

Comment Letter I3

From: Gungle, Ashley
To: Neufeld, Darin
Subject: FW: Jacumba Solar EIR Biological Comments
Date: Tuesday, May 26, 2015 7:17:04 AM
Attachments: 05-16-15 J-Sol Biological.doc
 12-01-11 Audobon Jacumba lake proposal.doc

From: Howard Cook [mailto:howwcook@yahoo.com]
Sent: Friday, May 22, 2015 12:44 PM
To: Gungle, Ashley; Bennett, Jim
Cc: Mark Ostrander; Donna Tisdale; Danielle Thomas; Ken Daubach; Helen Landman; Cherry Diefenbach; Howard Cook; Konawoman; Dave Landman; Janessa Dart; Mike Aiau; Evelyn Sepin; Eldon Caldwell; Eric Kallen; Des White; Joe Marshall; Jacob, Dianne
Subject: Jacumba Solar EIR Biological Comments

**ATT: PDS PROJECT MANAGER: ASHLEY, GUNGLE RE:
 COMMENTS ON DRAFT EIR: JACUMBA SOLAR MAJOR USE
 PERMIT, PDS 2014-MUP-14-041; PDSS2014-ER-22-001
 COMMENTS ON BIOLOGICAL RESOURCES SECTION**

Ashley,

Attached to this E-Mail are my comments on Biological Resources AND there other 3 additional attachments referenced in the comments. These additional attachments are a photo of the nesting bats referenced by the CPUC Biological monitor, a photo of a Golden Eagle over Jacumba and a letter from the State Audobon Coordinator for the Tricolored Blackbird talking about this species of special concern at Jacumba Lake. This letter also shows the importance of the lake to wildlife and why the wells and the springs must be protected from drawdown of aquifers over many months by Jacumba Solar. Since the letter, written in 2011, through the care and investment by the Landmans (lake, spring, well and Spa owners) and a team of dedicated volunteers, we are well on the way to achieving the goals defined in the letter. Lets not let the excessive pumping (100,000 gallons a day solid for more than 6 months) by Jacumba Solar in the face of our drought ruin this precious habitat and town asset.

Sincerely,
 Howard W Cook - 619-766-4640 (former Revitalization Committee Chairman for Jacumba Lake Restoration)

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Response to Comment Letter I3

**Howard Cook
 May 22, 2015**

I3-1

The County acknowledges receipt of Howard Cook's input and appreciates his comments regarding the potential impacts associated with implementation of the project. This comment does not address the adequacy of the DEIR, therefore no further response is required.

