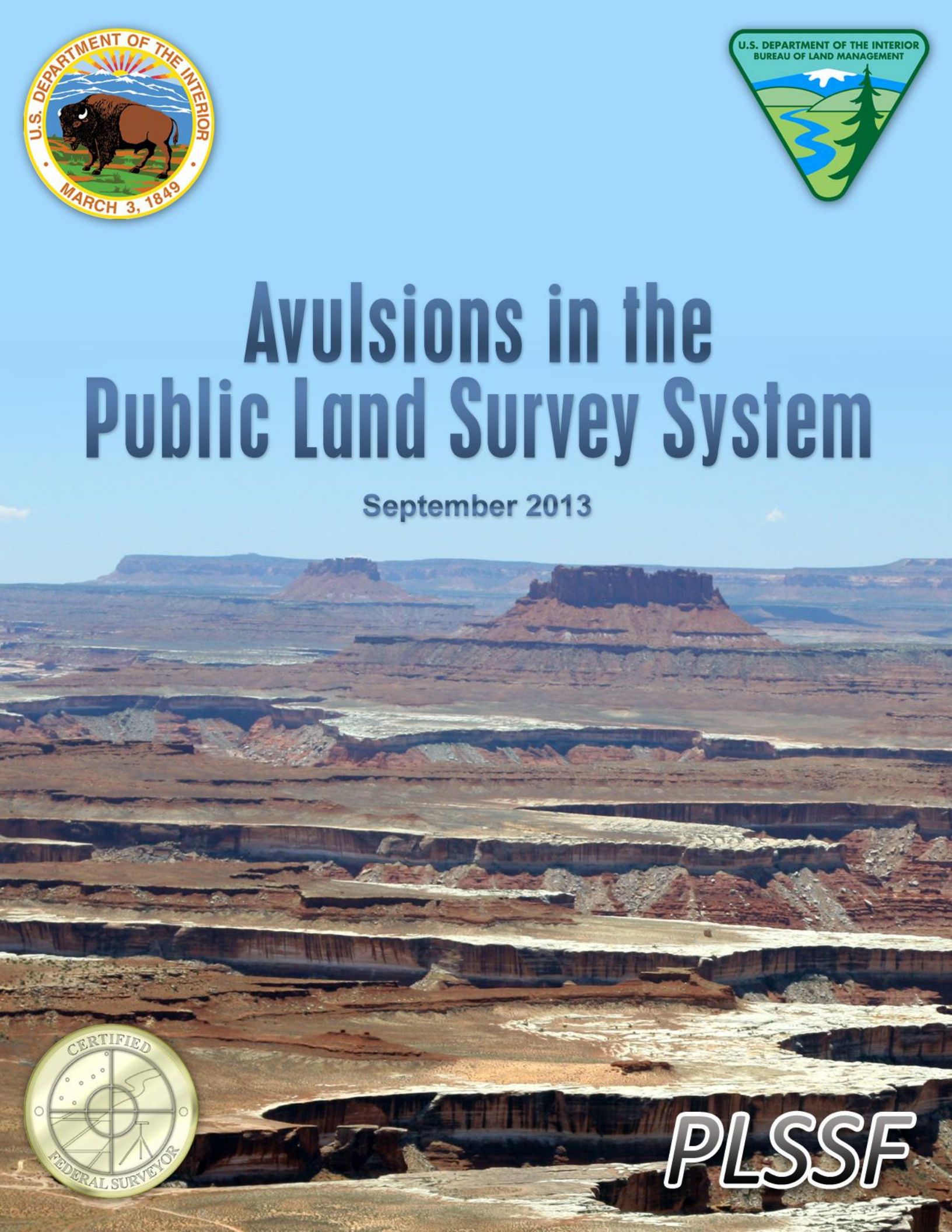
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Avulsions in the
Public Land Survey System
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Introduction

Hello and welcome to this course titled Avulsions in the Public Land Survey System. This is another one of courses that the Certified Federal Surveyors Program has funded in part to provide continuing education opportunities and it is also funded by the Public Land Survey System Foundation. All of this under the auspices of the Bureau of Land Management. So we will be looking at avulsions and those issues with water boundaries and riparian rights and talking about this in this course.

I am Dennis Mouland and I will be your instructor for this course and I welcome you to it. Let's take a look at what are goals are in this course.

Course Objectives

Our objectives in this course are:

- Given a change in the channel of a stream, we are going to be able to identify what steps we would take to determine that it was avulsive change as opposed to accretive.
- Given an avulsive change in the channel of a meandered nonnavigable stream, the student will be able to determine the proper procedures, to determine the boundaries of the affected land parcels.
- And given evidence of an abandoned channel, the student will be able to determine the medial line along the center of the channel and how the adjoining properties would deal with that.

So that is our objectives of where we are headed in this course.

Textbooks

Our textbooks in this course, of course the *Manual*, the *2009 Manual* and there is a website there for you if you want to go buy one if you don't happen to own one. Also the *Public Lands Surveying Casebook*. Some of which is available online but not all of it. We will be looking at a particular case about the avulsion of the Santiam River in Oregon. But if you are a CFedS, you probably have this already in your original CFedS stuff, and if you are not and you are taking this through the PLSSF, there is a copy of the case that we are looking at included.

The original *Casebook* was a very large book filled with lots of information and its worth having and you can still buy some at kind of half size but it was a great big book. But for what we are going to do in this course, everything you need will be provided from the *Casebook*. You just need to have your 2009 edition of the *Manual*.

