

Lake San Cristobal

Master Plan



DHM DESIGN LANDSCAPE ARCHITECTURE
URBAN DESIGN + LAND PLANNING
ECOLOGICAL PLANNING



GOFF
ENGINEERING + SURVEYING INC

FINAL -01/21/2022



Acknowledgments

Hinsdale County Commissioners

Kristine Borchers - Chair
Greg Levine
Robert Hurd
Sandy Hines - County Administrator

The Ben Brownlee Memorial Fund

Bureau Of Land Management

Jon Kaminsky

Master Plan Consultant Team

DHM Design
Walker Christensen
Lee Petty
Andrew Ehat

GOFF Engineering
Bill Hickman

Springboard Preservation
Timothy Stroh

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Project History

Section 1: Project History

Introduction

For many years Hinsdale County has been maintaining a Lake San Cristobal access point adjacent to the Lake San Cristobal Peninsula. This site contains gravel parking, a boat ramp, boat storage area, boat slips and courtesy dock. In 2020 Hinsdale County acquired Lake San Cristobal Peninsula, a formerly private owned piece of land. This rugged piece of land has one storage structure, a large bridge to an island, and several trails. With the acquisition of this land Hinsdale County is seeking to better plan development on it to protect users, the ecology and provide phased development opportunities. The rugged terrain is both the appeal and the challenge to the site. Spectacular views can be seen from this point; however, access is a challenge. With increased access opportunities it is important to take a look at the entire site for all user's needs, vehicular access, and future growth needs. While protecting ecological interest.



Ribbon Cutting Ceremony 2021



View of the Existing Boat Dock



Existing Inventory and Analysis

Section 2: Existing Inventory and Analysis

Ecology Input

DHM Design Ecological Services staff completed a site visit and meeting with Hinsdale County Commissioners and representatives from Lake Fork Valley Conservancy. DHM conducted pedestrian foot surveys to evaluate the ecological condition of the 7.5 acre peninsula and 0.61 acre island properties. A summary of findings for each is included on the next few pages.



Peninsula (7.5 acres)

Restoration Opportunities

- Utilize existing irrigation north of entrance for cottonwood plantings to provide shade for gathering area.
- Use this irrigated zone for riparian restoration and install native willow species.
- Restoration zone – see map – Restore to native landscape. Good opportunity for volunteer program and teaching opportunity. Utilize best management practices for soil preparation and management, seeding, and erosional protection.



Mountain Ball Cactus Bloom

Preservation Opportunities

- Preserve native vegetation and soils to extent possible.
- Clearly identify trail locations and use physical boundary markings (posts/rope/signage) to keep users on trail.
- Preserve and protect existing living trees (ok to remove dead/declining aspens).
- Protect/preserve old growth Douglas Fir. These trees are significant in character and age and should be celebrated. Place Interpretive signage along trail a safe distance from trees. Include general species info and unique growing conditions.
- Preserve existing scrub shrub inlet area. Interpretive opportunity – Include species info for Rocky Mountain Willow and Booth Willow.
- Utilize interpretive signage for western shoreline. Include general species info/photos, etc. Increase awareness and attention to minimizing impacts. Also include 'no pets allowed' in this area on signage.



Island (0.61 acres)

Preservation Opportunities

- Preserve existing natural native habitat to extent possible.
- Unique soil conditions include decomposed organic matter/peat like top layer of soil.
- Recommend seasonal wildlife/botanical closures – March 1 – June 15th for Canada Goose breeding and protection of unique colony of Mountain Ball Cactus.
- Recommend limiting overall use and identifying single trail – include physical boundary.
- Interpretive opportunity for Canada Goose breeding. Include species info and breeding habits importance.
- Interpretive opportunity for Mountain Ball Cactus - Note mutated/crested form due to unique growing/soil conditions.
- Access to the island should be restricted to pedestrian traffic. To protect the islands diverse ecology, pets should not be allowed.



Mutated Mountain Ball Cactus



Mountain Ball Cactus Colony

Existing Site Uses and Conditions

Adjacent Uses

A portion of the existing lake access and land that is being considered for development, is under ownership of the Bureau of Land Management and adjacent to their lands. Hinsdale County officials have been coordinating with the BLM to develop recreational opportunities on the peninsula. Ongoing coordination will be necessary to maintain this good relationship and continue to further the recreation development. All future development should include coordination with the local BLM manger.



Non-motorized and Motorized

The Lake San Cristobal Peninsula area has a single lane boat ramp that is in good condition and is meeting the current demand for motorized boats. The existing courtesy dock also doubles as rented boat slips for 7 boats. The location of the boat ramp, in the south bay, is in conflict with prevailing winds from the south creating difficult conditions to load/unload motorized boats. There is no defined non-motorized boat access. This has been observed to create a conflict at the boat ramp when non-motorized craft are staging at the boat ramp and limiting access for motorboaters.



Storage

One of the acquired structures is an existing storage facility. This is a sound structure adjacent to the north bay. The structure provides an opportunity to meet development storage needs or other uses. The construction materials of the structure are attractive and provide a roadmap for future construction materials with weathered barnwood and rusted corrugated steel. This structure also has attached an 8-paddle craft floating slip/dock.



Fishing

This lake access is one of the few areas along the shores of the lake that provides fishing access. The existing parking and facilities help support fishermen and is an attractive access point. However, on-site accessibility to the waters edge is limited. There is opportunity and desire to provide ADA accessible fishing piers to better serve the public. Currently fishermen can be found scattered along the shore.

Existing Site Uses and Conditions

The Bridge

The newly acquired bridge is a fun and unique asset that was constructed for private access to an island. This bridge will require modification to meet current accessibility requirements. It is structurally sound. The recommended items to accomplish prior to opening the bridge to the public are listed below. The full bridge inspection reports can be found in the appendix of this document.

- Bring Bridge Railings to the required standard of 42" high top rail and minimum 4" openings.
- Post signs at both ends of the bridge stating:

Maximum Bridge Capacity:

25 Persons - Please Do Not Swing or Bounce the Bridge - No Bicycles

- Excavate a swale and drainage trench at the south anchor plates in order to keep anchors clear of soil and free of standing water.
- Reapply a bituminous paint covering at all anchor bolt plates and tower welds at base plates.



Existing Site Uses and Conditions

Accessibility

The rugged terrain may be one of the biggest challenges to overcome. The newly acquired land has some vehicular and pedestrian trails that were roughed in by the previous owners. Much of these trails exceed 10%. The surfacing is scattered gravel on bedrock. These steep slopes do not meet accessibility requirements. There are no paved surfaces on-site. Existing trails to both the North Bay and South Bay are gradual with opportunities to develop into defined accessible routes.



Parking

The existing parking area is an undefined gravel lot. In large events this is a “free for all” mentality with vehicles finding parking wherever possible. One end of the parking area is used for trailer and boat storage. This parking area does exceed 10% slope in some areas. Though there are no accessible parking spaces present that meet ADA standards. Access to the vault toilet is through the gravel lot. The vault toilet structure was first installed in the 70’s and is functional, though not attractive.



