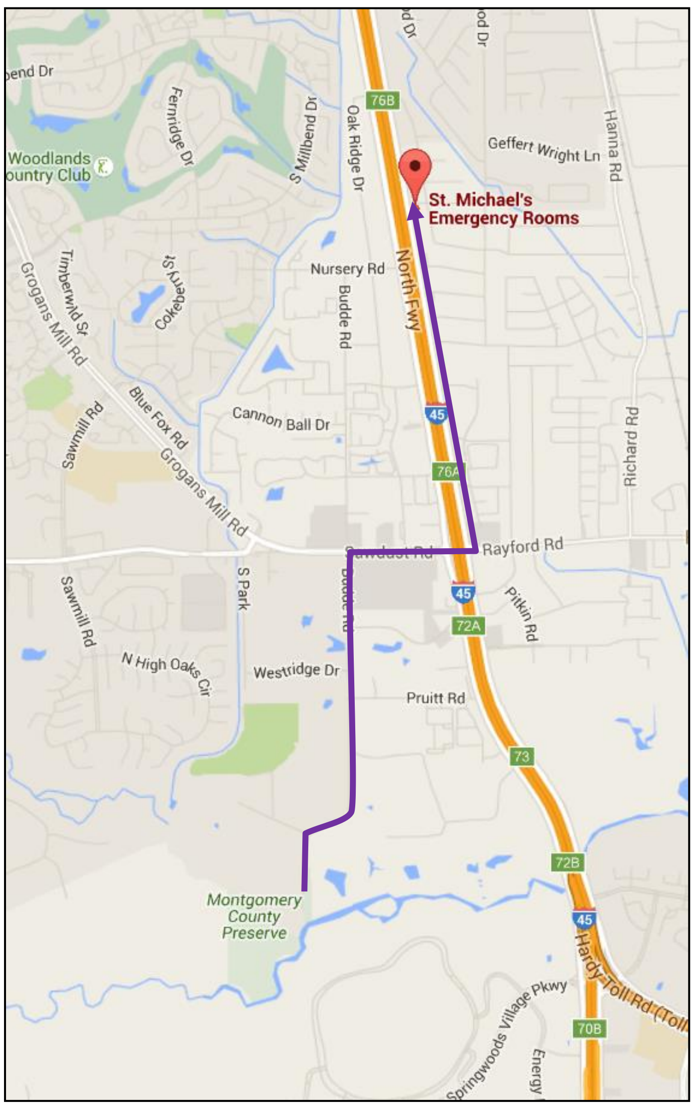
Emergency Contacts

There is mobile phone coverage across the field trip area.

In case of an emergency dial **911**. Be prepared to give the following information:

1. ***Your name and phone number***
2. ***Your location*** : Montgomery County Preserve at 1118 Pruitt Rd., The Woodlands, TX 77380
    - If you are on the trails or by the creek you will need to give additional location information
3. ***The nature of your emergency***

Closest Hospital	St Michael's Emergency Rooms 26226 Interstate 45N, Spring TX 77386 (281) 419-2911 *24hrer.com*



Setting

Panther Creek comes out of Lake Woodlands five miles to the north. The water that flows into the stream is the less muddy, cleaner upper part of the water column in the lake that comes over the dam spillway. This leads to the water flowing through Panther Creek to be clearer enabling us to see through the water and investigate features on the bed of the stream.

From Lake Woodlands, the stream runs through golf courses and by subdivisions where its course has been modified. However in the Montgomery County Preserve the stream has undergone very little alteration allowing natural processes to modify the landscape into what can be seen today.

Plan on getting wet if you would like to investigate all the features of Panther Creek, as the best way to see everything that is happening is to go into the stream itself and observe the active processes that are at work and the resultant deposits that are left behind.

There are three stops that will allow for investigatation of different features of Panther Creek.

