

Trail Planning and Design:

Foundations of Success

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Jeremy Wimpey, *PhD, PTBA*



Jon Altschuld, PLA, ASLA

Chinook Landscape Architecture

- Landscape Architect (CO, CA)
- FAA Remote Pilot
- Author, presenter
- 3D data collection and visualization



Professional
TrailBuilders
ASSOCIATION



PIX4D

Pix4D Ambassador



SketchUp Visiting
Professionals

Jeremy Wimpey, PhD

Applied Trails Research, LLC

- Geographer by training
- Supports sustainable trails system development and management
- Applied Field Investigations on visitor-use-related-impacts to wildlife, water, vegetation, soils and impacts to other recreationists
- Works with the National Scenic and Historic Trails on visitor use management



About PTBA

- Trade Association for the trail industry
- Private sector companies who specialize in trail design, planning and construction
- All PTBA companies are professionally vetted through portfolio submission and peer review process



**126 Member
Companies
Worldwide**



Foundations for successful trail planning and design

Organizational needs

Processes - Project Life Cycle



Tools and Technologies

Foundations for Successful Trail Projects

Organizational Needs



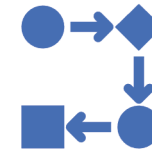
Resources



Coordination



Communications



Scaling



Resources

- Human
- Landscape
- Capital
- Fundraising – Grants, Fiscal Capacities
- Experience – Knowledge, Skills, Abilities





Coordination

- Land manager(s)
- Public
- User Communities
- Regulatory & Permitting Offices (State, Local, Federal)





Communications

- Internal & External
- Fundraising
- Awareness
- Political



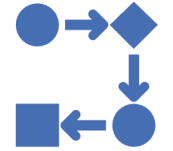
The Patapsco Valley's favorite fundraiser!

Thursday, June 8 - 6:30 - 9:00 pm

Guinness Open Gate Brewery 5001 Washington Blvd, Halethorpe, MD 21227

*Ticket includes our very own Guinness brew, THRU TRAIL IPA
delicious hors d'oeuvres, a silent auction, and our awesome park com*

Scaling for success



- Walk then run
- Take on projects well matched to available resources
- Build and stretch capacity through phasing and growth
- Success creates gravity

Section 2: Tools and Techniques



Trail Planning and Design Toolbox



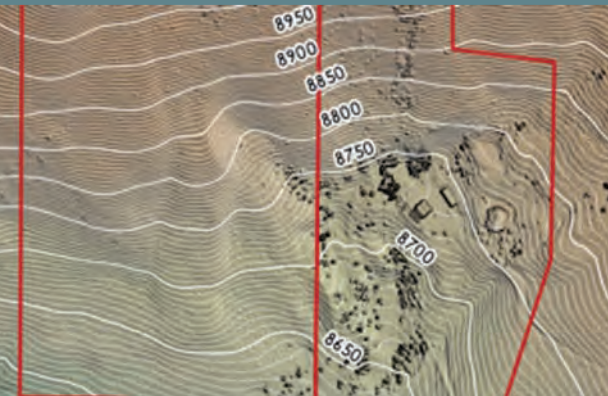


Categories of Tools

Data Collection



Presentation and Sharing



Design and Mapping

Category I: Data Collection Tools

Online Data Sources
Field Instruments
GPS, Phone Apps
Drones



Online Data Sources

GIS Data

- Can be used in QGIS, ArcGIS, Google Earth, others
- Base mapping
- Before site visits



Goals:

1. Understand a site enough to prepare scope and fees for a planning project
2. Jump start the planning process before visiting the site

Online Data Sources

Local COGs, County Assessor,
Government Agencies

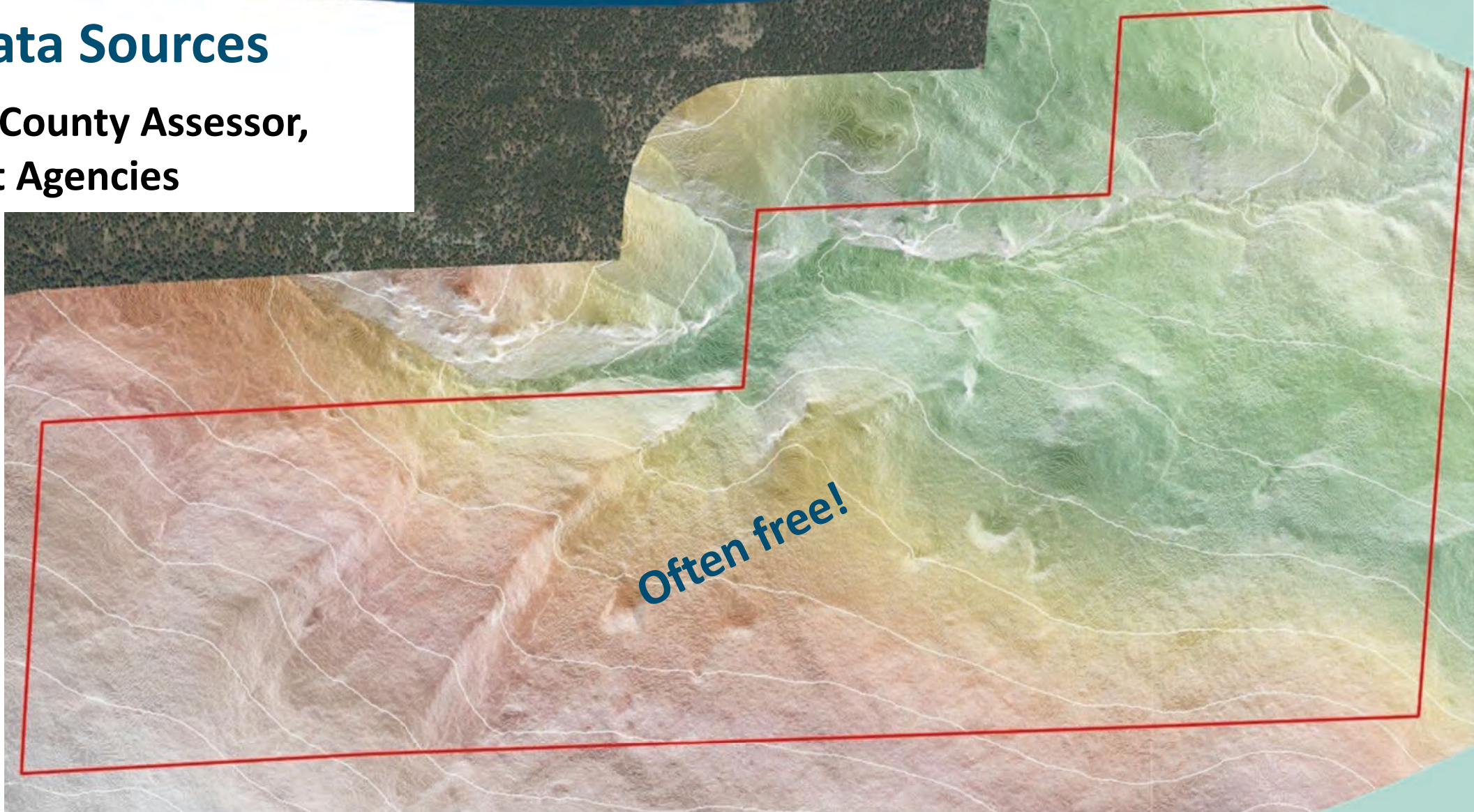
Property lines

Elevation

Roads

Trails

Buildings



Field Instruments

Clinometer*

- Measures slope/grade
- Key for assessing, planning, and flagging trails



**Don't trust a trail builder/planner who doesn't use a clino!*

Field Instruments

Laser Rangefinder, Handheld GPS, Measuring Wheel



GPS and Phone Apps

- Decent accuracy
- Easy to use
- Phone apps have largely replaced handheld GPS units
- OnX, ArcGIS Collector, Survey123

ON



HUNT





Pride Rock

06/12/21, 1:26 PM

Overview **Wind Calendar**

Lat/Long 39.55893, -105.39765 **Copy**

Hide on map

Waypoint Tools

Wind Direction
See the current wind direction over this waypoint.



Waypoint Radius
Set a range around this waypoint by choosing a distance.



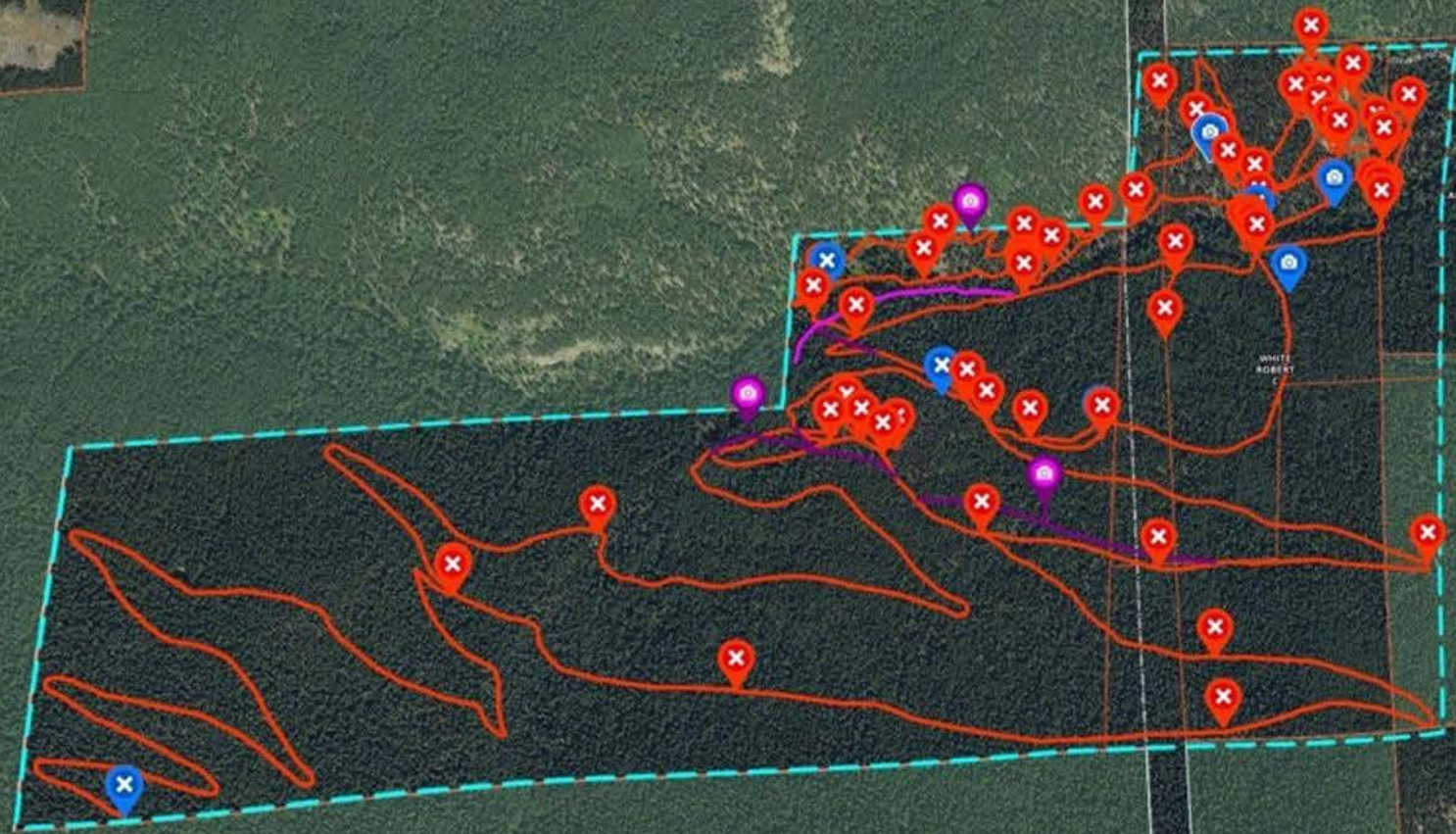
Photos



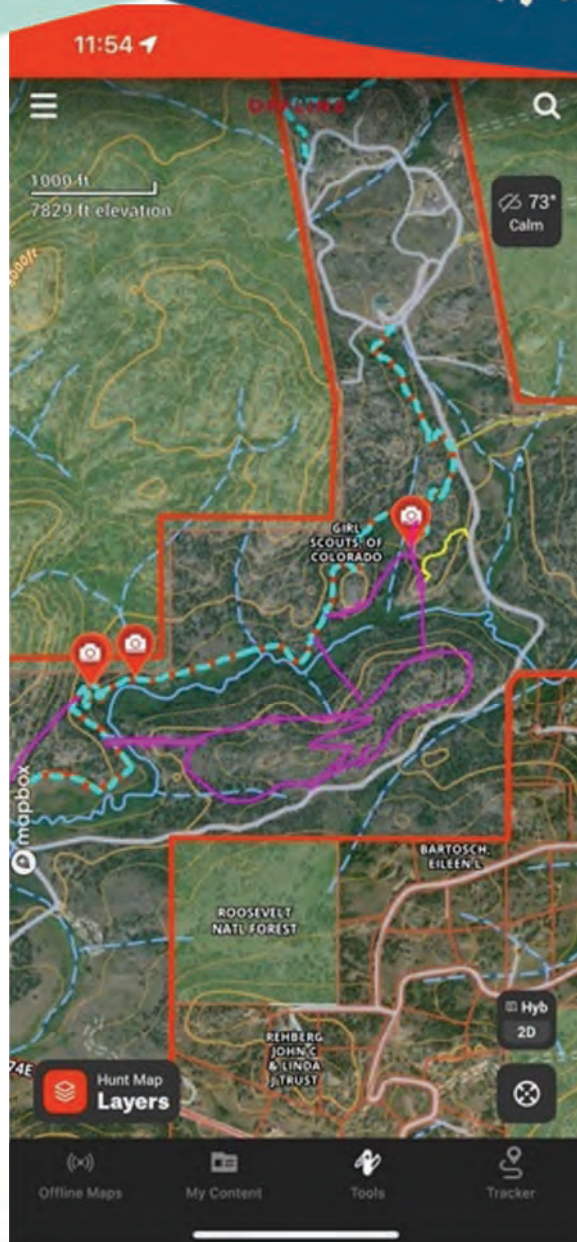
- Share
- Edit
- Add to Folder
- Delete

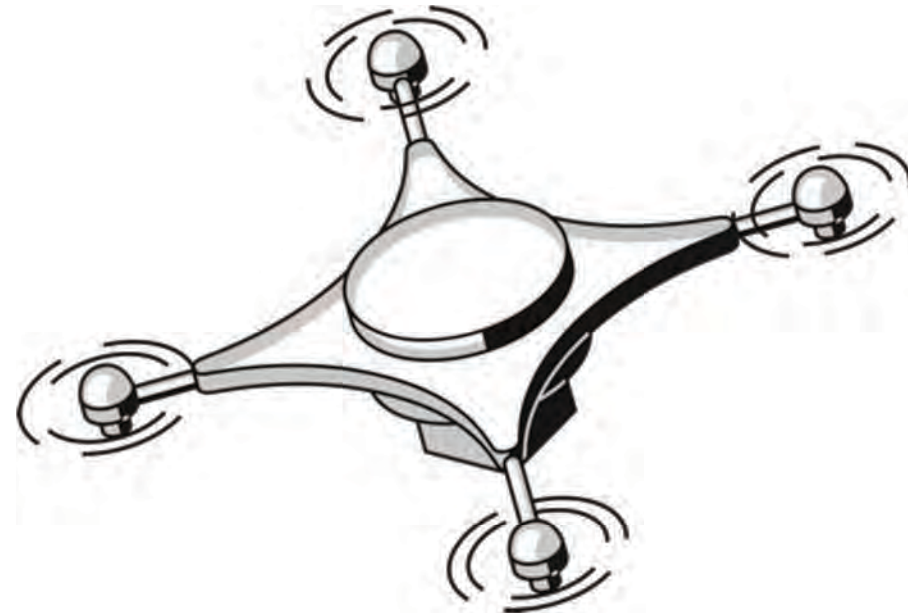
ON X HUNT

ARAPAHO NATL FOREST



- Map Layers
- Offline Maps
- My Content
- My Account & Settings
- My Account
- Settings
- Site Benefits
- Invite Friends
- Print
- Chip Updater