Course Pathway

Now let's discuss our course pathway. We will have a few preliminary things we will look at then we will have a reading assignment. And then an exercise then on the terminology and some of the principles. Then we will look at a particular case in the *Casebook*. We will look at the project site, we will review what evidence they looked at to prove if it was an avulsive change. We will also talk about why they had the survey. We are going to go into how to compute a medial line, how to deal with abandoned channels. We will learn to survey avulsive areas using a COGO-based exercise, which we will provide. Then we will talk about which of those methods best used to protect people's rights or the government's land ownership in the area. Then finally we will end with a final exam. *(This is accessed online from the CFedS website).*

Threshold Questions

With many a survey topic and especially with water boundaries, we have to have some threshold questions. Some things that we have to ask and answer, or understand the potential of the answers before we get started. A lot of that has to do with what kind of law, what kind of circumstance we are going to be dealing with to resolve the survey issues. So we are going to take a look at those as they apply to avulsive surveys or avulsive actions.

The first question, which is one that is asked on almost any kind of a survey of the public lands; and you should ask this type of question whether you are a Federal surveyor working as a CFedS on some Indian lands or working as a private surveyor working on private lands. That is: What is the land status of the land involved, including that of the adjoining properties?

Now we should understand that land status is a Federal term for the condition of the title. Who owns it? What rights do they have? What don't they have? Are there easements against it, that sort of thing. It's the equivalent to looking at a title commitment. What is the situation or the status of the land at this time and its ownership. So the first thing we ask is: Is it Federal?

If it is: Is it public domain or is it acquired? Now why would that be important. Well, because there are different rights associated with each of those. If its public domain, then it is going to be treated by Federal law. Understand that public domain, really means in almost every case, it means land that has been Federal in the public domain states and always has been Federal, it has never left Federal ownership. On the other hand you can have Federal land that is acquired. That is it left Federal ownership for some time then came back into Federal ownership either by purchase, land exchange, gift, whatever. Doesn't really matter, it came back into Federal ownership. The issue is that while it was outside of Federal ownership, it can be affected by state law.

We need to remember that whatever the person owned who sold it back to the Government they can only sell what they had. That is both in quality and quantity of land. So that is an important issue and there could be a, I won't say problem, but issues that affects the land status of acquired land.

Now, if it is not Federal, then we should understand that state law can and will affect the survey. In state law when we talk about that, that includes statutory law as much as it does case law. Interestingly that with water boundaries, some statutes, in some states where the legislature got together and addressed the issue or some issues, but in many states the legislatures has been essentially silent on most subjects about water boundaries. They have let the courts do the speaking, so we have case law that may differ from state to state.

A second threshold question which will be relatively obvious if it applies but that is: Is the river, we are talking about here in the case of an avulsion, is it influenced by the tide? Now understand that we can't like have a rule that says if it is within five miles of the ocean well then that is tidally influenced; because that is a function of the gradient of the river. The amount that the tide changes, which varies, greatly depending on where you are, so this is something that, even if you are remotely close to the ocean, then you need to consider that if there is some tidal influence, and that goes for any kind of water boundary movement, it is guided by a set of laws and principles that are not covered in this course.

You will have to find elsewhere, the *Manual* has some information on that. A really good source that I found is a book by George Cole simply called *Water Boundaries*. He has a lot more about the ocean than he has inland, so that is a great source. You know the book, or the *Manual* I should say, has a few things to say about it but it is not an in-depth study and we are certainly not going into it in this course. So if it is not tidally influenced then, then it is considered an inland water body and then will fall under the rules and principles that we are discussing in this course.

Then a very important question comes up: Is it navigable for title to the bed purposes? Now we ask the question that way because the term navigable or navigability is applied under many different laws in different ways with different definitions. We need to be aware of the fact that what we are talking about is simply who owns the bed. It may apply to other things, you know, as far as who owns the minerals that sort of thing, but we are talking about title to the bed as opposed to navigable waters of the United States, that is a term that comes from the Clean Water Act, which includes almost everything. That is not what we are talking about. We are talking about things that are navigable under the definitions as you see in the *Manual* for title to the bed purposes and the Supreme Court cases that have talked about it as an issue under the property clause as opposed to the commerce clause of the constitution.

So, if it is navigable for title of the bed purposes, then the state was given that and had the rights to it up to the ordinary high water mark. Now the states may have relinquished some of their claims or all of their claims or changed the location of their claims. Some states have completely relinquished, by statute, their interest in, their ownership of anything in the title to the bed of a navigable stream. Others have changed it; that they only claim to the ordinary low water mark. And so these are issues that have to be determined because we are in an avulsion or most other things we are talking about; where is that edge of the water by law and how does it affect things. So if it is claimed elsewhere, how does the state law affect it?

If it is nonnavigable for title to the bed purposes: Is the division going to be governed by Federal law or state law? And that brings us back to the discussion earlier, the first question, which was that of land status.

Then our last question: Is the change in the water body location due to accretion and erosion or is it due to avulsion? Of course that is a very direct question to our subject here and the case that we look at in the *Casebook*, certainly has that investigation done and that is something we would always be doing when looking for an avulsion. Now, we need to recognize as you will read in the *Manual*, that the burden of proof is on the person claiming avulsion. If there is avulsion or the possibility of it, then an investigation needs be made to determine the location of the water boundaries just prior to the avulsive movement.

If its accretion, did it occur prior to entry on public domain. So if there is accretion either before an avulsion or even after for that matter that can come into play. But if appears to be accretion, was there any fraudulent meanders or omitted lands and that is not our subject here and not really covered in this course. If its accretion will we apply Federal, state law, back to land status again that is on the accreted lands. But when it comes to an avulsion, a sudden change in movement of where the body; where the river is actually flowing, a avulsion generally leaves dry land between the old channel and the new one as we will see. That is what our investigation does is to look at those things. So it is very important to determine if we are dealing with accretion and erosion or with avulsion. And again this course is all about avulsion and we will see the thought process that BLM went through in the particular case that we study.