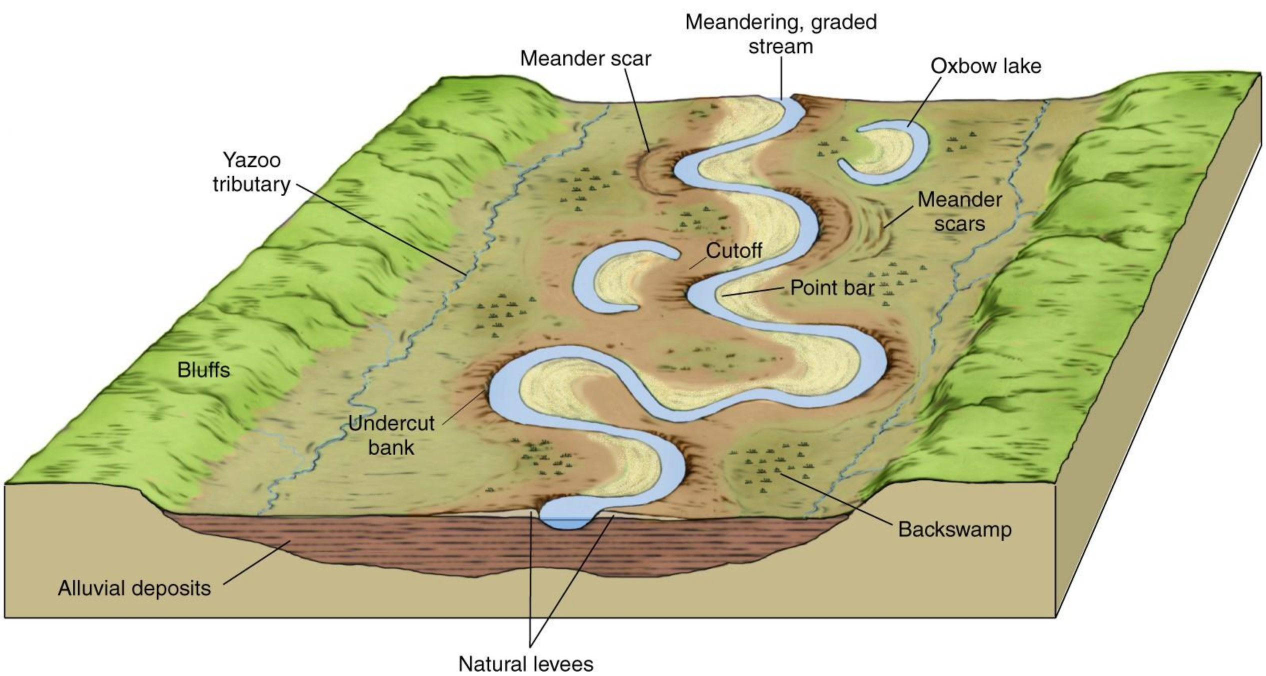
Location of stops along Panther Creek covered in this guide and the paths to access them. Recommended path walking up Panther Creek between Stop 1, 2 and 3 is shown in yellow.

Stream Morphology

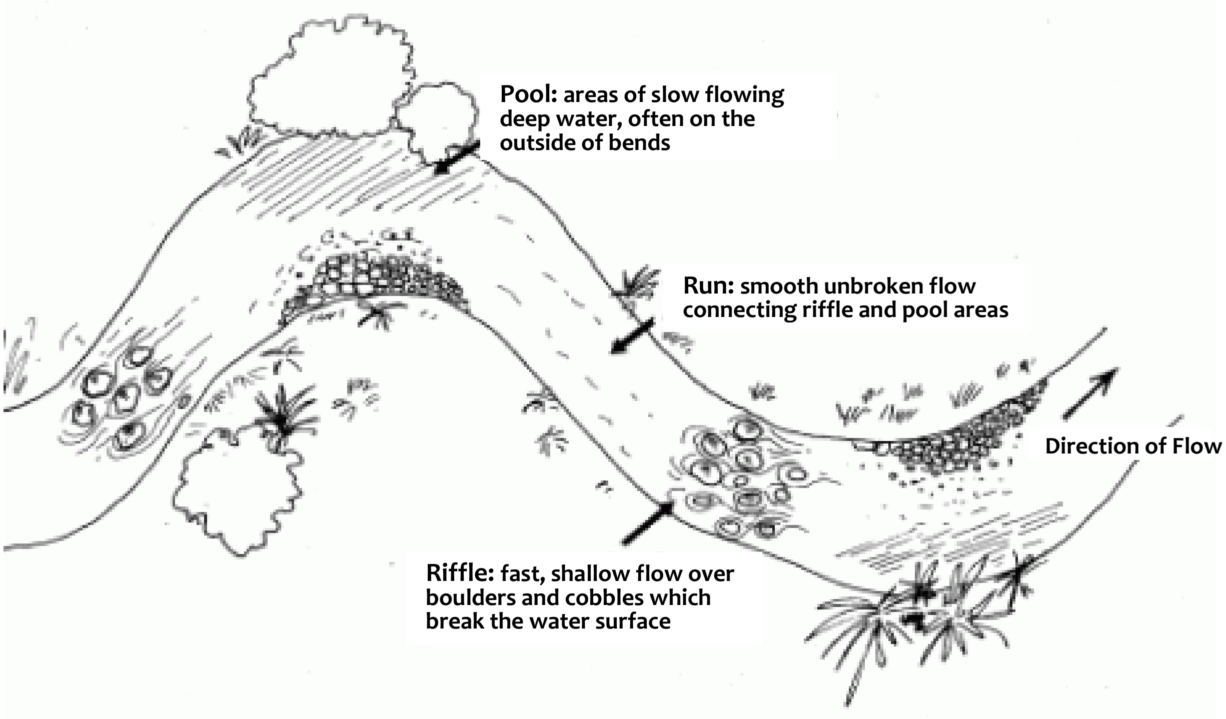
Most of us speak of rivers, but geoscientists tend to call everything a stream. A **stream** is any body of running water that occupies a channel: it can even be underground in a cave or underneath a glacier. A **river** is a large surface stream, but other than that there isn't a clear boundary between a stream and a river. Streams smaller than rivers, roughly in order of size, may be called branches or forks, bayous, creeks, brooks, coulées, runnels and rivulets. The very smallest kind of stream, just a trickle, is a rill.

