Your Name_____

Survey Partners_____

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Fluvial Terrace on the Huntington River – Deglacial and Post-glacial History of Northern Vermont

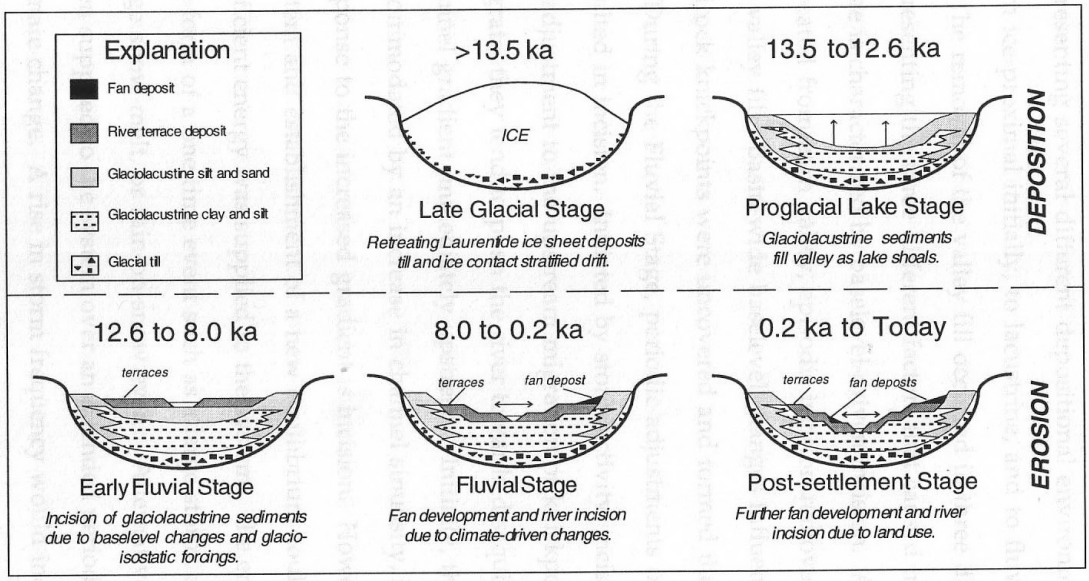


Fig 5.2 from Whalen, 1998. Schematic evolution of valley formation

Introduction:

We will return to the Huntington River Audubon Center this week to learn how to rapidly survey (using Pop-Levles) a flight of fluvial terraces formed during the deglacial and post-glacial history of the Huntington and Winooski River valleys, Vermont. In addition to these fast surveys, we will construct more detailed cross-sections of several fluvial features and terrace risers (scarps) cut into floodplains abandoned by the Huntington River during the Holocene using instruments called Auto-Levels. Finally, we will place the data we collect in the context of a pre-existing and comprehensive body of work assembled by Tim Whalen in 1998 in order to understand better how the landscape we tread upon today was created in the past through the actions of ice, falling levels of pro-glacial lakes, flowing water, changing climate, and the activities of humans over the past 200 years.

What to hand in:

This handout with all questions answered, your Pop Level and Auto Level field sketches drawn to scale, an excel plot of your auto-level cross-section (**Completed by end of class on Friday**), and your concept sketches of the Huntington River longitudinal profiles.

Gear we will need:

- 5 GPS units
- 5 of each the ortho and topo laminated maps.
- 5 pop levels
- 100 m, and several 30 m tapes.
- 5 auto levels, tripods, and stadia rods.
- Extras: extra batteries, cameras.

Specific Skills and Knowledge:

By the end of this week's lab, you should be comfortable with the following items:

- Collecting GPS points at the beginning and ending of both your Pop-Level and Auto-Level surveys.
- Collecting fast survey data using a Pop-Level and stadia rod.
- Collecting detailed survey data using an Auto-Level, tripod, and stadia rod.
- Plotting field sketches to scale.
- Plotting and analyzing your more detailed surveys of river meanders and terrace risers.
- Placing all of your findings in context of Tim Whalen's work studying Huntington River terraces, particularly longitudinal profiles.
- Contemplating how the Huntington River Gorge, located downstream of the terraces we surveyed fits into the evolution of the Huntington River Valley.