<u>ATT: PDS PROJECT MANAGER: ASHLEY, GUNGLE RE: COMMENTS ON DRAFT EIR: JACUMBA SOLAR MAJOR USE PERMIT, PDS 2014-MUP-14-041; PDSS2014-ER-22-001</u> <u>COMMENTS ON BIOLOGICAL RESOURCES SECTION</u> Jacumba Solar EIR on Biological Resources is a long compendium of previous studies and desk analysis and yet it is short on current field observations. The following comments are based on actual field observations. The Pallid Bat study covering the next-door ECO project is important because of its impact on the start dates of Jacumba Solar's construction. <u>PALLID BAT FINDINGS AT AND ADJACENT TO THE ECO PROJECT</u> The pallid bat (<i>Antrozous pallidus</i>) is a CDFG California Species of Special Concern and BLM sensitive species. Both California Fish and Game and The US Wildlife Service as habitat for the Pallid Bat and the Mexican ringtail bat have identified the project area. In March 2014, Howard Cook, author of this Comment and other Jacumba citizens noticed that work on the connection part of the project and most other work at ECO had been stopped. Equipment was setting around and the work was obviously undone. Two Jacumba citizens went out and talked to the watchmen guarding the sites. They were told that work had been suspended because of the discovery of a bat nest. The site of this nest is actually closer to the proposed Jacumba Solar site than to ECO. I am attaching a picture to the covering E-Mail of this nest taken in late August 2014. The Biological Monitor for the Eco Substation and interconnect Project had stopped in process work on the project. Work on this last portion of ECO resumed in October 2014. The author of these comments understood that this could and should be put in these Jacumba Solar EIR comments, because if these seasonable bat nesting had shutdown ECO in 2014, they would shutdown Jacumba Solar Construction from March through September or October in 2015 and 2016. He researched the shutdown on the ECO website. And this is what he found written: "CPUC approved environmental monitors, who conducted pre-construction wildlife sweeps prior to ground disturbing construction activities along the ROW in accordance with MM-BIO-1c". "On February 18, 2014, five pallid bats (<i>Antrozous pallidus</i>) were identified by the biological monitor roosting in the expansion joint of the Carrizo Creek Bridge where jack-and-bore drilling activities are occurring. A bat specialist monitored the bats during construction hours. Both the California Department of Fish and Wildlife (CDFW) and the Bureau of Land Management (BLM) were notified of this discovery as the pallid bat is considered a Species of Special concern (CDFW) and a sensitive species (BLM)". Cook wondered why there was no more reporting in these monthly reports even though actual construction was shutdown. He therefore called the California PUC, to verify the shutdown of the Eco project in 2014. The PUC acknowledged the shutdown, but had the SDG&E project monitoring office call me. They acknowledged the shutdown for April through September and said that it was because of the discovery of Pallid Bats at the ECO site. He was noncommittal when I asked why this had not been reported during the rest of the shutdown period. <u>COMMENT: BECAUSE OF THE FINDINGS ABOVE, JACUMBA SOLAR MUST EMPLOY A CERTIFIED AND BAT EXPERIENCED BIOLOGICAL MONITOR DURING THE CONSTRUCTION PERIOD AND PLAN ON NOT</u> 5/16/15 BY HOWARD W COOK	I3-2 The County acknowledges this comment. Numerous surveys of the site were completed as detailed in Tables 1 and 2 of Appendix 2.2-1. As outlined in detail within Section 2.2.6 of the DEIR, mitigation measure M-BI-1 includes the requirement of a County-approved biologist to be contracted to perform biological monitoring during all grading, clearing, grubbing, trenching, and construction activities. Due to the presence of this monitor on-site during these activities, and required coordination between the project biologist and the contractor regarding potential seasonal surveys and nesting, no additional mitigation measures are required. I3-3 The County acknowledges this comment; however it does not address the adequacy of the DEIR, therefore no further response is required. Additionally, bats are described in Appendix 2.2-1 acknowledging that they likely forage on the project site. The bat roost at the Carrizo Creek bridge referred to in the comment was a maternity roost, which requires avoidance during the pupping season. Maternity roosts are not expected to occur within the project area due to the lack of structures, large trees, caves, undercrossings, and other typical maternity roost habitat. I3-4 The County acknowledges this comment; however it does not address the adequacy of the DEIR, therefore no further response is required. The referenced maps do not include the Project site within identified ranges
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<u>ATT: PDS PROJECT MANAGER: ASHLEY, GUNGLER RE: COMMENTS ON DRAFT EIR: JACUMBA SOLAR MAJOR USE PERMIT, PDS 2014-MUP-14-041; PDSS2014-ER-22-001</u> <u>COMMENTS ON BIOLOGICAL RESOURCES SECTION</u> <u>CONSTRUCTING THEIR JACUMBA SOLAR PROJECT FOR AT THE LEAST THE SAME NESTING AND FEEDING PERIOD EXPERIENCED AT ECO, (MARCH THROUGH SEPTEMBER).</u> <u>ENDANGERED BIG HORN SHEEP</u> The Previously included NOP Comments are repeated because of the PDS verbal response on Endangered Big Horn Sheep made at The Jacumba Sponsor Group Meeting April 28/2015. The response PDS gave was that experts they talked to said they had not seen Big Horn at the project site. They did not refute our NOP findings so they still stand as follows: - San Diego County's 08/07/14 Preliminary Application project letter failed to list Big Horn Sheep in their "Comprehensive list of Sensitive Species" list in the letter. - Both US Wildlife and State Fish and Game Big Horn habitat maps show the project within the Big Horn habitat area. - The NOP (see the NOP section for recent photographs) Big Horn photographs, taken on 09/16/14 by Jacumba residents in direct eyesight of the project prove the area is prime habitat for the "Endangered" Big Horn. Three residents at the 09/23/14 NOP and Jacumba Sponsor Group meeting said that they had seen this band of Big Horn in the month of 09//2014. - The Jacumba Solar project is adjacent to one of two BLM Lands with