

# Adaptive Wet Weather Trail Management Plan (Revised 2013)

Bidwell Park, Chico, California

October 15, 2013



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## City of Chico

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## Table of Contents

<b>I.</b>	<b>Introduction</b> .....	<b>1</b>
<b>II.</b>	<b>Environmental Setting</b> .....	<b>1</b>
<b>III.</b>	<b>Trail Conditions Assessment</b> .....	<b>2</b>
	A. Protocol to Close Middle and Upper Park Trails and the Peregrine Point Disc Golf Course .....	2
	B. Protocol to Open Middle and Upper Park Trails and the Peregrine Point Disc Golf Course .....	3
	C. Middle and Upper Park Trail Assessment Route .....	6
	D. Peregrine Point Disc Golf Course Assessment Route .....	6
	E. Wet Weather Policy for Upper Park Road.....	6
	F. Notification .....	8
	G. Monitoring, Data Collection, and Reporting .....	8
<b>IV.</b>	<b>Conclusion</b> .....	<b>9</b>
<b>V.</b>	<b>REFERENCES</b> .....	<b>9</b>

### List of Tables

Table 1. Standard Operating Procedure for Estimating Precipitation in Middle Park/ Horseshoe Lake Trailhead Area (CESP 2009).....	3
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### List of Figures

Figure 1. Revised Trail/Disc Golf Closing Procedures.	5
Figure 2. Revised Trail/Disc Golf Opening Procedure.	5

### List of Appendices

Appendix A. Maps. 1) Trail Signs and Assessment Routes for 2) Trails and 3) Peregrine Point.

### Suggested citation:

City of Chico. 2013. Adaptive Wet Weather Trail Management Plan (Revised 2013). Bidwell Park, Chico, California. October 15, 2013. Public Works Department, Parks Division. Chico, California.

## **I. INTRODUCTION**

In December 2009, the Bidwell Park and Playground Commission (BPPC) adopted the revised “Interim (Adaptive) Wet Weather Management Plan” (CESP 2009). The Parks Division applied the protocol from 2009 to 2011. In October 2011 and also in December 2012, as part annual report reviews, the BPPC adopted several recommendations including revisions to the protocol and development of a protocol to supersede original original Interim plan (CESP 2009). This revision reflects those recommendations.

Bidwell Park contains over 50 miles of trails for recreation including hiking, running, horse back riding, and mountain biking (CESP 2009). A sustainable trail system provides quality recreational opportunities and access to Bidwell Park’s points of interest without diminishing the natural resources. Due to the nature of the soils in the park, and year-round heavy traffic from multiple uses, a plan is needed to mitigate and minimize damage to trails and natural resources.

CESP (2009) noted that when wet, trails with natural tread surfaces are “often subject to severe damage from trail users such as equestrians and mountain bikers. Horses and mountain bikes leave depressions and ruts in and around the trails, and compact soils leading to pools or channelization of runoff. Many trails in the park have been widened beyond what is necessary, and eroded down to bedrock, which has reduced vegetation coverage. “

The primary purpose of this plan is to outline a clear protocol to open and close Middle and Upper Park Trails and the Peregrine Point Disc Golf Course, in order to protect against resource degradation. This plan also outlines the procedures for public communication, monitoring, and developing recommendations.

We define wet weather trail closure as the prohibition of horses and bicycles on any trail due to wet soil conditions. During conditions that cause closures, we encourage pedestrians to use only designated trails (no off-trail use when wet). Similarly, we define the disc golf closure as prohibiting play on the Peregrine Point disc golf course and restricting pedestrians to designated trails.

The Plan is meant to complement the Bidwell Park Master Management Plan (EDAW 2008), Bidwell Park Trails Manual (Chico 2006), and the forthcoming Trails Plan (in progress) as an adaptive tool to manage wet weather use of Bidwell Park. As part of the adaptive management approach, we anticipate annual reports to the BPPC.