We will park at the Sugarhouse parking lot, and begin our lab with a short practice session using pop levels and stadia rods to survey a landscape as opposed to a river channel. Groups will then use these techniques to survey from the terrace scarp behind the peeper pond down to the Huntington River channel. There we will regroup as a class and go through the basics of surveying with an auto level. Groups will again split off and construct detailed cross-sections. Two groups will survey an abandoned meander, while the other three will survey terrace risers increasing in age to detect changes in slope.

Field Task 1 - Collecting GPS readings at the beginning and ending of your pop-level survey:

Collect a GPS reading at the first and last point of your terrace survey. This will enable you to see the angle of the trajectory you walked in relation to the active river channel on the grided laminated maps.

Beginning GPS point _____Easting_____Northing_____Elev

Ending GPS point _____Easting_____Northing_____Elev

Field Task 2 - Conducting your Pop-Level Survey:
(Gear you will need: GPS unit and maps, Pop level, stadia rod.)

Break up into 5 groups. Now get organized such that one person is the designated pop-leveler, one person holds the stadia rod, one person is the data collector and one person is the field sketcher. Refer to the pop level data collection sheet…it has many helpful hits regarding how to collect your data.

1) The first thing you need to do is figure out how many paces it takes for the person with the stadia rod to walk 30 meters. This way you approximate the distance between your points simply by counting how many paces it takes to walk to the next one. Stretch a 30 meter take out along the ground and have the person holding the stadia rod casually stride from beginning to end. Record how many paces it took. Now divide 30 meters by the number of paces and you have a measure of Meters Per Pace (MPP). Record this on your data sheet. It will be used to calculate all of your distances.
2) Have the person with the pop level stand directly in front of the stadia rod such that the pop levelers feet and the bottom of the rod are at exactly the same level. Record the height that the pop levelers see on the data sheet. This is the eye level of the pop level and will be used to calculate all elevation changes between points.
3) Have the pop leveler stand at the uppermost position of your cross-section. This is your starting position and first point. After using the data sheet to calculate, both your distance and height should be zero.
4) Now have the person with the stadia rod walk down hill to the next point, counting paces as he or she goes. Record the number of paces on the datasheet and immediately calculate the distance the rod person has walked and record.
5) Now, while the person with the stadia rod is standing at this point, have the pop leveler site the level they read on the rod and record this value on the datasheet. The *Height of the Pop Leveler* (HPL) minus the new height seen on the stadia rod will yield the elevation difference between the original point and the surveyed point. Note that because your first point is at a height of zero, and we are walking downhill, the height of every subsequent point will be negative.
6) Repeat these steps until you have surveyed down to the water's edge. You want to choose your points carefully such that you catch all major breaks in slope. Your point spacing will depend heavily upon how sloped the ground surface is. If the surface is flat, you probably only need a couple of points to characterize it. If the ground pitches steeply, you'll want more survey point sand you will want them at the inflections.
7) **Remember that all the while, the field sketcher must be constructing a cross-section field sketch draw to scale. You will hand this in, so make it neat. You can include any relevant information on it that you think is useful.**

Later in the lab, you will be asked to think about how much of the total height of terraces you just surveyed. Below, record the total elevation change in meters. If your beginning height is zero, and your ending height is -35.1 meters, your total elevation change is 35.1 meters.

Total elevation change = _____meters

Field Task 3 - Conducting your Auto-Level Survey:
(Gear you will need: Auto-Level, Tripod, and Stadia Rod)

After completing a rough survey of terraces, we will conduct a much more detailed survey of subtle geomorphic features using Auto-Levels. This will allow us to measure more accurately changes in height and distance, and allow us to visualize and quantify changes in shape and slope of the landscape.