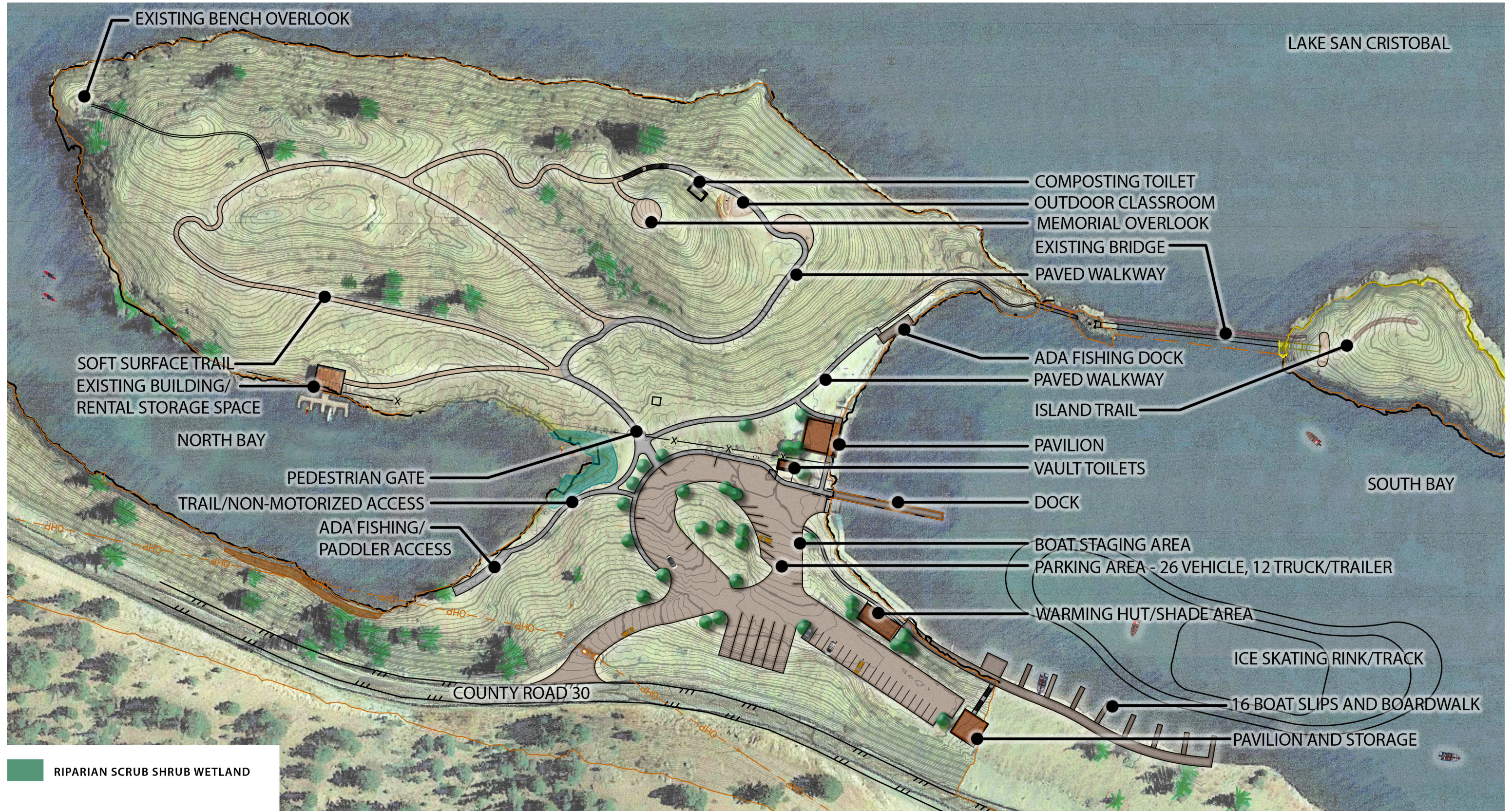
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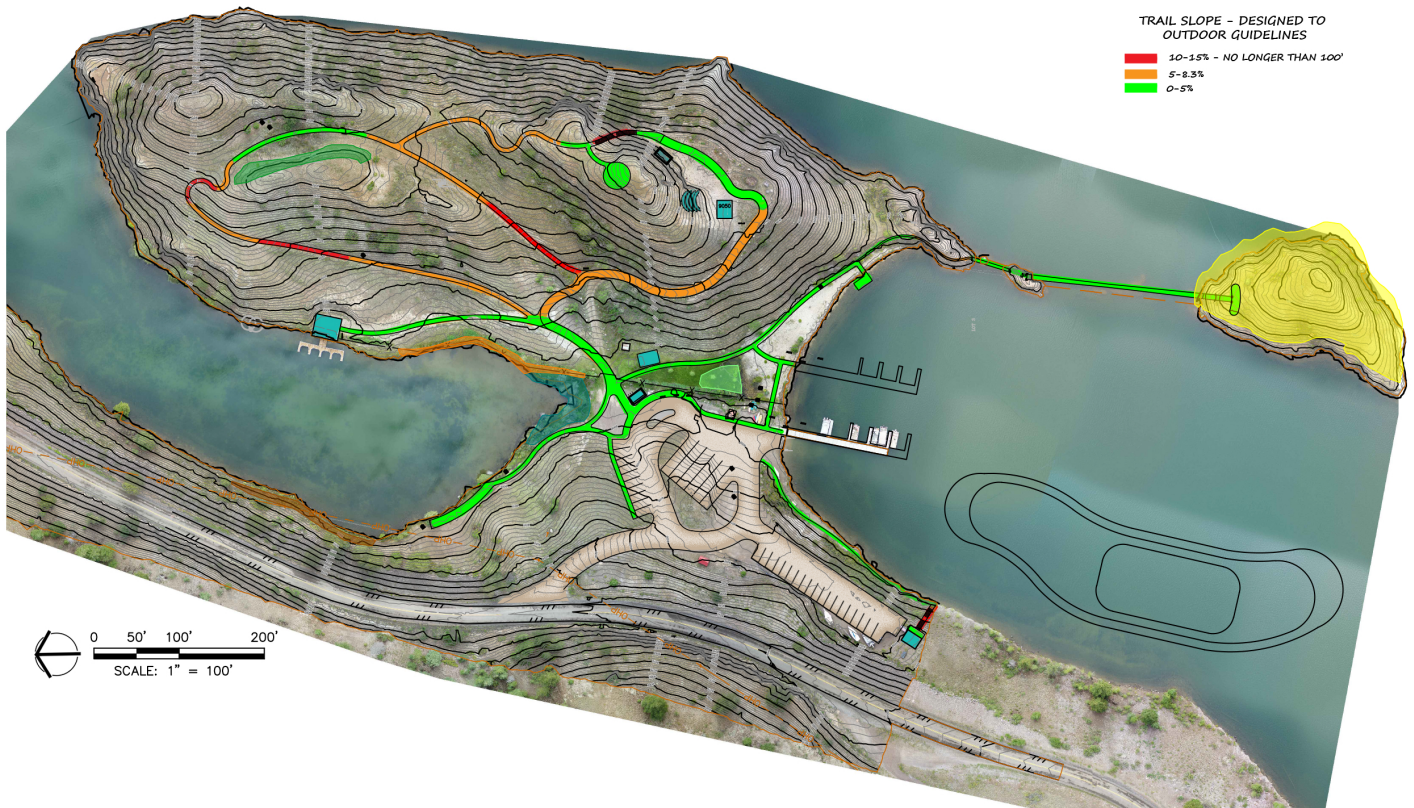
Preferred Design

Section 3: Preferred Design

Conceptual Site Plan



Trail Layout



Defining pedestrian routes onsite is one of the important elements of the design. These routes should be well defined to avoid social paths and protect the existing ecology. One of the challenges is designing trails/access routes that meet Outdoor Guidelines Standards for running slope. The Outdoor Guideline Standards are ADA design guidelines that regulate outdoor recreation spaces accessibility requirements. It is proposed that the main trail from the parking area to the outdoor classroom not exceed 8.33%. The below chart shows maximum running slopes as defined by the guidelines.

Source: United States Access Board - Guidelines for Outdoor Developed Areas

Running Slope of Trail Segment		Maximum Length Segment
Steeper Than	But Not Steeper Than	
1:20 (5%)	1:12 (8.33%)	200 feet
1:12 (8.33%)	1:10 (10%)	30 feet
1:10 (10%)	1:8 (12%)	10 feet

The proposed special amenity, Outdoor classroom and restroom should be on accessible route.

The secondary trails that access the north part of peninsula are proposed to be single track trails. The running slopes of these trails will exceed the Outdoor Guideline standards, they follow the existing trails and grade. To avoid excess disturbance these trails should remain at their existing slope. When possible, it is encouraged to provide resting areas along the trail for users.

The surface of the primary trail is to be a firm stable surface. The ideal material, for maintenance purposes and longevity is concrete paving. It is recognized this is an expensive solution and is not necessarily feasible at this time. It is proposed to utilize crusher fines in lieu of concrete paving. The Federal Outdoor Guidelines encourage this as well for areas that are not highly developed.

DESIGN TIP - Building a firm and stable surface

A firm and stable surface does not always mean concrete and asphalt. Some natural soils can be compacted so that they are firm and stable. Other soils can be treated with stabilizers without drastically changing their appearance. Designers are encouraged to investigate the options and use surfacing materials that are consistent with the site's level of development and that require as little maintenance as possible.

During the construction documentation phase it should be further explored if the existing gravel surface can meet the firm and stable surface requirements with some slight modifications, such as removing larger cobble. This would likely reduce maintenance demand for the walking surface.

The proposed Master Plan also identifies concrete paving at the higher use areas adjacent to the parking. This will ease the maintenance demand and guarantee an accessible route to special amenities such as restrooms, docks, fishing piers and restroom facilities. These concrete walks should be constructed to meet ADA guidelines.