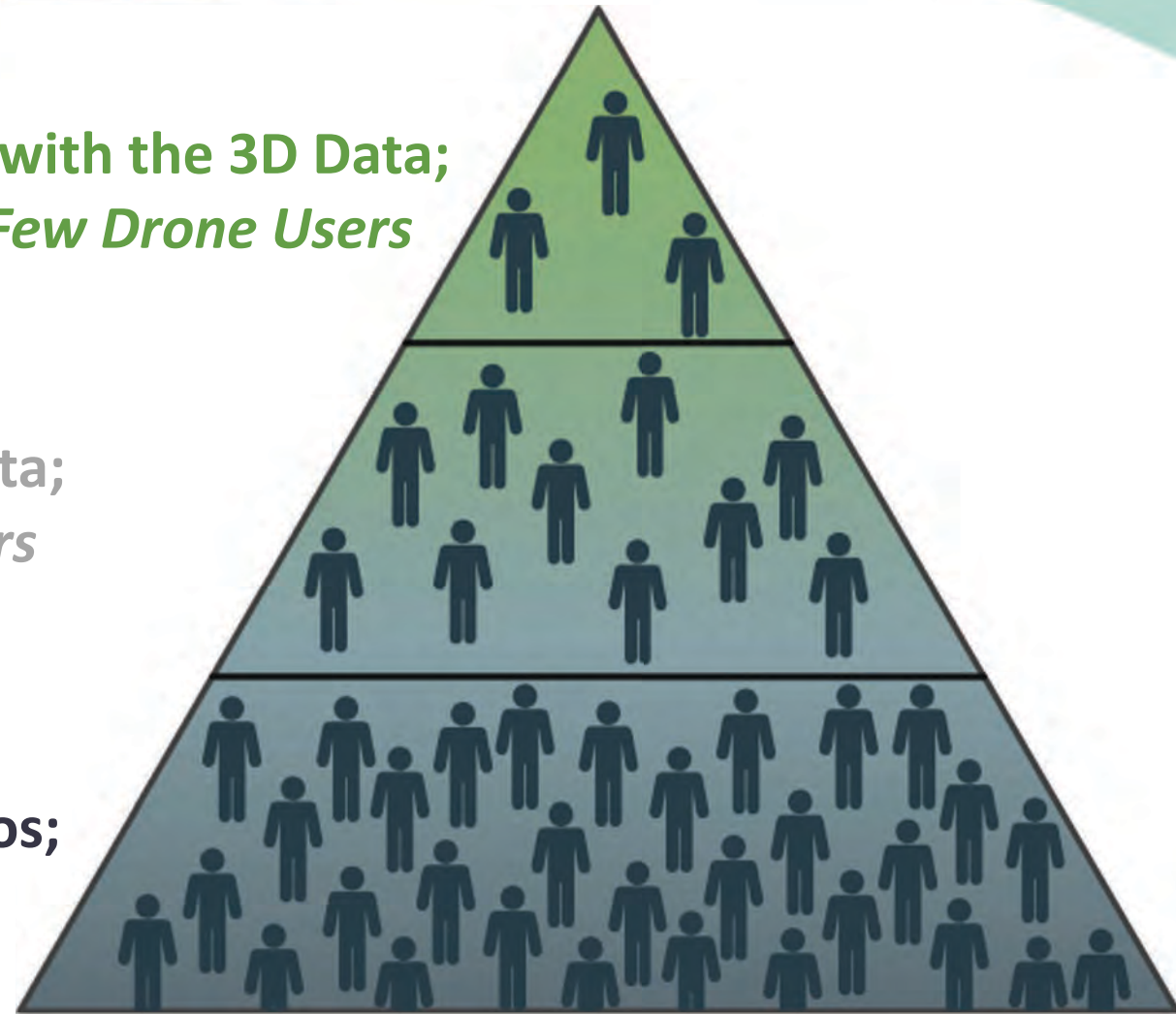
Types of Drone Users

3 Main Tiers/Categories

Working with the 3D Data;
Only a Few Drone Users

Collecting 3D Data;
Less Drone Users

Collecting Photos and Videos;
Many Drone Users



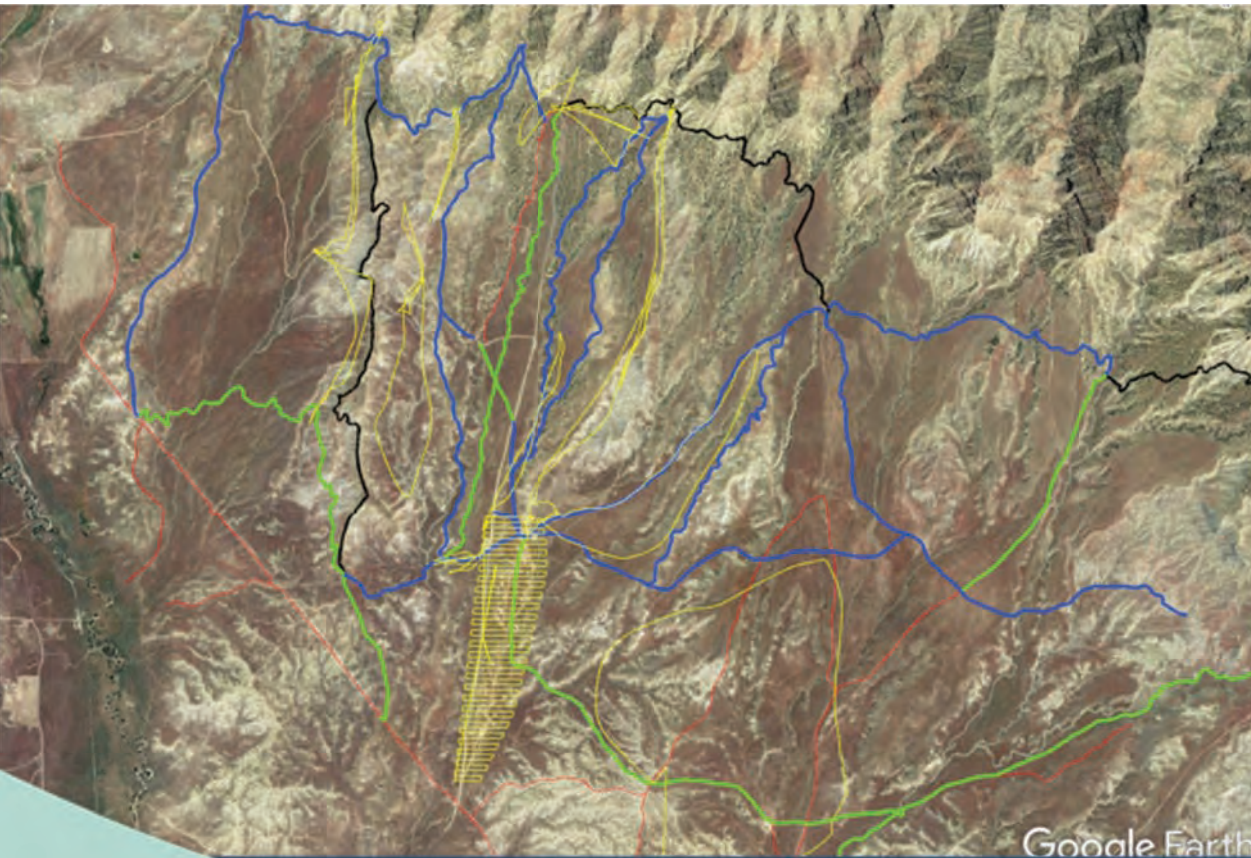
Tier 1: Photographs and Videos

Most common and basic type of drone use

- Photos and videos are geotagged
- Cover a lot of ground quickly
- Gain a better overall perspective of the site

Tier 1: Photographs and Videos

Geotagged videos and photos



Tier 2: Collecting 3D Data

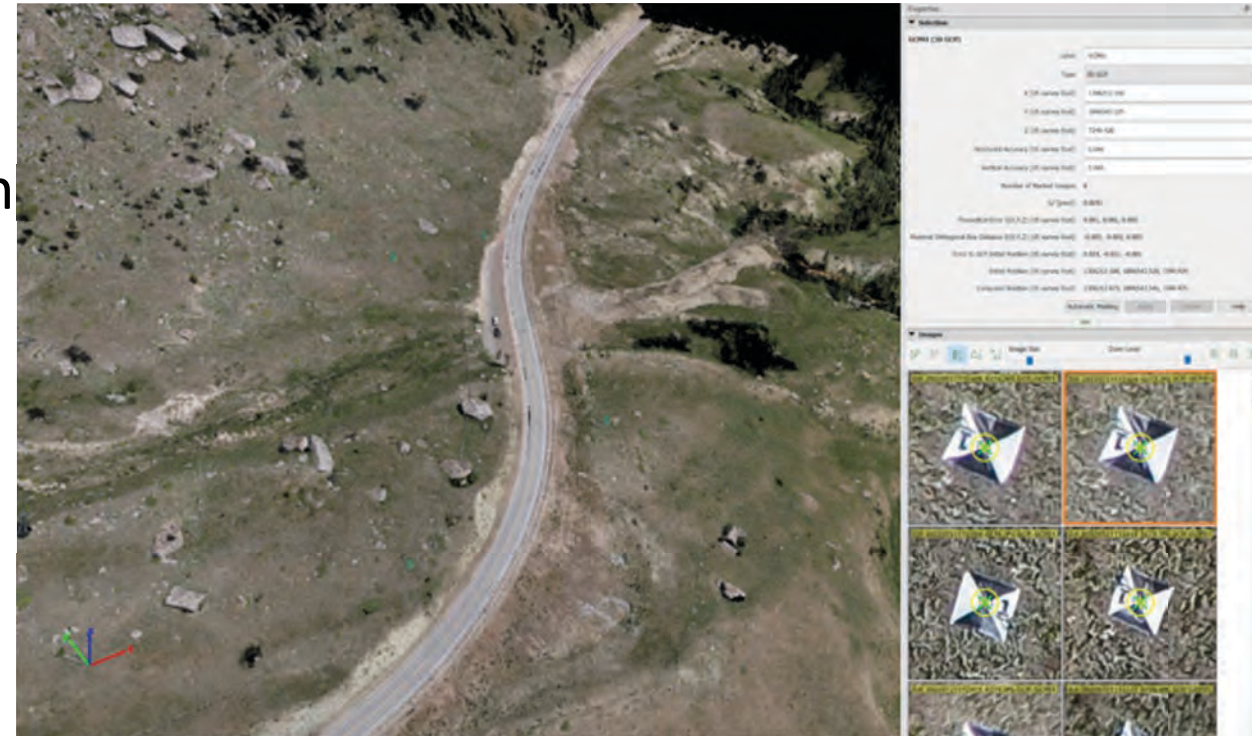
Less common, but quite a few 'drone people' do it

- Variety of methods
- Most use photogrammetry

Tier 2: Collecting 3D Data

Photogrammetry

- Uses a series of overlapping photographs
- Creates a 3D model (point cloud and mesh)
- Accuracy heavily relies on:
 - Photograph overlap
 - Angle of images (flight pattern)
 - Distance to subject
 - Ground Control Points (GCPs)



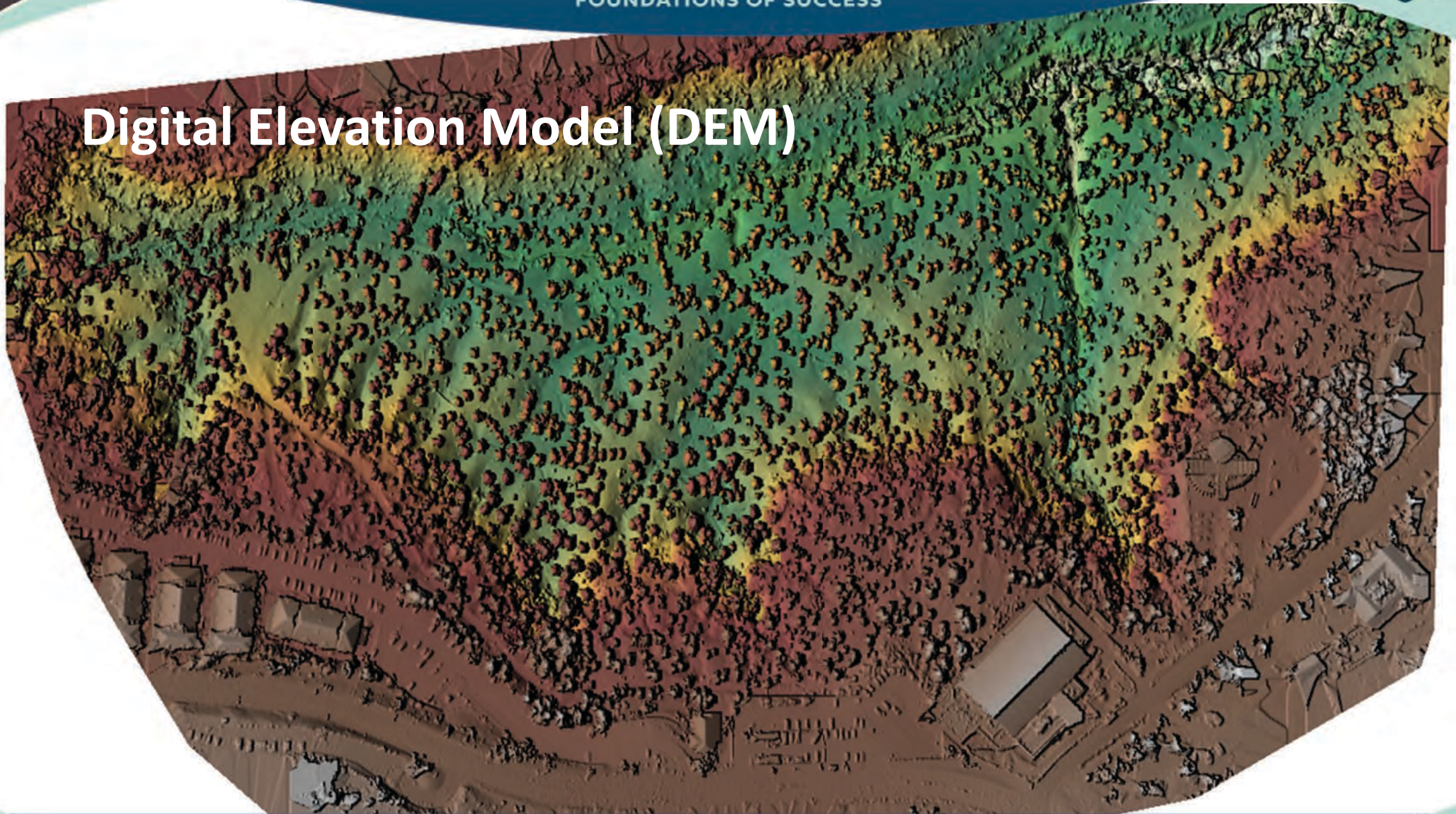


What can we get out of photogrammetry?