major breaks in the Border fence. These breaks allow movement of Big Horn and other sensitive species between both countries. - Note the radio collars on the pictured Big Horn indicating that they were placed on them in Mexico as part of a current ongoing two year study of biologically important cross border Big Horn. More on this study as follows. - Expand This EIR to specify the project alternative of a <u>two-year delay of the project. This will allow for the project completion, analysis and reporting of the Big Horn cross border study</u>. This two year 2014 and 2015 plus study is the subject in the 11/18/2013 San Diego Zoo Global News Release which describes the Big Horn study as follows: <i>"The collaborative effort included the Universidad Autónoma de Baja California, government agencies in Mexico, The Nature Conservancy, and San Diego Zoo Global with the goal of better understanding the movement, health status and genetics of the Sierra Juarez: bighorn sheep populations. The Peninsular bighorn sheep is an endangered species whose two major populations could be permanently separated unless we protect its habitat and key bottleneck connections throughout the Peninsular Range. Smaller, isolated populations are more susceptible to diseases and predation and are less resilient to climate change"</i>. Which is more important a not needed Solar Project or protection of our federally Endangered Big Horn Sheep? 5/16/15 BY HOWARD W COOK	of the Peninsular Big Horn Sheep. As discussed in Appendix G of the BTR, the species is not expected to occur due to the Proposed Project site being situated outside the known range of the species and poor habitat suitability. As shown on figure 6 of the BTR, Federal Critical Habitat for Peninsular bighorn sheep is situated approximately 12,000 feet to the north, northeast of the project site. The final Critical Habitat for the species does not cross south of Interstate 8 within San Diego County. Further, the species does not occur where they are unable to see. Chaparral and juniper woodlands do not provide for suitable sightlines for the species. I3-5 The County acknowledges this comment; however it does not address the adequacy of the DEIR, therefore no further response is required. The project site is not identified within the ranges shown on the referenced map. I3-6 The County acknowledges this comment; however it does not address the adequacy of the DEIR, therefore no further response is required. I3-7 The County acknowledges this comment; however it does not address the adequacy of the DEIR, therefore no further response is required. I3-8 The County acknowledges this comment; however it does not address the adequacy of the DEIR, therefore no further response is required.
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ATT: PDS PROJECT MANAGER: ASHLEY, GUNGLER RE: COMMENTS ON DRAFT EIR: JACUMBA SOLAR MAJOR USE PERMIT, PDS 2014-MUP-14-041; PDSS2014-ER-22-001 COMMENTS ON BIOLOGICAL RESOURCES SECTION In addition to the NOP data, above, is this statement from CA State Fish and Game in describing the range and habitat of the Endangered Peninsular Bighorn Sheep. It says the following about the geographic areas utilized by Bighorn; "Size of the home range depends on the juxtaposition of resources (water, forage, and escape terrain) and, therefore, varies geographically." The proliferation of Green Energy sites closing in on Big Horn habitat have the effect of forcing them into new areas. Some of these nearby sites are the: Semptra Sierra Juarez wind farm in Baja directly above the project site, Ocotillo Express Wind farm, Semptra, ECO and and other interconnect lines, The 2 high powered lines and Eco Substation. The regulators such as San Diego PDS are slowly strangling this important Big Horn Habitat area. Lets draw the line here at this unneeded Jacumba Solar Project. <u>GOLDEN EAGLES</u> Attached to the covering E-Mail on this Comment is an August 2014 picture taken by The Jacumba Birder.com individual of a Golden Eagle flying over Jacumba. Well-known Golden Eagle nesting sites are located just north of the project area at Inkopah and on Table Mountain. The EIR tries to explain these protected birds habitat away by a ton of words. The quoted Golden Eagle Helicopter studies are completely discredited, because the contractor conducting the study was convicted in 2013 of possessing Golden Eagle carcasses and surprise surprise experts have pointed out that Golden Eagles avoid Helicopters. <u>TRI-COLORED BLACKBIRD</u> Please see the EIR General Comments letter by this author dated 05/15/15, which describes the dangers of harming their Jacumba Lake habitat, by Jacumba Solar excessive ground water extraction (100,000 gallons per day for 6-8 months in 20016). The Tri-Colored Blackbird is a "California Species of Special Concern". See The California State Audubon Coordinator out of Sacramento, Keller Kyle information in the attached Letter to the covering E-Mail from Keiller. Attachments: Golden Eagle picture, Tri-Colored letter, Nesting Pallid Bat picture 5/16/15 BY HOWARD W COOK	I3-9 The County has analyzed a reasonable range of alternatives to the project, in accordance with CEQA Guidelines Section 15126.6. Under CEQA, the DEIR "need not consider every conceivable alternative to the project." (CEQA Guidelines, Section 15126.6(a).) The County has briefly described the rationale for selecting the alternatives discussed in the DEIR (DEIR, pp. 4.0-1 - 4.0-3.) and explained the reasons underlying the County's determination that certain alternatives were eliminated from detailed consideration according to the factors provided in CEQA Guidelines Section 15126.6(c). I3-10 The County acknowledges this comment; however it does not address the adequacy of the DEIR, therefore no further response is required. I3-11 The County acknowledges this comment; however it does not address the adequacy of the DEIR, therefore no further response is required. Please also see response to comment O5-134. I3-12 The County acknowledges this comment; however it does not address the adequacy of the DEIR, therefore no further response is required.
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The County acknowledges this comment; however it does not address the adequacy of the DEIR, therefore no further response is required.