Crusher Fines



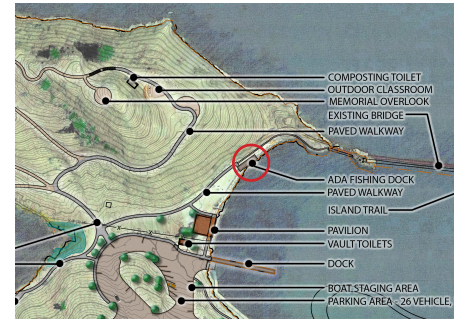
Paved

Just as important as it is for the pedestrian circulation should be clearly defined to avoid deterioration of the landscape, it is important to identify locations for pet use. If pets are allowed, clear signage identifying leash requirements and pet dropping bags should be provided. This is sometimes a maintenance and environmental concern that leads to the recreation manager restricting pets in certain areas, such as the island, to protect the local ecology.



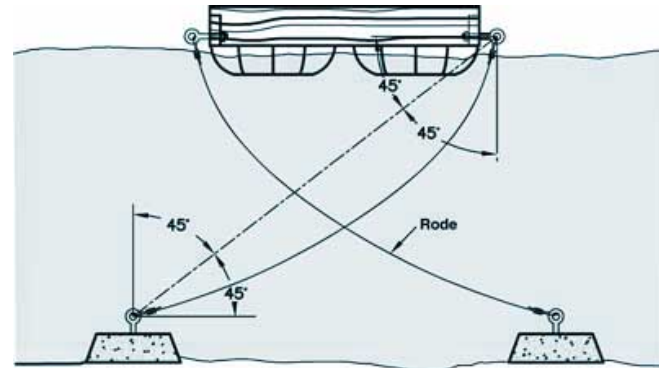
Fishing Access

Part of the goal is to provide an accessible fishing area. The South Bay is the ideal location as the water depth is more suited for fishing. The fishing pier, as it is a special amenity, should sit on an accessible route back to the ADA parking spaces.



There are 2 main options for a fishing pier; floating or fixed.

i. Floating: A floating dock/pier can be anchored with concrete anchors or piers. Floating docks are ideal for lakes with high water fluctuation. This also allows the surface of the dock to be at a constant height to the water surface and is ideal for entering a water craft. One of downside to a floating dock, is it must be accessed from a gangway. This gangway can exceed ADA standards of 8.33% but it is not ideal. The steepness of the gangway will increase with water fluctuation. Floating docks will have some movement in high wave activity.



Floating dock with concrete anchors

ii. Fixed: A fixed Dock is set on piers and at a fixed elevation. These are ideal for constant level lakes as this allows for the accessible route to be designed to running slopes that do not exceed 5% or 8.3% with handrails. Maintenance is less as they do not need to be removed in the winter to avoid ice damage. With combination of low water fluctuation and deep water in the South Bay, it is recommended that a fixed structure is built.



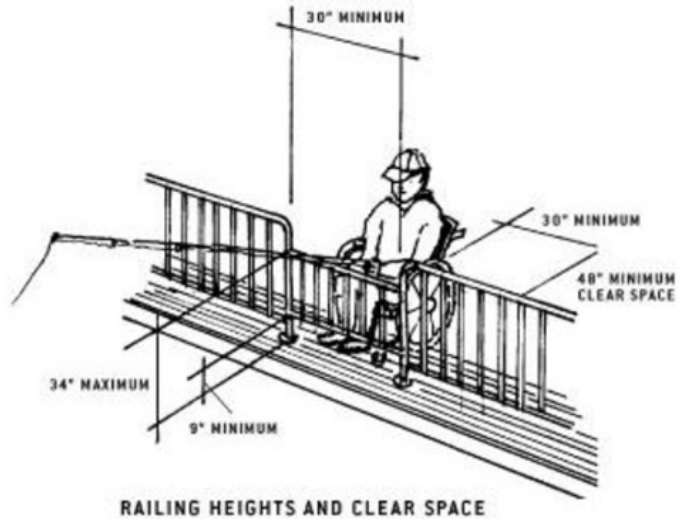
Floating dock on pier



Long gangway dock

Regardless of the type of dock system selected, ADA has some specific guardrail requirements. This graphic identifies the ADA railing requirements.

It is important to design the fishing dock as accessible, but large enough to accommodate several fishermen as this will be a desired fishing destination for those with or without disabilities.

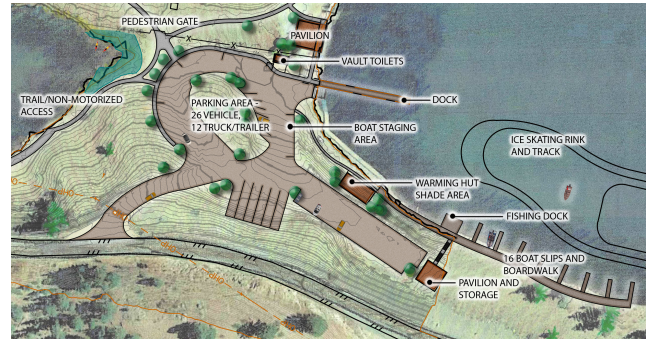


ADA Guidelines Chapter 10



Boat Slips

The current boat slip has 7 boat slips that are leased to people by the County. It has been recognized that more long-term boat slips are necessary to meet the needs of the community. The preferred design identifies 16 new slips along the west shore of the South Bay. This will allow for an increased long-term storage and an opportunity to secure the slips. This can be built in conjunction with a boardwalk that will provide access to the Warming Hut/Shade Pavilion. The existing dock should remain as a courtesy dock for boaters to tie to when loading and unloading.



Wave Attenuation

In conjunction with boat slips, consideration should be given to the installation of wave attenuation. Wave attenuation will protect boats, both stored and being loaded, from high wave action that frequent Lake San Cristobal. Wave attenuation will also better protect the cove from moving ice during periods of melt.



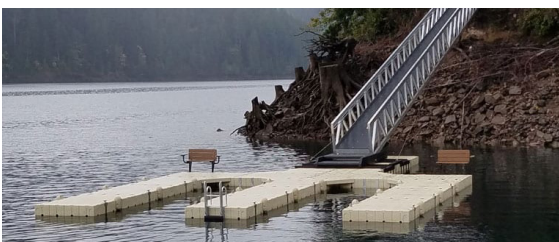
Wave Attenuation



Wave Attenuation Possible Locations

Paddle Craft Access

The Master Plan also recognizes the conflict between motorized boaters as well as paddle craft users. The north bay is an ideal location to provide a launching area for the non-motorized craft. The proximity to the storage building, paddle craft dock and protected cove provides ideal conditions to direct paddle craft to this area. There may be an opportunity for the County to team with a concessioner to provide paddle craft rentals in this area.

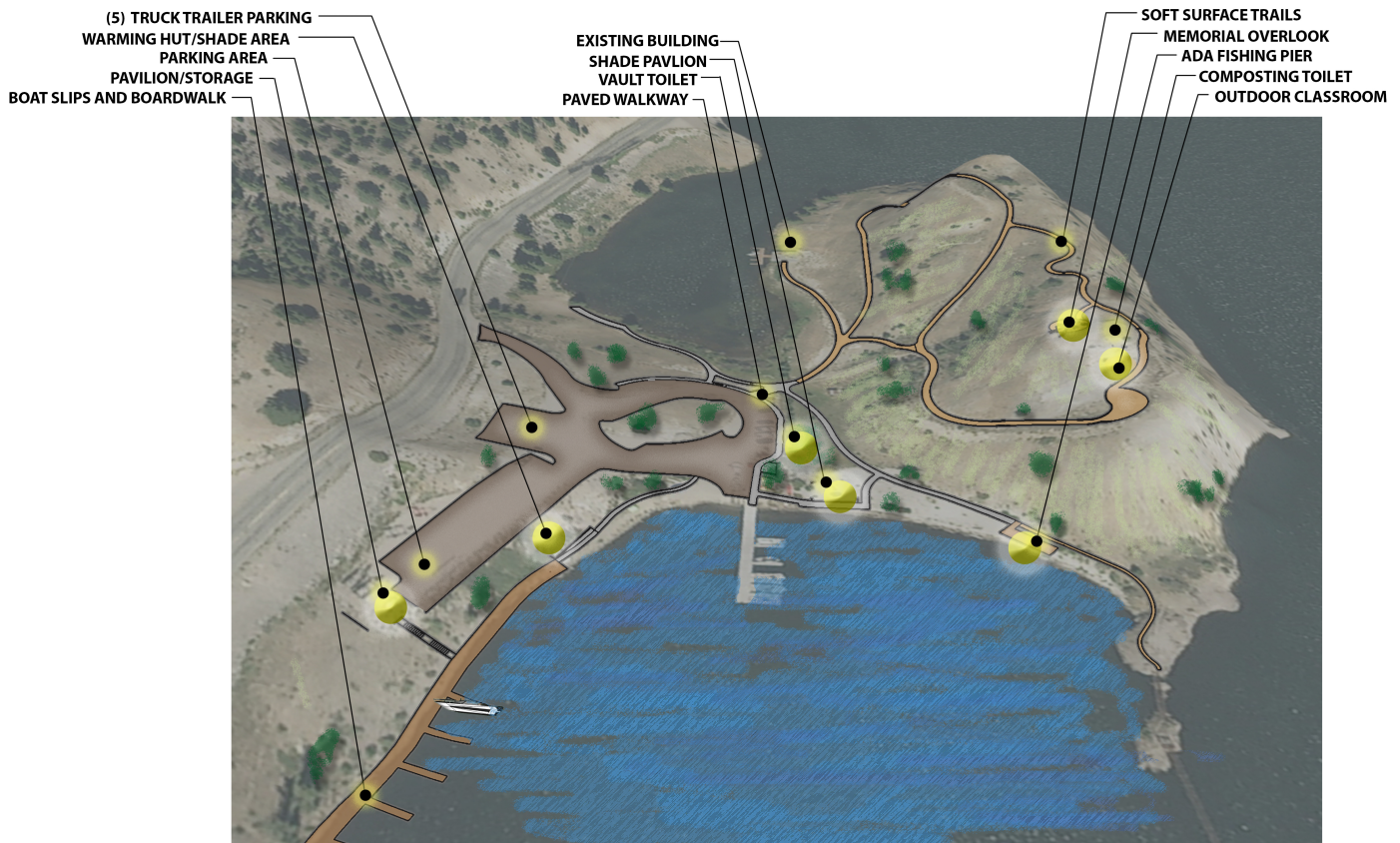
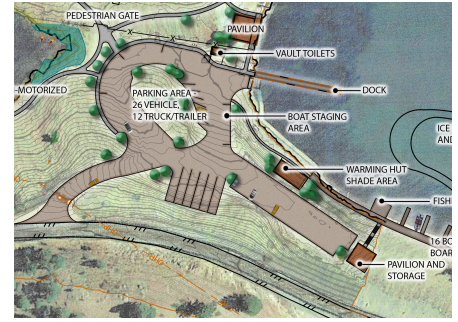