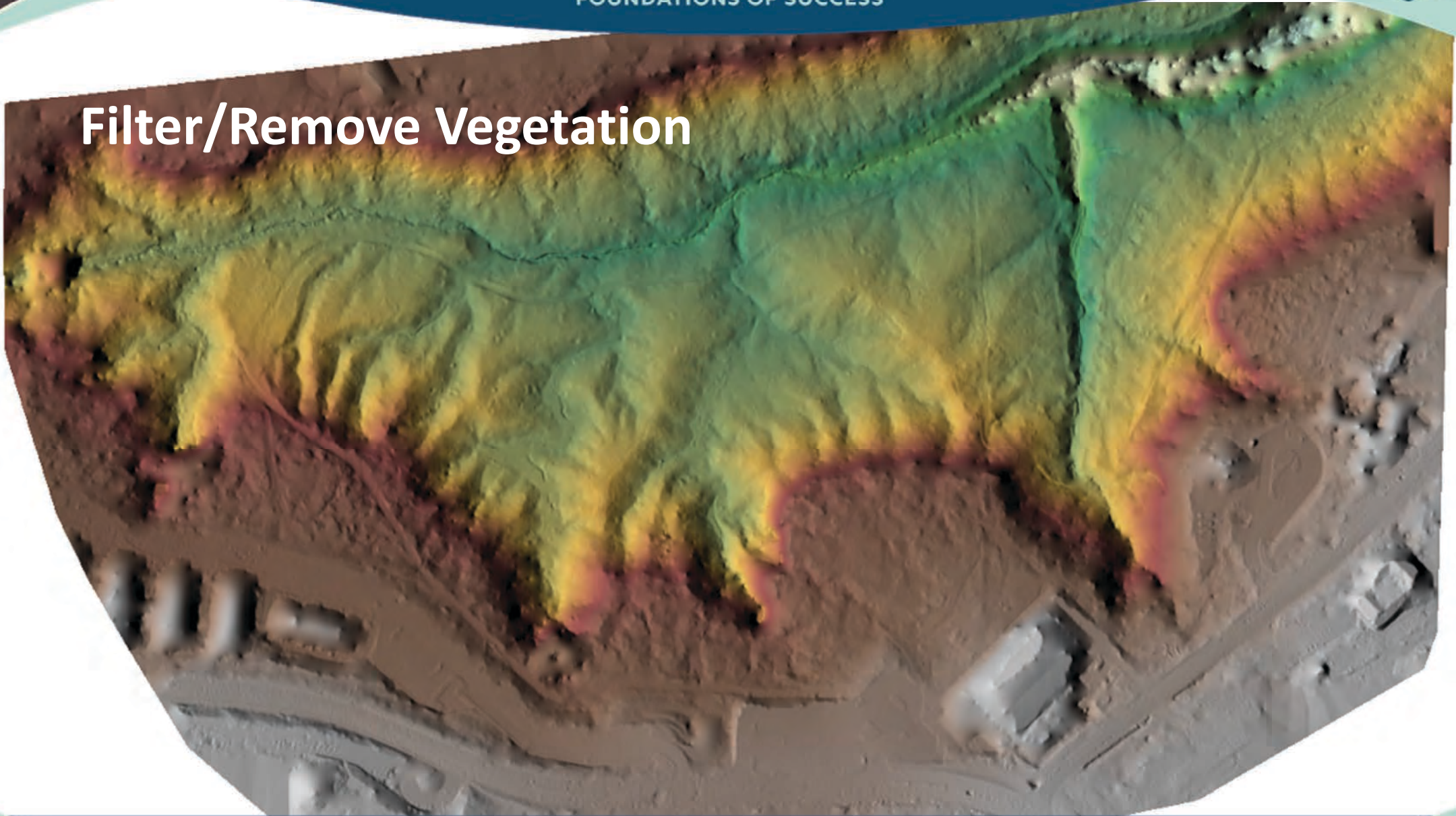
Orthorectified High Resolution Imagery



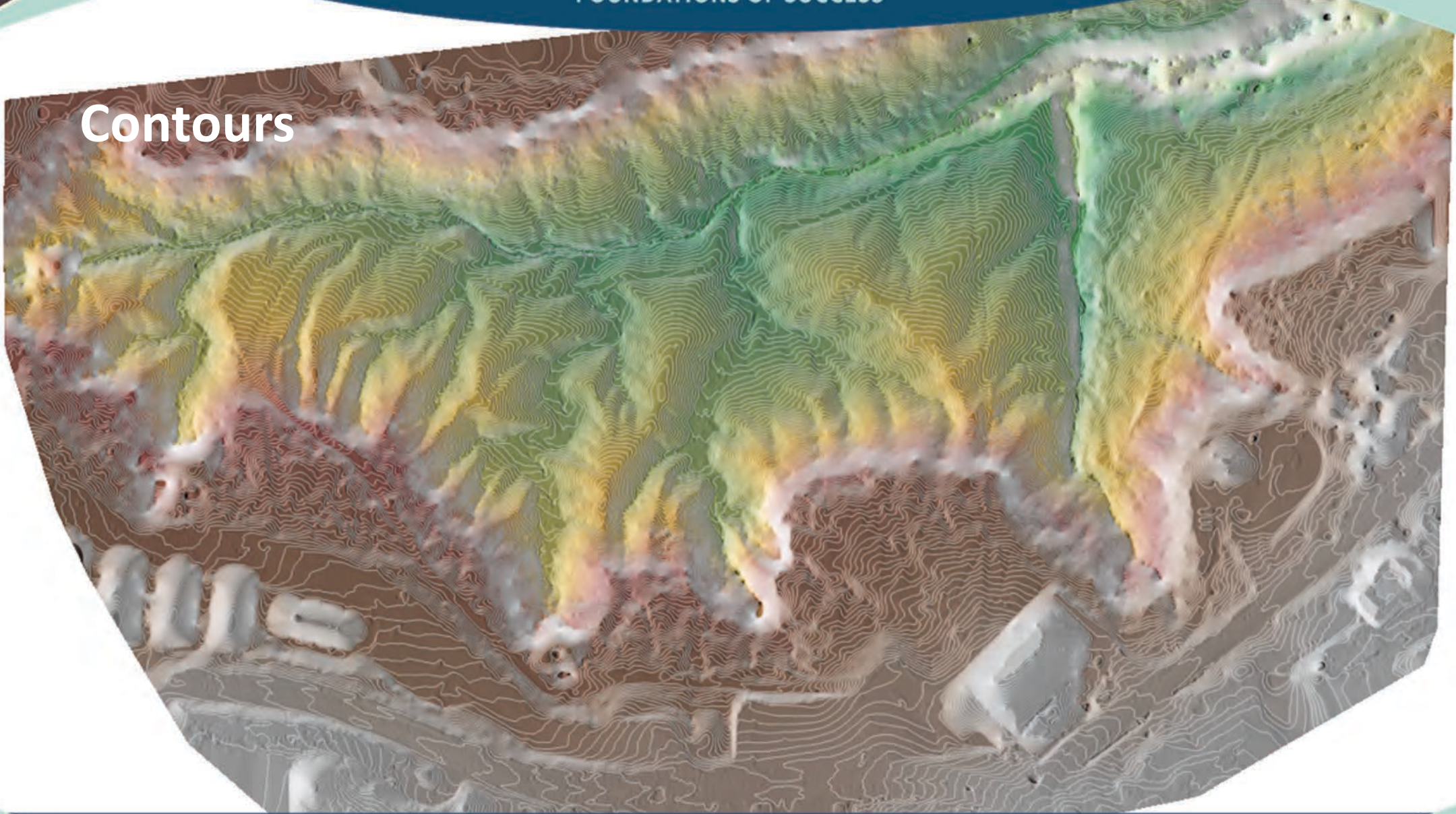
Digital Elevation Model (DEM)



