**Instructional Tour Supplement: Fluvial Geomorphology Lab, prepared by Katie Burles, College of the Rockies.**


**Figure 1**: Instructional Tour: Fluvial Geomorphology Lab. Your lab instructor will have provided a KML file of the Instructional Tour. If for some reason you are unable to view the KML file in Google Earth (web), use the images provided in this document to supplement your lab.


**Figure 2**: Examples. The following pages include examples of features (deltas, fluvial fans, braided streams, and meandering streams from around the world.

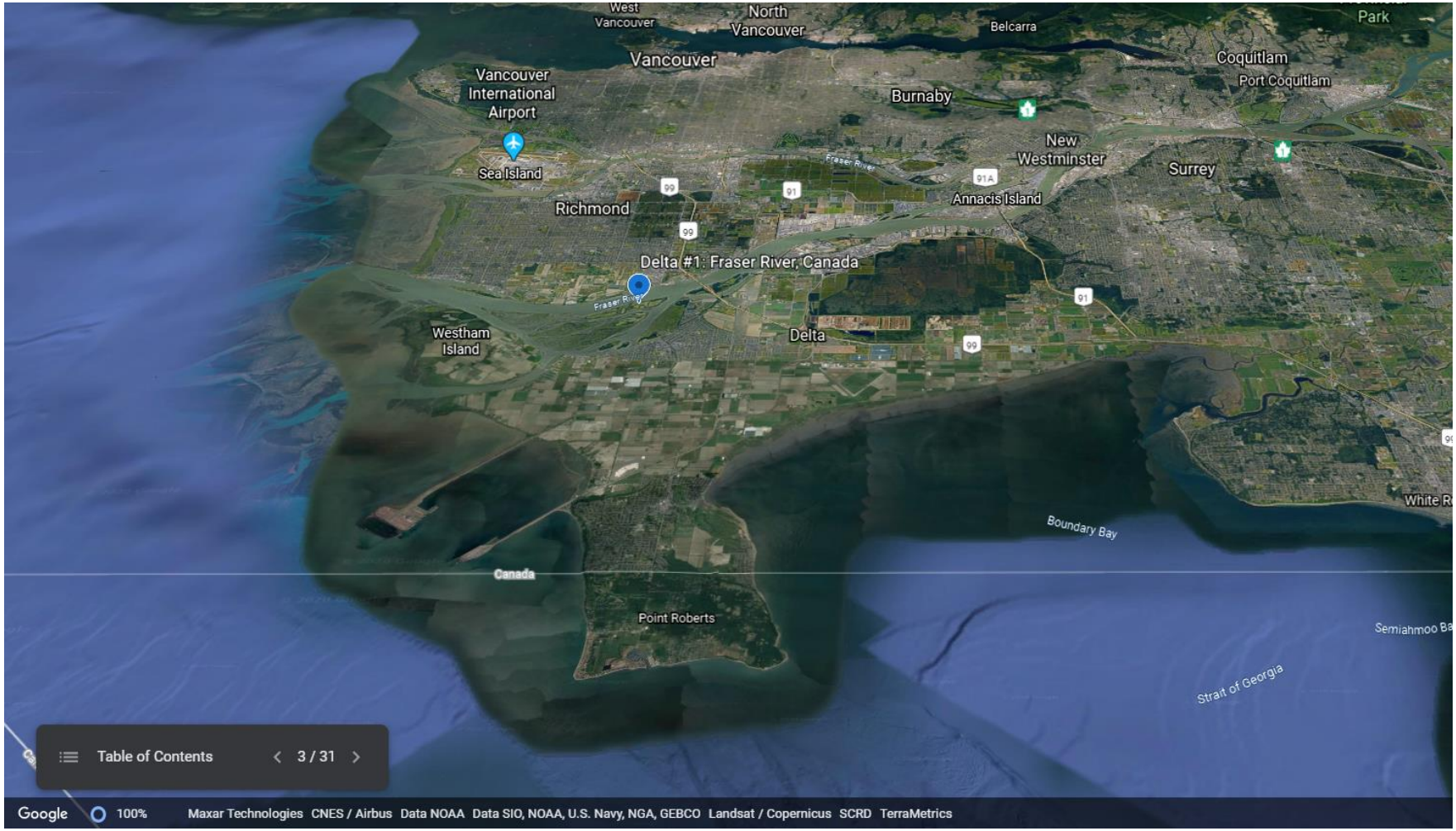


**Figure 3**: Delta #1: Fraser River Canada. A stream delta is an accumulation of sediment that forms where a stream reaches base level (i.e. lake or ocean) **What to look for**: 1. Locations where streams enter a standing body of water such as ocean or lake, 2. Distinct pattern of drainage often similar to branching of tributaries, 3. Deltas are often triangular in shape (resembles the Greek letter delta (Δ)), but not all deltas take this shape. and 4. The shape may depend on the stream's sediment load, influence of water currents in the other body of water, and whether or not surrounding land prevents the spreading of the delta sediment


**Figure 4**: Delta #2: Nile River, Egypt. A stream delta is an accumulation of sediment that forms where a stream reaches base level (i.e. lake or ocean) **What to look for**: 1. Locations where streams enter a standing body of water such as ocean or lake, 2. Distinct pattern of drainage often similar to branching of tributaries, 3. Deltas are often triangular in shape (resembles the Greek letter delta (Δ)), but not all deltas take this shape. and 4. The shape may depend on the stream's sediment load, influence of water currents in the other body of water, and whether or not surrounding land prevents the spreading of the delta sediment

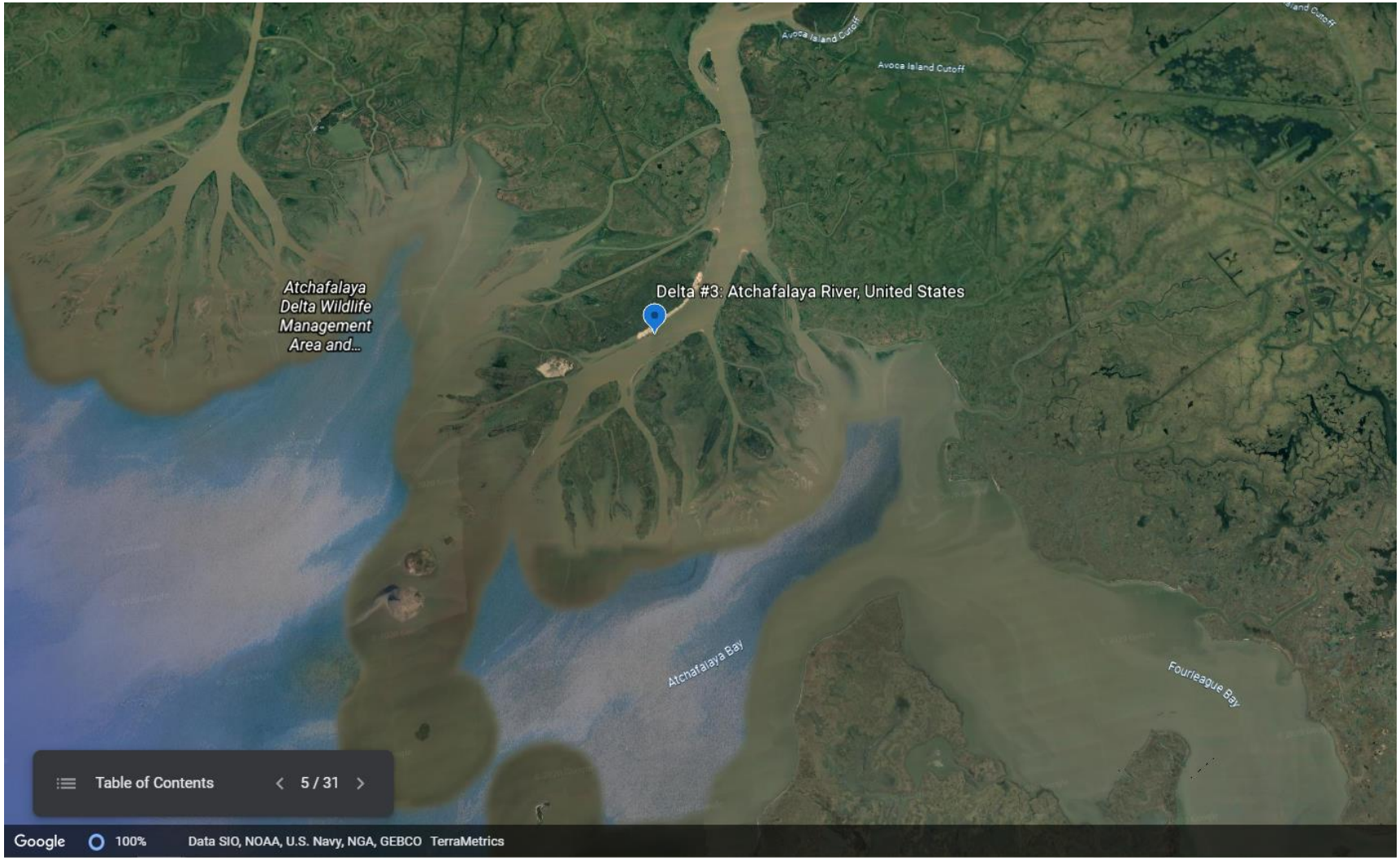


**Figure 5**: Delta #3: Atchafalaya River, United States. A stream delta is an accumulation of sediment that forms where a stream reaches base level (i.e. lake or ocean) **What to look for**: 1. Locations where streams enter a standing body of water such as ocean or lake, 2. Distinct pattern of drainage often similar to branching of tributaries, 3. Deltas are often triangular in shape (resembles the Greek letter delta (Δ)), but not all deltas take this shape. and 4. The shape may depend on the stream's sediment load, influence of water currents in the other body of water, and whether or not surrounding land prevents the spreading of the delta sediment