EZ-Dock



Parking Area

- i. The proposed parking area generally follows the existing disturbed areas yet better defines parking spaces to avoid conflicts. The proposed design has 27 standard parking spaces and 12 truck trailer parking spaces. The design also identifies a boat staging area that if necessary, can serve as an invasive species decontamination area. It is recommended that current boat and trailer storage within the parking area be limited or eliminated all together to provide the needed vehicular parking.
- ii. It is proposed that the parking lot surfacing remain gravel at this time. Parking stripes can be delineated with the use of fire hose, or nylon straps. This will help give structure to the gravel parking area, that otherwise would be challenging. It is recommended to provide concrete paving for the ADA parking area. There are strict ADA requirements for slopes and cross slopes in an ADA parking space. By constructing these of concrete it will keep the accessible parking spaces on the accessible route.



Architecture Character

The buildings, structures and places recommended are a future state of use and may be installed in phases or during different time periods.

Creating a Cohesive Place:

- Recommend adopting design guidelines that provides a list of major building materials that can be used repetitively when any new above ground construction takes place even as buildings or major signs could be built at different times.
- Recommended materials are based upon the existing buildings and structures and site. These are also materials and color pallets reflective of the historic districts of Lake City, mining sites such as the Ute Ulay Mine area or the Slumgullion Earthflow to the north of the site.
- Materials recommended: weathered wood, weathered steel, and local stone. Colors should be of natural tones found in the area or naturally occurring such as found in weather wood and steel or within the local stone that can be found on the peninsula and island.
- The various built structures should be created using similar building and structural details. Materials for roofing, walls and floors utilizing the same components will allow long term maintenance to be more streamlined and cost effective.
- The placement of materials in structures should be considered for durability.



Existing Boat House

- » Roofing should be of a metal standing seamed assembly with factory finish, including the fascia and any eave area. The roof structure can be of a wood or steel material. If wood materials are to be used for the roof structure, consideration should be given to cover the wood for long term sustainability and protections from the elements. If steel is to be considered for the roof structure, considerations should be given to expose the steel in a way to become part of the overall aesthetics.
 - » Exterior or exposed walls should be of a masonry or steel assembly. Finishes near the grade or areas receiving exposure to prevailing wind or not protected from a roof overhang should be of a stone finish. Other exterior finishes such as weather wood or steel panels may be considered. If using wood, consider using in areas that have less sun or weather exposure.
 - » Flooring should be of path or walking surfaces found within the Peninsula area. Concrete should be considered in any area that are expected to be high use such as a pavilion or hut. Those areas which might receive vehicle traffic may considered thickened concrete slabs.
- Roof slopes are generally recommended to be a of a lower, single slope with deep overhangs to allow for drainage to discharge further away from any foundation. Roof slopes should also take advantage of site conditions that allow for drainage away from programmed uses and sun angles that promote melting and run off.
 - The buildings become an opportunity for solar collection and use for the structures themselves or for other site amenities requiring electricity.

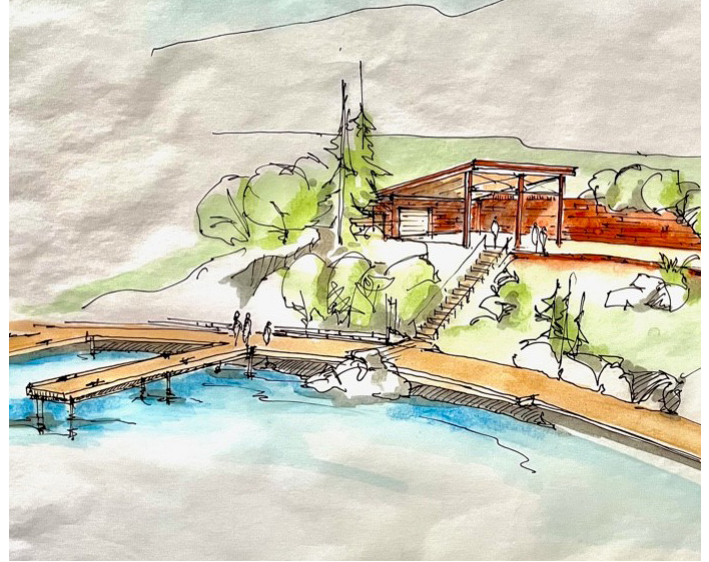


Various materials for structures

Pavilion and Storage Building - 1,123 sq. ft.

A multiple use space providing functional storage and equipment area for the County in support of the various functions at the peninsula and surrounding County amenities. The pavilion also provides an open air, covered gathering area for 15-20 people that is offset from the other site activities.

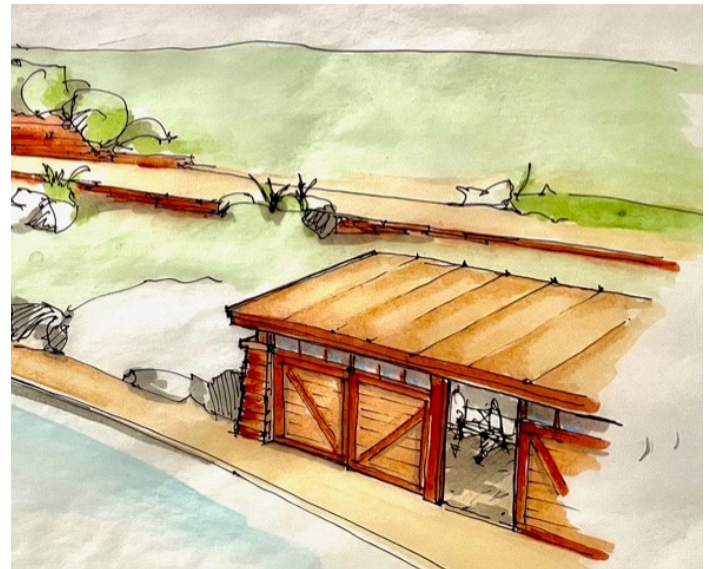
- Create a year round storage and maintenance room that can house tools and small equipment such as a zamboni.
- Provide a covered gathering area that provides a functional space separate from other functions and activities of the peninsula.
- Roof would drain towards the south and takes advantage of views and providing shade for those using this area. This would also allow the best snow and ice melt situation.
- Solar systems should be utilized to generate the electricity needed for heat and lighting of the small storage room.
- Pavilion has connection to a main parking area or to the fishing, docks and trail area via a stair.



Warming Hut - 300 sq. ft.

A smaller building for up to 10 people and provides a shaded structure in the summer and a warming hut for those ice skating in the winter.