Filter/Remove Vegetation



Contours



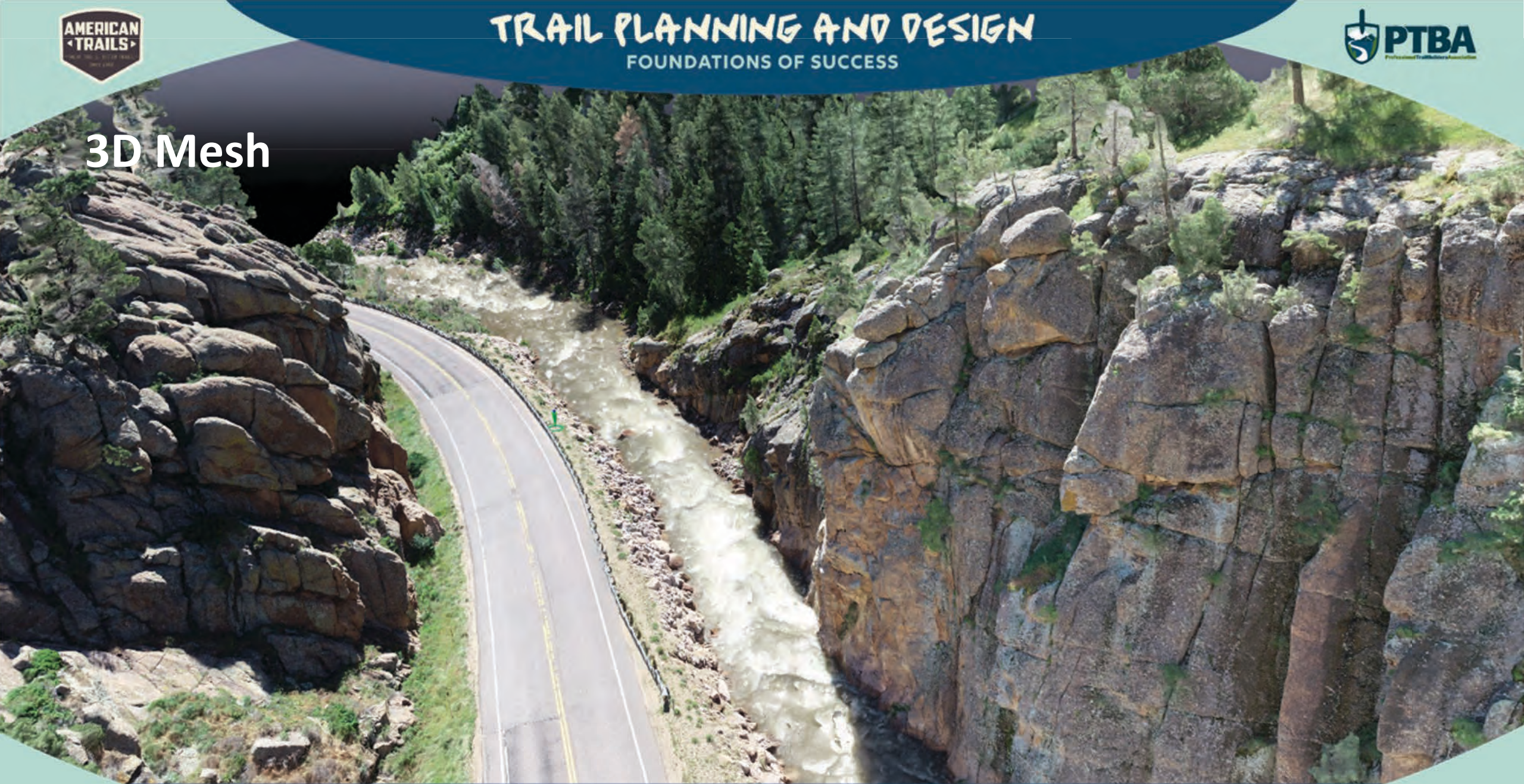


3D Point Cloud

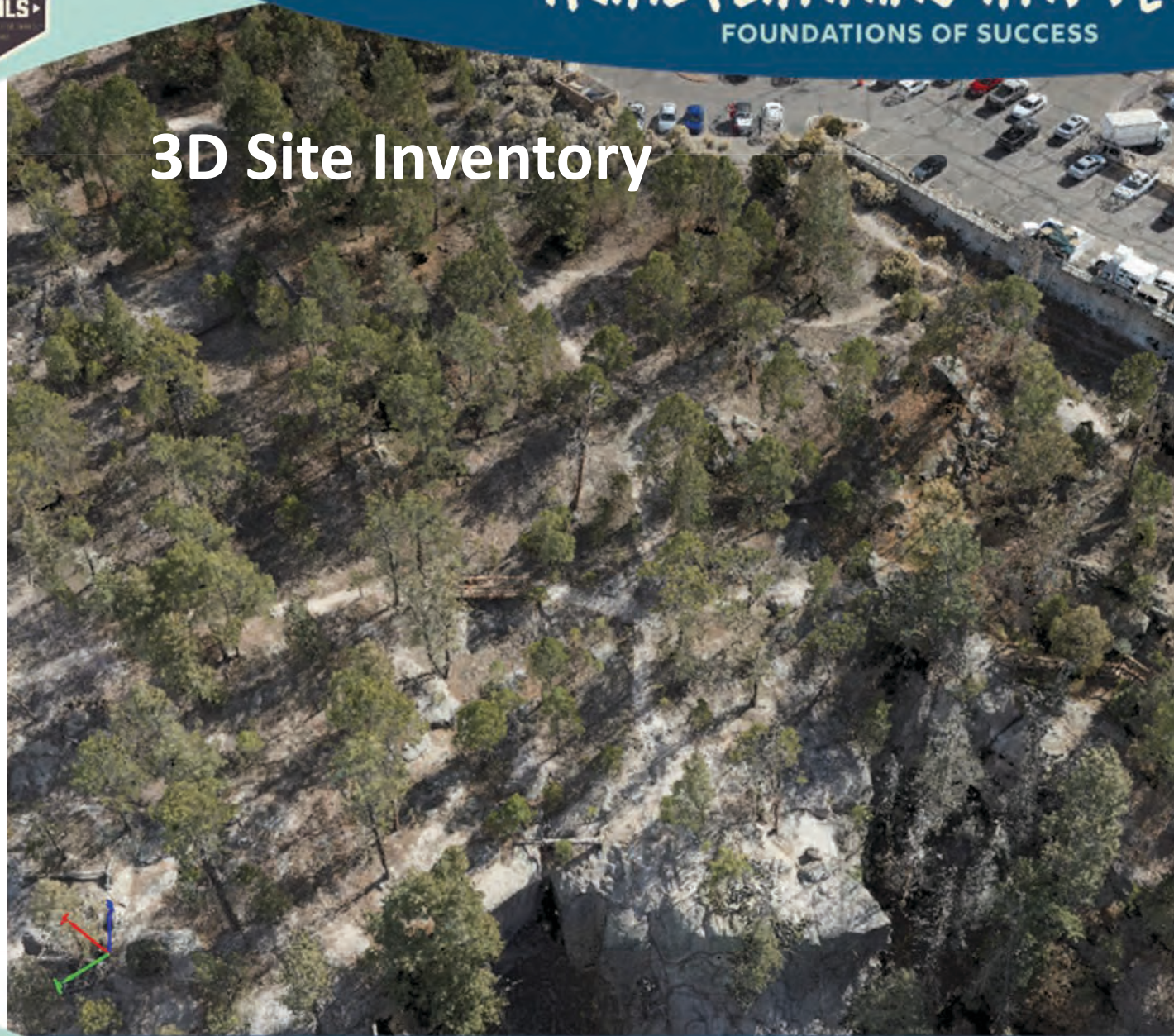




3D Mesh

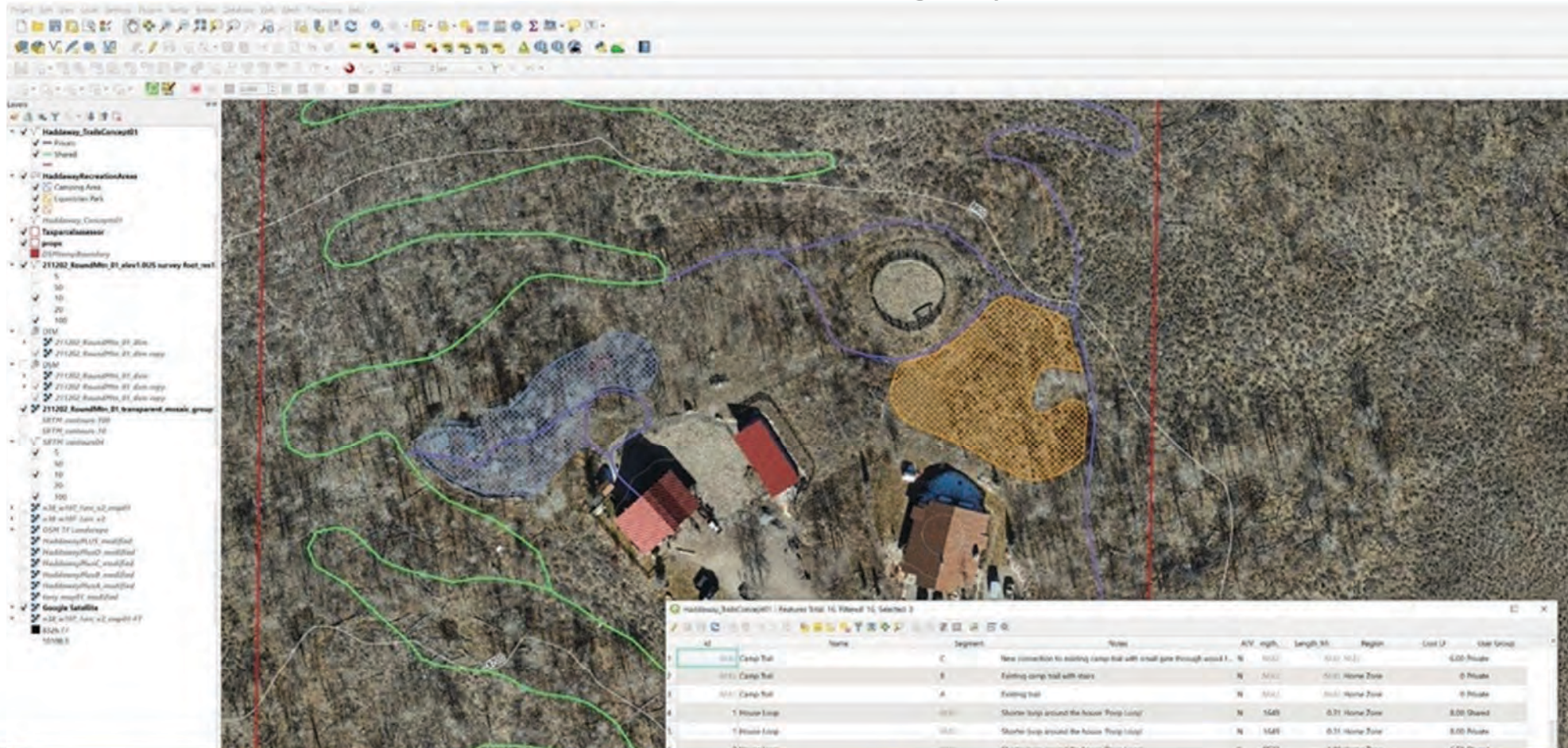


3D Site Inventory



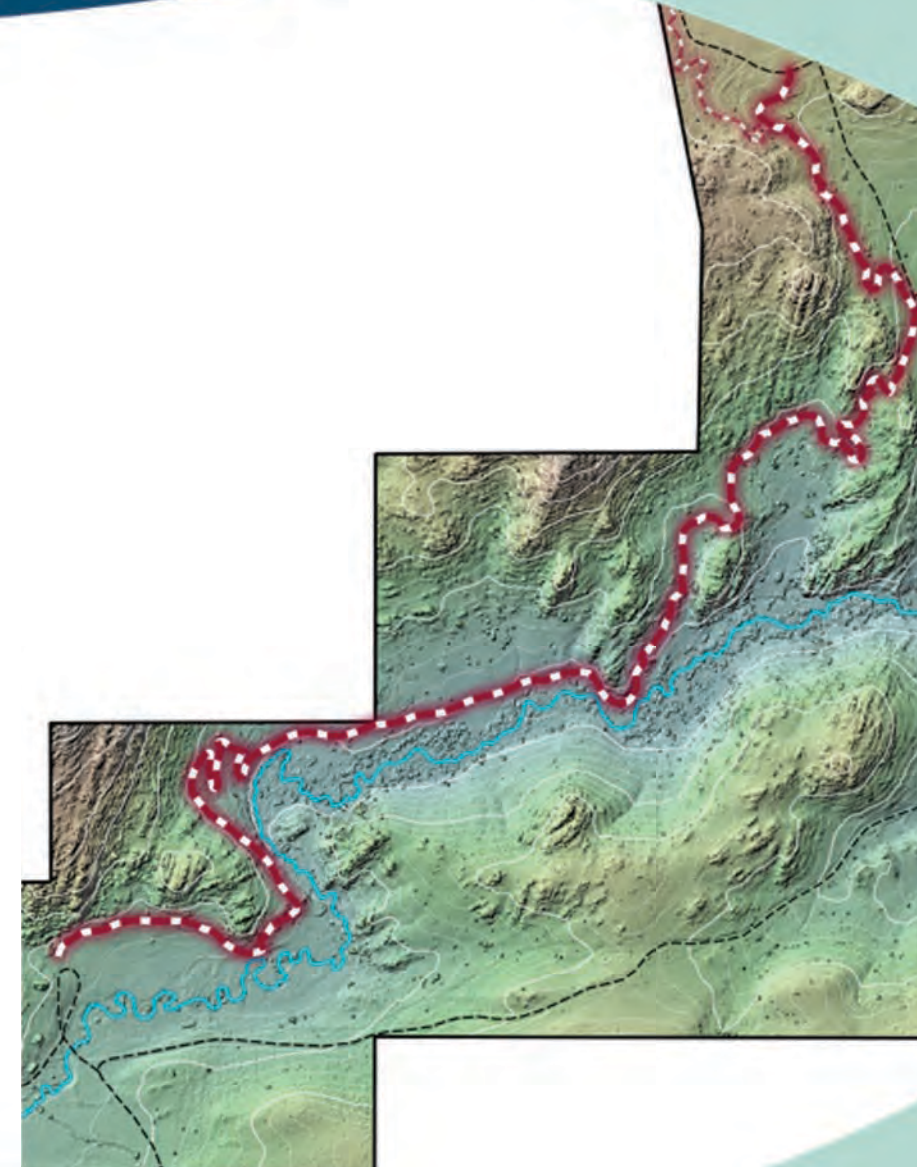
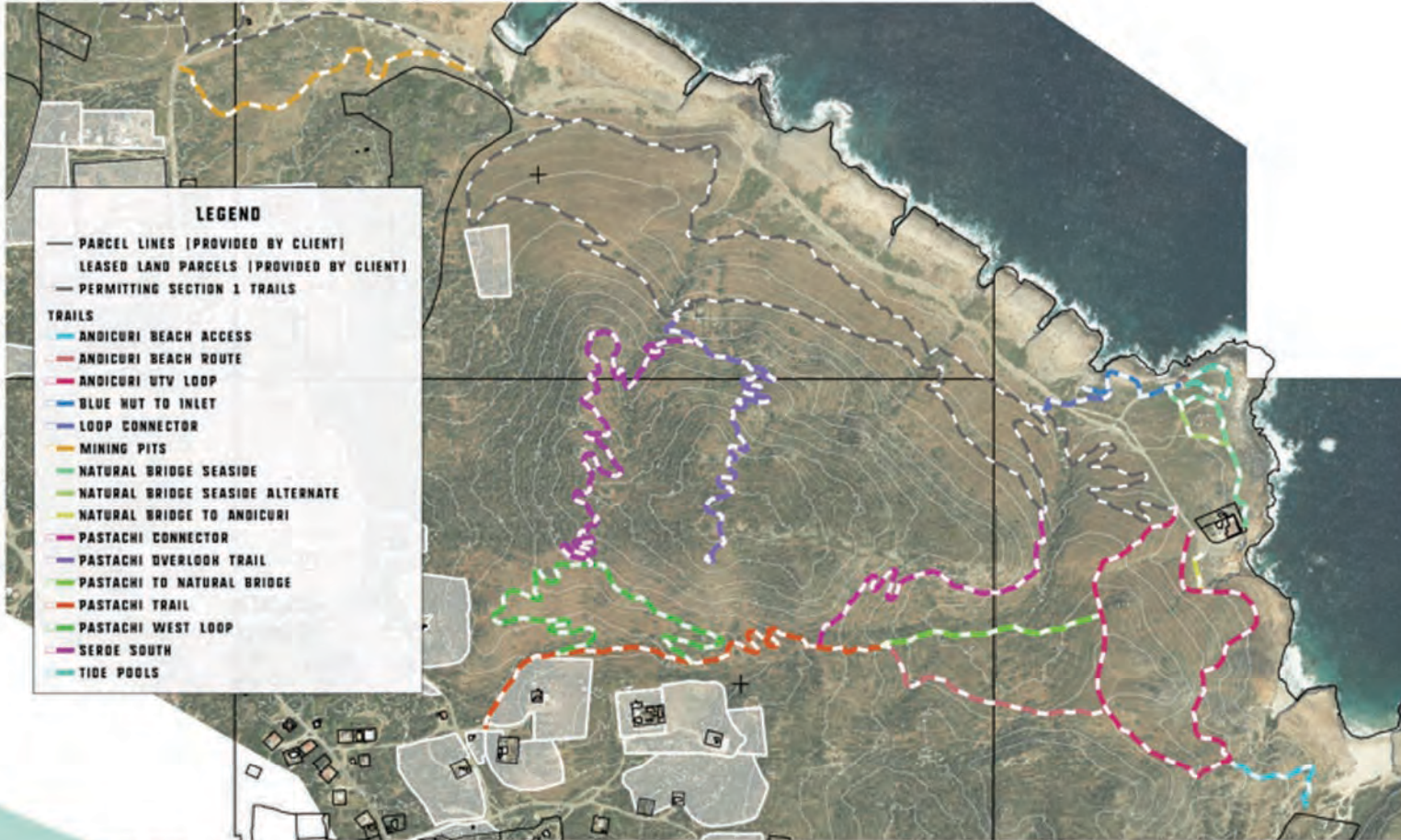
Category II: Design and Planning Tools