Avulsions in Rivers and Bona Fide Rights

Let's just briefly talk about rights. When an avulsive change actually occurs with a river, we need to realize that all of this is real property. The title to the bed or not owning the bed or whoever has the title to it; it is real property and while it may not have as much use or it may have jurisdictional issues on top of it especially if it is navigable under other laws, we need to realize that these are still, for private parties, bona fide rights.

The new channel as we will read is generally still owned by the underlying owner, but our task in a resurvey is to protect the bona fide rights of the private citizens and again bona fide rights are discussed quite well in the 2009 edition of the *Manual*, is all about location. Avulsions can be further complicated by accretions either before or after the avulsion, and we will talk about that.

The Federal Government technically does not have bona fide rights, although some people could argue that point, but they still have the right to the land in front of their holdings or in an avulsive case, you know, whatever rights they had before the sudden change, those need to be protected as well. So whether you call them bona fide rights or not on the Federal side, they are rights as to land, and ownership of land, and boundaries of land that we are going to be consciously protecting Federal or not, and again back to our threshold questions as to which kind of law, which kind of situation is going to control how we determine and protect those locations and those rights.

Source of Law

So we have bounced all around this discussion of source of law and that is what those threshold questions are all about. Here are some places in the *Manual* where that is discussed generically, not just about avulsions, but generically. And we need to recognize, that I already defined the term land status, I talked about the use of the term navigability in other places and that is discussed in 8-37 as a different application of navigability. But we want to pay attention to what law will control what we are going to do. That is what the threshold questions were about. Among other things so that we know, that we frame, we put a frame around what it is we are actually going to have to deal with, what we are going to have to know, what we are going to have to retrace, what we are going to have to investigate.

Limitations of this Course

We have already alluded to the fact then that this course doesn't cover every possibility and so here are some limitations on this course. So rivers that are navigable for title to the bed, we will discuss avulsion, where the boundary of the upland with the bed is the ordinary high water mark, so it can be somewhere different than that so the process might slightly differ. And for rivers that are nonnavigable for title to the bed purposes we are going to discuss avulsions where the boundary of the upland line is the medial line.

So there are some things we just don't cover in this course, and that includes anything about omitted lands, these other definitions of navigability, fraudulent meanders. I already mentioned the process if the boundary is at someplace other than the ordinary high water mark. And also, that the *Manual* citation there, 8-94 about rapid erosion, which is a slightly different situation. And so we don't cover everything in this course but we are sticking, if you will, with a pretty cut and dry (pardon the pun) situation with avulsion of a river. And one last issue here is that of the mineral estates. Let's remember that anytime we are dealing with this, with the beds of streams, rivers, and lakes, and whatever, that there are mineral estate issues that are closely tied to all of this. So we are not covering that in this course, but keep that in mind.

Reading Assignment

So with all of that background information kind of out of the way and those threshold questions, which again help us frame what we will be doing in the course; in a specific project. Then here is your specific reading assignment for this course, and you can see that there Case D6 is the case we will be studying in the *Casebook*. If you are new to riparian surveys, you may want to read Appendix A of this course, which is the introductory material to Chapter D of the *Casebook*. *(Located on your course map)* It is an excellent write up on water boundaries in general. It will help you get familiar with some terminology and principles that we expand on here when it comes to avulsion. So there is your reading assignment and I encourage you to make sure you actually go through and read that, and you mark it up, and you color it, however you do when you're studying or taking notes for anything, but it is good information and vital to understanding the subject at hand.

Exercise 1 Introduction

So this finally leads us to, we got the reading assignment and all that background stuff so we have Exercise 1. And it is based on that reading assignment and some of the other things that we have already discussed. It is a document in your course materials there and when you are completed with it then there is a document called Exercise 1 Answer sheet. You can go through there and it will tell you the applicable portion of the *Manual* or you may want to go back to that Chapter D of the *Casebook*, Appendix A for this course, just to refresh yourself on certain principles. But Exercise 1 is designed to help us refresh those basics that we have read and now we will dive into the course itself.

Terminology and Principles Exercise #1

1. The gradual deposition of soil on a river bank is called:
    a. Reliction
    b. Accretion
    c. Avulsion
    d. Reemergence

2. The meander lines of inland water boundaries are best described as:
    a. Fixed boundaries between uplands and beds of water bodies
    b. Approximations of the ordinary low water mark
    c. Approximations of the ordinary high water mark
    d. Fixed lines for state ownership on navigable streams

3. The title to the bed of a navigable water body is vested in:
    a. The state
    b. The upland owners
    c. The Federal Government
    d. The state unless reserved by the United States prior to statehood or relinquished all or in part by the state

4. The term “ancient bank” generally refers to:
    a. Where the river was at the time of acquisition by the United States
    b. Where the river was on the date of the original survey
    c. Where the river was on the date of statehood
    d. Where the river is as of the date of your survey

5. A sudden and perceptible change in a channel of a boundary stream with a new channel and remaining “fast” land between, is called a (an):
    a. Avulsion
    b. Accretion
    c. Erosion
    d. Channelization

6. When the runoff in a river rises over its banks, it is a (an):
    a. Avulsion
    b. Accretion
    c. Flood
    d. Meander

7. Which of the following is indicative of an avulsion?
    a. Backswamps
    b. Undisturbed uplands between two river beds
    c. Longer river course
    d. Slow movement of water's edge

8. Other than on Indian lands, a claim of an avulsion is:
    a. To be proven through positive evidence by the claimant
    b. To be automatically accepted
    c. Subject to tidal influence
    d. To be automatically rejected

9. After an avulsion, by Federal rules, the bed of the new channel of a navigable river belongs to:
    a. The state
    b. The owner previous to the avulsion
    c. The upland owners
    d. The United States