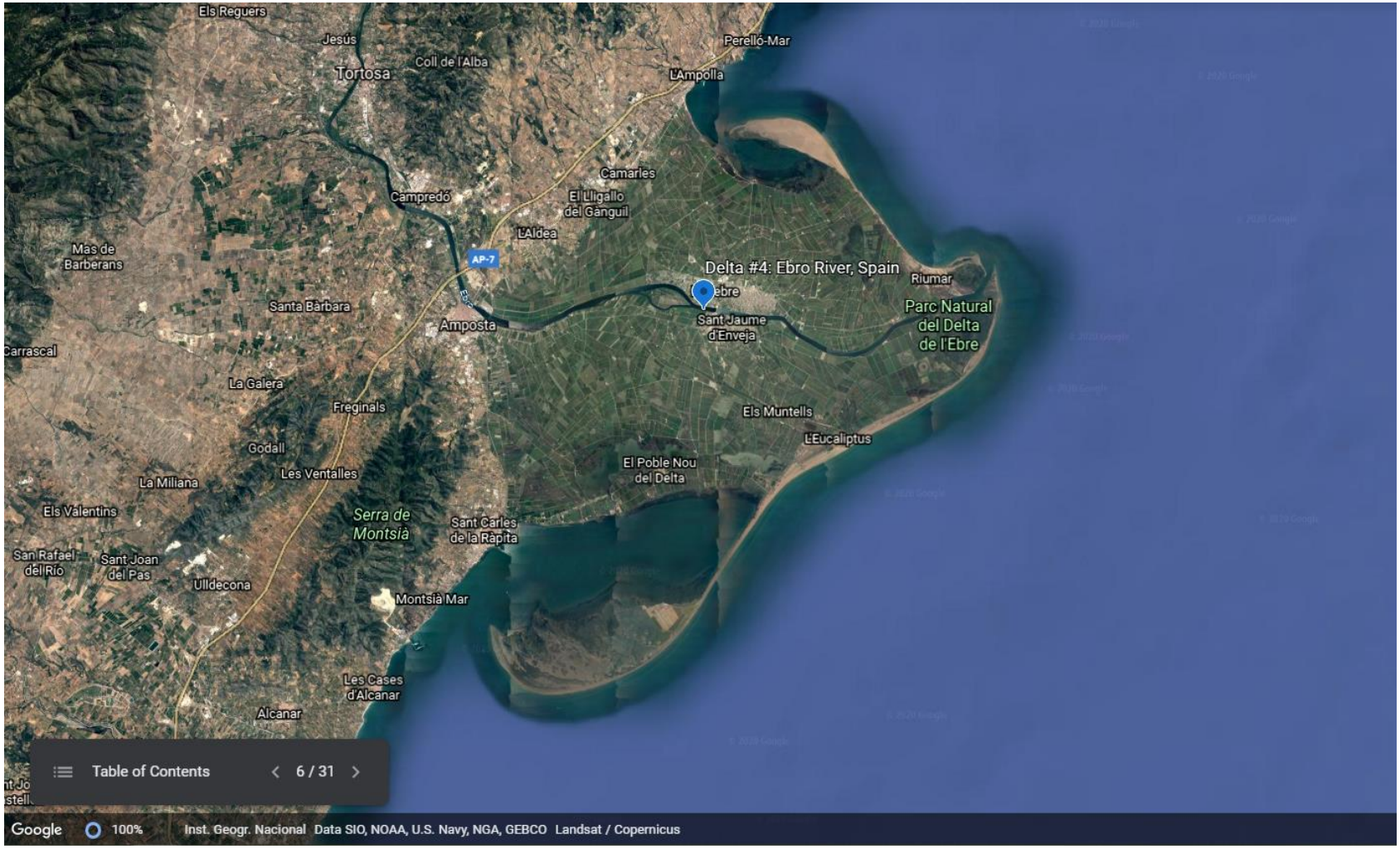


**Figure 6**: Delta #4: Ebro River, Spain. A stream delta is an accumulation of sediment that forms where a stream reaches base level (i.e. lake or ocean) **What to look for**: 1. Locations where streams enter a standing body of water such as ocean or lake, 2. Distinct pattern of drainage often similar to branching of tributaries, 3. Deltas are often triangular in shape (resembles the Greek letter delta (Δ)), but not all deltas take this shape. and 4. The shape may depend on the stream's sediment load, influence of water currents in the other body of water, and whether or not surrounding land prevents the spreading of the delta sediment

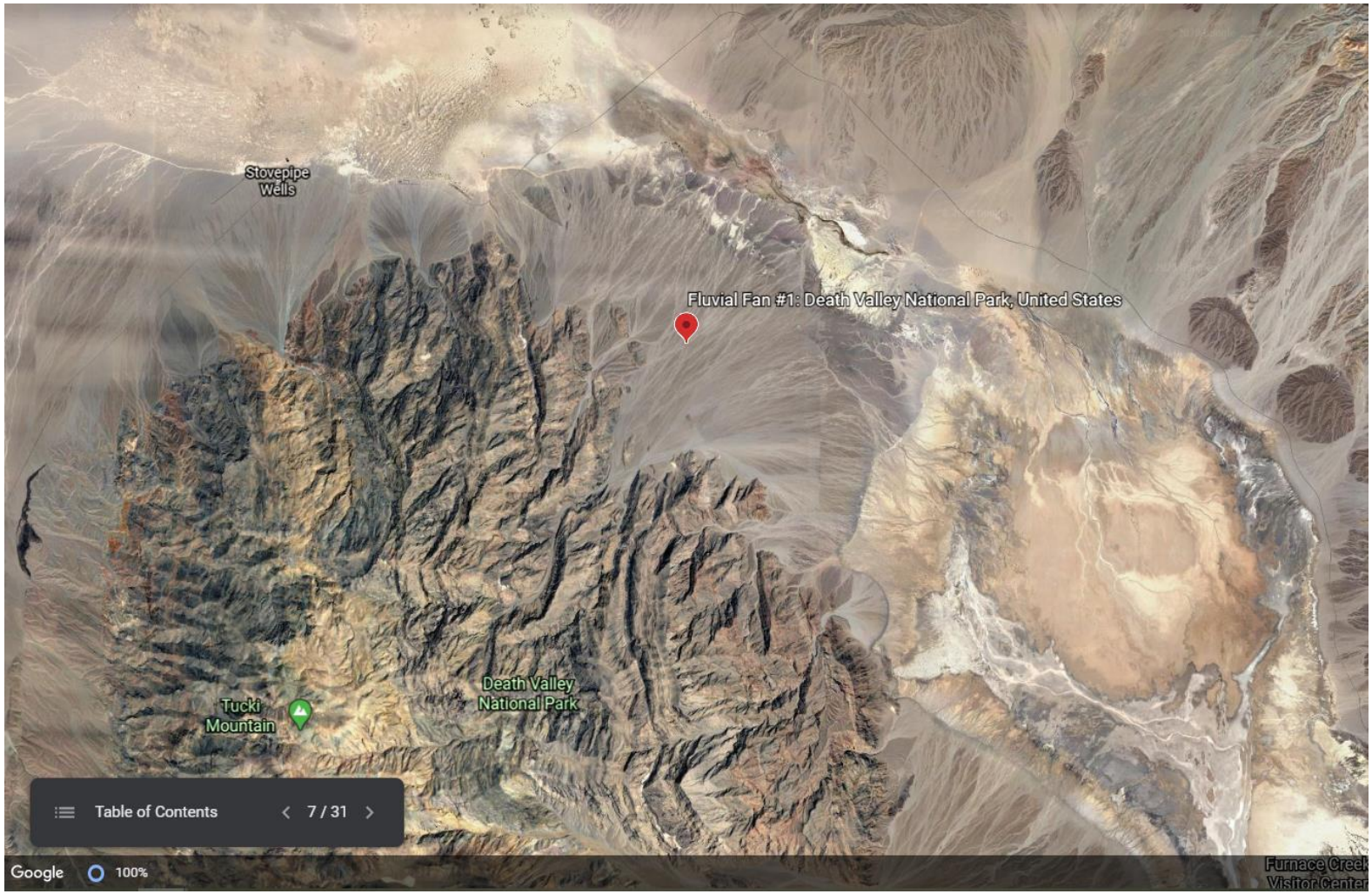


**Figure 7**: Fluvial Fan #1: Death Valley National Park, United States. A fluvial (alluvial) fan is a gently sloping, broad cone shaped accumulation of water-transported sediment deposited where a stream exits stepper topography and flows onto gentler ground at the base of a mountain range. **What to look for:** 1. Often are cone shaped, 2. The apex (higher elevation) is the narrowest part of the fan and the apron (lower elevation) is the widest part, 3. Can range in size from the very small to the truly massive (The largest are often seen best from space), and 3. Evidence of multiple stream channels on the fan surface (When water flows through channels on the alluvial fan it only occupies a small portion of the fan at any one time. Over many centuries or longer, the streams will migrate from one side of the fan to the other, building it up)

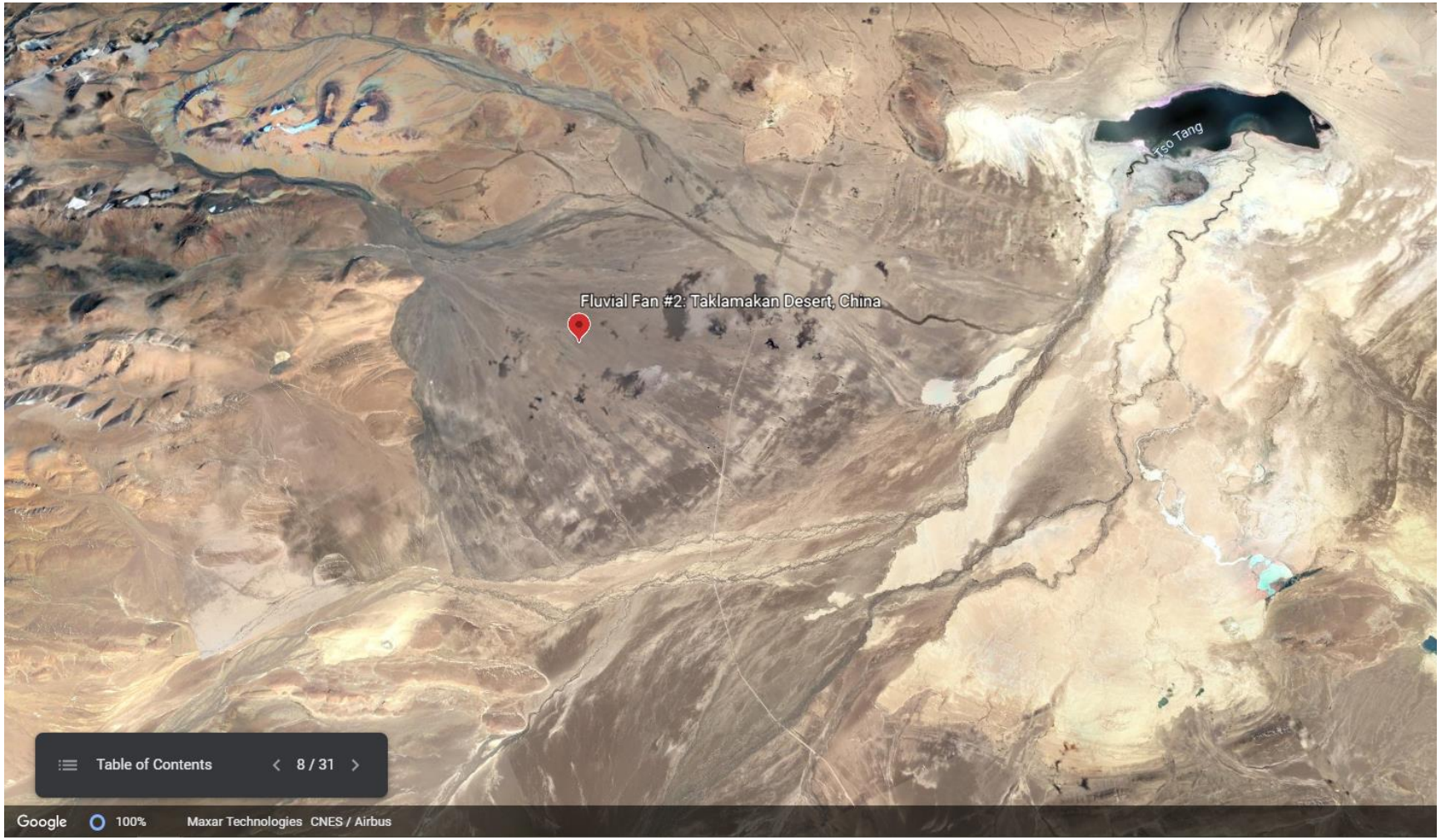


**Figure 8**: Fluvial Fan #2: Taklamakan Desert, China. A fluvial (alluvial) fan is a gently sloping, broad cone shaped accumulation of water-transported sediment deposited where a stream exits stepper topography and flows onto gentler ground at the base of a mountain range. **What to look for:** 1. Often are cone shaped, 2. The apex (higher elevation) is the narrowest part of the fan and the apron (lower elevation) is the widest part, 3. Can range in size from the very small to the truly massive (The largest are often seen best from space), and 3. Evidence of multiple stream channels on the fan surface (When water flows through channels on the alluvial fan it only occupies a small portion of the fan at any one time. Over many centuries or longer, the streams will migrate from one side of the fan to the other, building it up)