Features Associated with Meandering Streams

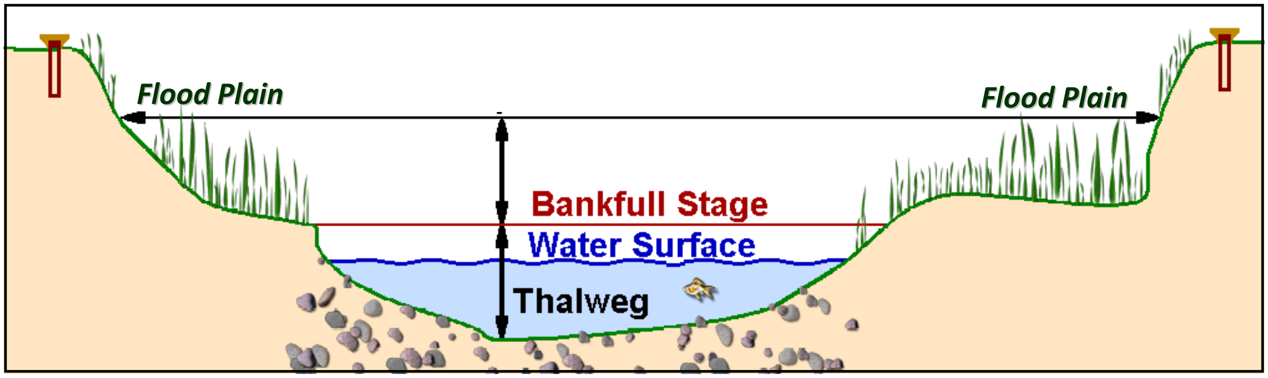
A meandering stream migrates laterally by sediment erosion on the outside of the meander and deposition on the inside. Adjacent to the channel, levee deposits build up, and gradually raise up the river over the floodplain (mainly fine sediments). If the climate is humid the floodplain area beyond the levees may be covered with water most of the time, and may form a swamp. Meanders may cut into each other as they grow (neck cutoffs), and then the river shortcuts (growing meanders reduce the slope, cutoffs are a means to increase the slope again) and the old meander is abandoned and slowly fills with fine sediment during floods (oxbow lakes). As a river builds up its levees and raises itself over the floodplain, the slope and the transport power of the stream decrease, the channel fills gradually with sediment, and finally (often during a flood) the river will breach its levee (this process is called avulsion) and follow a steeper path down the valley.

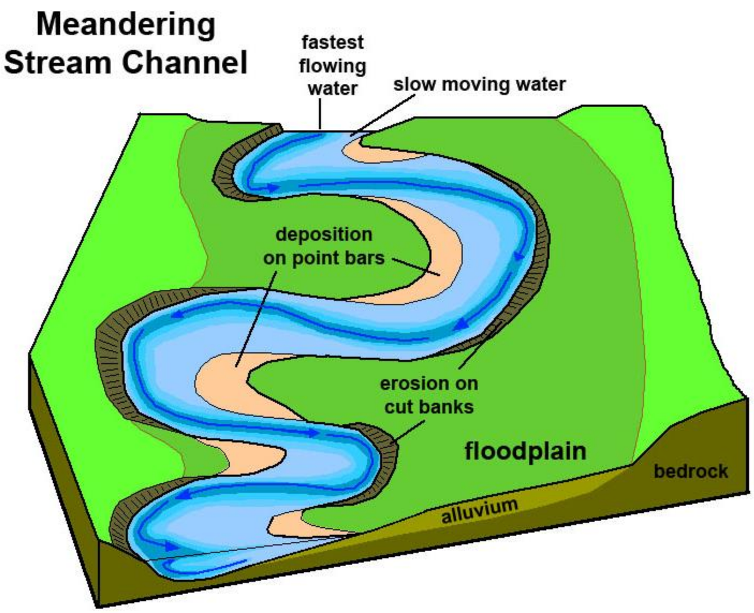


The morphology of a stream (its shape, dimensions and other characteristics) are influenced by the slope it is going over, the speed (**velocity**) of the current, the volume of water (**discharge**), and the size of the sediment it is moving. Streams may be permanent or **intermittent**—occurring only part of the time. The most important part of a stream is its **channel** or streambed, the natural passage or depression in the ground that holds the water. The channel is always there even if no water is running in it. The deepest part of the channel, the route taken by the last (or first) bit of water, is called the **thalweg** (TALL-vegg, from the German for "valley way"). The sides of the channel, along the edges of the stream, are its **banks**. A stream channel has a right bank and a left bank: you tell which is which by looking downstream.