- This structure is positioned along the path in an already level area being used by picnic tables. This allows easy access from parking areas adjacent to the site, and fishing opportunities. Its location provides excellent shade area in the summer and solar gain in the winter.
- The location, adjacent to the concrete boat ramp, is convenient in the winter to be near the local entry and exit to those activities happening on the ice.
- Large sliding doors, with glass or transparent materials, placed as the wall which faces the path side of the structure are recommended. The sliding doors allow both summer and winter users to help control the environment of the interior of the small structure. Small amounts of glass or transparent materials allow natural light for those instances when doors may be used in the closed position.
- Solar systems should be sized to accommodate winter heating this small space. Minimal lighting for the structure may also be considered based upon when the hut will be made available to the public for events such as evening ice hockey.



Restroom - Vault Toilet

The current restroom provides a key location at the peninsula and in close proximity to the boat launch area, pathways and shade structure areas. This is also a unique opportunity to reuse the existing toilet vault and provide modern amenities with a new above grade structure.

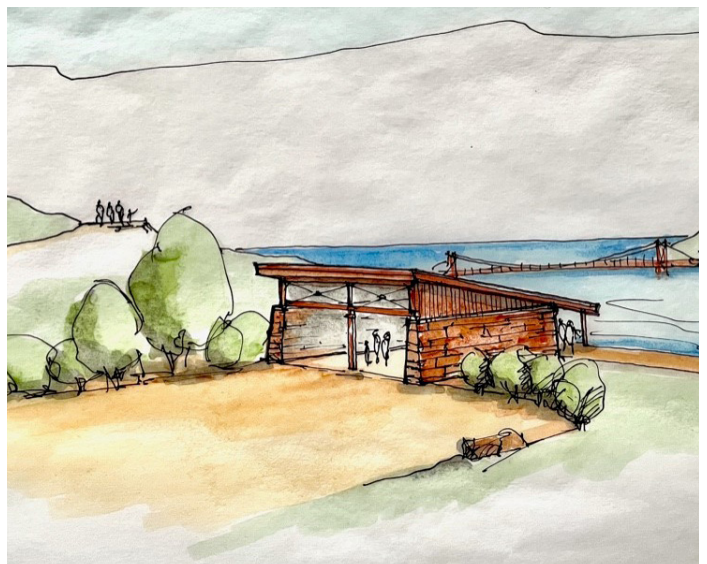
- The current configuration over the toilet vault should be rotated 180 degrees so the doors to the restrooms open to the east. This will allow less conflict with pedestrian flow and the boat launch area.
- The new structure provides necessary ADA upgrades, clearances, and accessories for a wide range of visitors.
- Small additions could be thoughtfully added to the north end of this restroom building to provide opportunities to install a fish cleaning station or increase the number of restrooms. Additional uses at this location could be considered when the traffic or volume of people increases to the point where these new uses are beneficial.



Shade Shelter at Dock - 1,200 sq. ft.

The main shade structure provides an area where small groups of up to 30 people can gather and provides access to the fishing areas, pathways, boat launch area and island as well as the ability to accommodate those people who want a sheltered area to use while visiting the site.

- The shade shelter provides an opportunity build a structure that can serve both those fishing and enjoying the south bay or have a small event.
- Small outdoor open space immediately north of this shade structure will allow more opportunity for flexibility in the use of the site. The combination of the covered and exterior space allows the shade structure to accommodate many small groups.
- A series of sliding doors are recommended to create separation from the main space of the shade structure and pathway or fishing area. The roof line would still extend out over the path to provide shade for those people fishing or enjoying the pathway. The option to slide the doors closed and create a wall allows events or gatherings in the structure without disrupting those enjoying the other amenities of the site.
- Roof would drain towards the south and provides the necessary shade and protection against the prevailing wind.
- Solar systems should be utilized to generate the electricity needed for any lighting of the interior space or accessories related to this space.



Composting Toilet

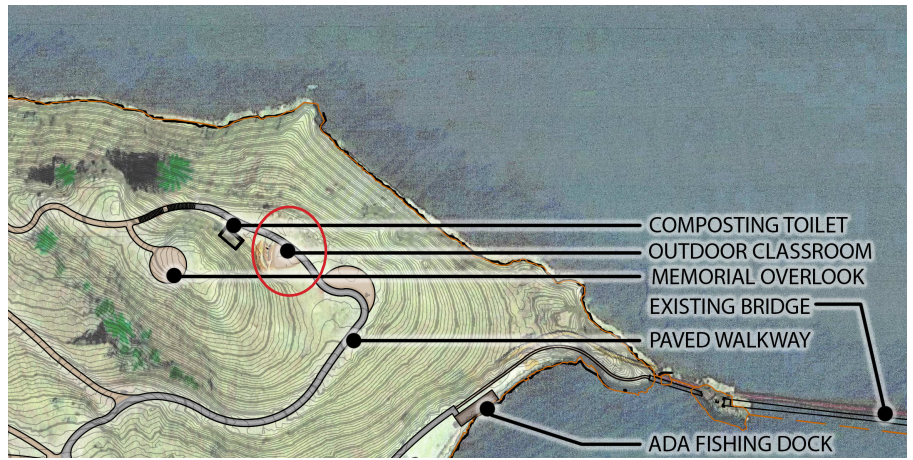
The small toilet area adjacent to the classroom on the upper portion of the island is a single occupant structure tucked into the north end of the classroom site taking advantage of the existing trees and hillside as a partial screen.

- Recommend the use of current technology associated with solid waste management toilets, similar to those used in national parks for high alpine sites.
- This toilet structure provides the convenience of having a facility near the classroom area while maintain a lower impact to the site either through its waste collections system or by reducing the type of vehicles needed to services the toilet.



Outdoor Classroom

An outdoor classroom has been proposed that can serve up to 20-30 people. This would be a space constructed with boulders to provide terraced seating and be nestled into the existing terrain with the view of the magnificent San Juan Mountains to the south. This is a simple space that can be constructed out of harvested boulders from on-site. The outdoor classroom serves students in a field trip adventure, a family or even an individual that just wants to sit and take in the scenery.