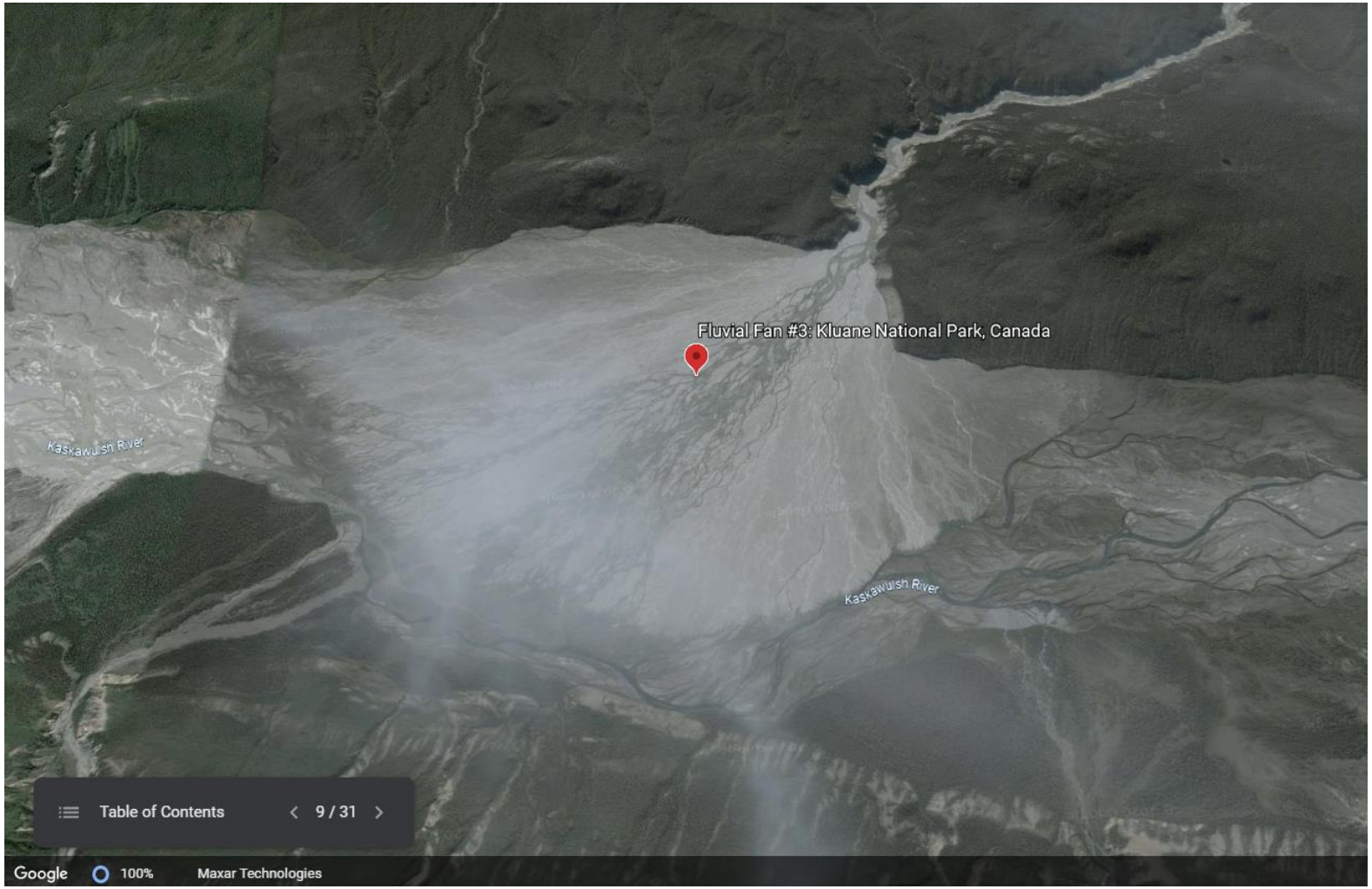


**Figure 9**: Fluvial Fan #3: Kluane National Park, Canada. A fluvial (alluvial) fan is a gently sloping, broad cone shaped accumulation of water-transported sediment deposited where a stream exits stepper topography and flows onto gentler ground at the base of a mountain range. **What to look for:** 1. Often are cone shaped, 2. The apex (higher elevation) is the narrowest part of the fan and the apron (lower elevation) is the widest part, 3. Can range in size from the very small to the truly massive (The largest are often seen best from space), and 3. Evidence of multiple stream channels on the fan surface (When water flows through channels on the alluvial fan it only occupies a small portion of the fan at any one time. Over many centuries or longer, the streams will migrate from one side of the fan to the other, building it up)

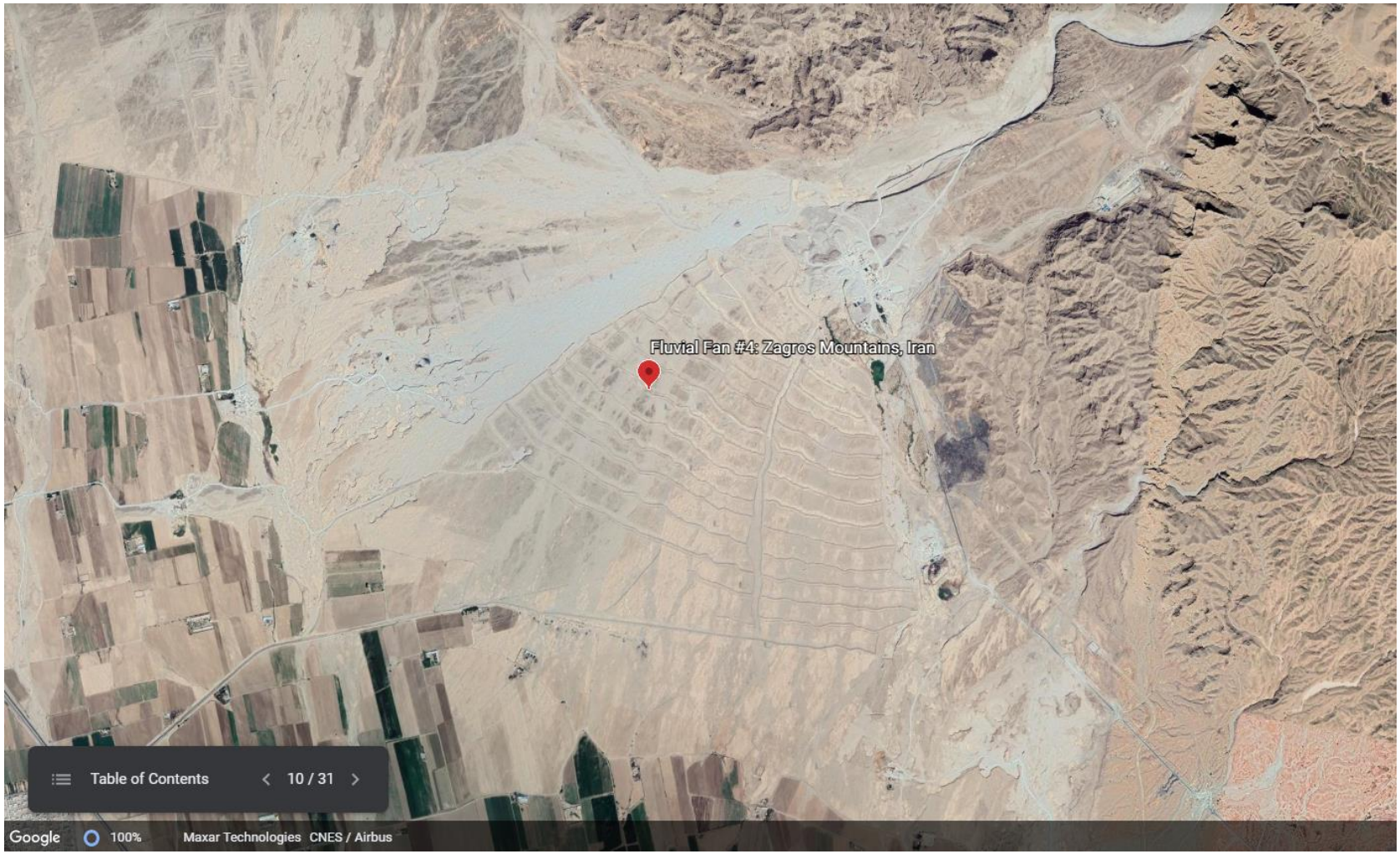


**Figure 10**: Fluvial Fan #4: Zagros Mountains, Iran. A fluvial (alluvial) fan is a gently sloping, broad cone shaped accumulation of water-transported sediment deposited where a stream exits stepper topography and flows onto gentler ground at the base of a mountain range. **What to look for:** 1. Often are cone shaped, 2. The apex (higher elevation) is the narrowest part of the fan and the apron (lower elevation) is the widest part, 3. Can range in size from the very small to the truly massive (The largest are often seen best from space), and 3. Evidence of multiple stream channels on the fan surface (When water flows through channels on the alluvial fan it only occupies a small portion of the fan at any one time. Over many centuries or longer, the streams will migrate from one side of the fan to the other, building it up)

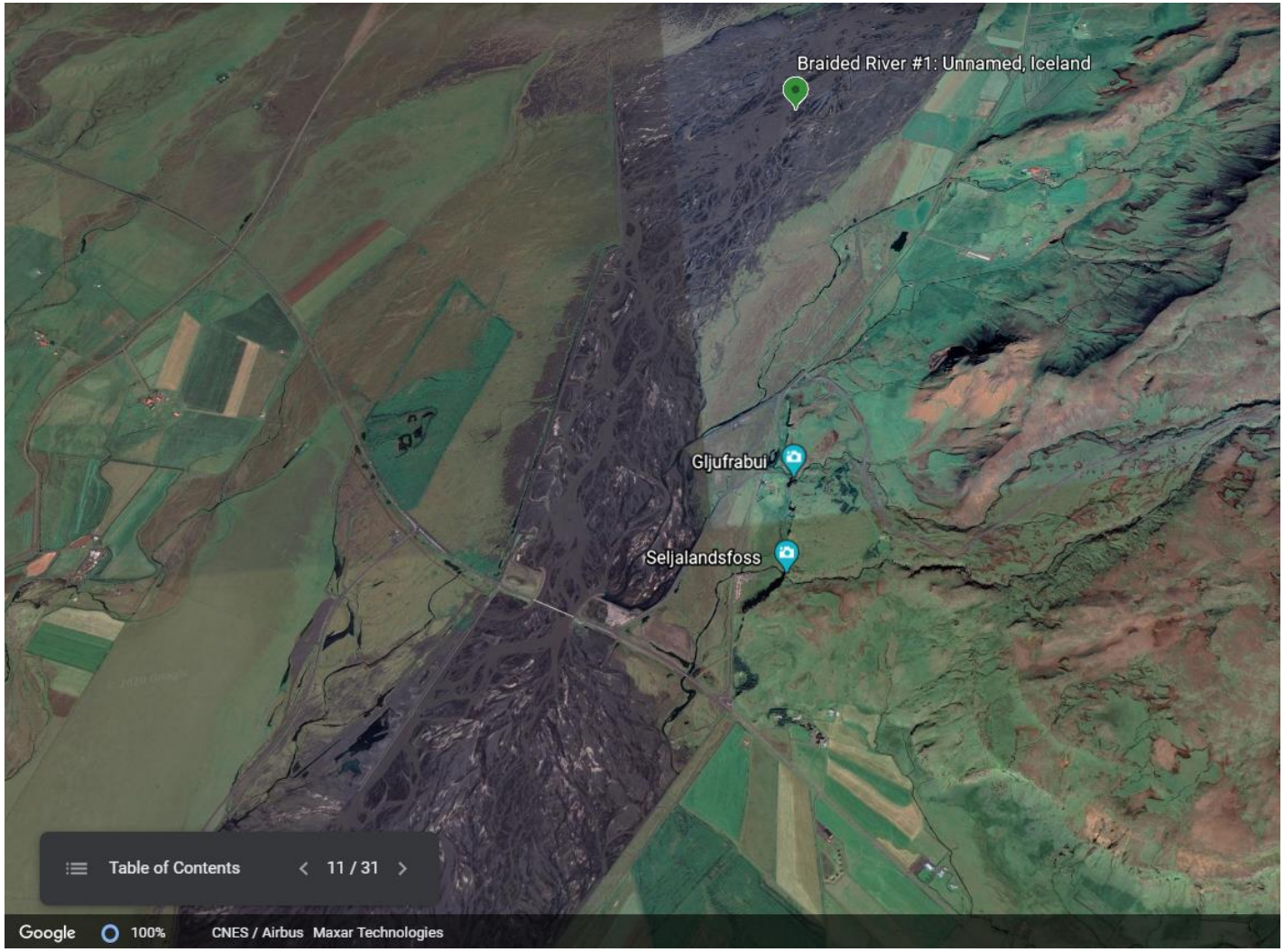


**Figure 11:** Braided River #1: Unnamed, Iceland. A stream that forms from multiple intertwining channels around sediments in the streambed. **What to look for:** 1. Multiple channels, 2. No or little (young) vegetation on islands commonly shaped like rounded diamonds of gravel or sand between channels, 3. High sediment load, 4. Most originate from glaciated areas, but they can form in other settings downstream from large quantities of sediment such as volcanoes, 5. Often found downstream of terrain that experiences significant erosion, including mountain ranges, 6. Can occur in low gradient areas with abundant fine sediments like deserts, and 7. Common pattern on alluvial fans.