Which feature is your group surveying? _____
(Either the channel meander, the oldest riser, the middle riser, or the youngest riser)

1) Get yourselves organized again. During the surveying, try and let everyone take a turn with all parts of the operation. For starters, designate one person as the auto leveler, one person as the stadia rod holder, one person as the data recorder, and one person as the field sketcher.
2) Take some time and familiarize yourselves with the data collection sheet. If used correctly, you will wind up with perfect X –Y coordinate pairs that you won't need to change at all when you get back to the computer lab.
3) First thing to do is measure the Instrument Height (IH) and record it on your datasheet. It will be used to calculate all elevations. Measure from the ground surface up to the eyepiece of the auto level mounted on the tripod. It should be set up so you can comfortably look through the instrument without bending over too far.
4) **Measuring Distance:** record both the reading of the top and bottom stadia lines on your collection sheet. By subtracting the bottom from the top, then multiplying by 100, you will get the distance that the stadia rod is away from the auto level. This is your X coordinate. All but one of the stadia rods are in meters. The group with the rod in decimal feet, make sure to talk to us before beginnging your survey.
5) **Measuring Height:** record the reading at the center of the crosshairs. By subtracting the Instrument Height from this value, you will get the height above or below the ground surface where the auto level is set up. This is your Y coordinate.
6) **Make sure that the field sketcher is constructing an accurate sketch as you go from point to point. It is much easier to spot a mistake in your sketch than in a table of numbers.**
7) If you are surveying the meander, make sure to survey all the way from the instrument, across the paleochannel, and up the adjacent terrace scarp as high as you can go (either until you are blocked by foliage, or the auto leveler can no longer see the bottom of the stadia rod). If you are surveying the terrace risers, make sure to survey a portion of the upper terrace, the entire sloping riser and a good distance down onto the lower terrace. You need to make sure you have surveyed far enough away that you are catching the actual lower terrace surface and not just the tail end of the riser.

Field Task 4 – Poking around Huntington Gorge:

(Gear you will need: Your eyes, ears, and an awareness of the edge)

After our surveying, we will drive downstream to Huntington Gorge and spend some time poking around and discussing how this feature fits into the post-glacial history of the Huntington River Valley. It should be a beautiful day and a great opportunity for pictures.

Collect a GPS point at the gorge so we can plot it up on the map and see how far upstream it is from the Winooski confluence.

Easting_____

Northing_____

Use the space below to take notes and draw any sketches you feel are relevant:

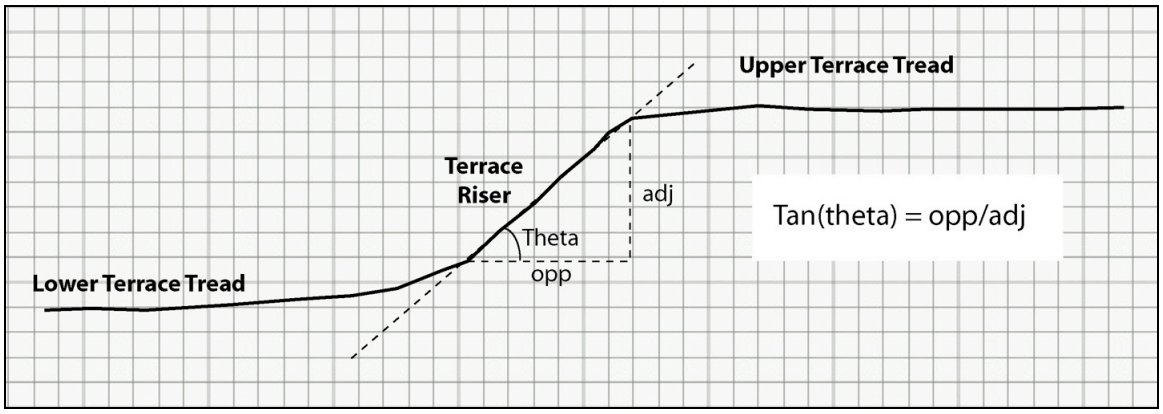
Lab Task 1 – Plotting up your Auto-Level survey data:

Get into your survey groups. Take a few minutes to finish up any calculations needed on your datasheets and enter your data into excel. This should be quick as the only two columns you are concerned with are the X and Y final coordinates.