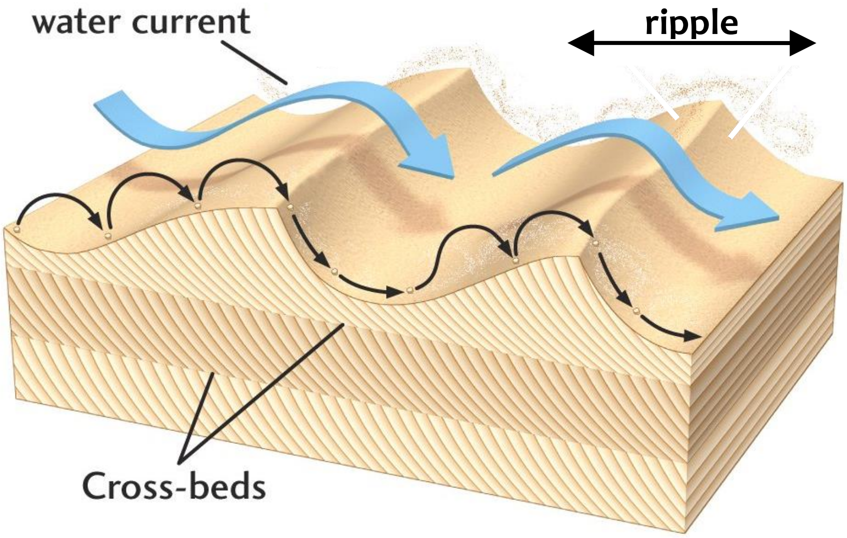
Under normal conditions, usually the water in a stream does not completely fill the channel up to the top of the banks on the side of the stream. After a heavy rain and there is extra water runoff the stream can fill up the whole channel to what is called the **bankfull stage**. If the water rises higher and overflows it banks it goes into **flood stage** and spills over onto the flood plain.





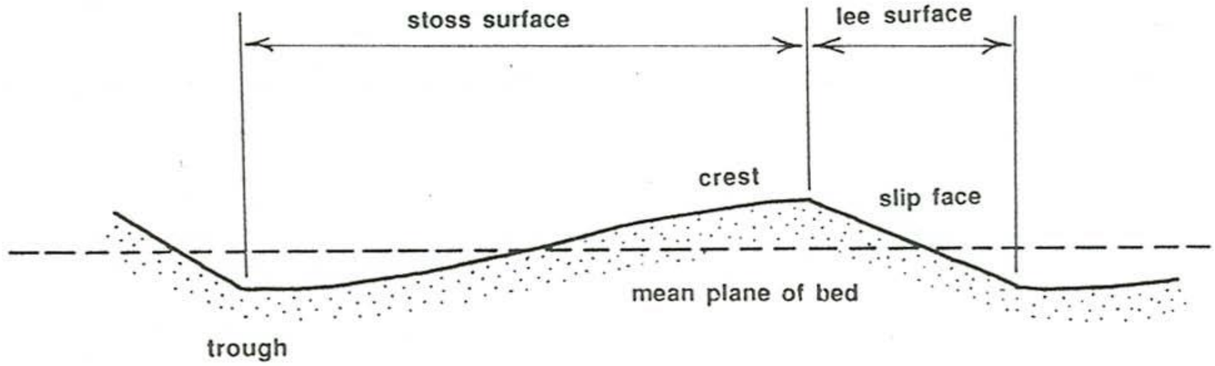
The loops and curves of a slow-moving stream are called **meanders**. Meanders are formed by erosion and occur where a stream has worn away its banks. Most erosion normally occurs on the outside bend of a meander called a **cutbank**. This is because the velocity (speed) of the stream is faster. As well as the water hitting the banks, pieces of sediment may also be thrown against the stream banks wearing them away. Meandering stream channels are **asymmetrical**. The deepest part of the channel is on the outside of each bend. The water flows faster in these deeper sections and erodes material from the stream bank. The water flows more slowly in the shallow areas near the inside of each bend. The slower water can't carry as much sediment and deposits its load on a series of **point bars**. Meandering streams erode sediment from the outer curve of each meander bend and deposit it on an inner curve further downstream. This causes individual meanders to grow larger over time.

Streams need energy to transport material. Normally, a stream has the energy to carry some sediment. When energy levels are very high due to a fast current and a lot of water (**velocity** and **discharge**), large rocks and boulders can be transported. When energy levels are low when the stream is slow with little water, only small particles can be transported. The **velocity** (speed) of a stream is not the same along its length or across is width. The thalweg of the channel contains the fastest current with the highest velocities. Lower velocities occur toward the banks of the stream. This allows the stream to erode sediment in one part of the stream and deposit it in another.