**Figure 12:** Braided River #2: Waimakariri River, New Zealand. A stream that forms from multiple intertwining channels around sediments in the streambed. **What to look for:** 1. Multiple channels, 2. No or little (young) vegetation on islands commonly shaped like rounded diamonds of gravel or sand between channels, 3. High sediment load, 4. Most originate from glaciated areas, but they can form in other settings downstream from large quantities of sediment such as volcanoes, 5. Often found downstream of terrain that experiences significant erosion, including mountain ranges, 6. Can occur in low gradient areas with abundant fine sediments like deserts, and 7. Common pattern on alluvial fans.

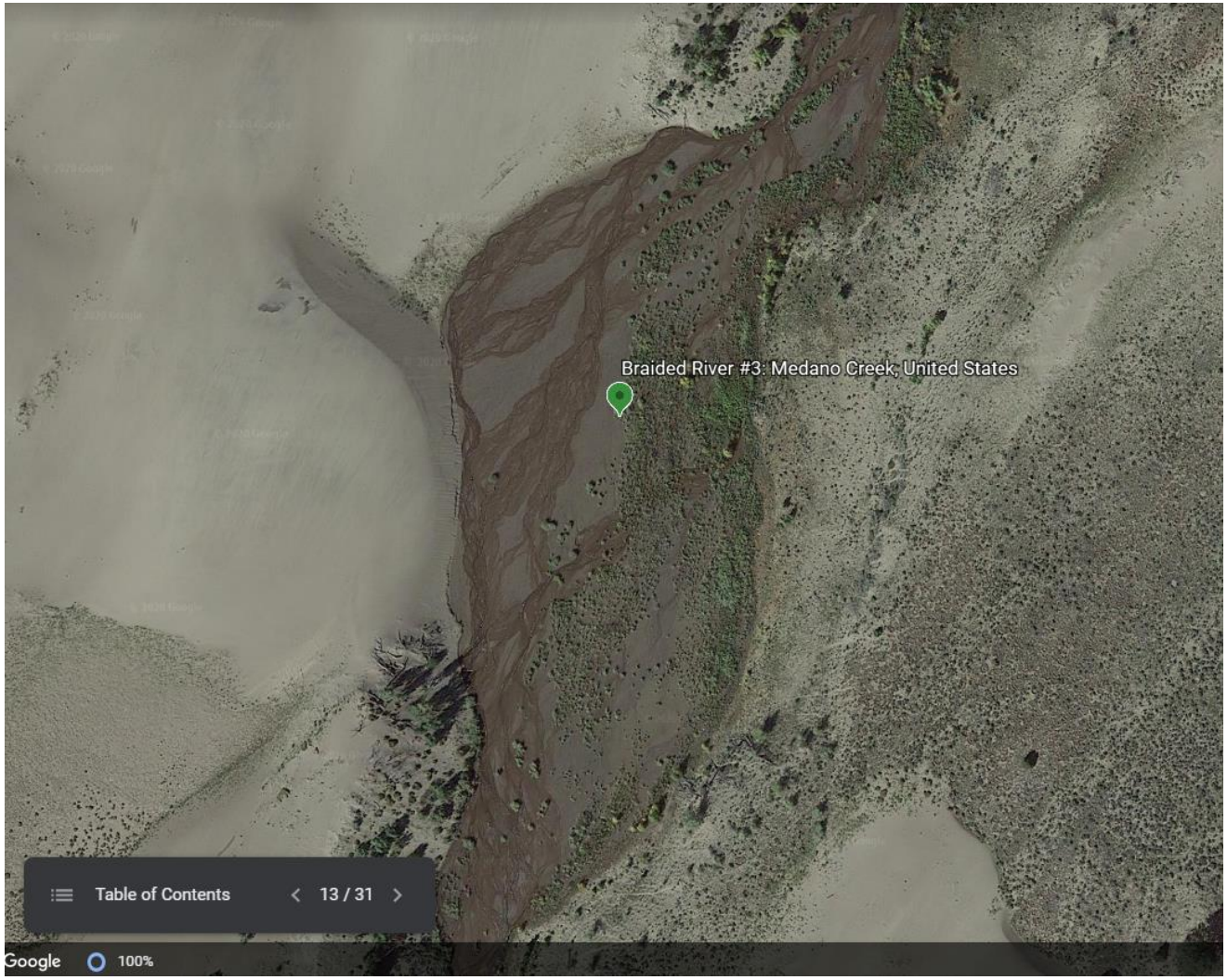


**Figure 13:** Braided River #3: Medano Creek, United States. A stream that forms from multiple intertwining channels around sediments in the streambed. **What to look for:** 1. Multiple channels, 2. No or little (young) vegetation on islands commonly shaped like rounded diamonds of gravel or sand between channels, 3. High sediment load, 4. Most originate from glaciated areas, but they can form in other settings downstream from large quantities of sediment such as volcanoes, 5. Often found downstream of terrain that experiences significant erosion, including mountain ranges, 6. Can occur in low gradient areas with abundant fine sediments like deserts, and 7. Common pattern on alluvial fans.

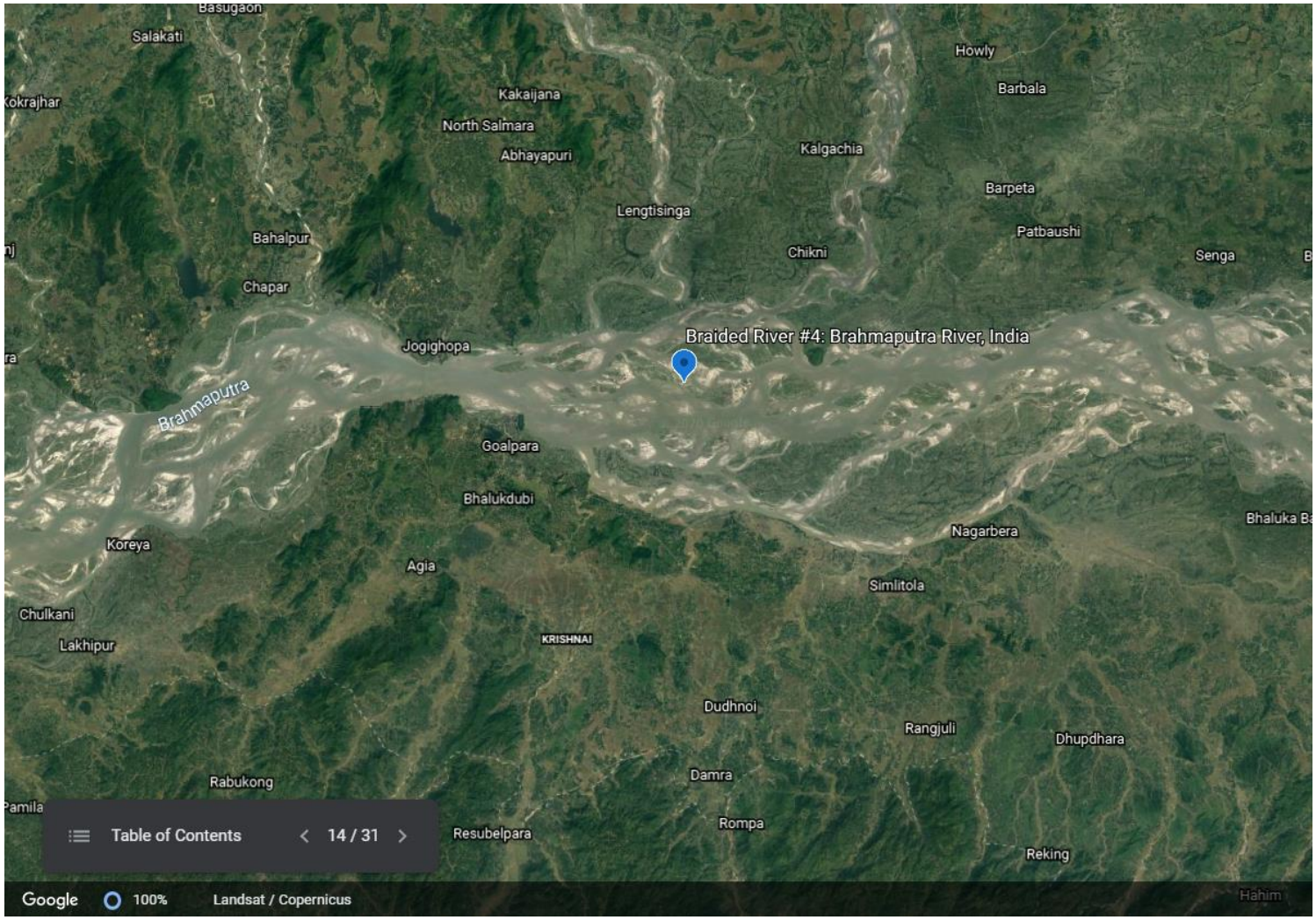


**Figure 14:** Braided River #4: Brahmaputra River, India. A stream that forms from multiple intertwining channels around sediments in the streambed. **What to look for:** 1. Multiple channels, 2. No or little (young) vegetation on islands commonly shaped like rounded diamonds of gravel or sand between channels, 3. High sediment load, 4. Most originate from glaciated areas, but they can form in other settings downstream from large quantities of sediment such as volcanoes, 5. Often found downstream of terrain that experiences significant erosion, including mountain ranges, 6. Can occur in low gradient areas with abundant fine sediments like deserts, and 7. Common pattern on alluvial fans.