When you are done, **Plot** up your detailed Auto-Level cross-section in excel. Make sure to include a title describing what the survey is of, label you axes, and activate both major and minor gridlines on your plot. When it looks pretty enough for you, print it out.

You will need to complete the following steps in the computer lab on Friday, and hand the cross-sections to Lee, Paul, or I before you leave. The entire class will use the cross-sections from all groups.

For the groups that surveyed terrace risers: Once you have printed out your cross-sections, you need to determine how steep (in degrees) the scarp separating the upper and lower terraces is. These three groups have surveyed risers of different age that have been exposed to the elements and hillslope processes for different durations of time. With this lab we are beginning to transition from rivers to hillslopes, and this exercise will be a good stepping-stone. How would you expect the relative ages of landforms to be related to slope? How would you expect slope to change over time? You will use the inverse tangent function to figure out how steep your scarps are. Before you set this up, grab one of us to see if you have decided on an appropriate slope for your scarp. Your set up should look something like this, but with titles and axes:



For those groups that surveyed the paleo-meander: Use your cross-sections to determine basic channel dimensions such as channel width, and depth at the inside of the meander vs. the outside, as well as anything else you feel is relevant.

All Groups: After you have printed out your plots, made your measurements, and recorded them on your labeled cross-sections, **HAND THEM TO LEE, PAUL, OR I**. We will scan them and post them on the website for you to think about over the weekend.

Lab Task 2 – Specific questions related to your cross-sections:

Answer the following questions here in your lab handout. Keep them in mind while putting together your concept sketches of the Huntington River longitudinal profiles.

Q1: On the attached figure of the Huntington River terrace profiles, located where we conducted our surveys (approximately 5.75 km upstream from the Winooski).

a) How does the total elevation change that you surveyed section compare to the elevation change between your beginning and ending GPS point? If they differ, which do you think is more reliable and why?

b) Does your surveyed section record the entire terrace sequence or just older or younger terraces? Defend your choice with a logical argument.

c) According to Tim Whalen's interpretation of the different stages of river adjustments recorded in the Huntington River Valley (***in* Wright, *etal.*, 1997**), do you think the terraces you surveyed represent climate and environmental changes or changes in base level? Support your conclusion.

Q2: Using the scans of the three terrace risers surveyed with auto levels that are available on our website in the "**Class Data to Download**" link, discuss the relationship (if any) between the relative age and slope of each riser. What would you expect and why? What do you actually see? If what you see differs from what you would expect, why could this be?

Q3: Using the same link, discuss what you see in the surveys of the paleo-meander. Are the surveys similar or different? Given what you know about the form and process of meandering river channels, do these measurement make sense? If not, what are some explanations for the discrepancies.

Lab Task 3 – Concept sketches of Huntington Longitudinal Profiles:

Using the information provided in the reading by Tim Whalen on proglacial lakes and river history, the data we collected today and discussions we had along the way, as well as concepts we went over in lecture on Monday, take a crack at another concept sketch, this time for the longitudinal profiles of terraces preserved in the Huntington Valley. Attached you will find a version of the profiles. Take notes on it, or jot down idea and sketches. We will provide you with a larger (11 x 17) version in class on Friday on which you should produce your actual concept sketch.

When creating your concept sketches, make sure to pay attention to the suggestions we made about them last week. You will find a complete version of "**Creating Effective Concept Sketches**" linked to the main page of our website. Read through it and try to incorporate these ideas into your sketches, as they are what help us determine how well you understand the material. Names and descriptions are great, but we want to also see that you understand the underlying processes and interconnections.

Some ideas to get started with:

What does the modern long-profile of the Huntington River look like? What processes could be responsible for this? Is it a smooth curve? Is it stepped? What does this tell us about energy and river adjustment?

How do the terraces differ from the headwaters to the outlet of the Huntington River? How would you describe this and what does it mean?

How do the terraces differ from oldest to youngest? What does this tell us about drivers for river terrace formation at different times? How does this relate back to Whalen's chronology of the deglacial and post-glacial evolution of the Huntington River Valley discussed in (**Wright, *etal.*, 1997**)?