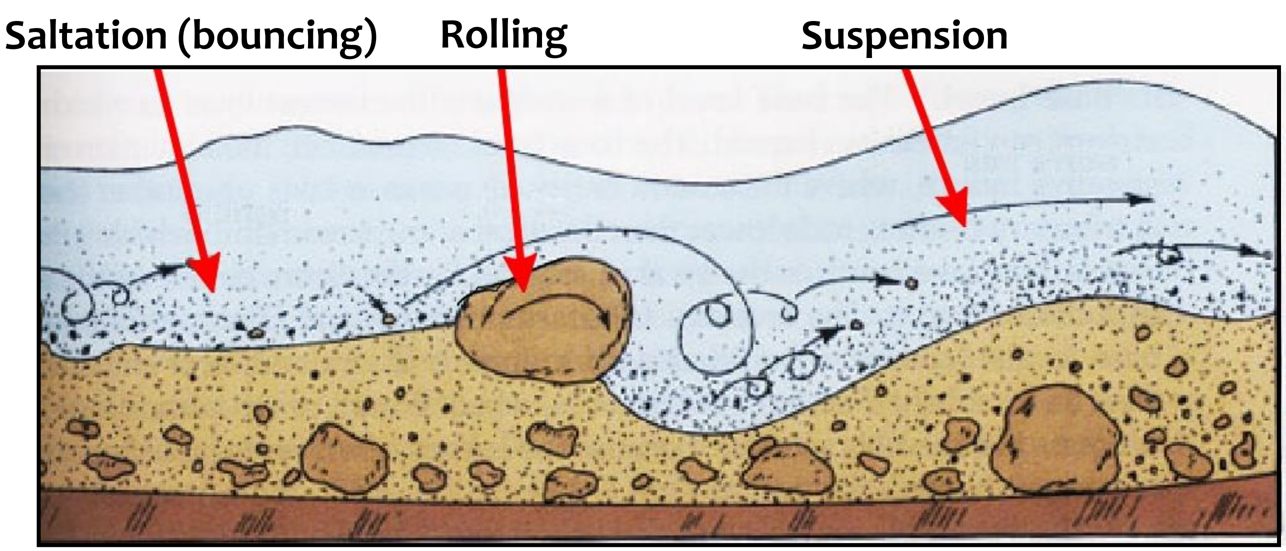
When a current flows over the bottom of the creek and moves grains along it, the larger size grains move along the stream bed in different ways (rolling, bouncing, sliding) and at different speeds and can form **ripples**.

A ripple generated from a uni-directional current (a current always going in one direction) has pointed **crests** and rounded **troughs**, and are inclined more strongly in the direction of the current with a gentle up-current slope (**stoss surface**) and a steeper down-current slope or slip face (**lee surface**). When the deposits from ripples stack on top of each other in layers composed of different angles of the lee surface of the ripples, this is called **crossbedding**. In the layers of a bar deposit you will mostly find only the lee side of the ripple. This is because the current of the stream will erode the stoss side of the ripple and deposit on the lee side as the ripple migrates downstream, only leaving part of the lee side behind.



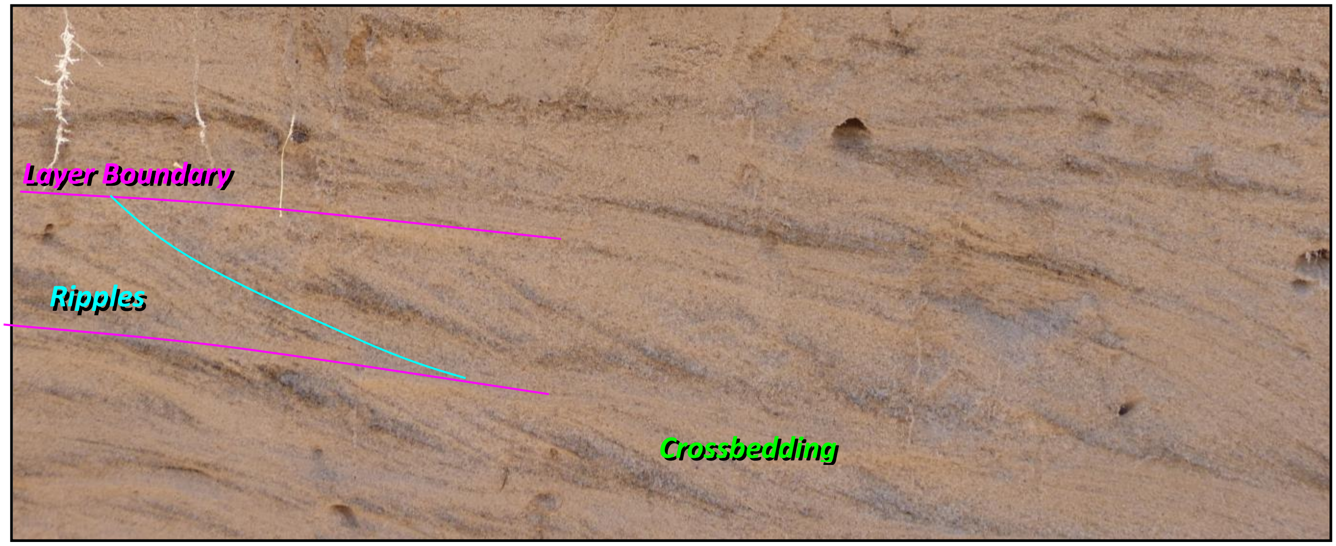
Deposition is where a river lays down or drops the sediment or material that it is carrying. Streams carry lots of different sediment or grains, including rocks, pebbles, sand, silt, and mud. These grains move along the stream in different ways depending on their size and the velocity of the current. The smallest sized grains (clays and silts) will be suspended in the water and not touch the stream bed. Bigger grains (sands and gravels,) are too heavy and they bounce, slide and roll along the stream bed.