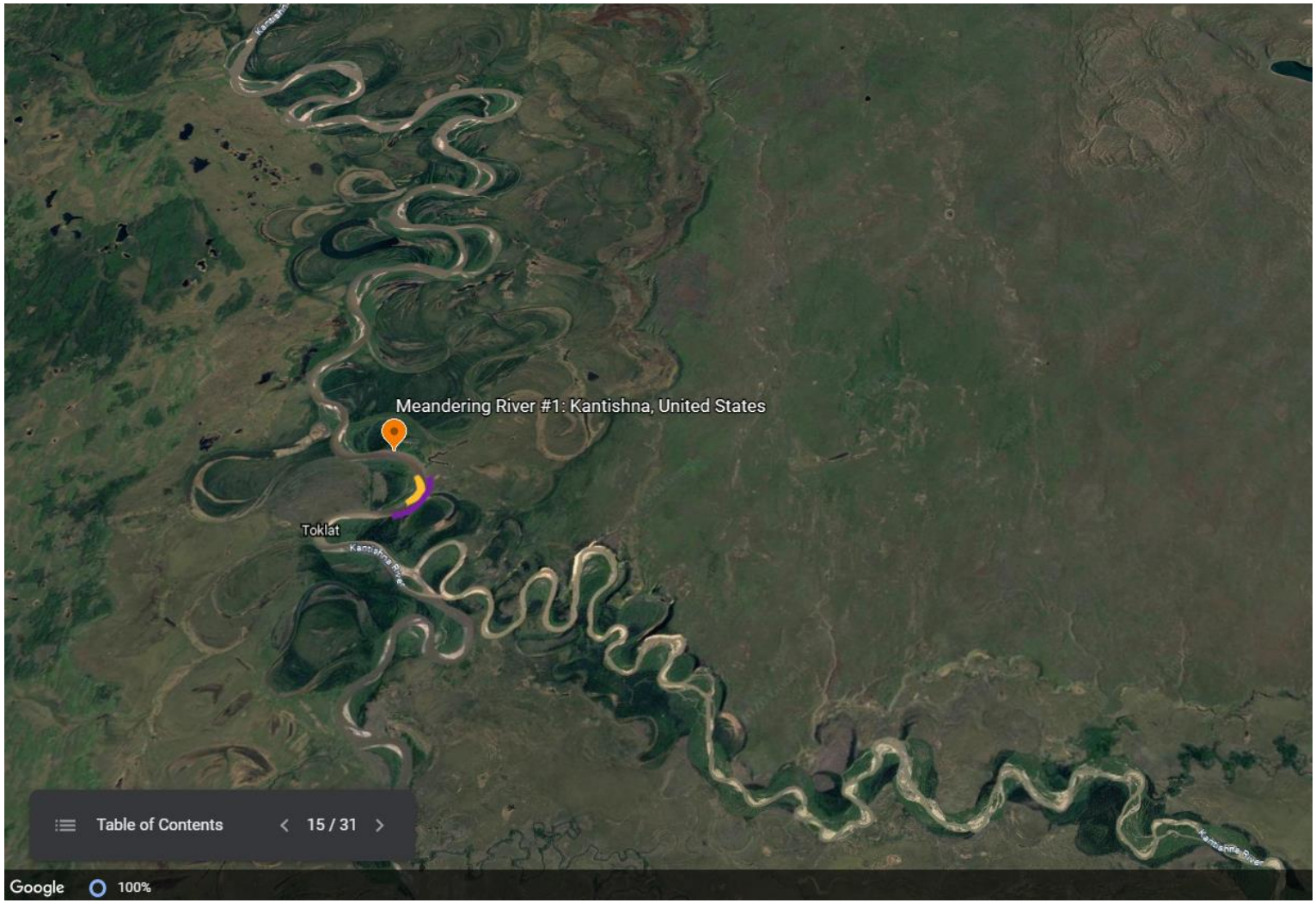


**Figure 15**: Meandering River #1: Kantishna, United States. A meandering stream has a single channel with a snake-like (sinuous) pattern. **What to look for:** 1. Streams channel resembles snake-like (sinuous) pattern with a series of broad loops, 2. Mid-channel bars (islands) will be uncommon and have established vegetation, 3. Streams migrate laterally by sediment erosion on the outside bend of the meander and deposition on the inside of the bend, and 4. Numerous oxbow lake (filled with water) and abandoned channels may be located in the flood plain surrounding the stream.

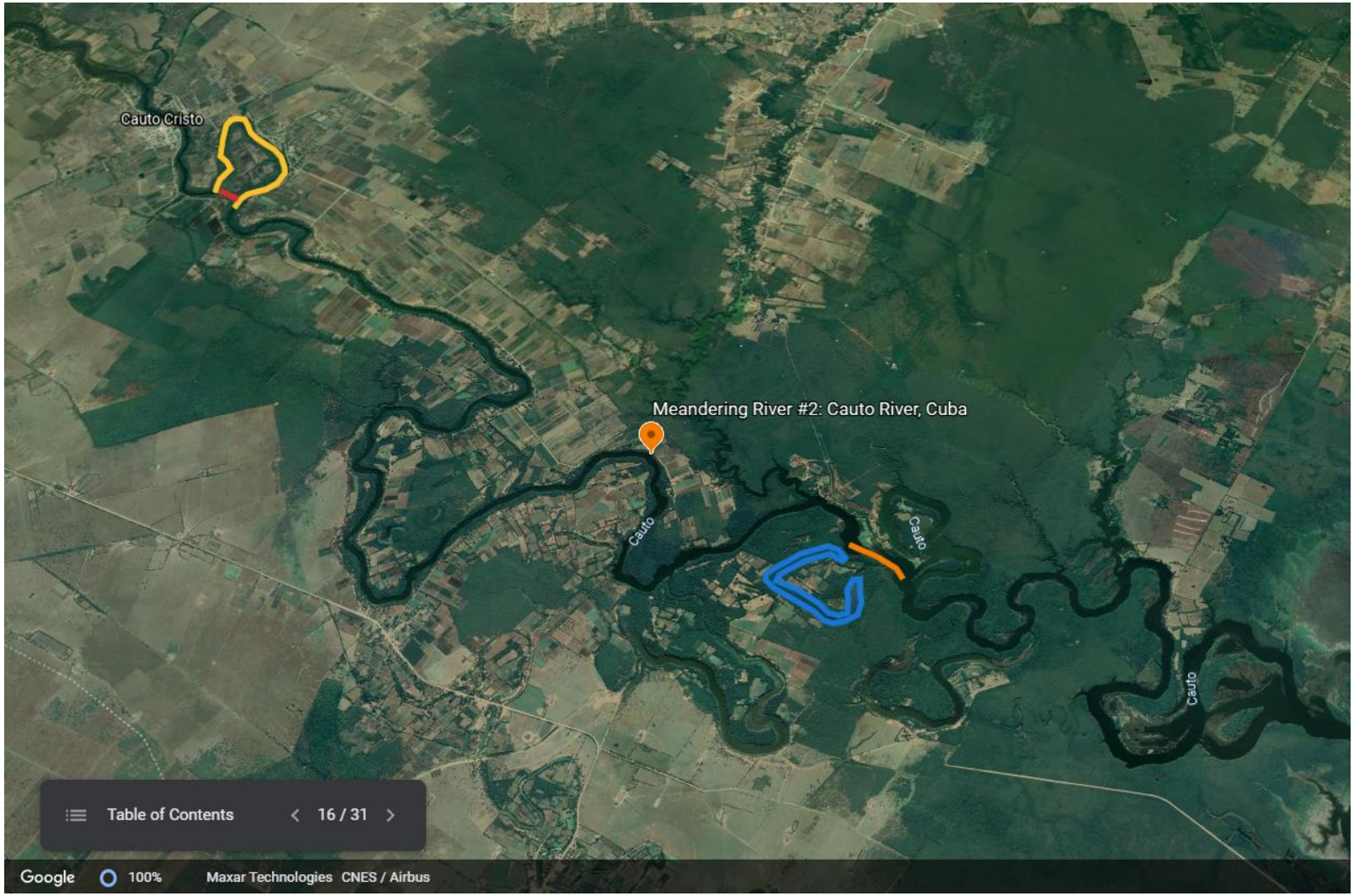


**Figure 16**: Meandering River #2: Cauto River, Cuba. A meandering stream has a single channel with a snake-like (sinuous) pattern. **What to look for:** 1. Streams channel resembles snake-like (sinuous) pattern with a series of broad loops, 2. Mid-channel bars (islands) will be uncommon and have established vegetation, 3. Streams migrate laterally by sediment erosion on the outside bend of the meander and deposition on the inside of the bend, and 4. Numerous oxbow lake (filled with water) and abandoned channels may be located in the flood plain surrounding the stream.

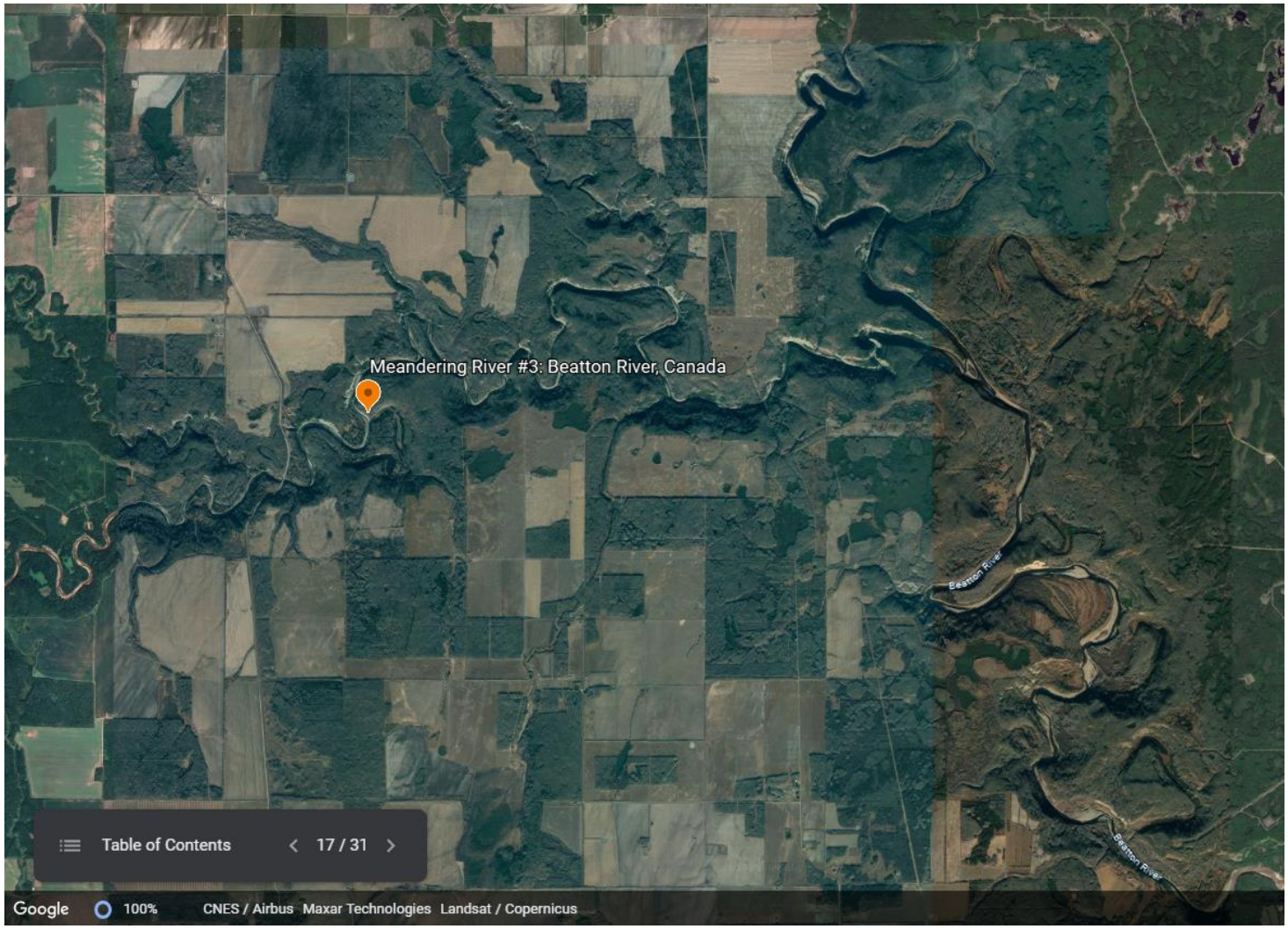


**Figure 17**: Meandering River #3: Beatton River, Canada. A meandering stream has a single channel with a snake-like (sinuous) pattern. **What to look for:** 1. Streams channel resembles snake-like (sinuous) pattern with a series of broad loops, 2. Mid-channel bars (islands) will be uncommon and have established vegetation, 3. Streams migrate laterally by sediment erosion on the outside bend of the meander and deposition on the inside of the bend, and 4. Numerous oxbow lake (filled with water) and abandoned channels may be located in the flood plain surrounding the stream.