When we look at river profiles and terraces in long-profile form, we see how slopes change over the entire river length, however we can't tell anything about the cross-sectional form of the channel. Conversely, when we look at a river channel in cross-section, we can't tell anything about channel slope upstream or downstream. What additional information do we gain from our Pop- and Auto-Level surveys of channel cross-sections that we don't see in the longitudinal profiles of terraces in the Huntington River Valley?

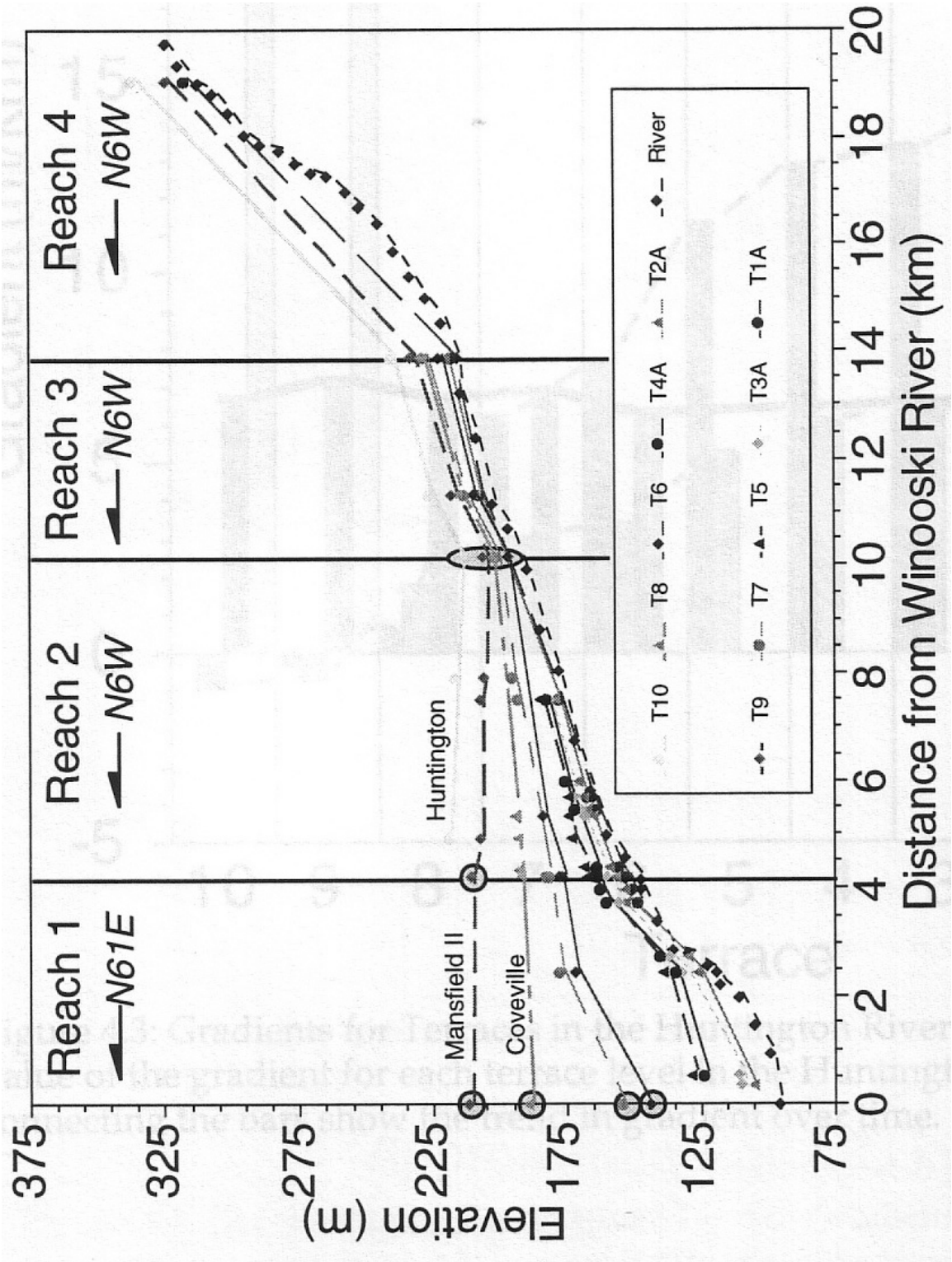
How does Huntington Gorge play into our story of river evolution? Does it pre-date glaciation? Does it post-date glaciation?