10. Human channelization of a river is generally treated as:
    a. Accretion
    b. Avulsion
    c. Erosion
    d. None of the above

Terminology and Principles Answer Key

1. The gradual deposition of soil on a river bank is called:
    a. Reliction
    b. Accretion (See 8-76 of the *Manual*)
    c. Avulsion
    d. Reemergence

2. The meander lines of inland water boundaries are best described as:
    a. Fixed boundaries between uplands and beds of water bodies
    b. Approximations of the ordinary low water mark
    c. Approximations of the ordinary high water mark (See 3-159 in the *Manual*)
    d. Fixed lines for state ownership on navigable streams

3. The title to the bed of a navigable water body is vested in:
    a. The state
    b. The upland owners
    c. The Federal Government
    d. The state unless reserved by the United States prior to statehood or relinquished all or in part by the state (See 8-100 and 8-127 of the *Manual*)

4. The term "ancient bank" generally refers to:
    a. Where the river was at the time of acquisition by the United States
    b. Where the river was on the date of the original survey (See 8-133 of the *Manual*)
    c. Where the river was on the date of statehood
    d. Where the river is as of the date of your survey

5. A sudden and perceptible change in a channel of a boundary stream with a new channel and remaining "fast" land between, is called a (an):
    a. Avulsion (See 8-81 of the *Manual*)
    b. Accretion
    c. Erosion
    d. Channelization

6. When the runoff in a river rises over its banks, it is a (an):
    a. Avulsion
    b. Accretion
    c. Flood (See 8-89 of the *Manual*)
    d. Meander

7. Which of the following is indicative of an avulsion?
    a. Backswamps
    b. Undisturbed uplands between two river beds (See 8-98 of the *Manual*)
    c. Longer river course
    d. Slow movement of water's edge

8. Other than on Indian lands, a claim of an avulsion is:
    a. To be proven through positive evidence by the claimant (See 8-97 of the *Manual*)
    b. To be automatically accepted
    c. Subject to tidal influence
    d. To be automatically rejected

9. After an avulsion, by Federal rules, the bed of the new channel of a navigable river belongs to:
    a. The state
    b. The owner previous to the avulsion (See 8-100 of the *Manual*)
    c. The upland owners
    d. The United States

10. Human channelization of a river is generally treated as:
    a. Accretion
    b. Avulsion (See 8-83 of the *Manual*)
    c. Erosion
    d. None of the above

History of the Project Site

Now that we have been through that first exercise, let's start discussing the particular project on the Santiam River. It is discussed in D6 of the *Casebook*. That township there in Oregon was originally subdivided in 1854 and the meanders were done at that time. In the mid 1960's it was discovered that the river had changed location to the north, and what really triggered this was that timber had been cut by private parties on lot 1. Lot 1 of section 23 was Federal land at this time.

There were very large stumps there and they were large enough that it was determined that an avulsion had to have taken place as opposed to an accretion. So this is a little history of the survey and then what happened with the Federal land managers in the area to recognize that something was wrong. They were wondering if it was actually Federal land and Federal timber that had been illegally cut. So that is what got this project rolling. So BLM issued special instructions in 1967 to perform a dependent resurvey and therefore establish the medial line of that old channel within section 23 to determine the location of Federal ownership because there was trespass action and for future management of those lands.

Just so we can see it, here is a picture of the Santiam River and it would appear at very close to ordinary high water mark. This is just a couple of miles from the project area. So that you can see that it is an active river and this area is not a lot of great timber but there was a couple of miles away.

So a real picture of the real thing. So we will look at an overhead of it later. Here is that original plat of that township. And when the river was meandered and so that gives us the original position, or I should say that, the position of the river at the time of the original survey. That of course is what our decisions and observations begin at that point and move forward to looking at what has happened to the river since that time. Now let's blow that up and put a red circle around the particular place there in section 23 where we are going to be dealing with this. You can see the Santiam River kind of running westerly, southwesterly running through here and it takes kind of a dip through there in the northwest quarter of section 23 and that is the area that we are looking at.

Now this next diagram is out of the *Casebook* and you can look at it for more detail, I have added a little bit, but it is showing us look here is where the river was, here is the corners that we found, and here is the record survey data, the record measurements and as you can see the only real lost corner that they had that affected the project was that double proportion of the section corner, and so that is kind of a sidelight to this discussion. We just, of course, accept the position that they computed for that but it is good because it shows that this is a typical project. Usually things aren't that simple where you just go in and do one thing. There is usually a series of events that lead you up to where you come up with your final solution of what it is that you are dealing with.

Here is another figure from the *Casebook* and it is just showing alright here is what we found the situation to be at least in the late 60's when they were doing this survey, and that is the North Santiam River was now a considerable distance north of there, through lot 1, government lot 1.

So the question arises; well is it an avulsive move or did that river just slowly erode to the north and accrete to the south. That is obviously important because lots 2 and 3, here you can see are patented, so our the land status situation is those are patented lands, but lot 1, which the river is now occupying and which is also where the timber had been cut is Federal public domain, so hence our issues here.

Now, the question that we asked earlier; and answer that now: Is it avulsion or is it accretion and erosion? Now as we have already discussed and you saw it in your reading is the burden of proof is on those who claim it is an avulsion and there is an IBLA decision on that *Quinton Douglas*. When you are in serious doubt, when it is really unclear of what it is, then it is assumed to be an accretion. The real question becomes: How can we prove an avulsive act has taken place as opposed to the actions of accretion and erosion? What kind of things can we look at to determine that?

Now there is at 25 U.S.C §194 in statute there is an exception about that burden of proof, that assumption, when it comes to Indian lands. So I will leave that to you to look that up, but you can usually find that through find law or some of these free internet sources to look that up unless you may have a copy of the United States Code in your office which is not a bad idea for certain chapters of the United States Code, but there is that exception about Indian lands and that is important to remember if you are a CFedS, in particular.