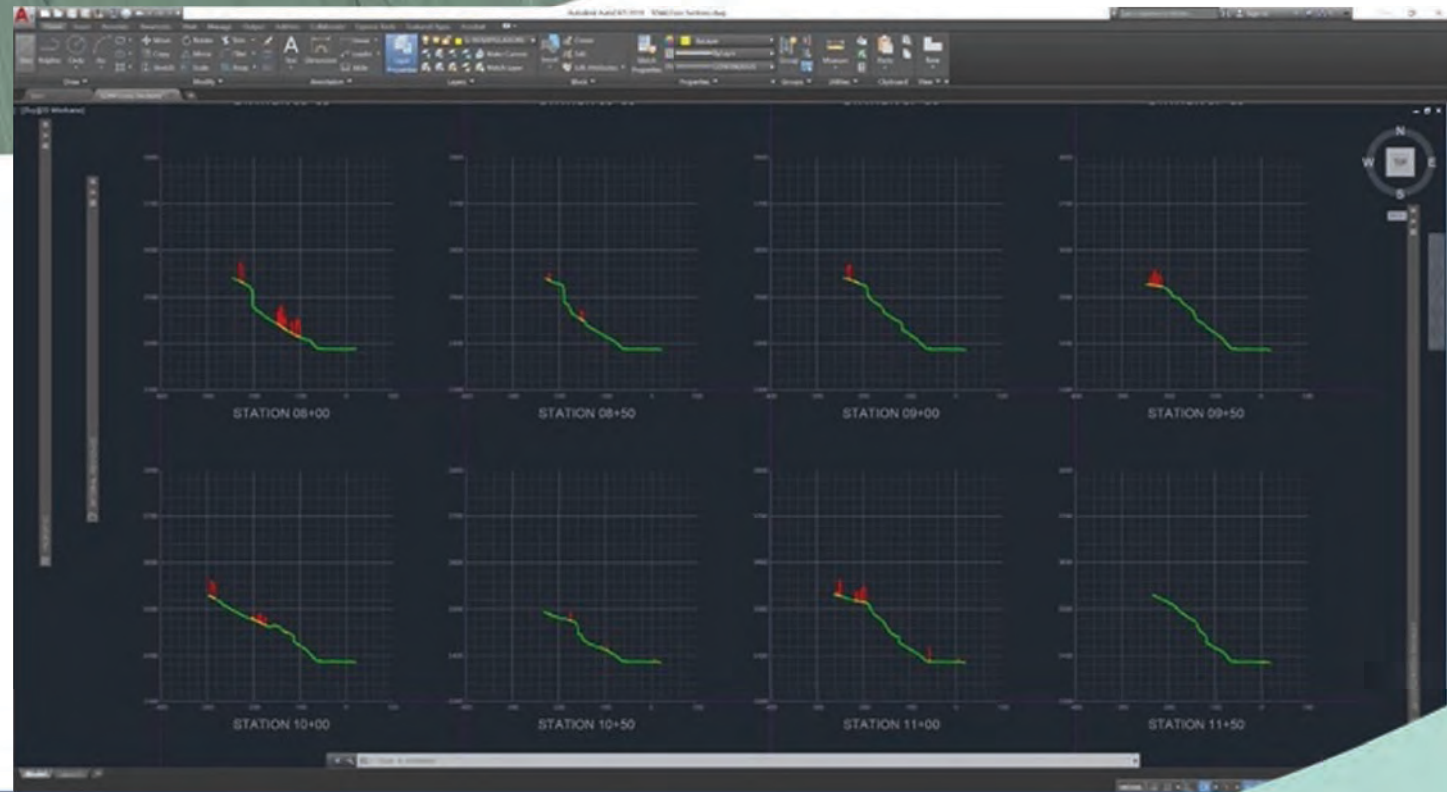
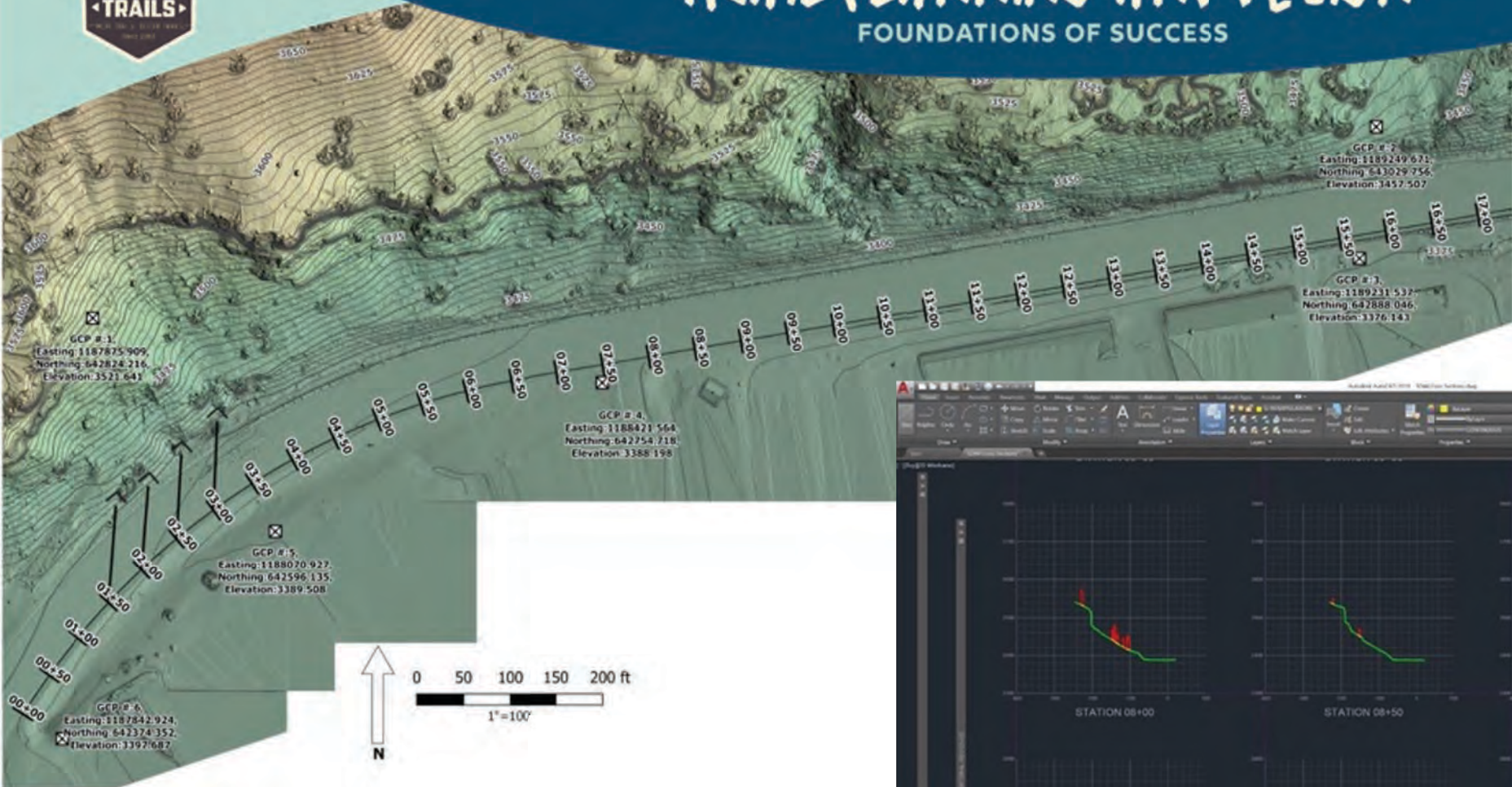
How to use the Category I data in the office



GIS Applications

QGIS and ArcGIS (ESRI)

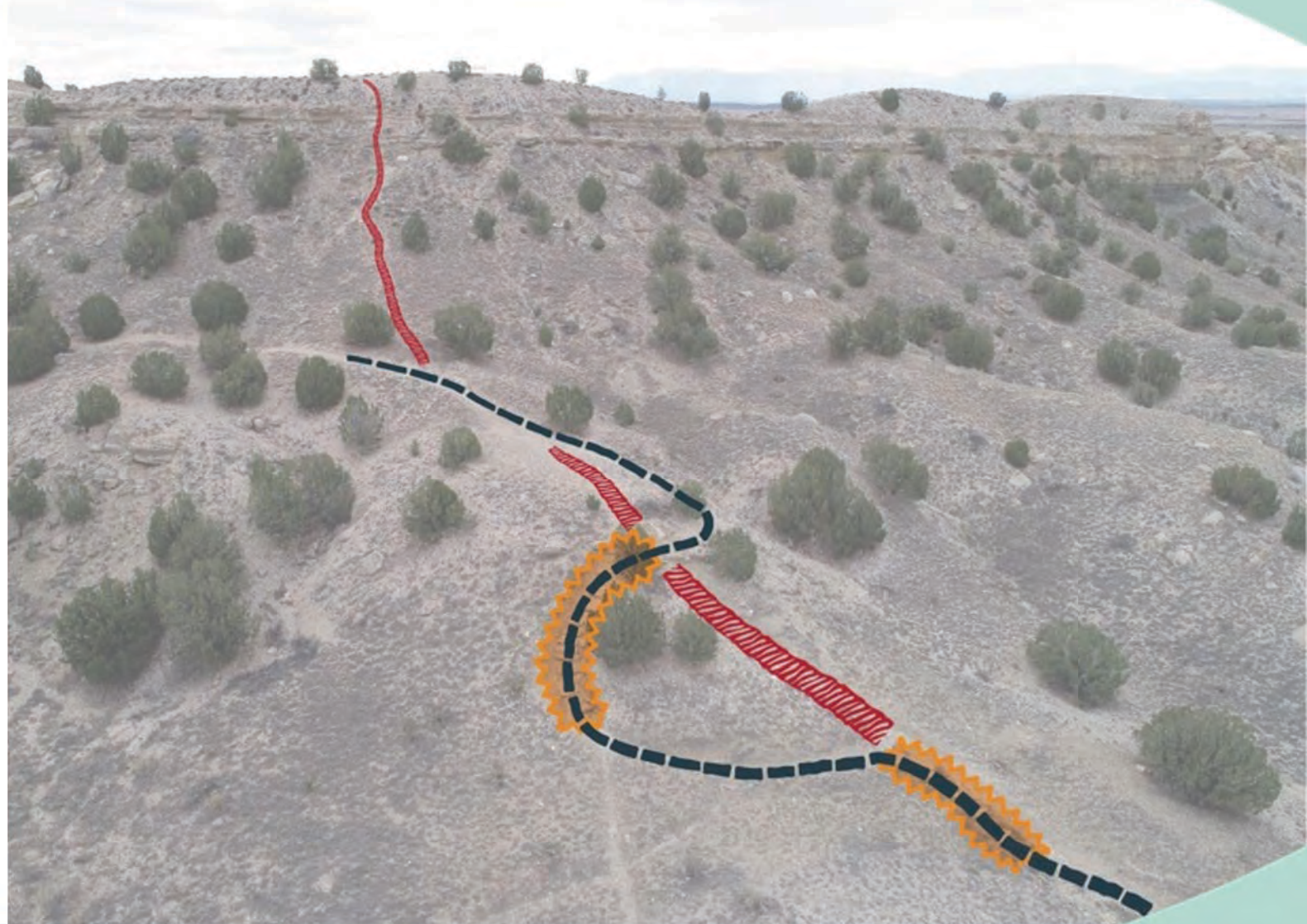




CAD Software

Adobe Products

Photoshop, Illustrator,
InDesign, Premiere



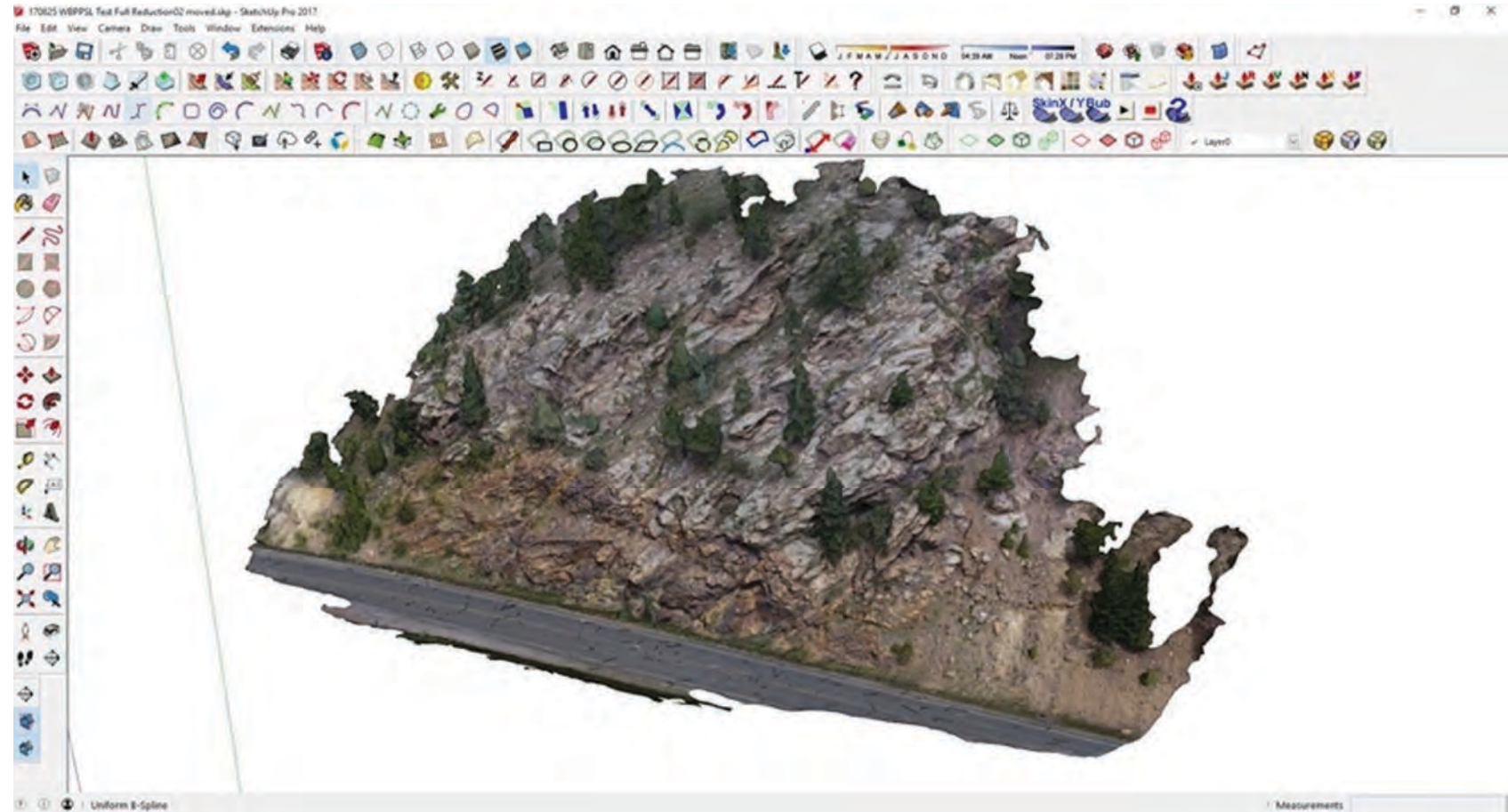
3D Modeling

SketchUp and Lumion



3D Modeling - SketchUp, Lumion, Photoshop

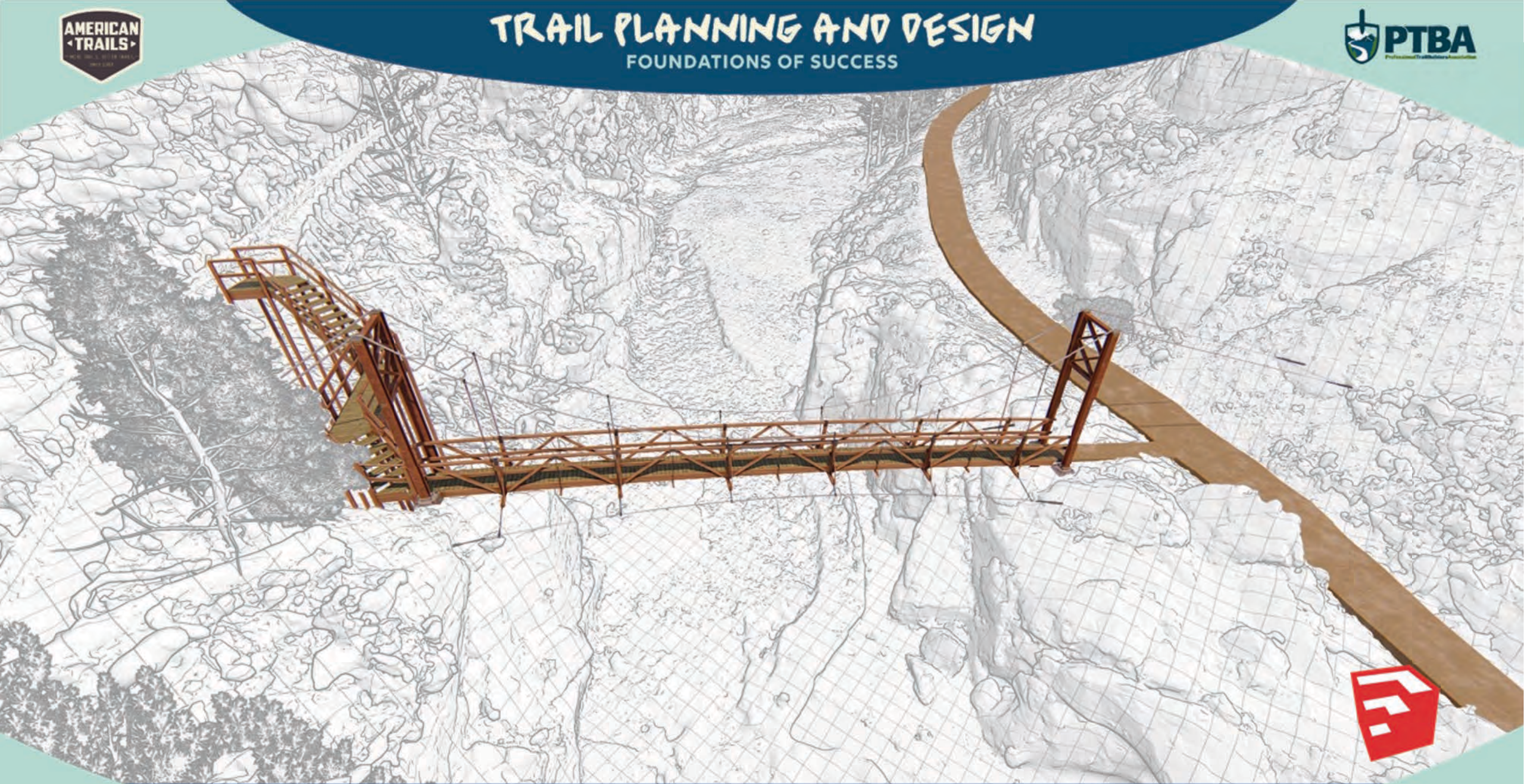
Photogrammetry model can be exported to SketchUp, or shared online for collaboration