Grain Diameter millimeters	Grain Diameter microns	phi		Wentworth Size Class	
256		-8.0		Boulder	Gravel
64		-6.0		Cobble	Gravel
4.0	4000	-2.0		Pebble	Gravel
2.0	2000	-1.0		Granule	Gravel
1.41	1410	-0.5	vcU	Very coarse sand	Sand
1.0	1000	0.0	vcL		Sand
.71	710	0.5	cU	Coarse sand	Sand
0.5	500	1.0	cL		Sand
0.35	350	1.5	mU	Medium sand	Sand
0.25	250	2.0	mL		Sand
0.177	177	2.5	fU	Fine sand	Sand
0.125	125	3.0	fL		Sand
0.088	88	3.5	vfU	Very fine sand	Sand
0.0625	62.5	4.0	vfL		Sand
0.002	2.0	9.0		Silt	Mud
				Clay	Mud



Sedimentary Structures

In the deposits of a stream, smaller scale features can be seen. As the stream erodes sediment in one area (like the cutbank) it will deposit that sediment in **layers** in other areas building up point bars and other features. These layers can be seen due to the different grain sizes and material found in each layer.



Layers of the lee side of ripples of different sizes seen in the point bars at Stop 2 resulting in crossbedding.

Stop 1 – Confluence of Panther Creek and Spring Creek

Directions – From the parking area walk down the road toward the creek and go past the metal gate and along the gravel road. Where the gravel road makes a bend to the right there is a marker on the left of the road for the Spring Creek Overlook path. Walk along the path until you get to Spring Creek. At the creek continue along the path upstream to where Panther Creek enters Spring Creek.

Stop 1 is where Panther Creek merges with Spring Creek. Here the clearer water coming from Panther Creek mixes with the muddier water of Spring Creek. The difference in the amount of sediment in the water coming down the two creeks causes the water in these creeks to have different **densities**. Where these different density waters meet, there are small swirling patterns (**eddies**) on the surface of the water along a line where the clearer, less sediment laden, lower density water from Panther Creek mixes with the muddier, more sediment laden, higher density water of Spring Creek.

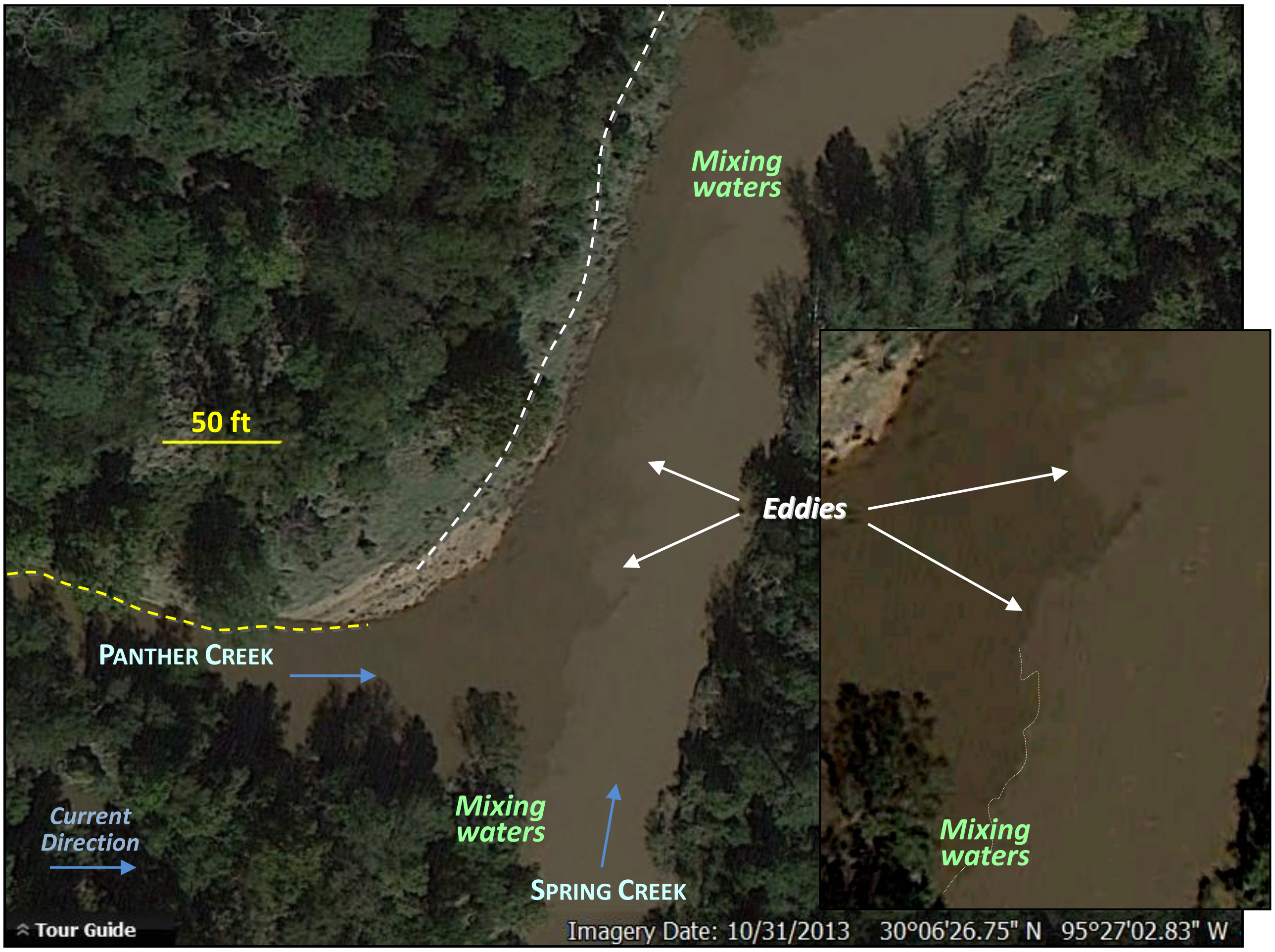
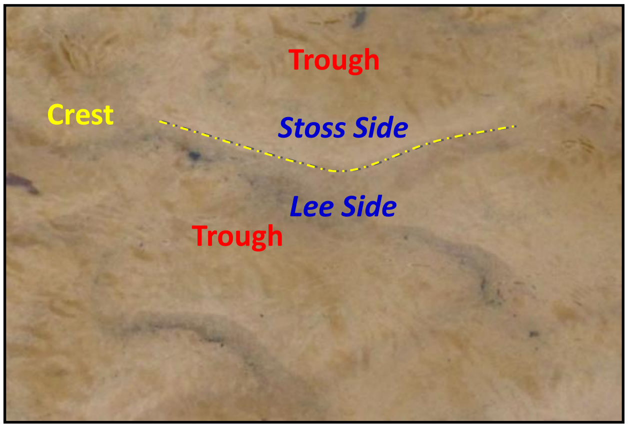