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Recovering a cultural and wildlife oasis in San Diego County: restoration of
Jacumba Lake

Keiller Kyle, Audubon California

Introduction

Jacumba Lake once supported two thriving communities; one was an environmental community consisting of migratory waterfowl and multitudes of songbirds along with a large colony of California's Tricolored Blackbird (*Agelaius tricolor*). The other community was a thriving cultural oasis centered on the thermal hot springs found in the town of Jacumba. Since the draining of the lake in 2004 Jacumba has lost both of these communities and there is now an opportunity to rehabilitate this site for both wildlife and the Jacumba community.

Jacumba Lake is a unique water feature that acts as an important oasis for many types of wildlife in an otherwise dry, desert scrub environment. One goal for restoring

the lake is to repopulate the lake with a large, thriving Tricolored Blackbird colony. In 2000, over 300 Tricolors nested on this 10-acre lake and other observers have seen close to one thousand birds nesting there in the early 2000s. Since the pond was drained in 2004 (Figure 1), the lake has significantly diminished in value for Tricolors and Tricolored Blackbird numbers have declined to less than 100 birds in a nearby seep no larger than a person's living room.

Tricolored Blackbirds are unique to California, with over 95% of the world's population occurring only here. Unfortunately, we have seen its population decline by more than 80% in 70 years to 250,000 in 2011, with the southern California subpopulation now hovering around 5,000 birds. As a result, this is a Species of Special Concern in California. Other wildlife have likely experienced similar declines in and around the lake since the availability of desert wetlands is so critical for many species.

Besides the loss to wildlife, the lake also offered town visitors and residents a source of outdoor recreation and a connection to its cultural history dating back to local Native American tribes using the natural mineral and fresh water springs that bubble to the surface in this area. The residents of Jacumba are joining an effort to restore the lake as a means of attracting not only



Figure 1 Jacumba Lake has been drained since 2004 but still holds water from natural springs and runoff from the many artesian wells dotting the hillsides around Jacumba.

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wildlife, but ecotourists and nature lovers to experience the beauty and wildlife of this desert oasis.

Given the unique value of this lake to both wildlife and the resident human population, restoration of the lake could be crucial to revitalizing the town of Jacumba, both economically and for Tricolored Blackbirds. With the combined effort of the landowner, community, conservation organizations, and state and federal agencies, this project could be completed in a short amount of time and have immediate impacts on the health of the environment as well as Jacumba's economy.

Site Location and Background

Jacumba is located in the southeastern border of San Diego County along the Mexican border in a unique area known for its thermal-heated mineral springs and vibrant desert landscape (Figure



Figure 2 Jacumba is located in eastern San Diego County along the Mexican border. Jacumba lake is on the western side of town while Tricolor foraging habitat in the lettuce fields is located on the eastern side of town.

2). Inconspicuous to the casual observer that sees a dry landscape of rock outcroppings and desert scrub is the warm mineral water and abundant fresh water bubbling up from the ground forming artesian wells and creating riparian habitat along the seeps. Local residents once maintained a well-known thermal spa, splash pools, and a 10-acre lake that was heavily used by migrating and overwintering birds as well as Tricolored Blackbirds for a colony site. The owner of the spa is also the owner of the lake site, and has access to an impressive amount of wells and gravity-fed water that are potential sources for filling the lake.

The lake was abandoned in 2004 by the former owner of the spa to avoid the additional cost of pumping water into it. The water level dropped due to evaporation and low inflow although the lake still fills during the rainy season and water puddles in the bottom of the lake from natural runoff.