## **II. ENVIRONMENTAL SETTING**

Bidwell Park and Chico experience a Mediterranean climate, characterized by hot, dry summers, and wet rainy winters. Approximately, 27 inches of rain falls annually with nearly all of it falling between December and April.

Steep slopes and thin soils characterize most of Upper and part of Middle Bidwell Park. Slopes on the ridges vary between 3-15%, with steeper slopes in the canyon between 30-50% (CESP 2009). While the soil depth and type varies greatly in Upper and Middle

Park, many areas have a shallow depth to bedrock of only 2-20 inches (CESP 2009). In contrast, Lower Park is relatively level with deep, loamy, alluvial soils that are much more resistant to erosion (and somewhat compaction). Elevations in the Park Range from 200 – 1600 feet above mean sea level (CESP 2009). Trails within the park meander through sensitive areas of annual grassland, oak woodland, and riparian vegetation with few of these trails designed for sustainable use. Bidwell Park is home to several endangered species and their critical habitat.

### **III. TRAIL CONDITIONS ASSESSMENT**

Several revisions simplify the protocol outlined in CESP (2009); making it easier for the public to understand and for staff to apply. Assessments are conducted to close and to open the trails. To make the closure policy objective and transparent to the public, the closures will be based on publicly available data.

#### **A. Protocol to Close Middle and Upper Park Trails and the Peregrine Point Disc Golf Course**

Trail closures will follow the protocol depicted in Figure 1. When precipitation reaches 0.25 inch in any 24 hour period (from the CHI gauge, below), Middle and Upper Park trails and the Peregrine Point Disc Golf Course will be closed.

Wet weather trail closure prohibits horses and bicycles on any trail. During trail closures, we will encourage pedestrians to use only designated trails and promote the ethic to stay off muddy trails. Similarly, the closure at the Peregrine Point Disc Golf Course prohibits any bicycle, horse, or foot traffic on the course. Pedestrians will be restricted to designated trails that may be able to better accommodate wet condition use.

CESP (2009) acknowledges that emergency or special circumstances/events may warrant closure at the discretion of the parks' staff. Note that Figure 1 also provides for a field assessment (explained further below) to determine the closure. The field assessment provides discretion for situations where weather conditions (cool temperatures, persistent light precipitation, high humidity, etc) may create wet trail conditions, but precipitation does not exceed the threshold.

Precipitation data available on the California Data Exchange Center web site (<http://cdec.water.ca.gov>) will be used (note: daily precipitation will differ than the total from any 24 hour period). The Chico (CHI) gauge placed at the USDA Experimental Forest is approximately 4.1 miles due south of Horseshoe Lake. This gauge will be used as a surrogate for the park even though elevation or field conditions on individual trails or parts of the course may be very different. Table 2 lays out the procedure noted in CESP (2009) for accessing the data.

Generally, the closure policy will be applied once a day before 11 am. However, Staff is provided discretion to close trails when the 24-hour precipitation total crosses the 0.25" threshold value and/or rain is forecasted.

**Table 1. Standard Operating Procedure for Estimating Precipitation in Middle Park/ Horseshoe Lake Trailhead Area (CESP 2009).**