Image of the confluence of the clearer waters of Panther Creek and the muddier waters of Spring Creek from Google Earth. Notice that the creeks are at bankful stage in this image.

Where the smaller Panther Creek flows in the larger Spring Creek, a **delta bar** can typically be found as sediment in the faster flowing Panther Creek falls out of the water column when it encounters the slower moving waters of Spring Creek. Different lobes of the delta bar can be seen on the below satellite image. Notice how the delta bar is elongated in the downstream direction. Because of subsequent flooding events and the variable flow of the creeks, these delta bars are deposited, eroded and modified on a frequent basis. Look at the delta deposits in the satellite images and compare them to the deposits you are seeing during your visit.

In the shallow portions of Panther Creek ripples are forming and migrating along the bottom of the creek. If you get in the creek and watch a single ripple for a minute or two, you can see sand grains bouncing along moving up the stoss (upcurrent) side of the ripple and then deposit on the lee (down current) side of the ripple. The whole ripple will move down the stream in this fashion. As you observe this process think about how a ripple feature can form a layer and why typically only the lee side of a ripple is preserved.

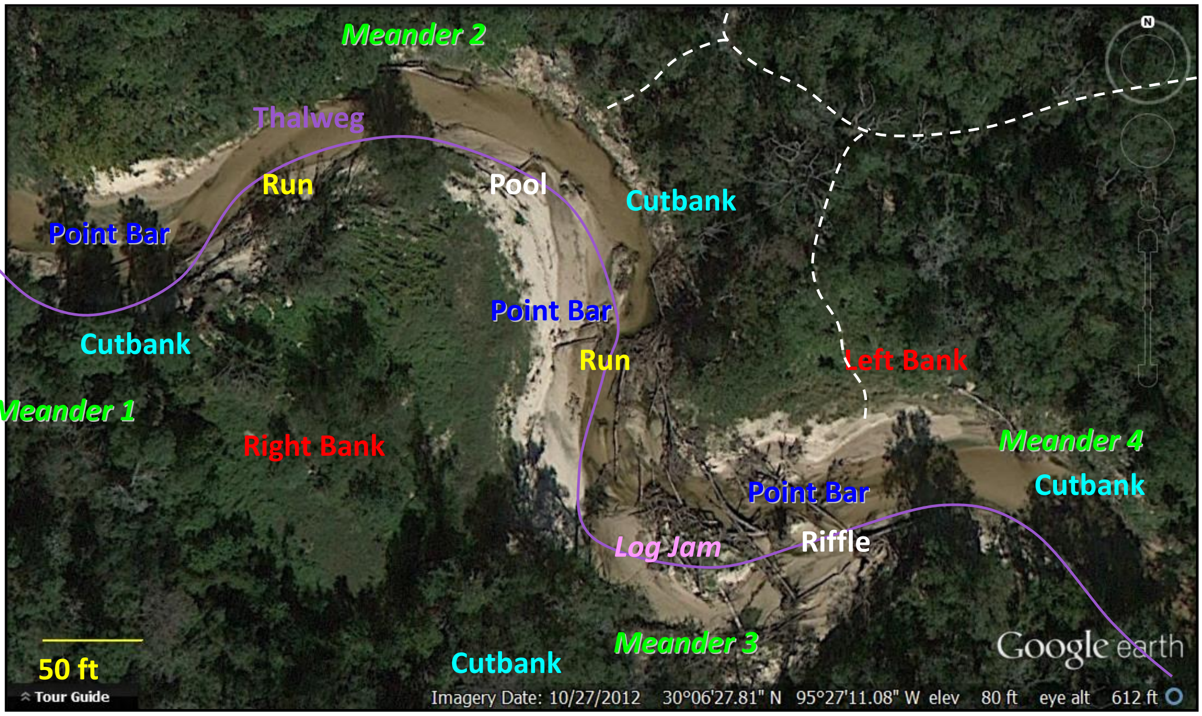


As you observe the ripples, look at the size of the grains that are being transported by the current. Compare that to the full range of grain sizes that can be observed in the creek. Under normal current conditions, the velocity of the water is capable of moving grain sizes from mud and silt to medium grained sand. The grains coarser than medium grained sand in the stream were moved under current conditions with higher velocities when the discharge of the creek was greater due to increased rainfall. Scraping at a bank can reveal the range of grain size that the creek can transport as well as various sedimentary structures including layering, ripples and crossbedding in the creek deposits.