What does the gorge imply about river adjustment?

How has the Huntington River Valley evolved since the time of deglaciation? Think about more than just the presence of terraces; think about the preservation of features upon the terraces. Would expect terrace risers and other topographic features on younger terraces to be similar or different than those on older terraces? Why?

Most of these questions don't necessarily have right or wrong answers. Use them to get you started thinking about the Huntington Valley as a constantly adjusting system through time. We can only see the present, but can make inferences about the past based on what we think we know about how river systems work.

You will use a larger version of this plot for your Concept Sketch:
(Use this version to take notes on)



Use this page if you need extra space for concept sketch notes:

Data Collection Sheet For Pop Level Survey:

Meters / Feet
Our Stadia rod is in: (circle One)

[ ] **= (HPL) Height of Pop Leveler (walk up to the stadia rod and write down the height you see).**

[ ] **= Number of paces to walk 30 m**

[ ] **= (MPP) Meters per pace (30 m / Number of Paces)**

Instructions:
1) The Pop Leveler should stand at the upper point.
2) The person with the stadia rod should walk down slope to the next point, counting paces as they go.
3) The Pop Leveler should read the Height seen on the stadia rod and the recorder should record it in meters in the appropriate box.
4) The Pop Leveler should walk to the point where the person with the stadia rod is standing.
5) Repeat for each new point.

	Total Distance (X)							Total Height Change (Y):						
Point #	**Number of Paces**		**MPP (meters)**		**Distance b/t points (meters)**		**Total Distance From Start (X) (meters)**	**HPL (meters)**		**Height read off stadia Rod (meters)**		**Negative Height Change (meters)**		**Total Meters Below Start (meters)**
ex pt 1	zero at start	**X**	1.7	**=**	0.0	**Sum**	0.0	1.50	**-**	1.50	**=**	0.00	**Sum**	0.00
ex pt 2	10	**X**	1.7	**=**	17.0	**Sum**	17.0	1.50	**-**	2.12	**=**	-0.62	**Sum**	-0.62
ex pt 3	5	**X**	1.7	**=**	8.5	**Sum**	25.5	1.50	**-**	3.20	**=**	-1.70	**Sum**	-2.32
		X		**=**		**Sum**			**-**		**=**		**Sum**	
		X		**=**		**Sum**			**-**		**=**		**Sum**	
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		X		**=**		**Sum**			**-**		**=**		**Sum**	

Data Collection Sheet For Auto Level Measurements:

Meters / Feet
Our Stadia rod is in: (circle One)

[ ] **Measure and record the instrument height (IH) here.**

* The Instrument height is the height from the ground to the eyepiece of the auto level. You need to measure this.
** All Heights (Y-coords) are relative the to ground below the tripod. Anything above your feet is Positive, anything lower is negative