<p>1. Navigate to <a href="http://cdec.water.ca.gov/cgi-progs/staMeta?station_id=CHI">http://cdec.water.ca.gov/cgi-progs/staMeta?station_id=CHI</a> (or go to <a href="http://cdec.water.ca.gov/">http://cdec.water.ca.gov/</a>, select data plotter, and search for station “CHI”)</p>	
<p>2. The 9th sensor from the top of the page is described as “<b>PRECIPITATION, ACCUMULATED</b>, inches (hourly)(RAIN)SATELLITE”- click on the (hourly) icon.</p>	
<p>3. Record the latest value (in inches) in the first column “Rain- inches” and note the time of that reading.</p>	
<p>4. Click on the “earlier” icon and locate the entry 24- hours prior to the value from <b>Step 3</b>.</p>	
<p>5. Subtract the earlier value from the later value to obtain the depth of precipitation (in inches) for the previous 24-hour period. This value will serve as a best estimate for the amount of precipitation in the Middle Park/ Horseshoe Lake Trailhead area.</p>	
<p><b>Note:</b> The CHI (Chico) station is located approximately 4.1 miles due south of Horseshoe Lake. This station represents the closest publicly accessible precipitation gauge to Middle Park/ Horseshoe Lake Trailhead.</p>	
<p>Chico- <a href="http://cdec.water.ca.gov/cgi-progs/staMeta?station_id=CHI">http://cdec.water.ca.gov/cgi-progs/staMeta?station_id=CHI</a></p>	
<b>Station ID</b> CHI	<b>Elevation</b> 230' ft
<b>River Basin</b> BUTTE CR	<b>County</b> BUTTE
<b>Hydrologic Area</b> SACRAMENTO RIVER	<b>Nearby City</b> DURHAM
<b>Latitude</b> 39.7120°N	<b>Longitude</b> 121.7830°W
<b>Operator</b> CA Dept of Forestry	<b>Data Collection</b> SATELLITE

Following any rain event, trails should remain closed for at least one day after the event and if there is a high (70% or higher) possibility of precipitation on that day (and thus no reason to field check the sites). If no foot steps within the trail tread are visible, the trails may be opened. Guidance for the plan notes that while staff will continue to evaluate and monitor site conditions, there will still be times when a judgment call has to be made based on both observations and data.

**B. Protocol to Open Middle and Upper Park Trails and the Peregrine Point Disc Golf Course**

While wet weather and a clear threshold (0.25” of precipitation) initiate the closure of trails and disc golf course, we should note that the trail opening is governed by the soil conditions.

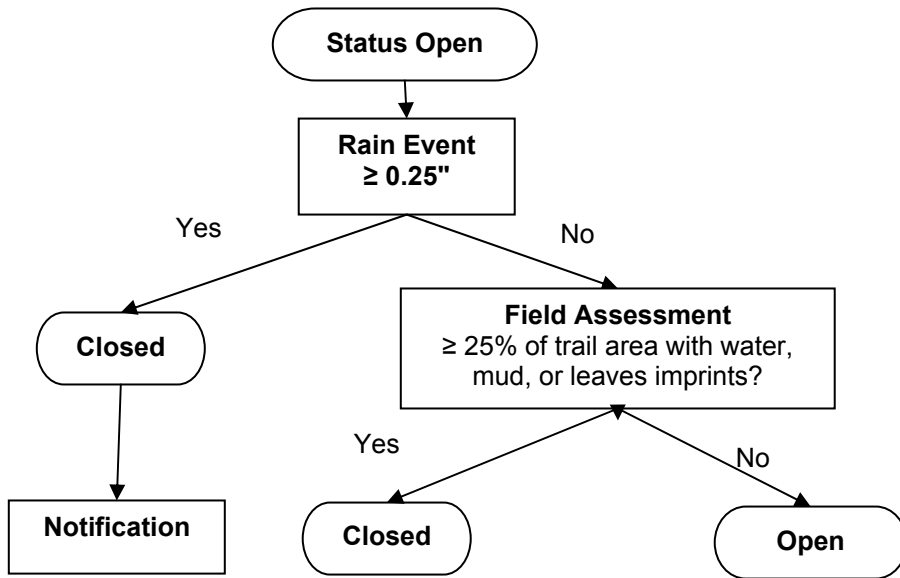
Temperatures, relative humidity, saturated soils, plant water demand, day length, wind speed, and many other factors can influence the opening of the trails. For example, it may take several days and even weeks for the soil to dry sufficiently in January as opposed to less than a day for a mid-summer rainfall event, even though the precipitation amount may be the same.