Recommended Actions

- 1) Return regular water supply to the lake: A water delivery system needs to be developed that will provide stable and consistent water to the lake and the habitat created there.

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- 2) Maintenance: Besides maintaining the water delivery system by fixing pipes and refurbishing pumps, the habitat within and around the lake will need to be maintained on a regular basis that would include burning or discing cattail patches, trimming trees and shrubs on and around the levy. Focal species like the Tricolored Blackbird will require regular management of cattails and other vegetation every three to five years.
- 3) Nature Trails: Developing and constructing nature trails around the lake will give people access to the newly restored lake and educate the public about the importance of desert oases, but the trails and educational signs will need to be kept up to maximize access and minimize liability. A volunteer-based maintenance crew could be organized to help maintain the trail system.

Expected Outcomes

Wildlife: Restoration of Jacumba Lake will have a significant positive impact on wildlife in this water-limited landscape. With increased water in the lake, appropriate management, and the presence of valuable foraging areas on the nearby farmland, we expect this site can once again support a Tricolored Blackbird colony of 500 birds or more. This represents nearly 10% of Southern California's breeding population. Restoration of the lake is also expected to significantly increase use of the site by a diversity of migratory and resident wetland birds and, songbirds as well as many migratory waterfowl.

Tourism: Restoring Jacumba Lake could begin attracting tourists back to town and begin the process of rebuilding tourism in the town attracted to its cultural and natural attractions. This lake was once a regular field trip site for avid birdwatchers in Southern California looking for Tricolored Blackbirds and other desert residents. Restoration and attraction of Tricolored Blackbirds will once again put it on the map as a go to spot. In addition, the lake could once again become a fishing spot for locals and tourists as well as provide outdoor recreation to guests staying at local hotels and the thermal spa.

Water Resources

The water sources for the lake include runoff from the many artesian wells dotting the hillsides above the site as well as pumped mineral and fresh water from nearby wells controlled by the landowner. Currently, these wells are being used at the spa, and one well, without the presence of a pump, is spraying water on the ground and filling the abandoned splash pool with hundreds of gallons of mineral water.

The spa also has gravity fed pools that are recharging 100,000 gallons of water every 24 hours that is currently being deposited in a nearby seep, which is consequently where the current Tricolored Blackbird colony is nesting in cattails. The excess water from the spa could possibly be diverted back to the pond after being used in the spa allowing for a continuous flow of water into the pond.

Options for supplying water

Option 1. Pump water from original source well into pond

The reason the lake went dry in 2004 was because the former owner of the lake property did not want to pay the expense of electricity to run the well. The pump is still intact and the well still provides adequate water to begin filling the pond (Figure 3). Minimal infrastructural investment

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would be needed although pump and water line maintenance would need to be conducted. Well capacity would also have to be tested to ensure that water levels over the long-term would not decrease due to the filling of the lake. To ensure the long-term stability of the lake ecosystem, water would have to be continuously pumped to sustain water levels. The electricity expenses have to be ensured either by the landowner or outside funding sources.

Summary:

Up front costs: LOW

Long-term Costs: MEDIUM/HIGH



Figure 3 Several wells, including the one that used to fill Jacumba Lake, could be used to refill the lake with either mineral or fresh water.

Option 2: Create a return water system to capture gravity fed water from spa

Given that the spa is currently taking advantage of the constant flow of water from an uphill spring that produces 100,000 gallons every 24 hours (.3 acre ft/day), sustaining water levels at the lake could be achieved by creating a system to capture the flow of water and return it to the pond. A buried trench with an associated lift pump would be needed to move the water back to the lake, which is uphill or level with the spa. Recycling the water from the spa would alleviate any concerns about lowering the current water table with extra pumping, and the long-term pumping costs would be minimal since the elevation change between the spa and lake is only several feet. Tests would need to be done to ensure that the high concentrations of minerals in the water coming from the spa would not be detrimental to the health of the lake ecosystem and the wildlife that depend on the habitat. Accumulating salts could eventually make the lake inhospitable to plants and wildlife. The pond does have an outlet, which may alleviate the issue of accumulating salts if the water is continuously flowing. Also cattails growing in the pond may be able to act as a filter and remove the salts from the water. Assessment by a water engineer is recommended for this potential issue.

Initial costs to construct the return water system would include engineering, machinery and labor costs for digging a trench and laying the piping as well as the purchase of a lift pump to push water into the pond. Long-term costs of providing water would be limited to the maintenance of the return water system and electric costs to fund the water movement into the pond.