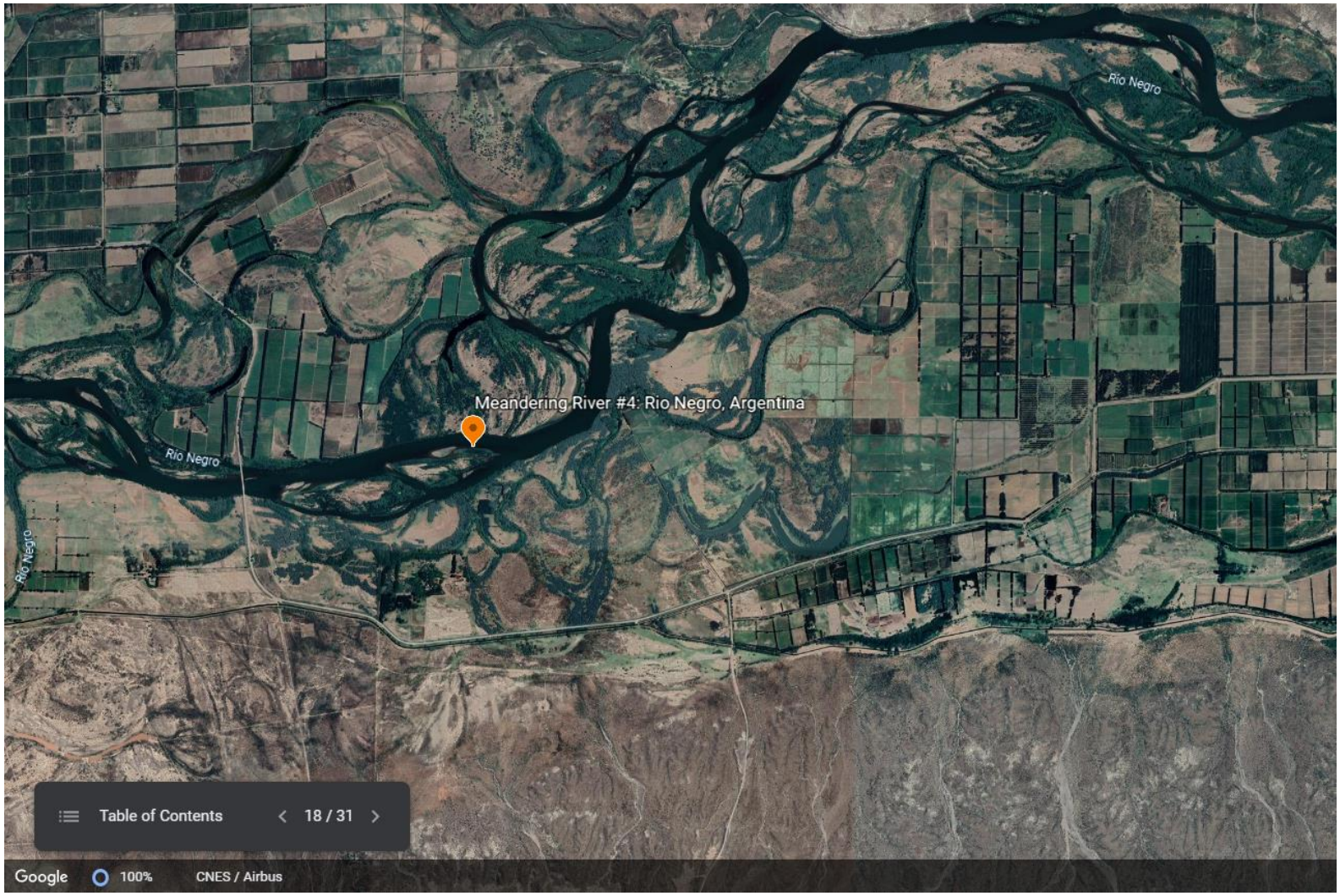


**Figure 18**: Meandering River #4: Rio Negro, Argentina. A meandering stream has a single channel with a snake-like (sinuous) pattern. **What to look for:** 1. Streams channel resembles snake-like (sinuous) pattern with a series of broad loops, 2. Mid-channel bars (islands) will be uncommon and have established vegetation, 3. Streams migrate laterally by sediment erosion on the outside bend of the meander and deposition on the inside of the bend, and 4. Numerous oxbow lake (filled with water) and abandoned channels may be located in the flood plain surrounding the stream.

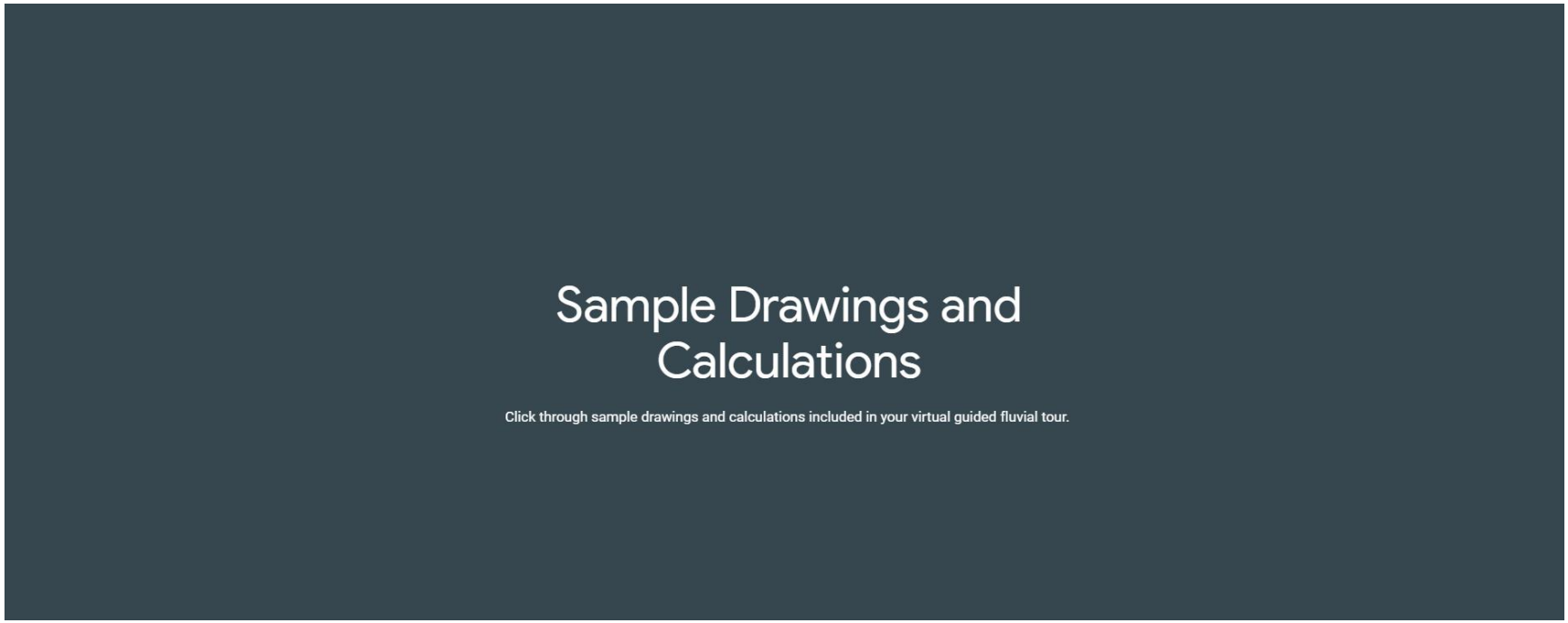


**Figure 19**: Sample Drawings and Calculations. The following pages include sample drawings and calculations includes in the virtual guided fluvial tour.


**Figure 20: Sample Point Bar #1: Kantishna River, United States.** An accumulation of sediment that forms along the inside edge of a stream meander (see yellow polygon). This is a depositional feature. **What to look for:** 1. Located inside of the meander, 2. Point bars will gently slope towards the water edge, and 3. Obvious sediment accumulation when stream level is low with little to no vegetation and appears light coloured


Figure 21: Sample Cutbank #1: Kantishna River, United States. Cut banks form on the outside edge of a meander where steam flow is highest (see purple line). This is an erosional feature. What to look for: 1. Located at outside edge of the meander, 2. No deposited sediment, 3. Often a steep slope between the steam edge and surrounding vegetation on the flood plain, and 4. Narrow band or no light coloured sediment exposed.


**Figure 22**: Sample Meander #1: Cauto River, Cuba. A meander is a looping bend in a steam channel (see yellow line). **What to look for:** 1. Meander will be one of a series of sinuous curves in the steam.


**Figure 23:** Sample Neck #1: Cauto River, Cuba. As meanders converge due to erosion along two cutbanks form meander necks (see red line). Once the neck shortens the two meanders join. The main flow of water (the thalweg) will abandon the meander and flow across the neck. The existing meander will eventually form an oxbow lake. **What to look for:** 1. Locations where two cuts banks on meanders are narrowing the distance between two meanders.