The protocol may be summarized as follows:

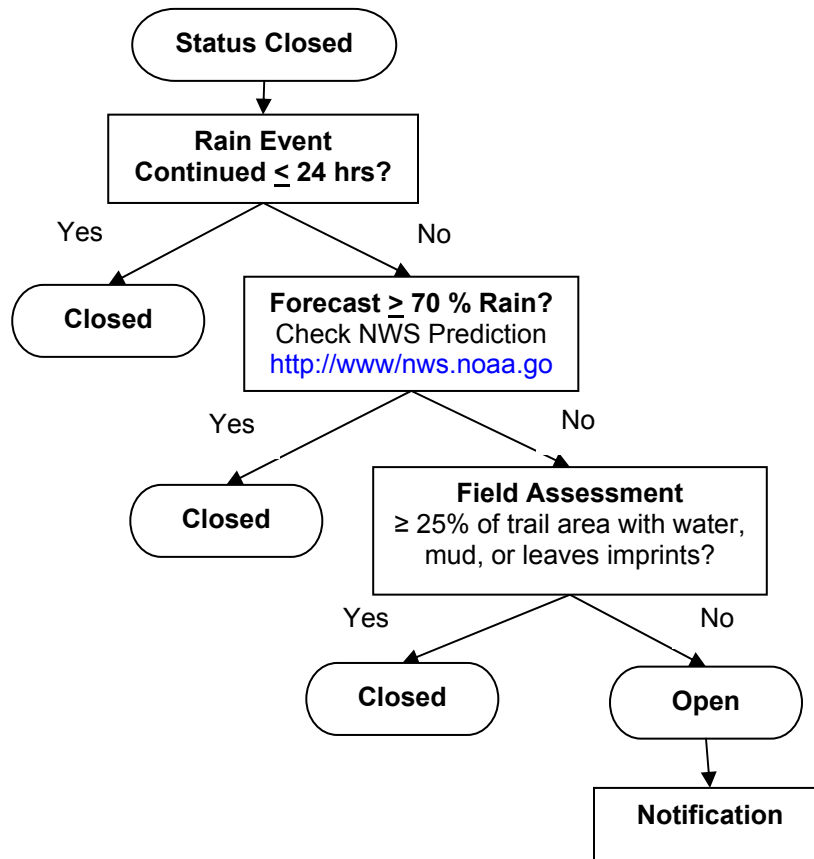
1. If trails are closed and the rainfall event continued after the initial closure, the trails remain closed.
2. If the rain stopped in the previous 24 hours, but the forecast calls for a 70% or greater chance of precipitation, the trails remain closed.

3. If the forecast does not call for additional rainfall than a field assessment is conducted.

Once the trails are open, trail assessments (walk) will not be conducted until additional precipitation falls.



**Figure 1. Revised Trail/Disc Golf Closing Procedures.**



**Figure 2. Revised Trail/Disc Golf Opening Procedure.**

### **C. Middle and Upper Park Trail Assessment Route**

From the Horseshoe Lake Trailhead, a park employee should walk along the Middle Trail and observe the impact of their footprints, then cross (down a connector trail) to Lower Trail and return to the parking lot (CESP 2009) (Appendix A).

If the assessment reveals more than 25% of the trail has puddles, mud, or the observer leaves imprints of more than 0.5 inches, then the trails remain closed. If less than 25 % of the trail matches these conditions, then the trails are likely suitable for non-pedestrian use.

As soon as one of the threshold values is reached or exceeded, the observer may terminate the observation and make a determination without completing the route.

In the short-term, Staff will retain the current assessment route, but would like to explore a new route and report back to the BPPC on any suggested route changes. The new route may be recalibrated (the 25% rule modified). For example parts of the existing trail are damp during most of the wet season, while other areas are on rock that does not make an imprint even if completely saturated.