Boulders from on-site



3D Visualization of Outdoor Classroom

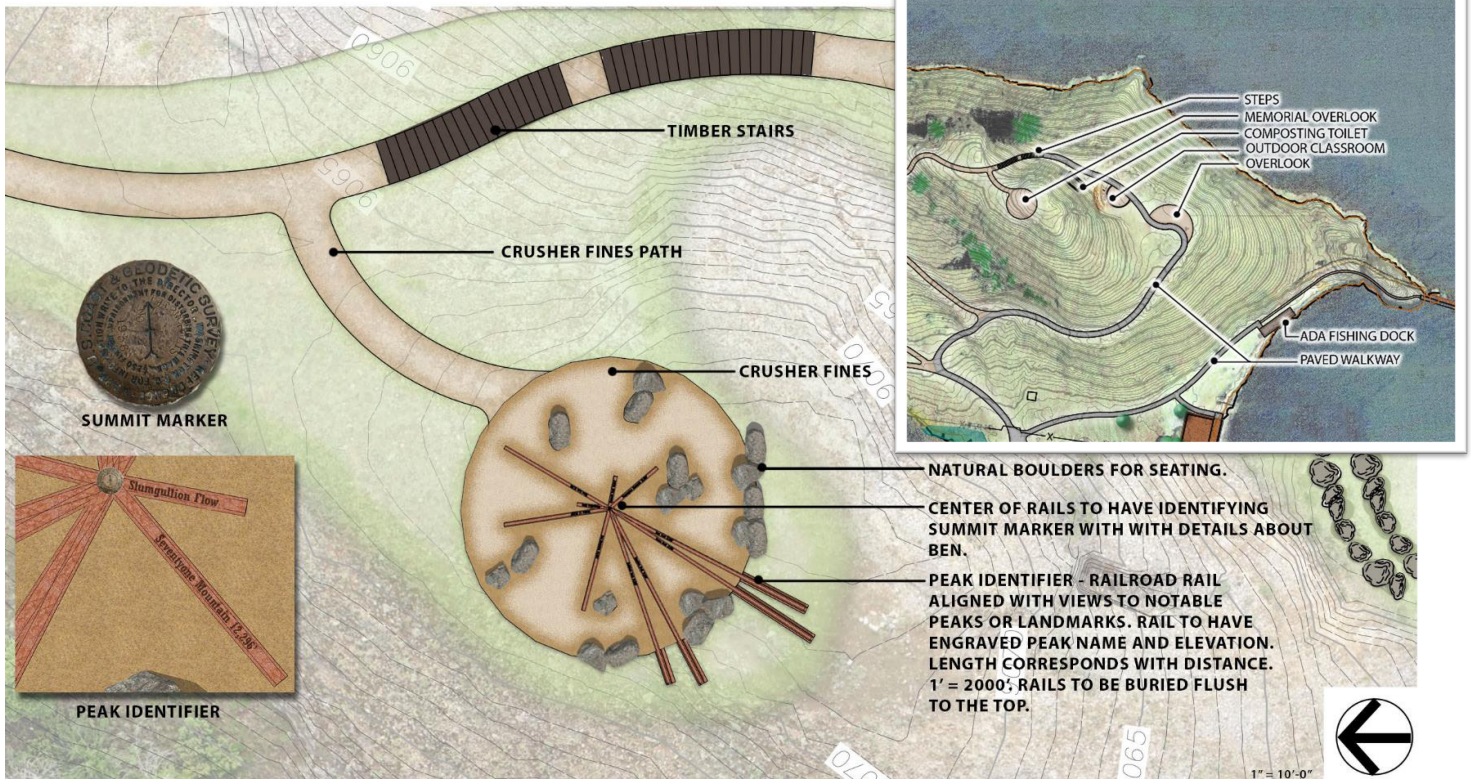
Ben Brownlee Memorial

At the peak of this peninsula it has been proposed to provide an overlook in memorial to Ben Brownlee. Ben was an avid mountain climber that had summited most of the peaks in this region. This memorial, that sits at a small peak, uses engraved steel to point to some of the surrounding mountains. At the center of this peak identifier there is proposed a summit marker that would commemorate Ben Brownlee. This area would be interspersed with boulders where one could reflect and enjoy the natural splendor.



Some of the surrounding peaks that can be identified.

1. Bent Peak 13,038'
2. Carson Peak 13,661'
3. Sunshine Peak 14,001'
4. Redcloud Peak 14,034'
5. Red Mountain 12,815'
6. Station 11 10,728'
7. Slumgullion Earthflow
8. Mesa Seco 12,792'
9. Sawmill Park 10,611'
10. 71 Mountain 12,296'



Proposed Design Features

As the development of this site progresses it will be important to provide wayfinding and interpretive signage. Much of Lake San Cristobal Peninsulas is easily accessible and there is a low probability of getting lost, however wayfinding will help users better experience the site. The site signage should be simple and should also identify areas that are desired to be protected.



Vehicular Lake San Cristobal Sign
North Facing

Source DHM Design

Other basic amenities such as benches, trash receptacles, non-motorized boat storage, picnic tables and possibly swinging benches, should be installed to meet the passive recreation needs of the users. A few examples of amenities are provided for consideration.

Swinging Benches



Benches



Trash Receptacles



Non-motorized Boat Storage





Preliminary Cost Estimate

Lake San Cristobal Master Plan Rough Order of Magnitude

ITEM NO.	CONTRACT ITEM	UNIT	PLAN	UNIT COST	TOTAL
TRAILS					
	CRUSHER FINES TRAIL TO OUTDOOR CLASSROOM	LS	1	\$64,900.00	\$64,900.00
	BRIDGE IMPROVEMENTS AND SINGLE TRACK TRAIL	LS	1	\$81,400.00	\$81,400.00
	PENINSULA LOOP TRAIL	LS	1	\$91,500.00	\$91,500.00
	TRAIL TO NORTH OVERLOOK/BOULDER STEPS	LS	1	\$14,880.00	\$14,880.00
	SOUTH BAY TRAILS/ACCESS	LS	1	\$44,400.00	\$44,400.00
	NORTH BAY TRAILS/ACCESS	LS	1	\$32,700.00	\$32,700.00
PARKING					
	GRADING	CY	1500	\$35.00	\$52,500.00
	4" CLASS 6 GRAVEL ON PARKING AREA	CY	515	\$190.00	\$97,850.00
	NYLON STRAP STRIPING	LS	1	\$3,500.00	\$3,500.00
	SEEDING DISTURBED AREA	SF	10,000	\$0.50	\$5,000.00
	TREES	EA	30	\$950.00	\$28,500.00
	IRRIGATION	LS	1	\$25,000.00	\$25,000.00
	RETAINING WALL	SF	880	\$75.00	\$66,000.00
	WAYFINDING AND INFORMATIONAL SIGNAGE	LS	1	\$20,000.00	\$20,000.00
	BENCHES	EA	10	\$1,800.00	\$18,000.00
	PICNIC TABLES	EA	10	\$2,500.00	\$25,000.00
	STORAGE RACKS	EA	5	\$1,500.00	\$7,500.00
	STORAGE LOCKERS	EA	3	\$2,500.00	\$7,500.00
STRUCTURES					
	PAVILION AND STORAGE	SF	1123	\$230.00	\$258,290.00
	PAVILION/WARMING HUT	SF	300	\$200.00	\$60,000.00
	LARGE PAVILION AT DOCK	SF	1,200	\$200.00	\$240,000.00
	SEEDING DISTURBED AREA	SF	8,000	\$0.50	\$4,000.00
	VAULT RESTROOM	LS	1	\$85,000.00	\$85,000.00
	COMPOSTING VAULT TOILET AT OUTDOOR CLASSROOM	LS	1	\$40,000.00	\$40,000.00
OUTDOOR SPACES					
	OUTDOOR CLASSROOM	LS	1	\$20,000.00	\$20,000.00
	MEMORIAL OVERLOOK	LS	1	\$23,000.00	\$23,000.00
LAKE ACCESS					
	16 BOAT SLIPS AND BOARD WALK	LS	1	\$360,000.00	\$360,000.00
	ADA FISHING DOCK-INCLUDES PAVED WALKWAY	LS	1	\$115,000.00	\$115,000.00
	WAVE ATTENUATION	LS	1	\$250,000.00	\$250,000.00
				SUBTOTAL	\$2,141,420.00
				Design and Construction drawings 12%	\$256,970.40
				Contingency 25%	\$535,355.00
				TOTAL	\$2,933,745.40

Assumptions:

Assumes no utility work.

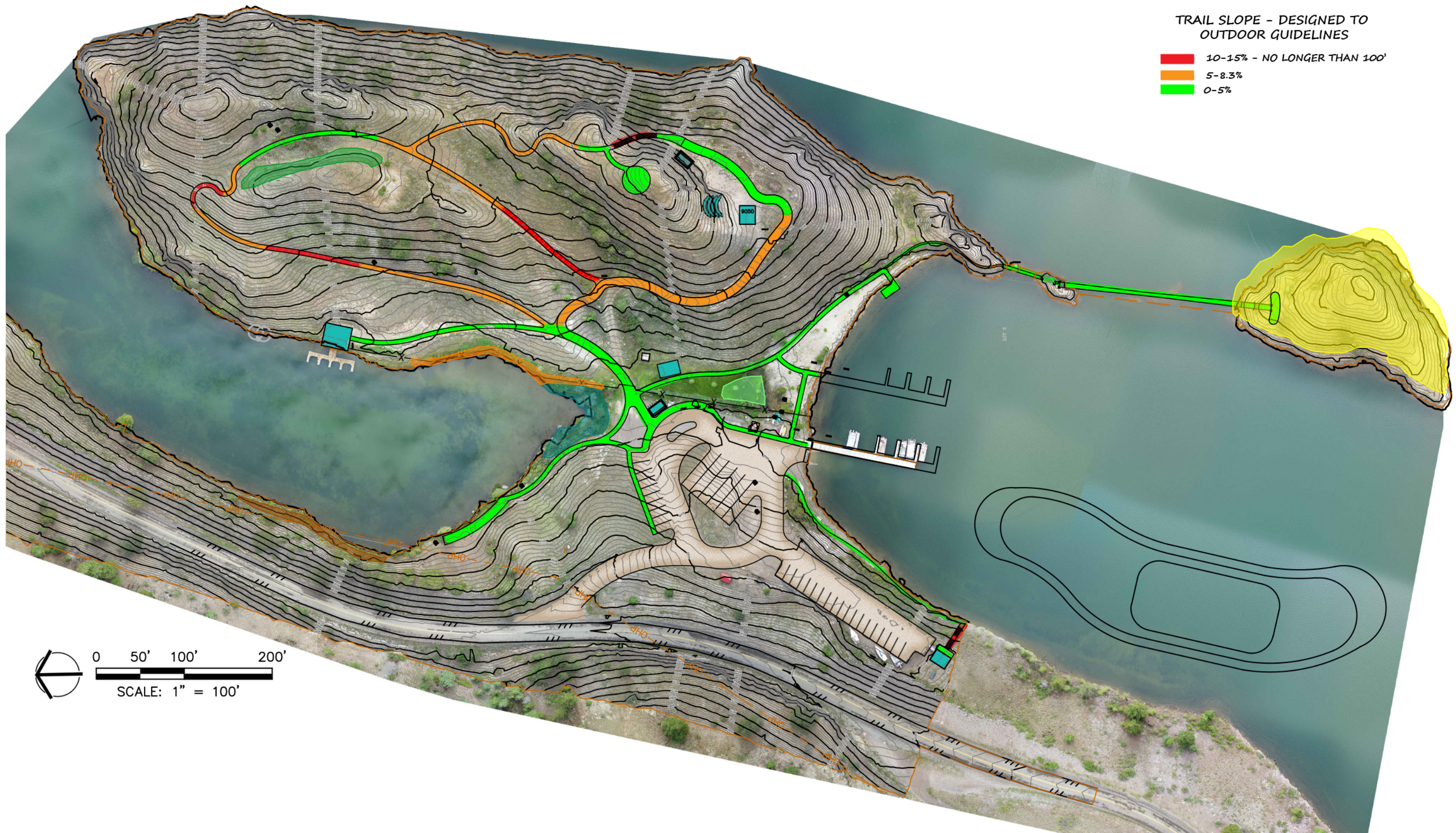
Does not include dewatering, if required.