TRAIL PLANNING AND DESIGN

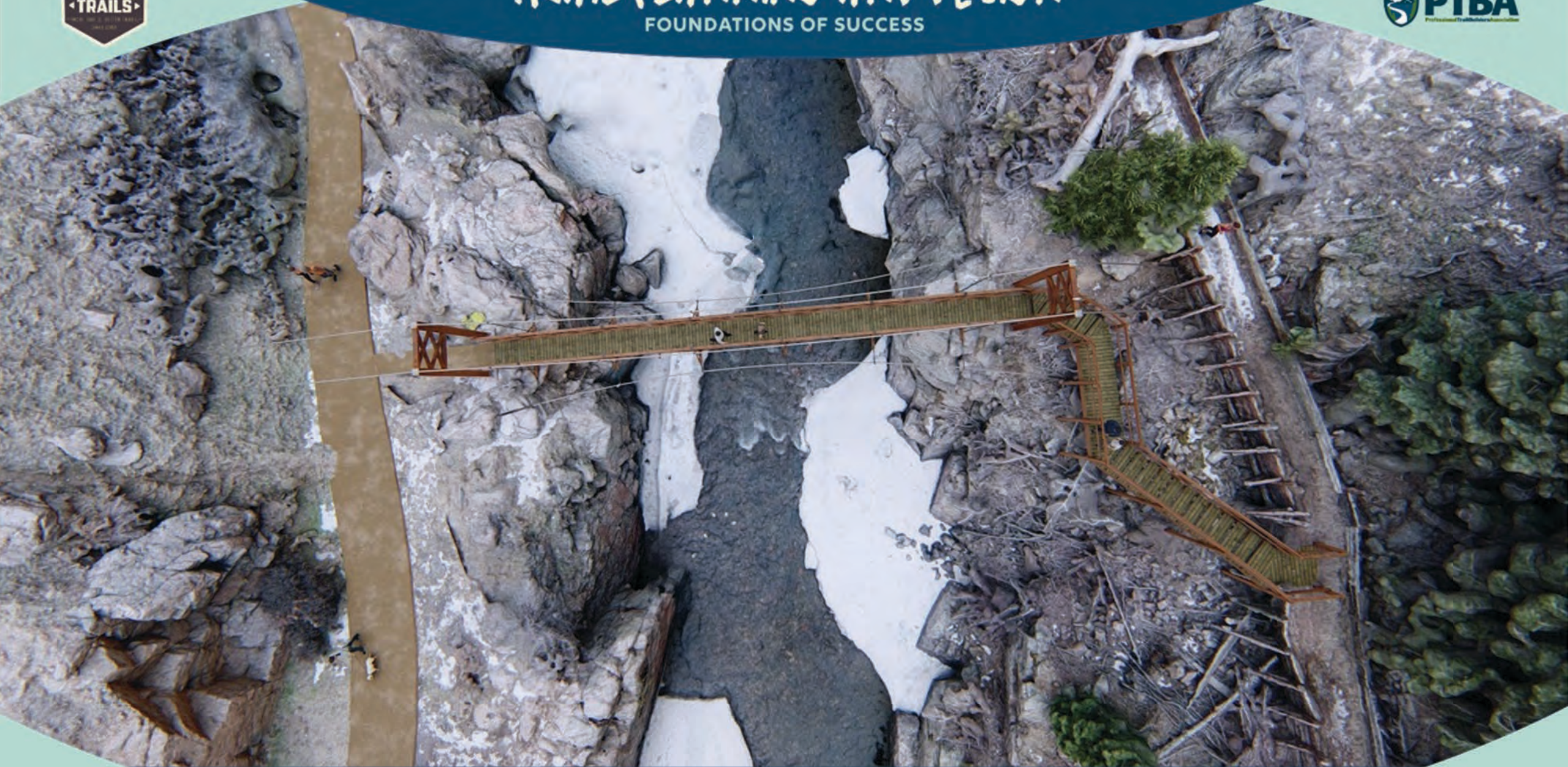
FOUNDATIONS OF SUCCESS





TRAIL PLANNING AND DESIGN

FOUNDATIONS OF SUCCESS





TRAIL PLANNING AND DESIGN

FOUNDATIONS OF SUCCESS



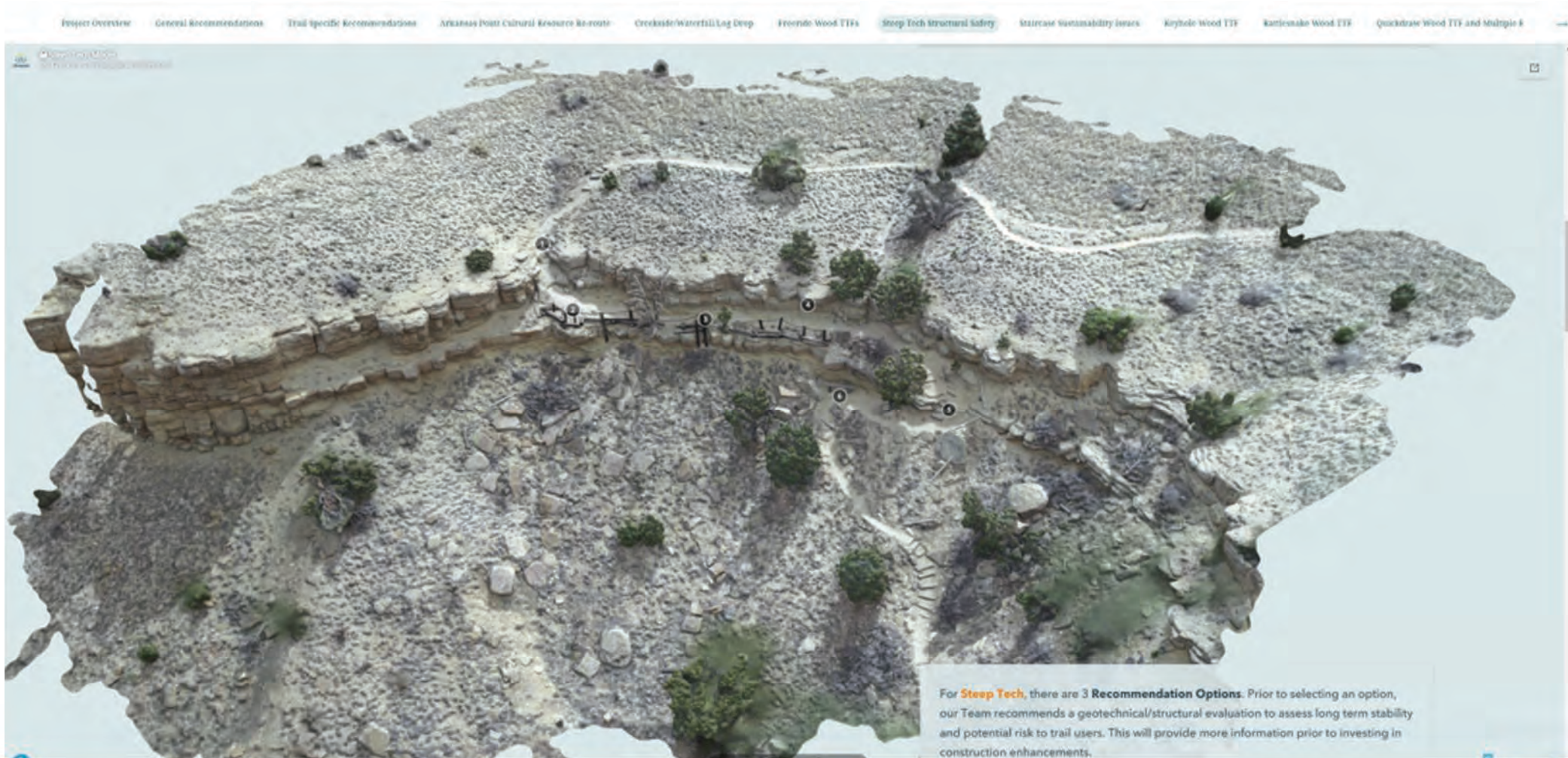
- name or tag...
- Annotations
 - South Boundary
 - Low Line South
 - Low Line North
 - Overlook Low line
 - POL
 - Approx- Boundary line
 - NW Property Corner
 - High Line
 - High Line North
 - Property Corner
 - POL
 - POL
 - POL
 - POL
 - Overlays
 - Outputs
 - Orthomosaic
 - DSM
 - 3D Textured Mesh
 - Point Cloud



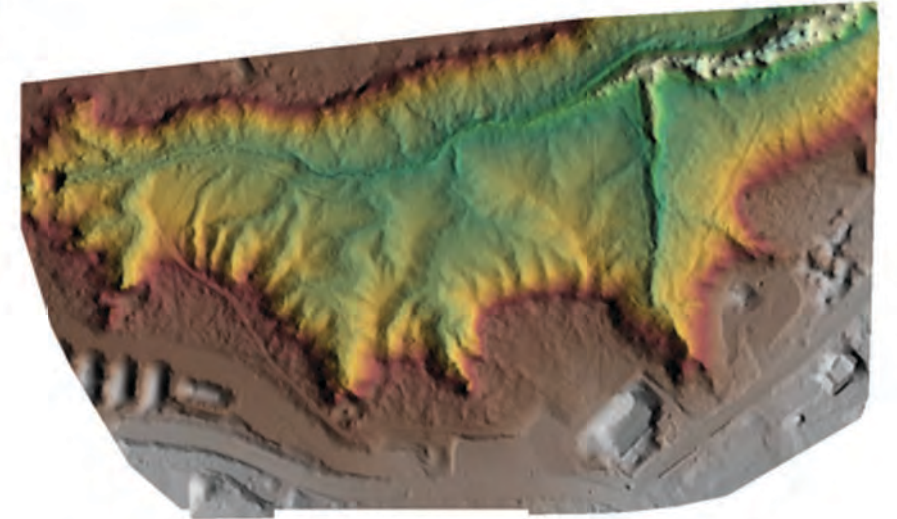
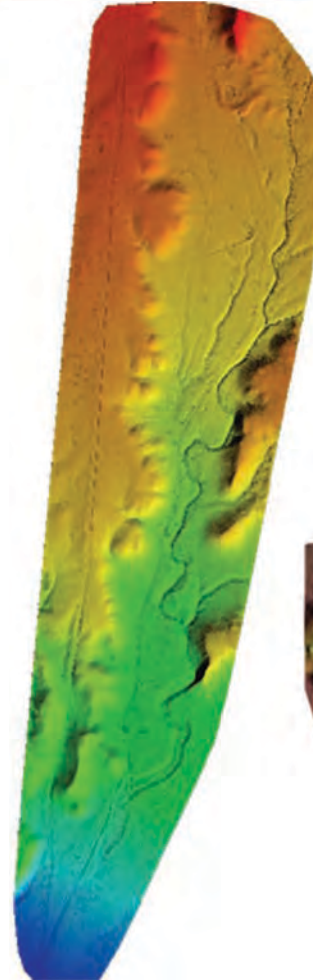
Select a



Category III: Presentation and Sharing Tools



Tons of Graphics...



...how do we share them with clients?

PDFs

InDesign to dress them up

TTF Inspection and Routine Maintenance Schedule

Several trails at Lake Pueblo State Park include Technical Trail Features (TTFs), many of which are deteriorating wood and do not meet Best Management Practices. These aging TTFs urgently need to be removed and/or replaced. All TTFs, but especially wood ones, require regular documented maintenance inspections and repairs (based on industry standards) to effectively minimize injuries and manage risk. Understanding, inspecting, maintaining, and documenting the TTFs on the property is crucial to avoiding trail user injuries and property manager liability.





General Recommendation #3 is to develop a routine safety inspections and a maintenance schedule for all TTFs in the Park. International Mountain Bicycling Association (IMBA) guides and the Resort Municipality of Whistler's Trail Standards for Environmental and Technical Trail Features are both good resources for creating such a schedule.