Time to complete Task: 5- 30 minutes (600 meter walk)

### **D. Peregrine Point Disc Golf Course Assessment Route**

Because the short course has been closed, a new assessment route to capture conditions on the long course area (Appendix A) seems appropriate. The previous assessment route focused on the short course and trails. The new route is focused on the course fairway paths and trails and can be described as follows:

From the Disc Golf kiosk, a park employee should walk toward the Tee area for Hole 1, proceed west down Hole 1 past the pin to Hole 2 and continue north on the fairway path to the pin and observe the impact of their footprints. The employee should then cut over to Hole 14 and follow the path to 15, 16, 17, and 18 returning to the kiosk area.

Like the Middle and Upper Park trail assessment, if the assessment reveals more than 25% of the area walked has puddles, mud, or the observer leaves imprints of more than 0.5 inches, then the Course remains closed. If less than 25 % of the trail matches these conditions and no imprints are greater than 0.5 inches, then the Course is opened.

Time to complete Task: 10 - 25 minutes (800 meter walk)

### **E. Wet Weather Policy for Upper Park Road**

Historically, the unpaved portion of Upper Park Road (past Parking Lot E/Horseshoe Lake) is closed during and following inclement weather. Upper Park Road is closed on Sundays and Mondays to vehicles.

Upper Park Road is a thinly graveled surface with poor drainage in places. During and



after rain events, vehicles on the road cause considerable damage (rutting) and can slide off the road. To ensure safety, protect against road degradation and reduce costs associated with maintenance Upper Park Road is closed when wet.

When trails are closed, park users are allowed on Upper Park Road for recreational activities. For purposes of the code, Upper Park Road is considered a trail when the road is closed to vehicles; however, horses and bikes are permitted to use Upper Park Road.

The current policy may be articulated as follows:

1. The gate at the Diversion Dam will be seasonally closed from November 1<sup>st</sup> to April 30<sup>th</sup> annually.
2. An assessment of road conditions should occur daily during wet conditions, before 7:30 am.
3. When more than 0.25 inches of precipitation falls within a 24-hour period or if tire impressions are evident while driving on the road, the road shall be closed to vehicles.
4. If the National Weather Service indicates a 70% chance or greater of precipitation that day, the road will be closed to vehicles.
5. The Road will remain closed to vehicles (open to pedestrians, bikers, and equestrians) when Upper Park trails are closed.
6. To open, the surface should be firm with few puddles present.
7. In addition, emergency, weather damage, or special circumstances or events may warrant closures at the discretion of Parks Staff.

The policy tracks fairly closely with the current trail closure, except that conditions typically dry more rapidly than the trails and the road opens earlier. Item number 5 is new and based on BPPC direction following the 2011-2012 review.

We recommended modification of the protocol so that the opening of Upper Park Road is tied into the trails assessment. In other words, when Middle and Upper Park Trails are closed to bikes and equestrians, the Upper Park Road is closed to vehicles.

Reasons for this change include:

1. Consistency and easier communication to the public.
2. When the trails are closed, more bikes and equestrians use Upper Park Road; removing cars may improve safety and trail closure compliance (some offenders say that they did not feel safe on the road and use the trails).
3. Allows for more centralized access points: Minimizes use of parking areas deeper in the Park (i.e. Bear Hole), when trails are wet, and removes the temptation to bring in a bike in a vehicle to access closed trails in Upper Park.

Note that in the past year, damage to the road closed it for a significant part of the year, and we could not do a meaningful comparison. However, for the previous 433 day monitoring period (2011-12), we experienced only 2 days (3/23-3/24/12) in which the trails were closed and the road was opened. We began collecting data during the 2011-2012 monitoring period, and cannot compare the road and trail closures during past years. We anticipate that the discrepancy between the trails and road closures would have been greater in wetter years such as 2010-2011, although the gate closure on

Sundays and Mondays would minimize the effect.