	Distance From Instrument (X):								Height of Point (Y):				
Point #	TS Top Stadia Reads: (meters)		BS Bottom Stadia Reads: (meters)		Diff Top minus Bottom (meters)			X-Coord Distance From Inst. (meters)	IH* Instrument Height (meters)		CL Centerline Reads: (meters)		Y-Coord** Elevation Change (meters)
Ex Pt 1	1.61	-	1.39	=	0.22	x 100	=	22.00	1.3	-	1.50	=	-0.20
Ex Pt 2	1.63	-	1.37	=	0.26	x 100	=	26.00	1.3	-	1.63	=	-0.33
		-		=		x 100	=			-		=	
		-		=		x 100	=			-		=	
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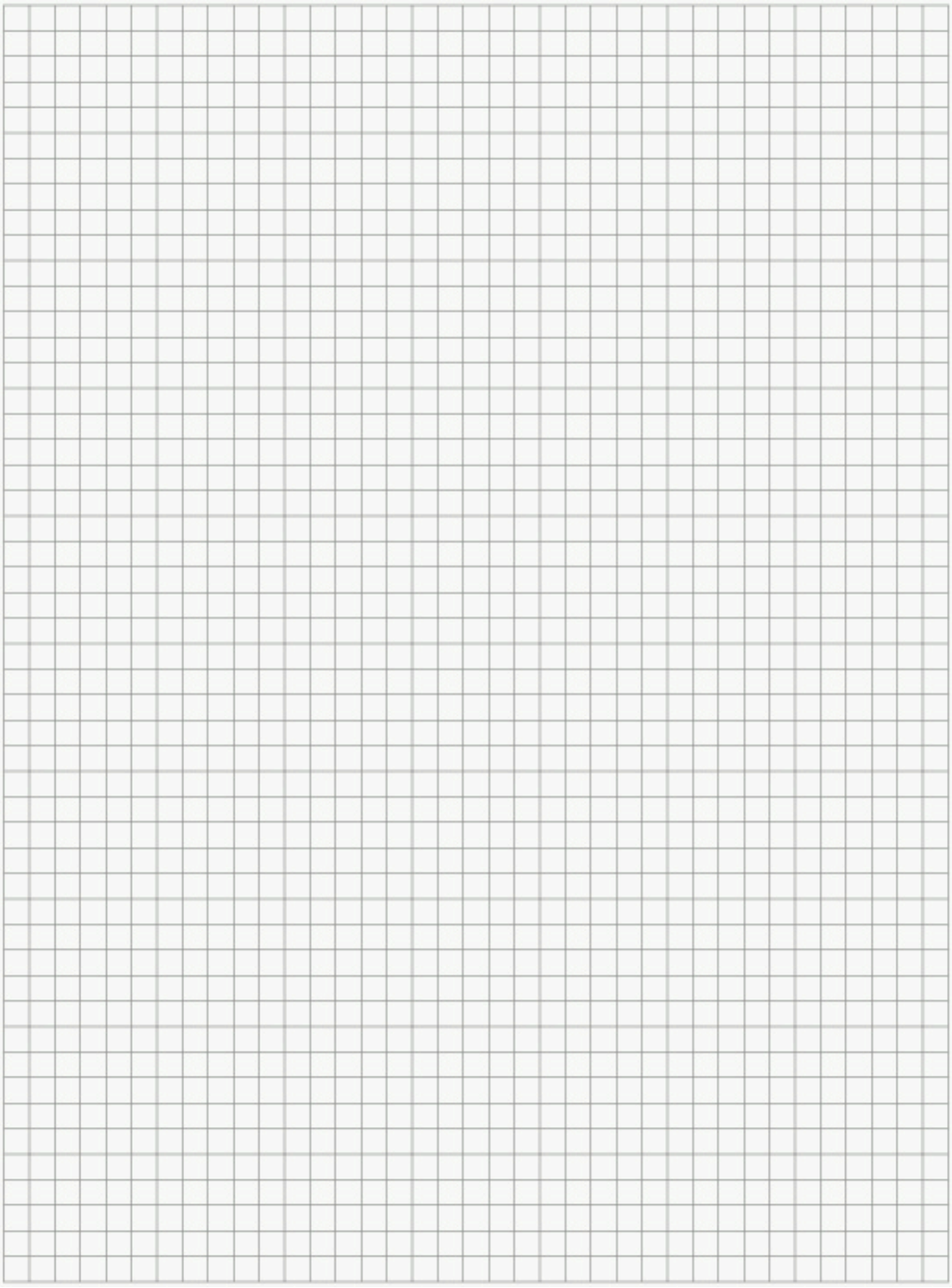
Use this sheet for your Pop-Level cross-section of terraces:
(Remember, this needs to be drawn to scale, so decided on X and Y scales and label)



Use this sheet for your Auto-Level cross-section of risers or meanders:
(Remember, this needs to be drawn to scale, so decided on X and Y scales and label)