So here is a list of possible indicators. The first one is pretty obvious in this particular case: Do you have timber or other foliage or improvements, cabins and other things, that are in the area between the old channel and the new channel that are old enough to have predated the move? In other words what you are looking at: Did the water rise up and slowly move across that or flood that and wipe everything out and just end up in another place? Or did it actually go around it and not interfere with that upland that is there? So you can see with number five a significant high ground needs to exists between the beds. And that is what you are trying to prove with number one about the timber or the improvements.

Basically the dynamics and science of avulsed river channels. The avulsed river channel is usually shorter than the original because the river is looking for a faster way or a shortcut across a gooseneck or across a place where the river had been veering around something now it is veering around the other side. You could eventually have testimony of individuals that yeah the river suddenly moved in the flood of 1942 whatever that would certainly help. And there is climate records and social history records, photos, maps, etc. I've had an occasion to use a book that was about ghost towns in a certain state and in there it specifically talked about the two big floods that occurred in 1921 and 1924, or something, I forget the dates, but this was a different case. But it proved that the change in the river had occurred before they had any aerial photographs. Because it was talking about these ghost towns and how this town became a ghost town because the river wiped out the railroad bridge that is what it was.

So, and we are also looking for, you know some kind of evidence, either from some testimony of individuals, or other records of a sudden change. Erosion and accretion are slow and imperceptible. Now let's understand that even an avulsion, you know when we say it is a sudden

change, and many times it take several days for an avulsion to actually finally cut through and it has been eroding and eroding at the base of the gooseneck if you will. Then finally cuts through. It may take it a few days to do this. When we say slow and imperceptible we are not saying as opposed to instant or instantaneously for avulsion. One of the things about avulsion that some people misunderstand and that there will be a time when both the old bed, or the abandoned bed as we call it, and the new channel, will both have water in them. That is not really counted in that time of suddenness. In fact in many cases it is months or even a few years before the abandoned channel to completely dries up. The fact that there is still water flowing or just standing in the abandoned channel is not proof of slow and imperceptible. The avulsive change itself is what we are really looking for and that should have taken place in a relatively short period of time as opposed to slow and imperceptible, years, decades, that it takes erosion and accretion to occur.

A couple of other things then we have referred to earlier but are important legal principles that we are reminded of now that we looked at that those list of things. That *Quinton Douglas* IBLA case there, that is the case that makes it clear that avulsion has to be proven with real facts and real evidence not just people's wishful thinking you know, circumstantial evidence, or as the *Manual* calls it indirect evidence. I also mentioned that statutory law regarding Indians and there is a quote from that regarding the burden of proof on the person claiming an avulsion. There you have both of those, not exceptions but important principles that we need to consider. Think about it, the one on the left *Quinton Douglas* is talking about real hard evidence that there has been an avulsion; and the one on the right, the statutory law, is talking about land status is it not. Land status in this case that it's an Indian or Indian-owned lands.

Here is an aerial view of this case; 2012 this was taken and I have drawn in the blue line there as the section line, and the red line as the old abandoned channel; and it gives you an idea of what was going on there. There was farming in the area on both sides. You can also see lot 1, where it was and is and where the large stumps were in the high ground. If you have had any training in studying aerial photography and interpreting it, you can also look at this and tell just by looking at the photo without even my red line where the abandoned channel probably had been and that there was some kind of action or movement in there. You know this taken 50 years after and so, there are big trees down in the abandoned channel now, but remember it was those stumps that really played the key in the determination of that high ground.

In this particular case D6, we have proven that there was avulsion because of the high ground, because of the stumps. Had this had been accretion, the private lands to the south, in other words if that river had slowly and imperceptibly moved north, then the owners of lots 2 and 3 would have moved northerly with it. Meaning that by the time the river had got to where it is now, if it had been accretion, then they own that land, and could have cut that timber and it wouldn't have been a trespass of natural resources that were federally owned. But there did not appear to be any accretion and avulsion is pretty clear and the last bullet there on that slide, there appeared to be no accretion or erosion prior to the avulsive move, which is nice, and clean that way. So it just leaves us with the task of identifying where the property lines are going to be that are fixed at the time of the avulsive act.

This is a nonnavigable river. That means that this nonnavigable river bed must be divided between the owners on each side of it. Because in Oregon that is an ordinary high water mark state and the state still claims the beds of navigable, but on nonnavigable, which this is, they don't own the beds of that. The upland owners do. We are going to have to determine the medial line between them and that Federal land, that was called lot 1 on the original survey plat.

Now let's talk for a minute about the median line and the thread and we will talk in a moment about the difference between the median line and the medial line, which is what we will actually end up using.

There are some rare situations where access to the water is more important. In the equity of how we divide up the abandoned bed. It is more equitable than using a median line or a medial line. Now, in most cases with an avulsion, the medial line is going to be the most equitable. I have seen a couple of places where the avulsed channel ended up still being a stream that was coming in from the side, you know some other stream, and it used the old bed. So access to the water was an issue there and there might be some other situations where that is the case. In 8-71 of the *Manual* does discuss that. In most cases with an avulsed abandoned channel we are going to use a median line, which will actually use the medial line as we will discuss here.

While the words median line and medial line are often used synonymously, they are not synonymous. We need to understand the difference between those and we will discuss in this course how to compute those. The *Manual* goes into pretty good discussion of the median line. The thing to remember about the median line and you can see on the left that it is a point that is equidistant from the nearest point on opposite banks everywhere at all times. So a median line is a continuous line that is formed by straight line and curved segments. The median line may also refer to the average of the distances between non-parallel lines.