## **F. Notification**

Once the trail status changes, staff will update:

1. Trail status signs throughout the park (Appendix A).
2. GSD administrative staff who often get calls from the public on trail status.
3. The trails hotline (530) 896-7899
4. The Bidwell Park webpage –  
[http://www.chico.ca.us/General\\_Services\\_Department/Park\\_Division/Bidwell\\_Park.asp](http://www.chico.ca.us/General_Services_Department/Park_Division/Bidwell_Park.asp)
5. The Park Division Facebook Page (<http://www.facebook.com/CityofChicoParks>) and Twitter Account (<https://twitter.com/ChicoParks>).

## **G. Monitoring, Data Collection, and Reporting**

Park rangers conduct regular assessments of Upper/Middle Park trails and the Peregrine Point disc golf course to determine trail openings and closings. Data collected included: observer id; time; Chico weather station precipitation (available at the California Data Exchange, <http://cdec.water.ca.gov/>); rain forecast exceeding 70%; footstep imprints; comments, and trail status (open or closed). The data from the US Forest Service Station (using the query tool and station CHI) is downloaded as a CSV (Comma Separated Values) text file and open file in Excel, following prompts to place values in columns.

The Rangers and Natural Resource Manager enters a number of factors for the analysis and to develop the summary tables (an Excel Spreadsheet). The data collected include:

- Date, Month, Day of week
- Employee number (Emp\_No),
- Time assessment recorded (Start\_Time),
- Average Temperature (Ave\_Temp),
- Cooling degree Day (cdd\_50),
- Precipitation Daily (PPT\_CHI\_daily) and in the last 24 hours (PPT\_CHI\_24),
- Forecasts that indicate a better than 70% of precipitation (chi\_forecast),
- Imprints from Horseshoe Lake and Peregrine Point assessment (HL\_footsteps, and PP\_footsteps),
- Open or closing of Trail (Trail\_status), road (Road\_Status), and disc golf (PP\_status).
- Date of last precipitation and number of days that trails are closed,
- Comments,
- Indicator variables for temperature, precipitation that day, precipitation that exceeds 0.25", wet\_season, month number.

Many of the items above are calculated values from the downloaded or collected data. Analysis (ANOVA, paired t-test, regression as appropriate) will be completed using MINITAB statistical software importing the Excel spreadsheet.

Since the original protocol, staff evaluated several questions related to the protocol (for example, whether there was a statistical difference between field collected data and the weather station data at the Chico airport). Over time, we anticipate the analysis to become more routine (for example, just a simple reporting of the number of days that trails were closed each month). While we suspect that other statistical questions may arise (such as whether a predictive equation may be developed as years of information accumulate), the annual summary should contain the following:

1. A summary of weather data and number of days closed each month,
2. A graphical display of rainfall events and trail closings, and
3. A graphical display of average daily temperature and trail closings.

Other information, especially related to compliance issues such as enforcement or educational efforts, may also be summarized in the report. Each annual report should also provide recommendations to the protocol and to improve compliance.

#### **IV. CONCLUSION**

This plan is an evolution of the Interim Plan developed in 2009 (CESP 2009). The plan has provided the closure rationale to the public and we have experienced increased wet-weather compliance. This plan has been developed with considerable public input and is intended to be modified as information is developed and will be assessed and updated as needed. The annual reports will provide an opportunity to check on the protocol and revised as necessary.