Construction inflation rate should be calculated from 6-9% per year.

Existing Dock is to remain in place.

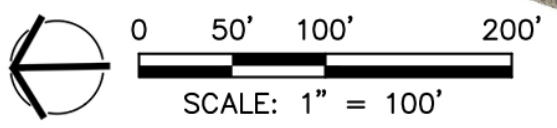


Appendix



TRAIL SLOPE - DESIGNED TO
OUTDOOR GUIDELINES






- █ 10-15% - NO LONGER THAN 100'
- █ 5-8.3%
- █ 0-5%



Peninsula/Island

Ecological Opportunities and Constraints Map

Legend

-  Degraded/Dying Plant Installations - Cottonwood Planting Opportunity
-  Emergent Wetland Area - Protect/Interpretive Opportunity
-  Native Restoration Zone - Volunteer/Educational Opportunity
-  Riparian Scrub Shrub Wetland - Preserve/Interpretive Opportunity
-  Seasonal Closure Recommended/Goose Breeding Area - March 1 - June 15th



Preserve, Protect, Celebrate



Sensitive Habitat/Protect and Preserve

Google Earth

© 2021 Google

DHM DESIGN

380 Main Street, Suite 110
Carbondale, CO 81623 | 970.963.6520

900 ft



Lake San Cristobal

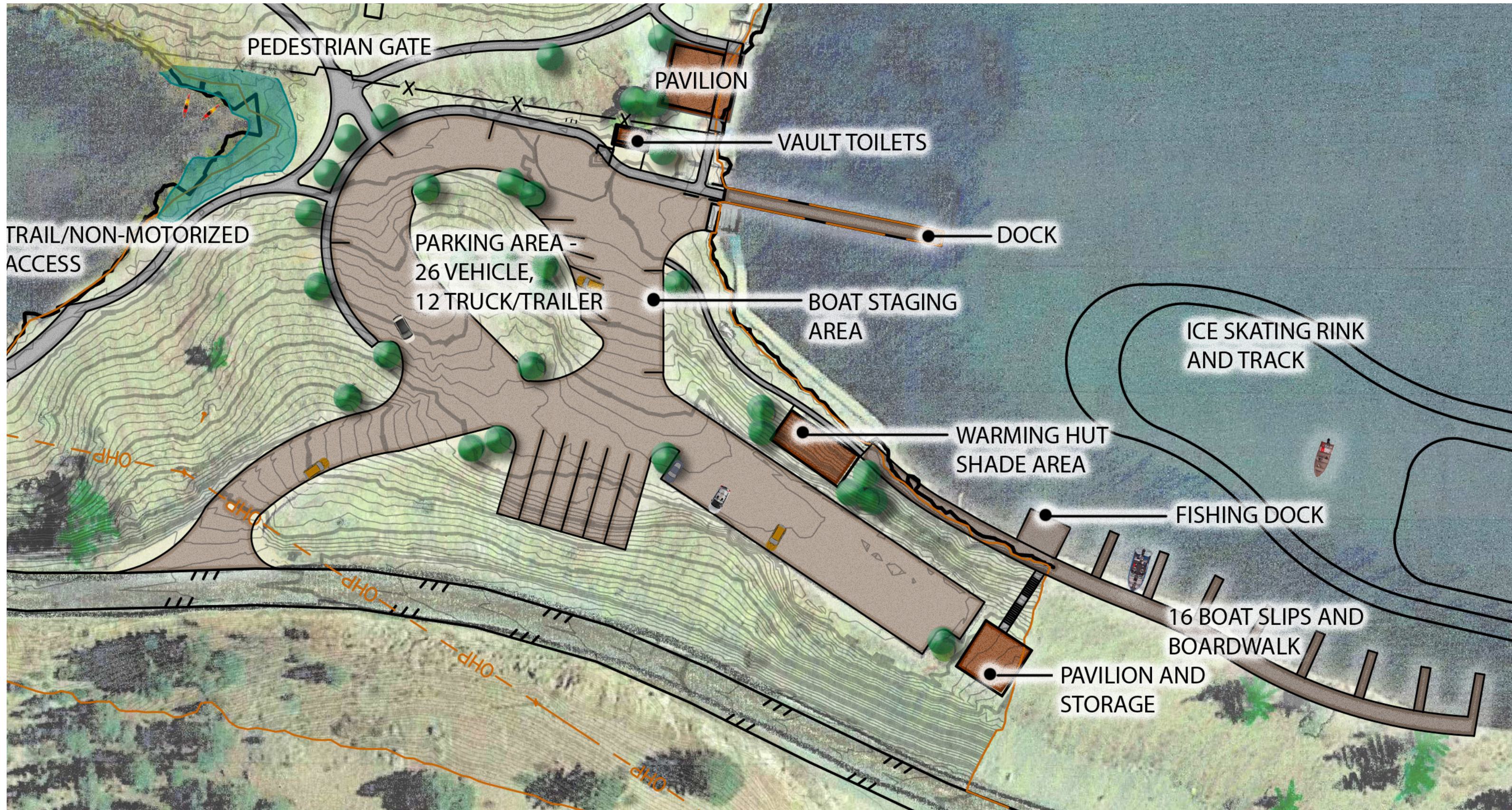
HINSDALE COUNTY

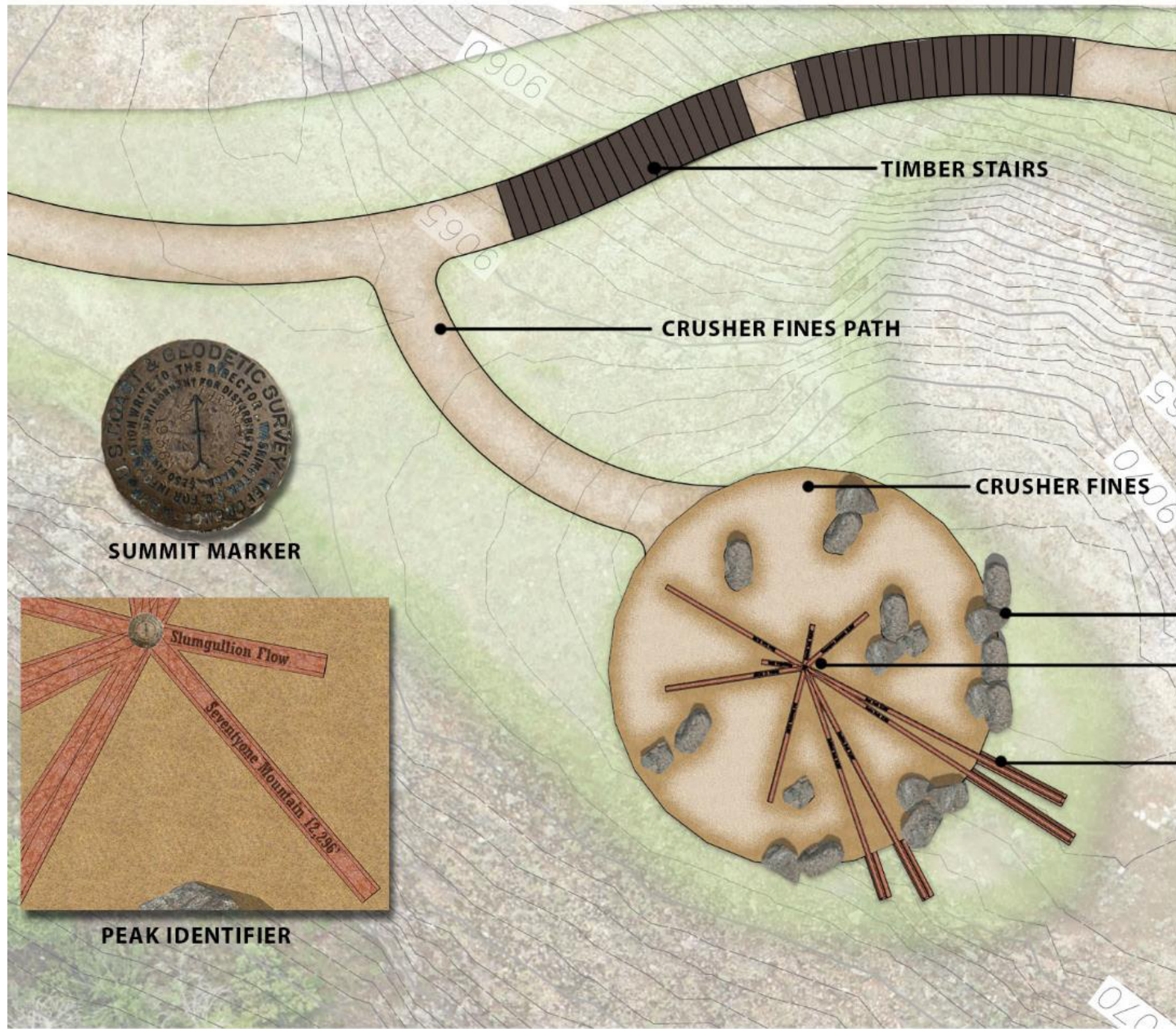
(5) TRUCK TRAILER PARKING
 WARMING HUT/SHADE AREA
 PARKING AREA
 PAVILION/STORAGE
 BOAT SLIPS AND BOARDWALK