Summary:

Upfront costs: HIGH

Long-term costs: LOW

Option 3: Solar pumping of water in pressurized well

The well that is currently without a pump but is under pressure is a mineral water well with overflow water flowing into the abandoned splash ponds built as a community pool (Figure 4). Adding a solar pump that could divert the flow from the well into the lake rather than the splash

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pool could provide a low cost, constant supply of water to maintain water levels in the pond. The initial filling of the pond would most likely need to be done with a larger pump, but the solar pump could be sized correctly to maintain water levels in the lake. An expert on solar pumps would need to assess the capability of a solar array to pump enough water to sustain the lake. Typically solar pumps are used to fill stock tanks and small ponds on cattle ranches. The limitations of the solar pump to fill the pond fast enough may prohibit its use, although given the fact that the well is flowing under pressure may assist the pump in moving enough water to maintain the lake.

As with the other options, the accumulation of salts in the pond from a mineral water well may need to be evaluated. Given the smaller volume of water flowing from this well, there most likely would not be a constant flow of water through the outlet and therefore the accumulation of salts is more of an issue with this option.

Cost for this option would be overall very low since the solar panel would power the pump and very minimal infrastructure would be needed to move water into the pond besides the pump and piping.

Summary:

Upfront Costs: LOW

Long-term Costs: LOW

Recontouring lakebed

Since the water was turned off to the lake, little has been done to manipulate the lake bottom or the berms surrounding the lake (Figure 5). The lake bottom still holds water year round and continues to naturally fill in the rainy season. Maintenance on the lake bottom will consist of removing the vegetation that has grown up and possibly evaluating the berms to ensure there will be no seepage. It will be crucial to avoid the need to obtain streambed alteration permits that can be very expensive and difficult to obtain. If the lake is below grade, earth moving permits are much easier to secure. It is quite possible that the pond is partially below grade while the berms along it to hold water above ground level. Working with an engineer to determine the necessary permits will be



Figure 4 One well in close proximity to Jacumba Lake is under pressure and the upwelling water is currently filling the historical splash ponds with several feet of water. This water could be used to refill and maintain Jacumba Lake.



Figure 5 The lakebed has not been altered since 2004 and still holds water. Minimal earthwork would be needed to prepare the lakebed to hold water again.

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essential to avoid any violations. Members of the Jacumba Sponsor Group have indicated that there is heavy machinery including bulldozers, excavators and backhoes as well as labor to do any necessary earth moving work.

Walking trails and public education signage

The landowner and the Jacumba Sponsor Group have both expressed interest in opening the pond up to the public and allow them access to walking trails and to portions of the lake shore (Figure 6). The cost of constructing trails and educational signs needs to be estimated and the layout of the trail system needs to be developed. Given the importance of the lake for wildlife, access to the lakeshore and potentially sensitive Tricolored Blackbird habitat would need to be balanced to avoid any conflict. Insurance covering the open access to the property was a concern for the landowner although he was advised that he could incorporate any additional insurance into his current policy at the spa. The major costs for opening the site to the public will be planning the trail system, installing trails, and printing signs. Some of the construction of the trail system could be done on a volunteer basis organized by the Jacumba Sponsor Group.



Figure 6 Local residents would like to open the lake shore up to the public with walking trails and educational signage as well as having access to the lake for fishing and recreating. Public access to the site would attract ecotourists and anglers.

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Budget

Option 1: Pump water from original source well into lake

Practice	Cost
Refurbish pump	
Test well for pumping capacity	
Maintenance on the pipeline	

Long-term
Electricity
Pump maintenance

Option 2: Create return water system to capture water from spa

Practice	Cost
Obtain permits for digging	
Dig trench for return pipe	
Install piping (600m)	
Install lift pump	

Long-term Costs
Electricity costs per year
Pump maintenance

Option 3: Solar pumping of water in pressurized well

Practice	Cost
Install Solar Pump	
Dig trench for pipe	
Install piping (50m)	
Engineering costs	

Long term Costs
Solar pump maintenance
Pipe maintenance

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Lakebed Construction

Practice	Cost
Engineering	
Permitting	
Labor	
Machinery Cost	

Walking Trail Construction

Practice	Cost
Engineering and Planning	
Permitting	
Insurance	
Signage	
Trail Construction	
Long term Costs	
Sign maintenance	
Trail maintenance	

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