#### **V. REFERENCES**

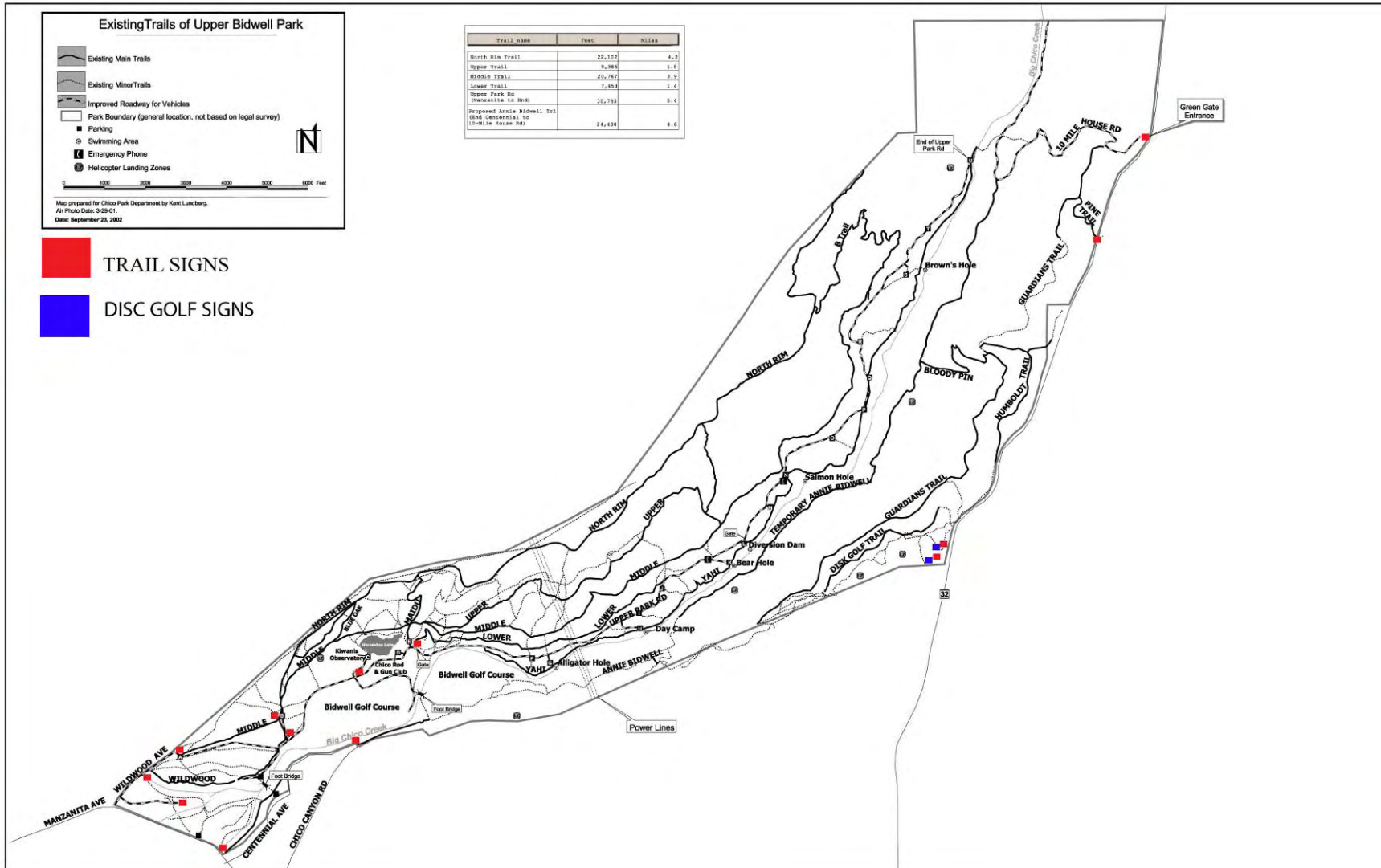
[CESP] Chico Environmental Science and Planning. 2009. Interim (Adaptive) Wet Weather Management Plan. Prepared for City of Chico, General Services Department, Parks and Open Space Division. December, 2009. Chico, California.