Here is the bottom line; a median line, even on a short piece of land like we are working in just this section 23, could potentially have hundreds and on bigger projects thousands of bearings, distances, and little curves. That makes it extremely complicated to work with and to deal with and it is almost ridiculous because you are dealing with guestimates. You are dealing with your guess as to where the high water mark was at the time of the avulsion. Or you are dealing with the record meanders, which didn't close by often quite a few feet.

So, why we are creating this incredibly precise median line off of data that isn't that clear, so we introduce the medial line, which in surveying, is like a median line except it has been greatly smoothed. Let's put it that way, it has been greatly smoothed so it comes out with just a few bearings and distances. It is not equidistant to opposite banks at every single point. It is just at salient points or at more important places. That is a really, I won't say super easy, but is something easily done with the technology that we have with our coordinate geometry software and AutoCAD type applications these days. I will talk about that here in a little bit. So the medial line is a much simpler smoother line. It is easier to establish, to monument, and to intersect.

So you can make this as complicated as you feel like, but it really isn't that important. The *Casebook* references a certain method with a calculator used by BLM in the late 70's. Obviously

before we had the computers, simple computers and good software. The software that they mention isn't available anymore. You are encouraged to use the *Casebook* data and compare it to the medial line that you compute using your software. We will give you that opportunity. Now no two surveyors will ever arrive at the exact same medial lines due to differences in interpretation of the controlling data. That is just part of the reality of this. But let's understand that the use of AutoCAD, or Terramodel, or Microstation, or whatever other COGO/CAD program you have, they have fabulous tools that you can click on opposite points, salient points, angle points in the meander lines, whatever and that you can use to center, midpoint those two, and connect those dots if you will, to come up with a decent medial line. Remember also that there may be times where you are using aerial photography, older surveys that didn't close or whatever, that it is not that precise of positioning. Let's just say that this had avulsed but it had accreted first and we will discuss that later in the course, but you are looking where that difference took place. So you might be using photography to help you with that. So that is not very precise, that is why the medial line is such a good way to go and to use this software that way.

Here is an example, that I just drew and said ok, here are these salient points, the points on the adjusted meander line and I am going in there just picking those points doing a mean on those and connecting the dots in the center and calling that my medial line. You know if some of those angle points are too sharp in your mind and maybe it needs to be a little bit more precise if that's what you really think depending on the data that you sourced all this from. Then you can do this, you could add that line there at another ninety degrees instead of just point-to-point and come up with an additional point. It puts a slight less of an angle in there. But thats all really part of this difference that no two surveyors are going to ever come up with the same thing. What we want to do is something that is just basically equitable.

COGO Exercise Introduction

So to help in the learning process here we are providing a COGO exercise and there is a file that exists in there called Avulsions that actually comes in three formats, RTF, TXT, and PTS formats. It has some information in it from the survey that they did under these specials issued in 1967. You can load that into your computer or data collector whatever you use for COGO and you should be able to complete this exercise. (*Download the appropriate file from the course map. Answer keys are also provided in each format on the course map.)*

What we are going to do is encourage you to compute your own medial line, and then you can take that data and compare it to the *Casebook* solution. You should hit pretty close to what the BLM came out with. You might come out with exactly the same, who knows. We will look at that in a second on slides of the approved plat. But it will be a good exercise in how to do a medial line as well as to see there can be slight differences and they are not worth arguing over. I believe that if someone else has been in there before you and they have done a reasonable job and it is not illegal and not totally inequitable then accept what they have done.

Here is the approved plat, which is also shown in the *Casebook*, and you can see it more clearly really in the *Casebook* than you can on this slide. But it is showing that what they ended up dealing with was the abandoned channel, being nonnavigable, was split by a medial line. So, lot 2 is going to go own out to that medial line, but the Government still owns lot 1 and owns out into the bed of the nonnavigable river where it has been avulsed. It is an abandoned channel. So clearly lot 1 is still Federal land and there was trespass on the timber there.

But now that you can actually access the river bed because it has been abandoned, then it helps to delineate the boundary line between private lot 2 and Federal lot 1. That can be monumented even on the ground here. Here is a blow up of that. When you do the COGO exercise, you can compare it to this, and see how that divides that up. A couple of things to note. We don't have complex ownership in here, where we had a whole lot of other owners; the BLM did not deal with lots 2 or 3 and how they separated their land because BLM was only interested in what is now what is called lot 4, because it has an official acreage. So we have that issue. Also you will notice that they didn't go at ninety degrees to the line or anything down on the west side, they simply extended the section line it was so close. That's fine too.

So our COGO exercise is limited to you being able to compute that medial line and compare it to what the BLM had come up with so we will leave you to do that now. Just so we understand what the extent of a resurvey really would be in this situation, we would have to:

- Retrace the existing lines of a survey.
- Set lost corners by the appropriate method if proportionate measure.
- We would have to adjust the record meanders, because they almost never close.
- You might have to subdivide a section if you're dealing with the different partitions or different ownership within the section.
- You have to calculate the medial line of the abandoned channel.
- You have to establish, normally, partition lines in channel if there is mixed ownership.

So that is the extent of a resurvey, we are going to stop the lecture here where you can go work on the COGO exercise and practice your medial line. And then when we pick it up, we will a little interim review and then move on.

COGO Exercise #2

A file exists of the coordinates for existent corners and adjusted record meanders of the North Santiam River Case, in three formats (.txt, .rtf, .pts). You should load this file into your personal COGO program in order to complete this exercise. You will need to do the following:

1. Compute your own medial line and compare it to the solution shown in the *Casebook* from the official approved plat. You should hit very close to the BLM's solution.
2. Calculate the bearing and location of the division line between sections 14 and 23 as it runs at a normal to the medial line.