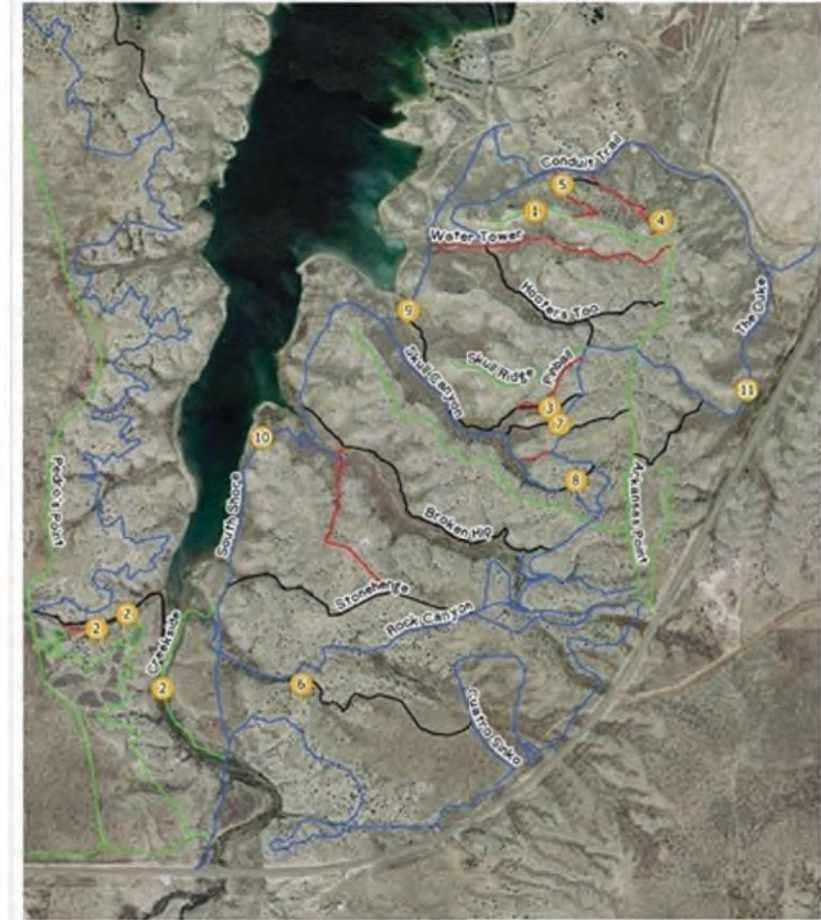
These documents are commonly accepted as Best Management Practices and are frequently used in both construction and litigation as industry standards.

chinook  

This report focuses on 13 trail issues that were identified by CPW as high priority areas. Some of these areas must be addressed together and have therefore been combined into single projects. A map of these locations can be seen on the facing page, as well as a table below. Numbers on the map/table refer to priorities of the issues as assigned by CPW. Duplicate numbers indicate separate issues that must be addressed together.

Trail Name	Issue(s)
1 Arkansas Point	Cultural resources conflict
2 Creekside/Waterfall/Log Drop	Riparian bird habitat conflict
3 Freeride	Aging wood TTFs
4 Steeptech	Aging wood structures and dangerous trail
5 Staircase	Steep and braided unsustainable trail sections
6 Keyhole	Aging wood TTF and new line opportunity
7 Rattlesnake	Aging wood TTF
8 Quickdraw	Aging wood TTF and multiple lines
9 South Shore Black Hill	Too steep hill and erosion issues
10 South Shore Big Hill	Too steep hill
11 Conduit	Erosion issues

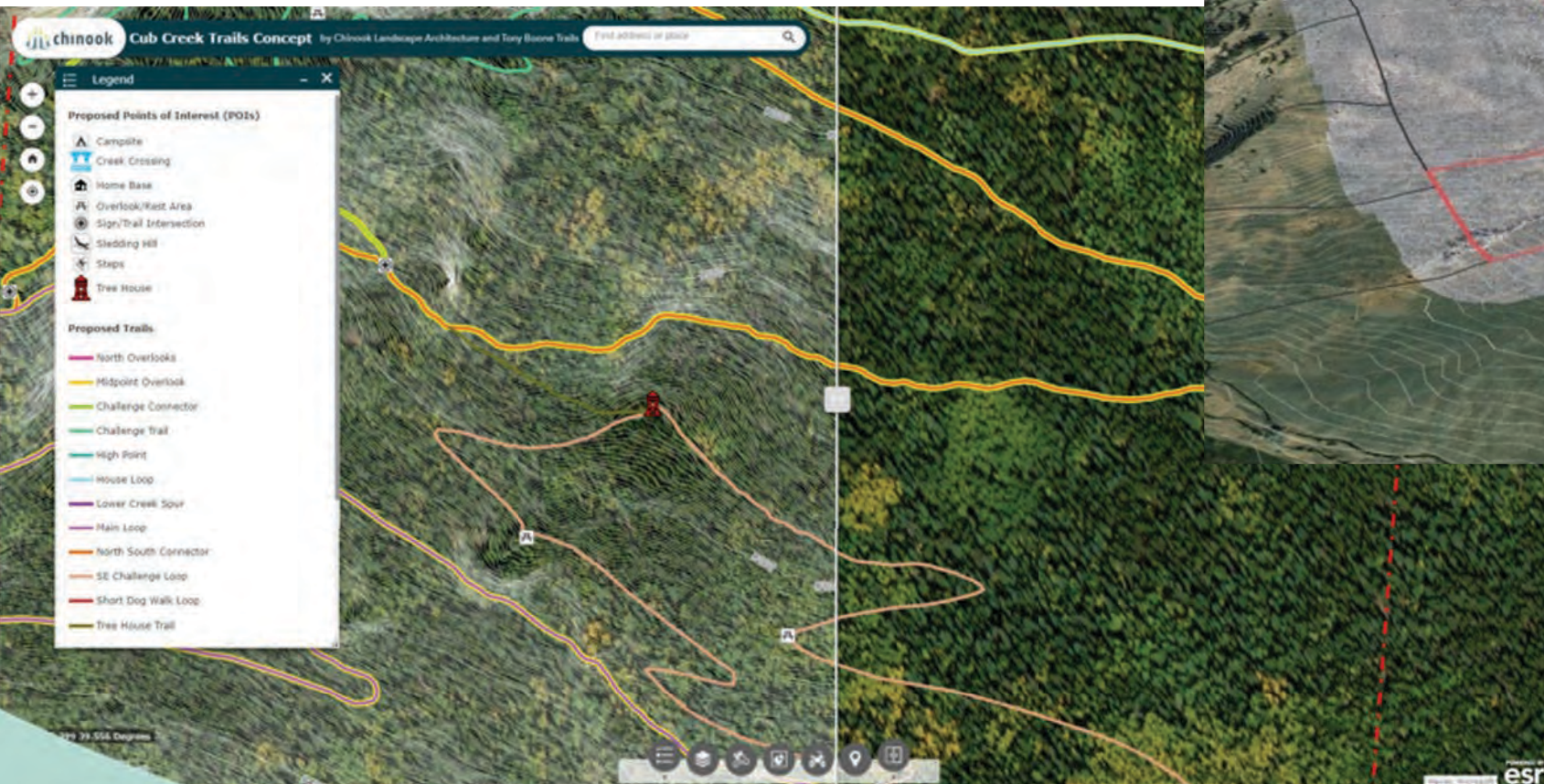
chinook  



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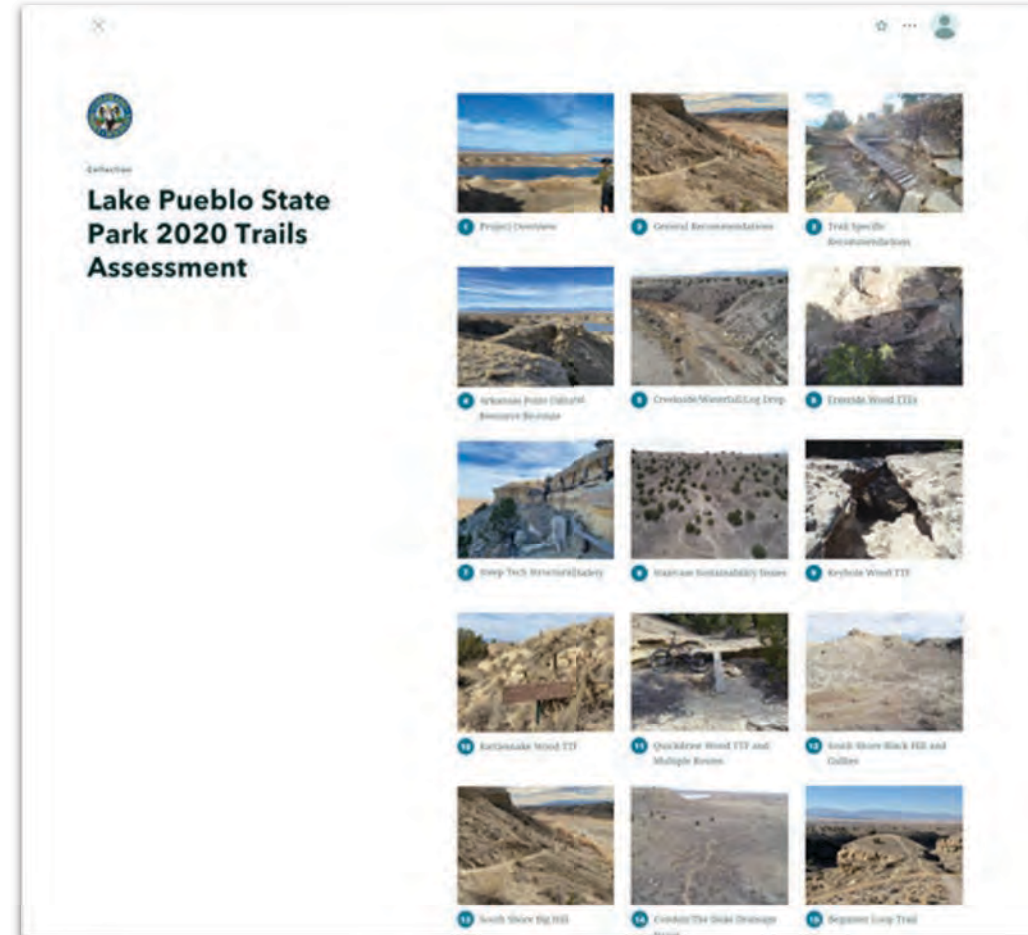
Sharing Maps ArcGIS Online

WebMaps and WebApps



Sharing an Entire Project and Narrative

StoryMaps





Trail Project Life Phases

PLANNING

DESIGN

PERMITTING

APPROVALS

CONSTRUCTION

MAINTENANCE & MANAGEMENT

FUNDRAISING & COMMUNICATIONS

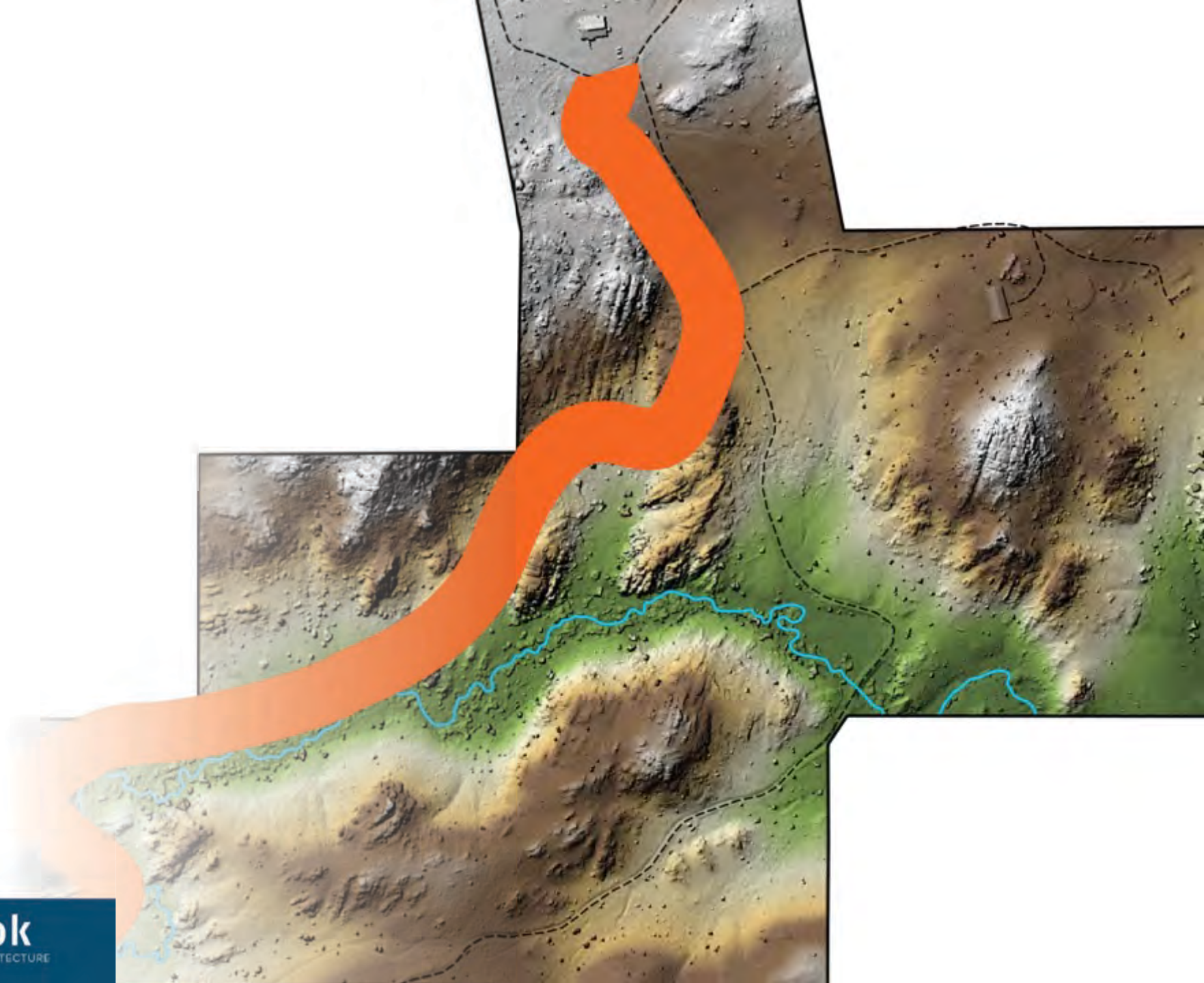
Planning

- Master Plan (narrative, 30,000-foot view)
- Conceptual Plan (narrative, placeholders for budgeting, guides field work, opportunity for agency and partner review, permitting initiation)