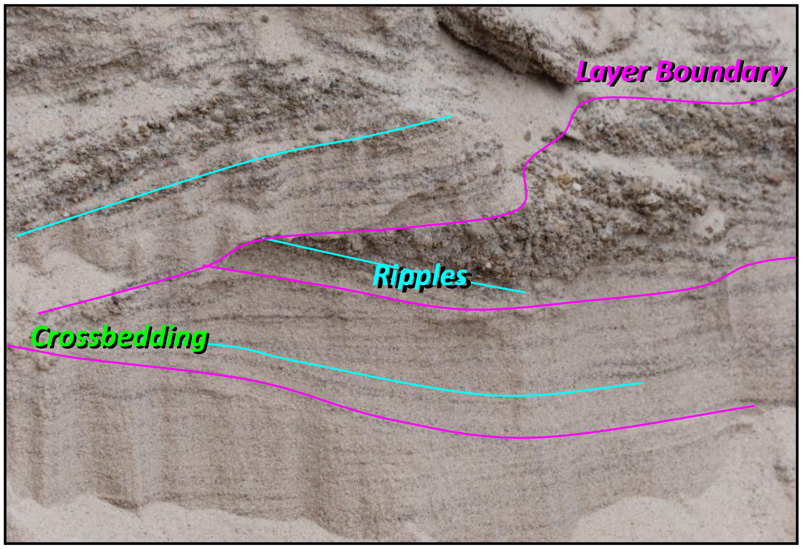
Stop 2 – Meander Bends along Panther Creek

Directions – Walk in Panther Creek upstream from Stop 1 to the first meander (curve) in the creek. As you walk up the creek observe the depositional patterns (bar forms) and sedimentary structures. Alternatively, return to the road along the same path that you took to get there. At the road turn left and continue ~20 yards and enter the Circle path on the left. Go down the Circle path until the path splits. At the split go down the left hand path and follow it to Panther Creek.

Panther Creek has a number of **meanders** (curves) along its length. At this stop, observations can be made of the many morphological features of a meandering stream including cutbanks, point bars, pools, runs and riffles. The sharp bend in the creek at Meander 3 typically has a log jam.



Scraping at a bank can reveal the range of grain size that the creek can move as well as various sedimentary structures including layering, ripples and crossbedding.



Stop 3 – Bridge over Panther Creek

Directions – From Stop 2 continue walking upstream in Panther Creek through some more meanders. Continue to observe the depositional patterns (bar forms) and sedimentary structures until you get to the bridge. Alternatively return to the Circle path along the same path that you took to get there. At the Circle path go the left and continue on the Circle path until in comes back to the gravel road. At the road, turn left and continue along until you reach the bridge crossing over Panther Creek.

The previous stops have looked at the morphology of a stream under natural conditions. At Stop 3 a bridge has been built across the creek and has modified the natural process. Take a look around and see how the stream has changed because of the bridge from what we have observed at the previous two stops.

1. How has the stream interacted with the man-made structure of the bridge?
2. What parts of stream morphology can you identify here?
3. The bridge was completely rebuilt in the fall of 2014. Below is a photo of the bridge that was replaced. From your observations and understanding of the natural processes occurring, why was it necessary for a new bridge to be built?
4. The new bridge is built differently than the old bridge. What are the differences? Why did they build it this way?
5. What will happen to the new bridge in the future?


Bridge (Fall 2014)


Bridge (Fall 2013)
Erosion at base of concrete
Erosion around pipes

References for Material Used

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Exercise 1

Label the features of a meandering stream that can be seen on a section of Spring Creek.

1) Cut bank 2) Point bar 3) Thalweg 4) Right bank 5) Left Bank 6) Riffle 7) Pool

Exercise 2

Sketch and label the sedimentary structures found when a section of a bar is scraped clean. Include a scale bar. **1) Layering** **2) Ripple features**

Exercise 3 – Stop 2

At Stop 2, locate these points on one of the cross sections from one side of the stream to the other to use for your sediment sample descriptions. The creek will be different from the satellite image so just do you best to find locations that cover different features of the stream.

Exercise 3 – Stop 2

In a cross-section across the stream where do you think will be the coarsest grains?

In a cross-section across the stream where do you think will be the finest grains?

Describe the location of the sample point (bar, thalweg, right bank, left bank, pool, riffle)
Describe the sediment at the sample point (grain size, roundness, sorting, color, composition)

Sample	Location	Sediment description
1		
2		
3		
4		