Note:

BLM did not run normals to the medial line on the west line of the section on their final plat. A detail on D6-6 shows a normal but this was not used. Apparently the angular difference between normals and the section line itself (less than 10 degrees) was close enough they chose to simply extend the section line across the abandoned channel and set a SMC at the intersection with the medial line.

Interim Review

Welcome back and now let's have a brief interim review of what it is, where we are going here. Five questions here, so I will stop talking here for a few seconds and let you take a look at those questions and jot down an answer.

1. Name three pieces of evidence that an avulsion has taken place?
2. Who owns the land under an avulsed river?
3. The old channel is fixed by what evidence?
4. T/F – An Indian may not have to prove avulsion?
5. T/F – A median line and a medial line are the same thing?

Now let's take a look at the answers here.

1. Name three pieces of evidence, I guess I gave you four there in the answer; improvements, high ground, old trees, and a shorter course. Those are parts of proof of an avulsion.

2. Who owns the land under an avulsed river? The owner of the land prior to the avulsion actually owns that.

3. The old channel is fixed by what evidence? The ordinary high water mark; that is if the river moved prior to but if it really hadn't move prior to the avulsion, then the adjusted record meanders are fine. You may have to use other evidence as we talked about with photos.

4. Number 4 is that statute about the Indian may not have to prove avulsion?

5. And finally, a true/false, a median line and a medial line are the same thing? That is false. They are not the same thing mathematically. But one is far more practical and to use and to compute and that is why we mostly focus on the medial line.

Complex Questions to Consider

Now as I mentioned earlier in the course, we have a couple of things we do want to discuss regarding avulsions. This case is a great case because it is a simple avulsion. We proved what it was, that sort of thing, but here is the problem.

What if one of these following scenarios took place:

1. What if accretions and erosions occurred prior to the avulsion?
2. Then what if the avulsion took place and then accretions and erosions took place after that avulsion?
3. Or in number 3 here, what if both have occurred?

Now of course this starts getting extremely complicated when trying to deal with a lot of historical information. As we will discuss, it is similar to the information, history and records that we looked at to begin with, but we don't want to just jump to the conclusion that this is either an accretion or an avulsion, but recognize that sometimes there are combinations of those two. And we need to be careful of that because that starts changing were people's rights might be located or how we might divide up that land.

Obviously to deal with this we are going to have to track the river's history and understand what has occurred in the past. That can be difficult at times. You will have to put together a timeline of all that stuff. Here again are things we can use:

- Aerial photos
- Local history
- USGS data, which exists on most rivers in the country
- Maps, they could be USGS or other maps by surveyors or entities
- Court records
- Government surveys, local, private surveys and maps
- People's testimony
- Tree rings, counting the rings in the trees, dendrochronoligical evidence
- And other Federal agency surveys

All kinds of information that we can look at that helps us piece together what has actually occurred with that river. And if there is the possibility that we have a mixture of these events. Sometimes this process and this effort takes more time and energy than the actual survey does in the field. We need to recognize how important this is and is not something you just gloss over. It really is important to take a look at to make sure you have a pretty clear picture of what the river has done since the time of the original platting.

The result of that history brings us to this. We are going to protect people's rights including the Government's rights. So accretions prior to the avulsion are generally going to belong to the upland owners. If the abandoned channel does not closely match the original meanders, there has been some non-avulsive movement that requires some protection of rights. Similarly, erosion prior to the avulsion has taken away some land before the avulsion fixed in place those

positions, so we are looking at both the erosion and the accretion side of this prior to an avulsion taking place. We understand that when an avulsion takes place, generally property lines or at least the water boundary lines are fixed.

Now let's turn that around. If the avulsion appears to have taken place first, then you have erosions or accretions after that you got a couple of problems, potentially. One is; it might be hard, depending on how its moved, to figure out where the abandoned channel was at the time of the avulsion and it may be difficult to determine where the new channel was immediately after the avulsion. Obviously the better the maps and all that other data that you are going to use, the more you have the better that is, the better you will be able to figure that out.

Now avulsion as we know fixes the property lines at the time of the action and pretty well stops there. We need to consider the subject of reemergence for just a moment. I suggest you read 8-87 again in the *Manual* and here is why. Reemergence is a very confused topic and that term has been defined many different ways. You will find that the *Manual* defines it differently than the *Casebook*, differently than textbooks, and differently than what court cases have done both federal and state. So we need to look closely at 8-87 and realize that the *Manual* is very limited in what it looks at under Federal common law as to what qualifies as reemergence or not.

So I strongly suggest you read that and maybe ask other questions to folks, but the bottom line under the federal system and the way that the *Manual* interprets, reemergence really doesn't take place unless it is the same soil.

That is a complicated subject and here just is a picture of it. Just imagine again that yellow is where our abandoned channel was. It moved up to the 1955 blue, which is what we have computed and done, but now it has wandered further north. And just understand that just as the river and the blue in lot 1is just occupying lot 1 it is also doing the same thing up there in lot 4 and property lines have not moved unless its true reemergence.

Assuming that the river is nonnavigable, the abandoned channel is divided by Federal law as we have already discussed in this course. If we are dealing with public domain land, which lot 1 section 23 was, then the ownership of the new bed is in the underlying owner; so the Federal Government still owned where it abandoned to and no new riparian rights are established in that case that impact the Federal interest. But if there are acquired lands or private lands in the area, then state law is going to determine if new accretions can occur after the avulsion. The Federal law generally doesn't allow for that, but under some state laws, it does. Again that can be statutory or, in many cases, case law. So many states have adopted the Federal rules which is nice and it makes things easy.