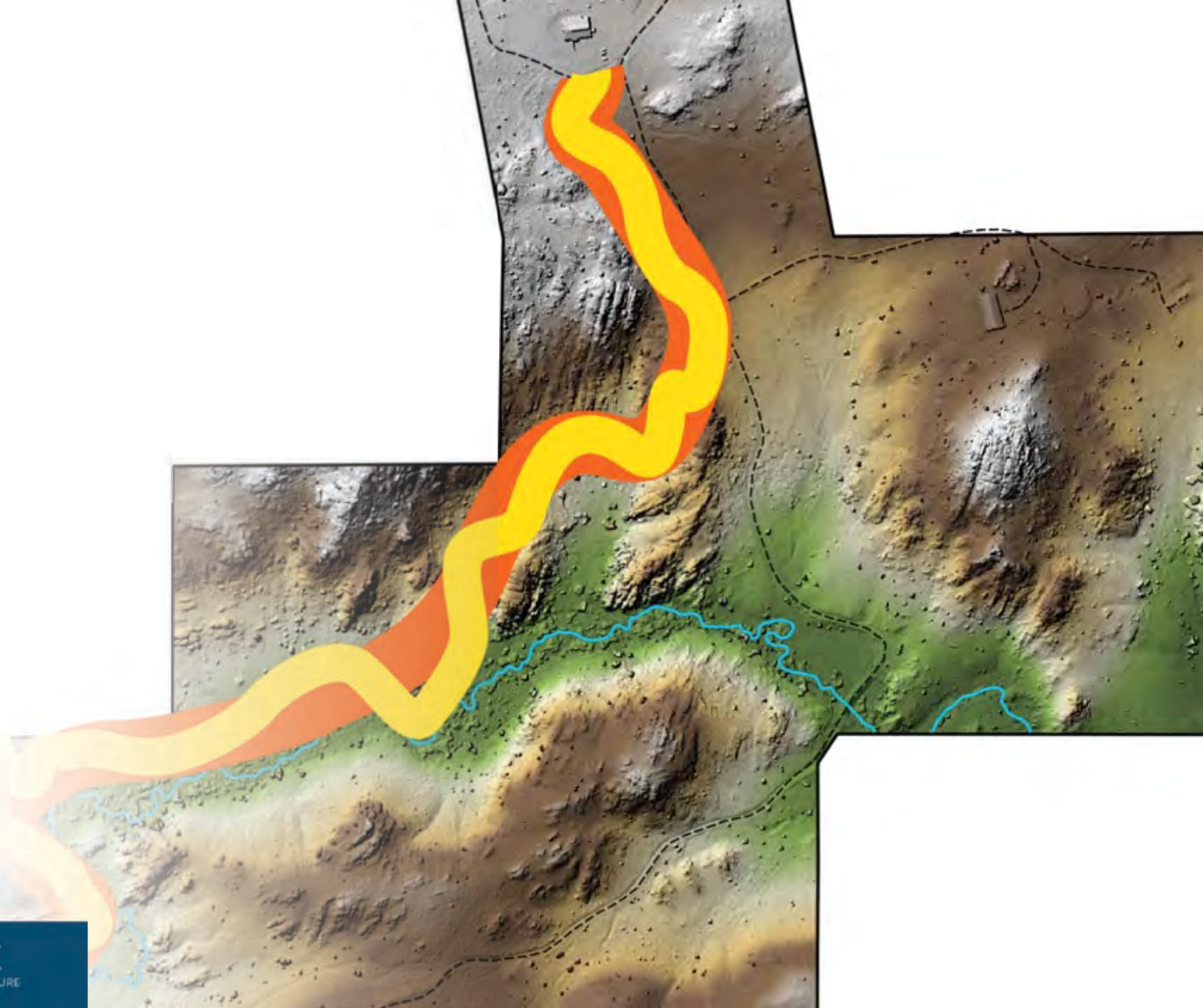
Design

- Conceptual Trail Plan
 - System Level
 - GIS/Digital Based w/limited scouting
- Field Design
 - Review and permit ready
 - Field designed and flagged
 - GPS
- Final Design
 - Construction ready



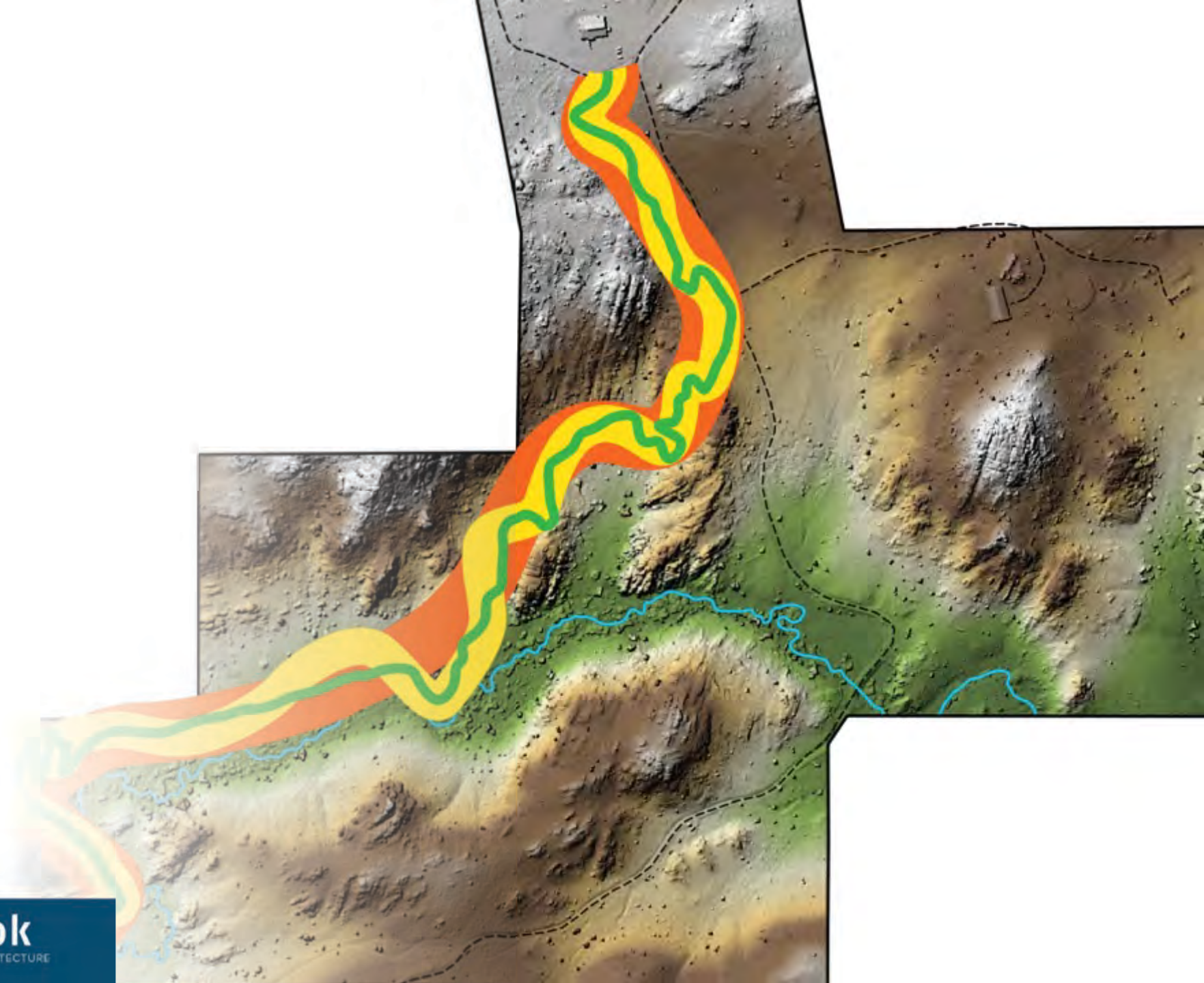
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Design

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Permitting & Approvals

- See previous webinar
- Complexity and requirement scale with project size and components
- Federal, State and local coordination likely needed on projects >1 acre of disturbance

Construction

- Typical sequence:
 - Solicitation – bidding
 - Award – contracting
 - Construction management
 - Kick-off, coordination, inspections, approvals, payments
 - Closeout
 - As-built documentation
 - Grant and permit closure
 - Trail opening



Maintenance & Management

- Manager and partner O&M of trails/systems
 - Inspections
 - Coordination on repair, closure, adaptation
 - Development of skills and capacity specific to system

Photo Credit: Trail Eyes, LLC

Trail Project Life Phases

PLANNING

DESIGN

PERMITTING

APPROVALS

CONSTRUCTION

MAINTENANCE & MANAGEMENT

FUNDRAISING & COMMUNICATIONS

MN Iron Range (<https://www.ridetherange.com/>)

- Year Round Recreation redevelopment on MN's Iron Range
 - 3 recently built trail systems
 - 1 Update trail system
 - 145+ miles of trail



MN Iron Range [\(https://www.ridetherange.com/\)](https://www.ridetherange.com/)



- Project Roots in regional efforts (5+ years)
- \$5M+ Initial Funding 2018 → Field Design, Permitting Initiated
 - 2019-20 80 Miles constructed across 3 sites
 - 2023 announced an additional \$2.25M for expansion of RedHead system



University of Denver - Kennedy Mountain Campus Phase I Trails

Quick project turnaround required
Identified 3 trails (~3 miles)
Concept to Final Flagging in <2 months
Future Master Plan Guidance

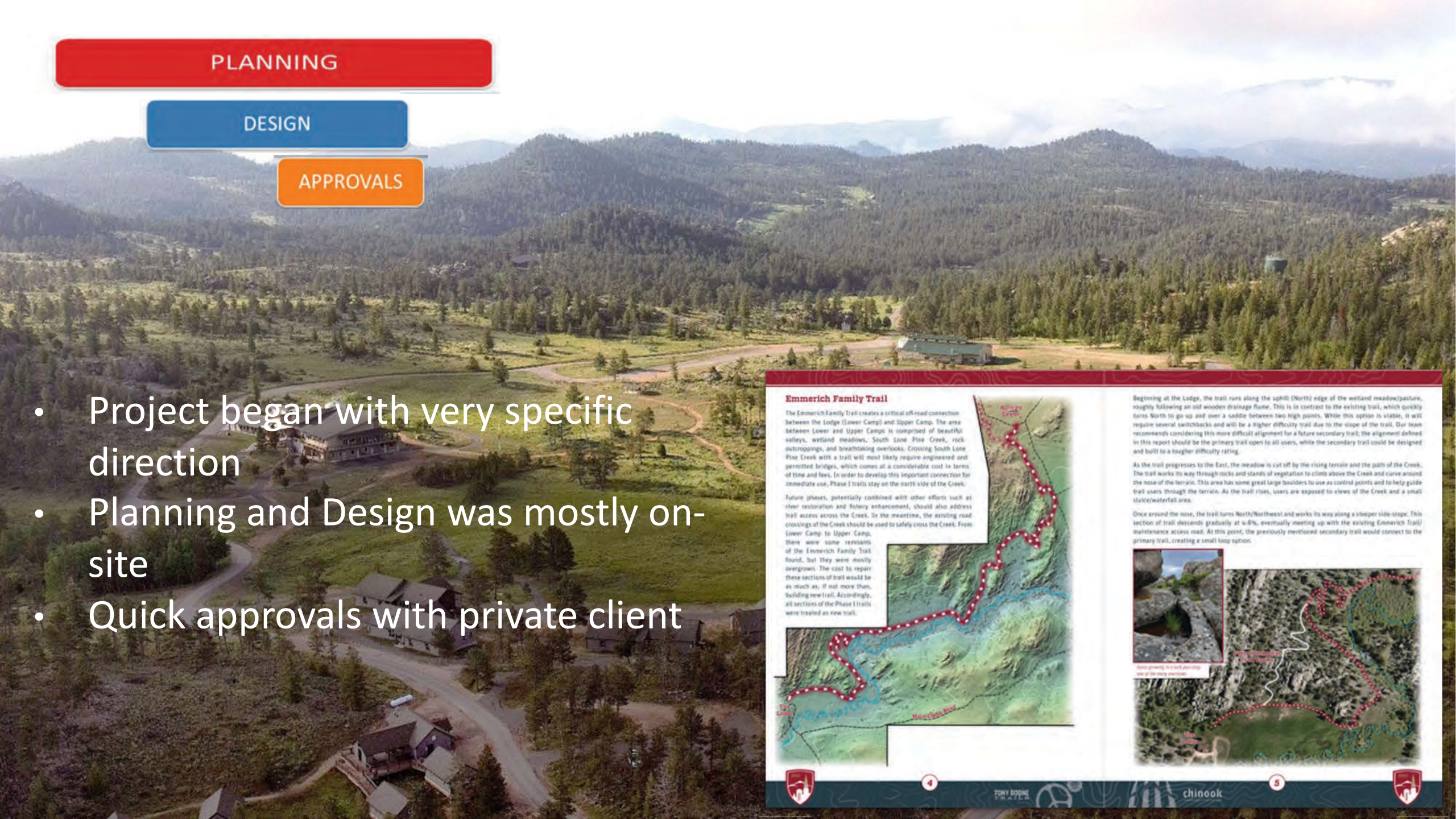


PLANNING

DESIGN

APPROVALS

- Project began with very specific direction
- Planning and Design was mostly on-site
- Quick approvals with private client



Emmerich Family Trail



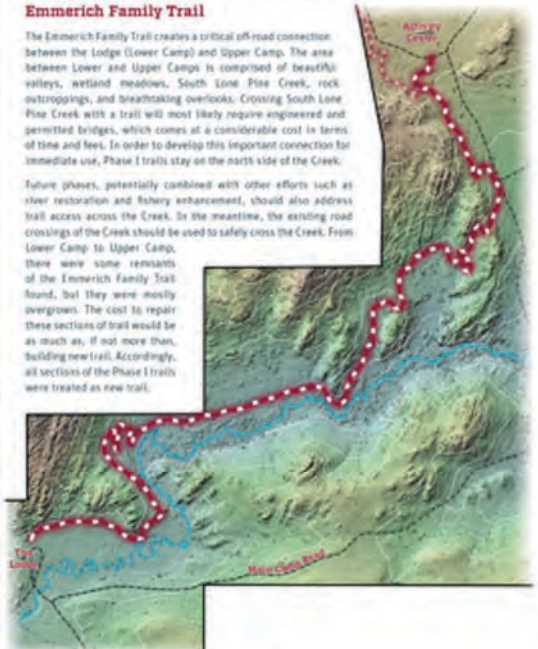
The Emmerich Family Trail creates a critical off-road connection between the Lodge (Lower Camp) and Upper Camp. The area between Lower and Upper Camp is comprised of beautiful valleys, wetland meadows, South Lone Pine Creek, rock outcroppings, and breathtaking overlooks. Crossing South Lone Pine Creek with a trail will most likely require engineered and permitted bridges, which comes at a considerable cost in terms of time and fees. In order to develop this important connection for immediate use, Phase I trails stay on the north side of the Creek.

Future phases, potentially combined with other efforts such as river restoration and fishery enhancement, should also address trail access across the Creek. In the meantime, the existing road crossings of the Creek should be used to safely cross the Creek. From Lower Camp to Upper Camp, there were some remnants of the Emmerich Family Trail found, but they were mostly overgrown. The cost to repair these sections of trail would be as much as, if not more than, building new trail. Accordingly, all sections of the Phase I trails were treated as new trail.

Beginning at the Lodge, the trail runs along the uphill (North) edge of the wetland meadow/pasture, roughly following an old wooden drainage flume. This is in contrast to the existing trail, which quickly turns North to go up and over a saddle between two high points. While this option is viable, it will require several switchbacks and will be a higher difficulty trail due to the slope of the trail. Our team recommends considering this more difficult alignment for a future secondary trail; the alignment defined in this report should be the primary trail open to all users, while the secondary trail could be designed and built to a tougher difficulty rating.

As the trail progresses to the East, the meadow is cut off by the rising terrain and the path of the Creek. The trail works its way through rocks and stands of vegetation to climb above the Creek and curve around the nose of the terrain. This area has some great large boulders to use as control points and to help guide trail users through the terrain. As the trail rises, users are exposed to views of the Creek and a small slope/waterfall area.

Once around the nose, the trail turns North/Northeast and works its way along a sleeper side-slope. This section of trail descends gradually at 4-8%, eventually meeting up with the existing Emmerich Trail/maintenance access road. At this point, the previously mentioned secondary trail would connect to the primary trail, creating a small loop option.



Some growing in rock providing view of lower meadow.

4

5

TONY BOONE
714.414.1111

chinoak

Questions & Discussion