EXISTING BUILDING
 SHADE PAVLION
 VAULT TOILET
 PAVED WALKWAY

SOFT SURFACE TRAILS
 MEMORIAL OVERLOOK
 ADA FISHING PIER
 COMPOSTING TOILET
 OUTDOOR CLASSROOM

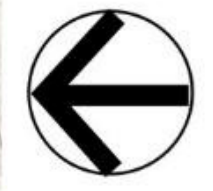






- NATURAL BOULDERS FOR SEATING.**
- CENTER OF RAILS TO HAVE IDENTIFYING SUMMIT MARKER WITH WITH DETAILS ABOUT BEN.**
- PEAK IDENTIFIER - RAILROAD RAIL ALIGNED WITH VIEWS TO NOTABLE PEAKS OR LANDMARKS. RAIL TO HAVE ENGRAVED PEAK NAME AND ELEVATION. LENGTH CORRESPONDS WITH DISTANCE. 1' = 2000'; RAILS TO BE BURIED FLUSH TO THE TOP.**

1" = 10'-0"



Goff Engineering & Surveying, Inc. - 125 Rock Point Drive, - Suite A - PO Box 97 - Durango, CO 81301

To:	Walker Christensen, DHM	CC:	File
From:	Bill Hickam	Goff Proj. No.:	21-084
Date:	09/20/2021	Re:	Structural Assessment
Project:	Lake San Cristobal Cable Bridge		

Goff Engineering & Surveying performed a visual assessment of the cable suspension pedestrian bridge located at Lake San Cristobal in Lake City, Colorado.. The assessment was performed at the request of Hinsdale County. The assessment was a general assessment intended to provide an overall assessment of the bridge and to attempt to determine a safe capacity.

SITE OBSERVATIONS

I conducted a site visit on Tuesday, March 31st to perform a visual assessment of the structure.

My observations were as follows:

General

In general, the Lake San Cristobal bridge is a single span suspension bridge supported by two suspended wire ropes. The wire ropes are supported by steel upright structures at each end and are anchored into formational material with base plates. The walking surface of the bridge consisted of a framework of steel channels and angles supporting a steel grating walking surface. The channels were suspended from the main suspension cables with suspender cables.

I observed the visible structure and framing from each side of the bridge and from the bridge walking surface. A list of my observations is as follows:

- The main suspension cables were wire rope spanning between steel uprights:
 - 1 ¼" dia steel wire rope
 - Approximate span between uprights = 224 feet
 - Approximate sag (under self weight of bridge) = 14 feet
- The suspender cables were recently replaced by Canyon bridge:
 - ½" dia steel wire rope with 1.5 ton (allowable) quick link connection
 - Spaced at 8'-0" oc
- Walking deck framing was steel framing supporting steel grating
 - C5 channels suspended from the suspender cables, spaced at 8'-0" oc
 - Steel angle spanning between C8 channels
- The main span cables were supported by steel upright structures on each end:
 - W8x31 steel uprights supporting a steel crossbar.
- Wire ropes were anchored into formational material with steel baseplates with anchor bolts
 - Base plates were 1'-6" x 1'-6" x ¾" thick
 - Base plates had (4) 1 ¼" dia anchor bolts
 - Information from Canyon Bridge indicated the anchor bolts were embedded 3'-0" deep and epoxied into rock.

ANALYSIS and SUMMARY

Analysis

Based on information provided by Canyon Bridge and Goff's analysis of the suspended cable structure, the following capacities were estimated:

MAIN CABLES

- 1 ¼" diameter main wire rope cables, poly core per Canyon Bridge: 65 ton ultimate strength
- Suspended cable span = 225 ft.; unloaded sag = 14 ft.; allowable uniform load = 50 plf per cable with factor of safety (FS) = 5.0
- Note supported bridge deck length is approximately 200 feet.

SUSPENDER CABLES

- Ultimate capacity of suspender cable and turnbuckle = 11, 000 lbs
- Spacing of suspender cable = 8'-0" oc; FS = 5.0, allowable uniform load on bridge = 275 plf per cable.

BASE ANCHORAGES

- Maximum forces in cables = 25,000 lbs to match allowable cable force
- Max anchor bolt forces (approx.): Tension = 2,500 lbs/ bolt; Shear = 5,800 lbs per bolt

Based on the above, it is our opinion that the capacity for the allowable capacity for the bridge is approximately 100 pounds per linear foot (50 pounds per linear foot per cable), which equals an approximate area load of 30 pounds per square foot or a total load of 20,000 lbs. This is equal to approximately sixty five (65) people.

During our site visit, it was observed that the bridge exhibited motion under footfall impact significant enough to effect occupant comfort. It is therefore our opinion that the serviceability limit of occupant comfort shall be considered in the determination of the capacity of the bridge. Based on field observations and consultation with Chris Haaland of Canyon Bridge, who has extensive experience with similar structures, it is our recommendation that the occupancy of the bridge be limited to 25 persons.

SUMMARY

Based on our field assessment and analysis of the Lake San Cristobal suspension bridge, including information provided by Canyon Bridge, it is our recommendation that the occupancy of the pedestrian bridge be limited to 25 persons or less.

Goff appreciates the opportunity to provide you with this assessment, and please do not hesitate to contact us with any questions, or should you desire any future assistance.

William H. Hickam, PE

Colorado PE # 42893

Lake San Cristobal Suspension Bridge Inspection Report and Improvements

May 23, 2021

On May 8th and May 23rd, I performed inspections at the Lake San Cristobal Suspension Bridge and improved the Suspender Hanger connections.

Inspected:

- Main Cable Anchor Bolt Plates: Good Condition, no loose bolts.



- Tower Anchor Bolt Plates: Good Condition, no loose bolts
- Main Cable 1¼" Wire Rope Clips, Good Condition, tight
- Main Cable Galvanized Turnbuckles: Good Condition

Improvements:

I removed the "severed" 7/16" wire rope sling connectors and replaced them with 1¼" wire rope clips and 1.5 ton "quick links". All the suspenders are now of an approved configuration and are rated at a minimum of 11,000 lbs. A total of 16 suspenders in the central area of the span were reconfigured. \$296 was spent in material costs.



New Configured Suspender and View along East Main Cable

Recommended Items to accomplish prior to opening bridge to the public:

- Bring Bridge Railings to the required standard of 42" high top rail and minimum 4" openings.
- Post signs at both ends of the bridge stating

**Maximum Bridge Capacity: 25 Persons
Please Do Not Swing or Bounce the Bridge
No Bicycles**

- Excavate a swale and drainage trench at the South Anchor Plates in order to keep anchors clear of soil and free of standing water.
- Re apply a bituminous paint covering at all anchor bolt plates and tower welds at base plates.

Conclusions:

It is calculated that each Main Cable Assembly maximum tension would approach 14,000 lbs if the bridge were loaded with 25 persons of 200 lb. weight. The 1¼" Main Cables are rated at approximately 100,000 lbs ultimate strength.
Factor of Safety = $100,000/14,000 = (FS) = 7$

A maintenance check list and schedule should be set up to be performed annually by the Hinsdale County Public Works Department.