But let's understanding what we are talking about with accretions attaching to the remote parcel. Well let me bring that diagram back up, understand that, you notice the parcel to the north there is patented. It says lot 4 of section 14, what we are saying is that once the river avulsed to the blue position as you see there, then slowly moved up to the north, then the person to the north is probably losing land if the state law allows for that. The person to the south is gaining land, which could be, if lot 1 was private or acquired Federal land, it might be actually gaining and so that is a function of land status once again but helps to understand why the status and those

issues are so important when we start dealing with more complex cases as we are discussing here.

So let's take a look at this and make sure we understand this drawing, it is a little unclear. So let me add a callout arrow here. What we are seeing is this is where the abandoned channel was, that was the same one that we done the project on, the case on. The red arrow is showing where it moved to, in other words it moved south and then it avulsed to the blue position that we have, like we did the project. In this case, we have lot 1 actually accreted see, it went south and east and lots 2 and 3 were eroded, right, when following the way that I just showed you how that drawing is to be interpreted.

Here is a summary of that. Accretion and erosion prior to the avulsion operate under the same basic principles of accretion, which we have a separate course on, slow and imperceptible. At the time of the avulsion, the division of the abandoned bed is what will be divided, so that is after accretions and erosion have taken effect. So lot 1 would have gained land, lots 2 and 3 would have lost land and then we have the abandoned channel that we would deal with. The avulsion fixes the boundaries as of its moment, not just based on where the original meanders were located. Because in this case the river moves slowly and imperceptibly after the original meanders and prior to the avulsive act.

Now what if it went the other way. Well what if we had erosion of lot 1, which means accretion to lots 2 and 3. Here we have where our original abandoned channel, or where our original channel, was and we are saying it went way up to the north there, which is kind of a yellowish tan color on here and then it moved to the position we just did in the *Casebook*. So what we have is lot 1 was eroded prior to the avulsion, lots 2 and 3 were accreted. We would have to deal with this depending on what land we are working with and what rights we are dealing with but it would end up looking like this. Lots 2 and 3 would have accreted way up to the north, lot 1 would have been eroded down to a small piece. Then when the river avulsed to that position through the middle there, well then it is just flowing over the lands that belong to lots 2 and 3 and partly lot 1.

By the way, I realize, you know I hope that you realize you need to maybe play this two or three times and look at these sketches that I got and make sure you understand it. Because even as I am putting it together, you know, I have to look very carefully to make sure I understand what the drawing is showing me and what is taking place there. Hopefully I convey it correctly by words, but it is something that I can do very quickly one shot through and if I mess up I rerecord it, right. But I want to make sure that you follow it and understand it, so it's certainly appropriate to be stopping the course in different places and looking at those drawings to make sure you understand what we are saying under these different scenarios.

Here then is the summary discussion of that drawing that we just looked at. Lot 1 was eroded, the area of Federal title had been reduced. Lots 2 and 3 had gained by accretion. Lands in section 14 were also lost by erosion and that is just the way that is. But the channel, as of the date of the avulsion, is what will then be divided between the upland owners. That process may differ based on Federal or state law; land status once again. But this is what happens when these, when the non-avulsive actions are taking place prior to the avulsion.

Now while all that discussion may seem, once you have sorted through the pictures, seem simple enough let's just understand that the most complex water boundary, riparian situations are those when erosion and accretion has occurred before and maybe after the avulsion. You can also have more than one avulsion; and the historical records become crucial to try and figure that out, but let's also recognize that there are limitations as to what the record can tell us. As we have already discussed, with just one significant exception, if we can't positively prove and identify an avulsion, then we deal with accretions.

We say its accretion and its erosion and I have had to deal with that situation myself where I know that an awful lot of movement has taken place over the river, but I can only track it back so far, like into the 30s with aerial photography. Maybe a little bit further back with other data but it's obvious from the time of the original survey when the meanders were platted and returned on the plat.

And then up until the time when I start having historical records, a lot may have happened but I can't really tell. Unless there is just clear evidence of highlands that sort of thing that date back to such that it would have been an avulsion. Obviously combinations of those things get very complicated but you also don't or can't spend forever working on it and running all of the what ifs. My point is at some point in time we just have to be practical and say look I really have a pretty good idea of what has happened since, you know just whenever, the 30's, I don't have a good idea before but if you are in doubt we are going to call it accretion/erosion. But if there is some significant proof that there was an avulsion, then you have to deal with it the best you can.

Do the best you can estimate as to where those ordinary high water marks or other if some other locations, where those were at the time the avulsion occurred. Because that is where those boundaries are going to be fixed.

Course Review

So that brings us to the conclusion of this course. What I have done here on the left is given you our objectives that we had and on the right we have covered the issues and the complexities that take place with mixtures of avulsions and other processes. We talked about how to do basic avulsion and medial line computations of the abandoned channel. We really discussed how important research of the record, applicable law is and how much other information there is. I do want to encourage you get to know chapter 8 in the *Manual* quite well, as well as the chapter 8 Notes that are in the *Manual* because this is a lot of good information there, and guidance, and case law studies on different various applications of this.

You know, as with so many things in surveying the subject here is easier to talk about than it is to actually do. Because you get into so many what if's and possible conflicts and that sort of thing. We tried to present here, for you, the basics of avulsion. So there is a final exam with this course and depending on what format you are getting this, you will get the exam and the answers to it.

That brings us to the end of the course and I do want to thank you for your patience in it and taking it. This is one of those subjects as with most things about water boundaries and other issues, there is a lot to go with, there is a lot, you know, you may want to go back and look at the whole course again. I know that I have read portions of chapter 8 many, many times then had to ask people for help. Read things in the *Casebook* and have had to ask people for help to make sure I understood what they were really saying and what was really going on. So we encourage you to do that. Recognize that this is a fundamental course, but it should get you started on whatever you may be dealing with, with avulsions in the public land survey system.

So we thank you for taking this course and we wish you well in all that you do.