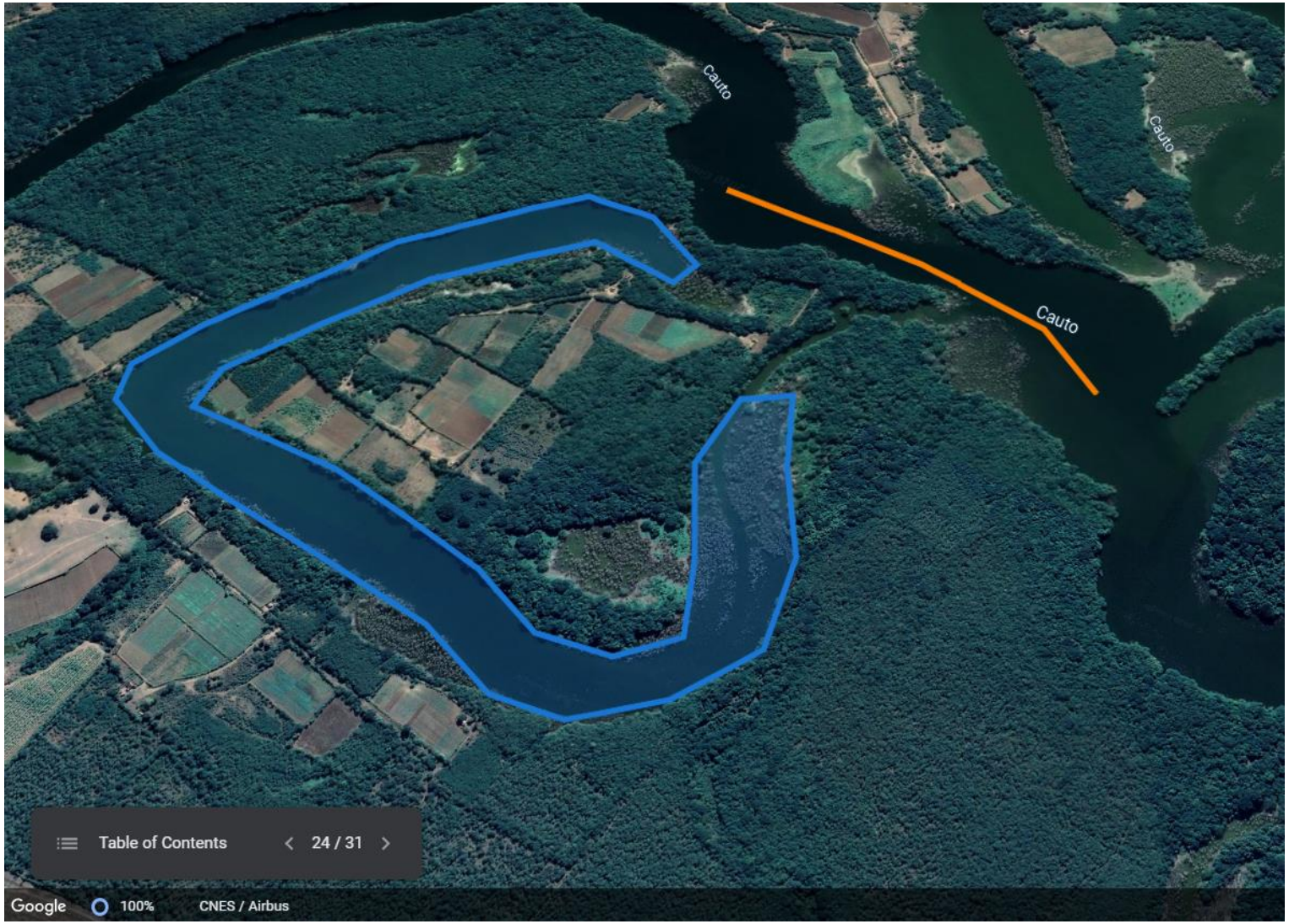


**Figure 24:** Sample Cutoff #1: Cauto River, Cuba. When the meander neck closes, a cutoff forms where the two meanders join (see orange line). **What to look for**: 1. Straight new stream channel section adjacent to a newly formed oxbow lake, and 2. In some locations the edge of the new stream channel will have natural levees separating the new channel and the oxbow lake.

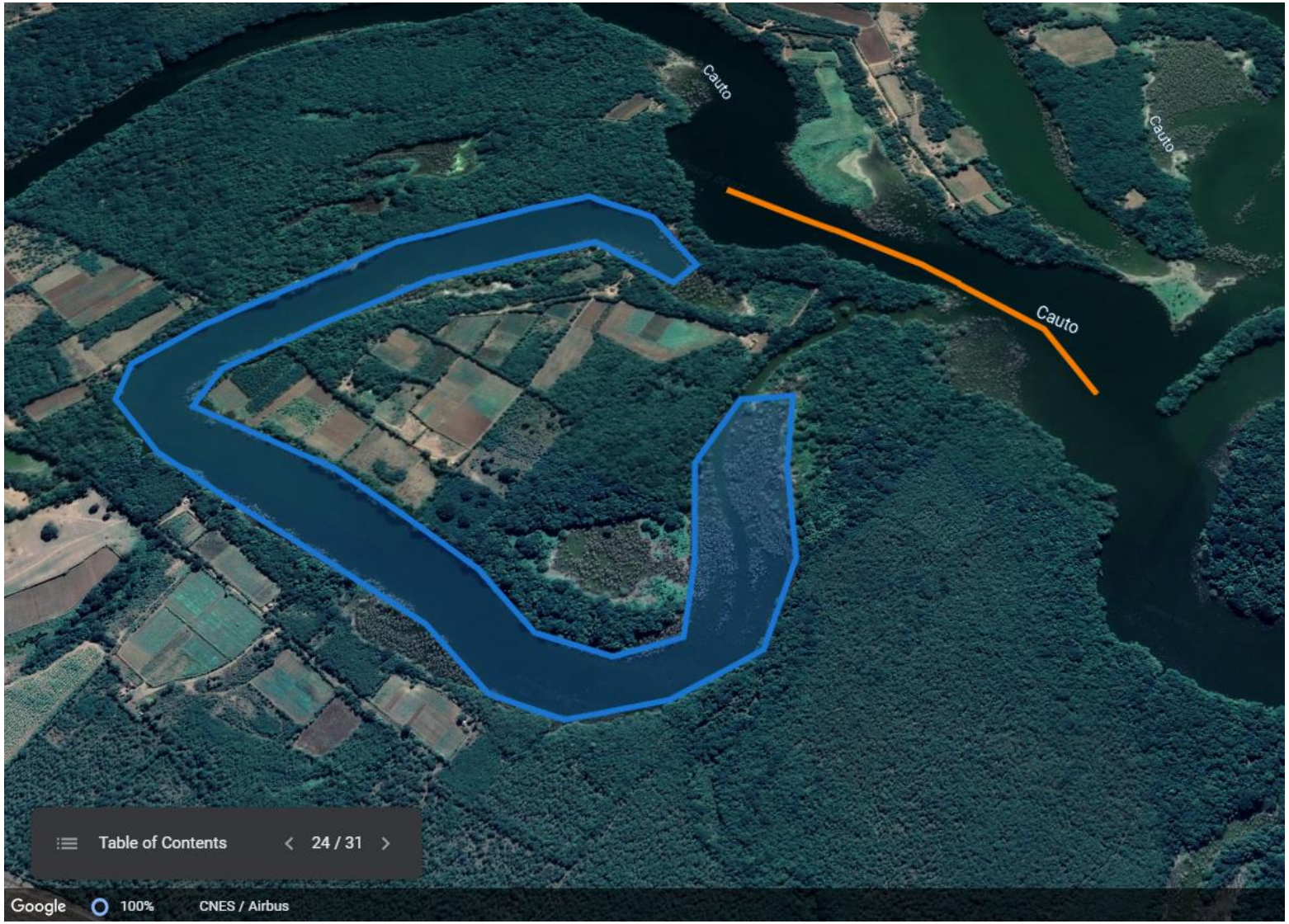


**Figure 25:** Sample Oxbow Lake #2: Cauto River, Cuba**.** Oxbow lake forms when a meander is cut off from the channel (see blue polygon). **What to look for**: 1. Meander full of water separated from the main channel, 2. Adjacent to a suspected oxbow lake will be a cutoff in the main channel, and 3. Artificial leeves may separate the oxbow lake and the main channel

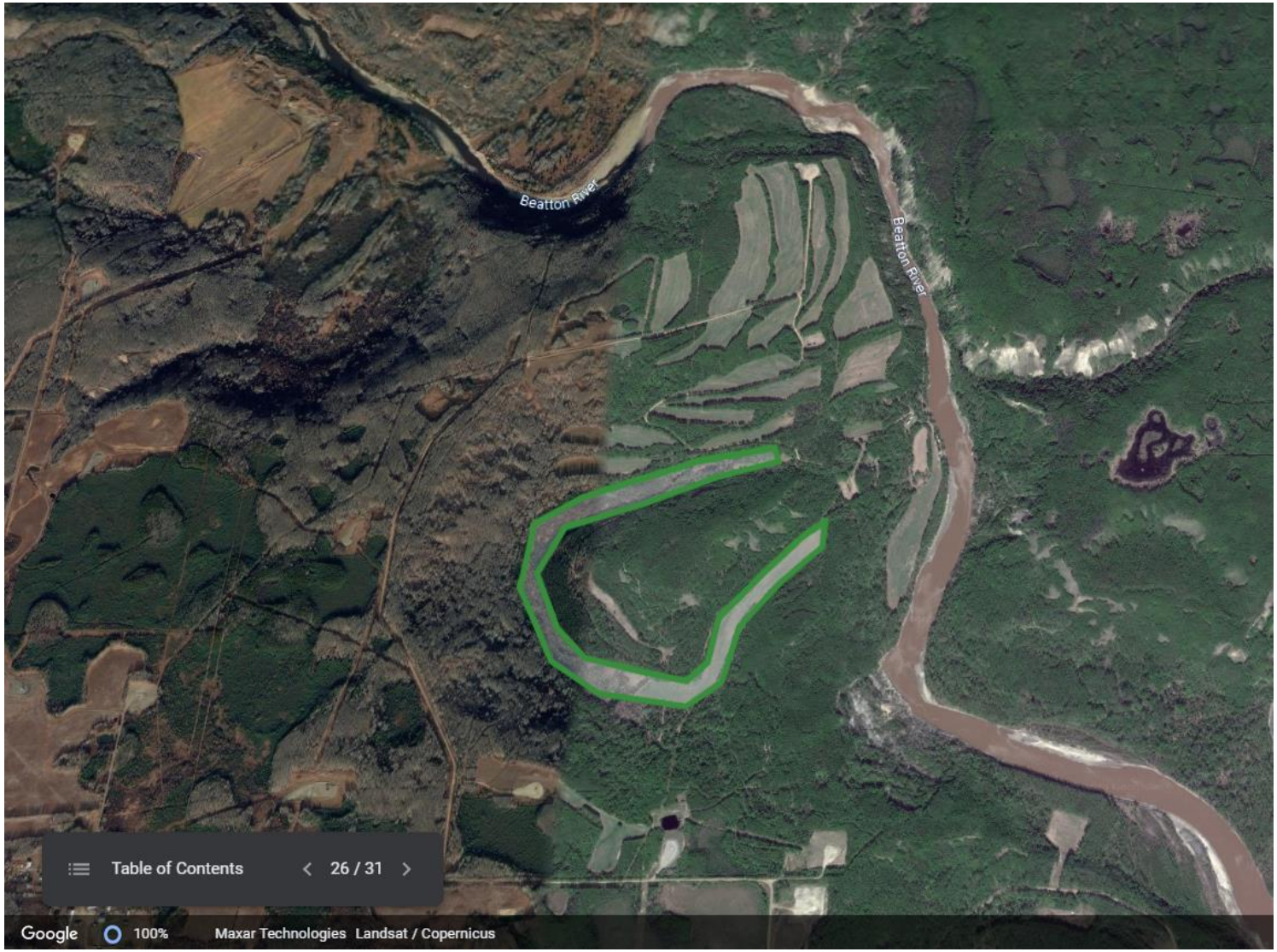


**Figure 26:** Sample Meander Scar #1: Beatton River, Canada. Meander scars are oxbow lakes that are now filled with sediment and vegetation. **What to look for**: 1. Evidence of past oxbow lake adjacent to stream cutoff, and 2. Often filled with young vegetation and can be important wetland areas.