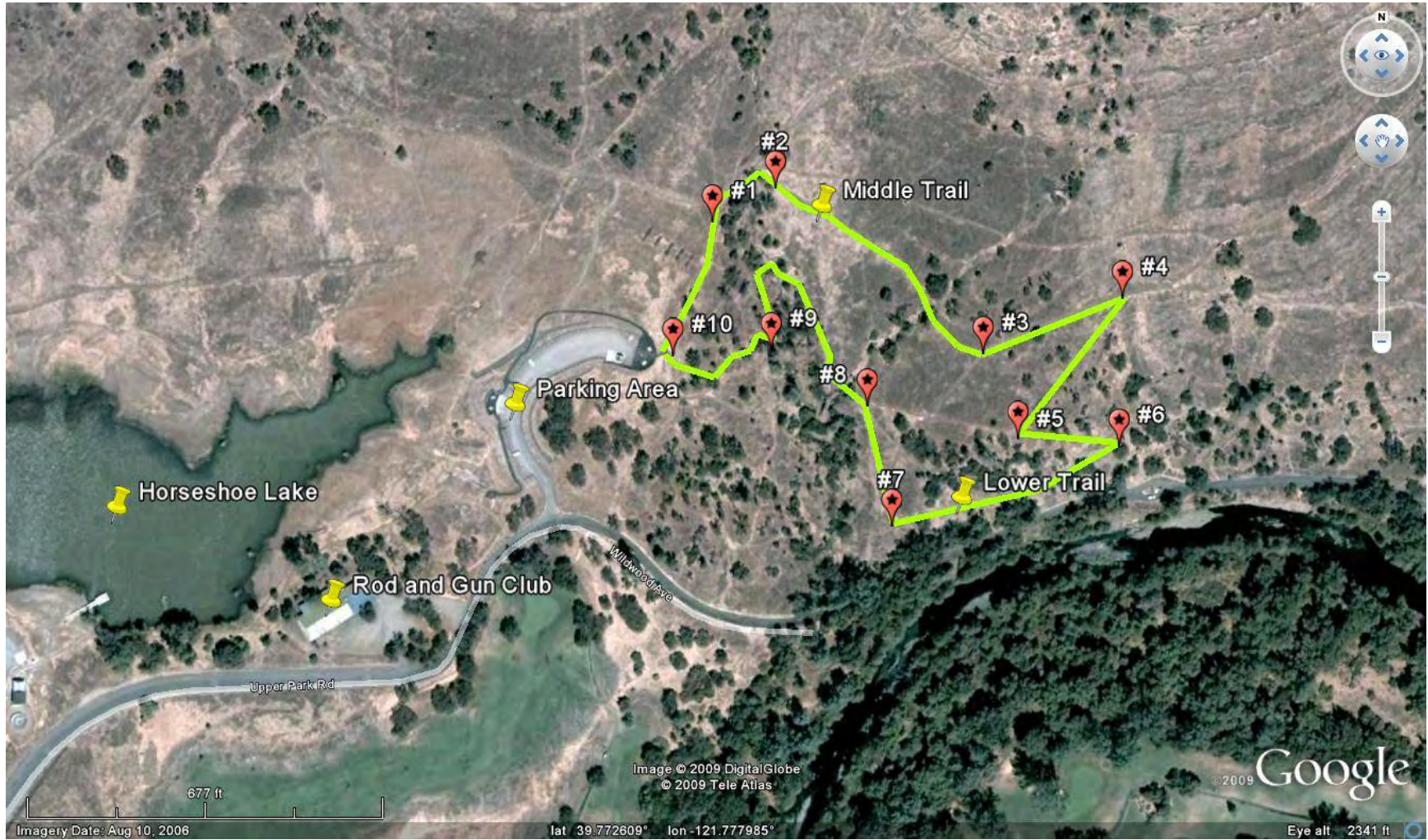
[www.cdec.water.ca.gov](http://www.cdec.water.ca.gov)

[www.nws.noaa.gov](http://www.nws.noaa.gov)

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# Appendix A. Maps. 1) Trail Signs and Assessment Routes for 2) Trails and 3) Peregrine Point.





# Course Assessment Route, Peregrine Point Disc Golf Course