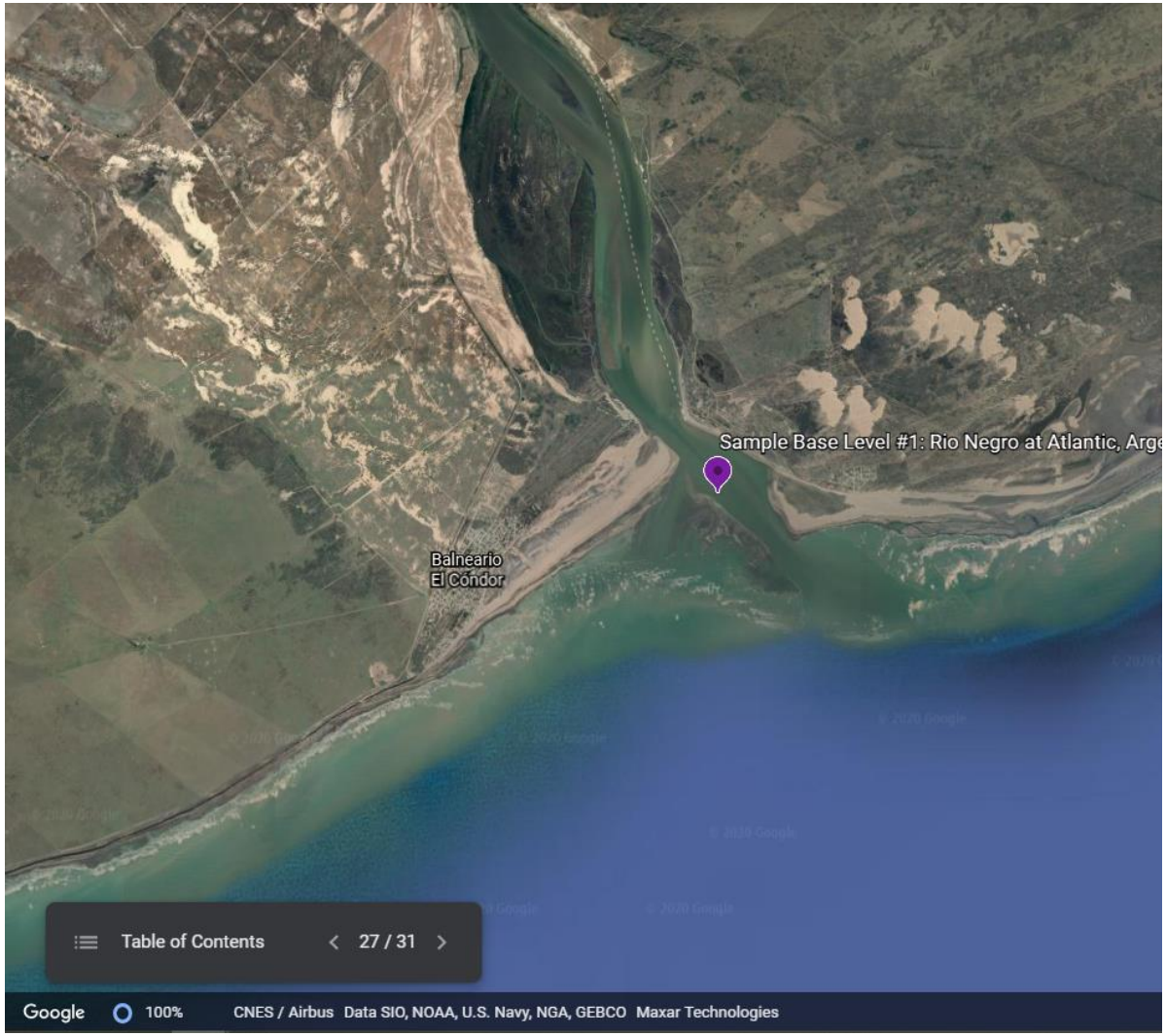


**Figure 27:** Sample Base Level #1: Rio Negro at Atlantic, Argentina Ocean. Streams stop flowing when they reach base level. Local base level can form when the stream is dammed by naturally (such as beaver dams or landslides) or artificially by people (such as an artificial lake called a reservoir). **What to look for**: 1. Follow the stream channel until it reaches a local base level or ultimate base level (ie. sea level), and 2. Look for delta features.

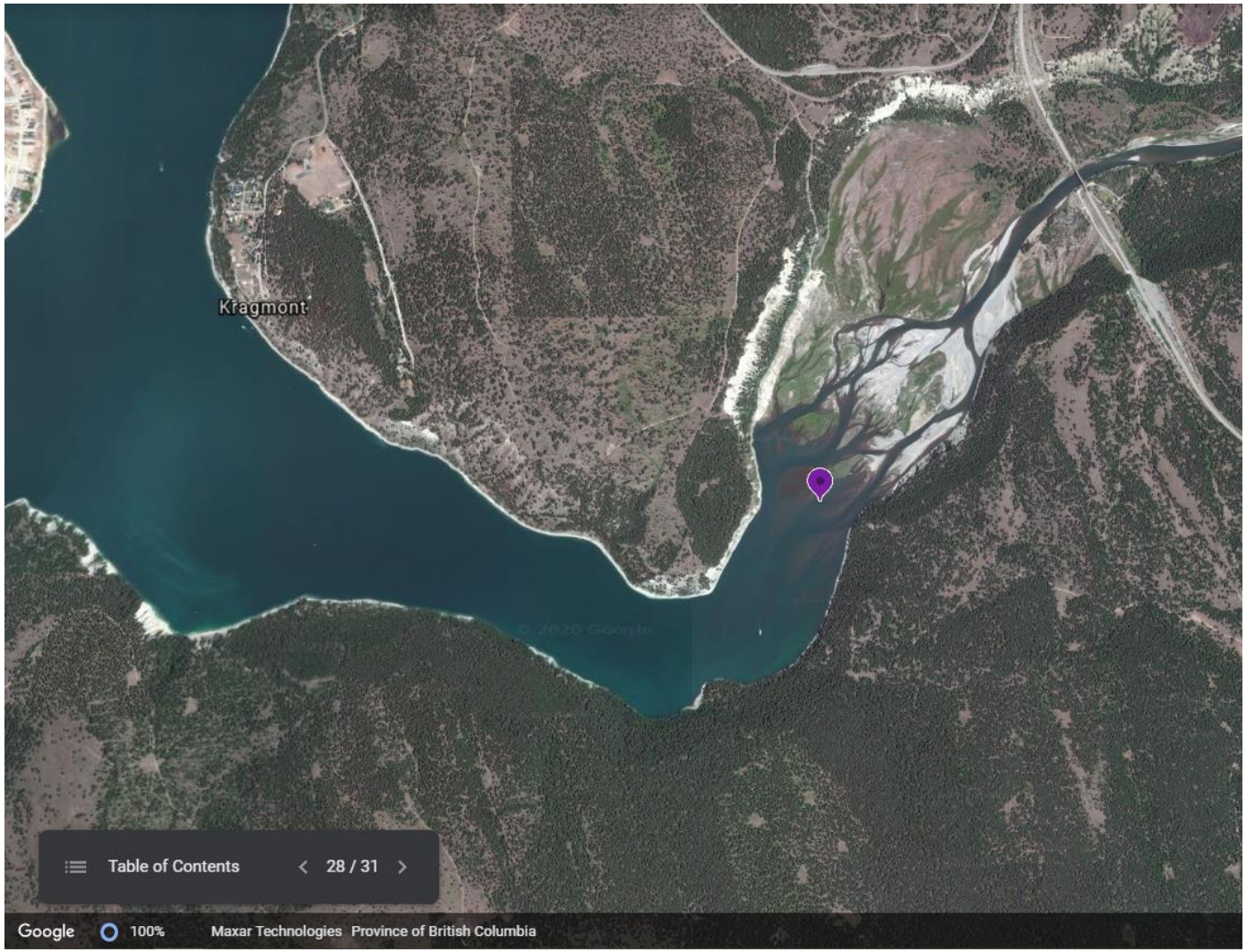


**Figure 28:** Sample Base Level #2: Elk River at Lake Kookanusa, Canada. Streams stop flowing when they reach base level. Local base level can form when the stream is dammed by naturally (such as beaver dams or landslides) or artificially by people (such as an artificial lake called a reservoir). EX: Construction of the Libby Dam in 1972 created the Kookanusa Reservoir which altered the Kootenay River and it's tributaries (Elk River). The purple placemark represents a local base level for the Elk River. **What to look for:** 1. Follow the stream channel until it reaches a local base level or ultimate base level (ie. sea level), and 2. Look for delta features.


**Figure 29:** Sample Gradient Calculation #1: Braided River. Beginning and end of the drawn line represent an elevation loss of 20 m on this section of this braided river in Iceland. The channel length distance follows the line traced along the obvious channel pattern. Calculations for gradient can be found in the lab pre-readings. Upstream Elevation = 81 m, Downstream Elevation = 61 m, Difference (rise) = 20 m, Channel Length Distance (run) = 1.88 km. Therefore: Gradient = 10.64 m/km, Gradient = 1.06 %, Gradient = 0.63 degrees.


**Figure 30:** Sample Gradient Calculation #2: Beatton River. Beginning and end of the drawn line represent an elevation loss of 20 m on this section of the Beatton River, BC. The channel length distance follows the line traced along sinuous channel pattern. Calculations for gradient can be found in the lab pre-readings. Upstream Elevation = 642 m, Downstream Elevation = 622 m, Difference (rise) = 20 m, Channel Length Distance (run) = 15.1 km. Therefore: Gradient = 1.32 m/km, Gradient = 0.13 %, Gradient = 0.07 degrees.

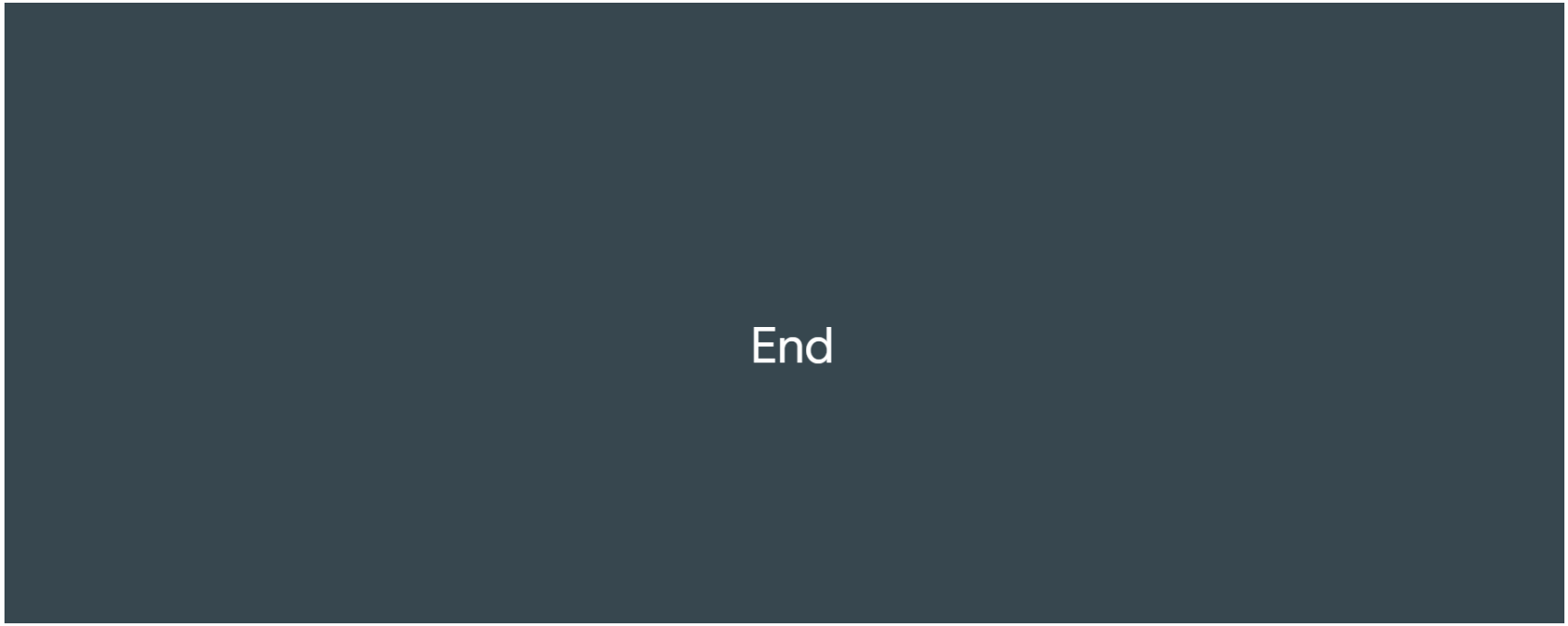


**Figure 31**: End of the Instructional Tour: Fluvial Geomorphology Lab.