

# HF and VHF Communications at Hell Hole Reservoir

## Summary

HF and VHF communications were tested on March 6, 2014, at Hell Hole Reservoir to identify amateur radio frequency bands suitable for redundant emergency communications for the Placer County Water Agency ("PCWA"). Daytime communications tests were successful using the 40-meter HF band but not on the 20-meter band. Several amateur radio 2-meter VHF repeaters were identified that reach the Hell Hole Reservoir. Initial recommendations are made for amateur radio equipment for a grant application by the PCWA to Homeland Security.

## Introduction

Placer County Water Agency is responsible for water and power resources at several locations. The 2014 King Fire reached the Hell Hole Reservoir which is in Placer County where PCWA operates a major power station (figure 1). There is a helipad and a dormitory at the top of the dam (Figure 2a, 3a). Water from the French Meadows Reservoir, which is located in Placer County at a higher elevation North-West of Hell Hole Reservoir, goes through the French Meadows Power House located on the North-West shore of the Hell Hole Reservoir. Downstream are the Middle Fork Power House, the Ralston Power House and the Oxbow Power House (figure 1). These later three locations are all in deep canyons near rivers. There are 60kV/230kV power lines are routed from Hell Hole along the Ralston Ridge to Foresthill and Georgetown.

PCWA's main concern is the wide area of service that includes canals that run the length of the county and the power houses. PCWA has a few satellite phones but they are only as good as calls that can be routed in from Texas to CA. Peter Cheney, Risk and Safety Manager for PCWA, was asked to come up with a redundant communication plan in the event of a service problem. He is exploring the ability to respond to service problems during communication difficulties by consulting with the Placer County Amateur Radio Emergency Service ("PC-ARES"). A joint exercise with ARES is also under consideration. Initial conversations started with Young ("Rod") Rodrigues, Placer County OES, and with Chuck Minton, then the Emergency Coordinator (EC) for PC-ARES. An initial meeting was held at the PCWA office in Auburn with Pete Cheney, Chuck (KG6FFK), Marty (W6TOC) and John (NT6ET). At about the same time a grant from Homeland Security was announced that could accept proposals for 2015 projects for the Sacramento region. Randy Cox, a PCWA Water Management Specialist, will participate in the preparation of a PCWA grant proposal.

A PC-ARES test team was assembled consisting of the following four ARES radio operators:

Fred Carey (KF7QVB), EC for PC-ARES, test team leader  
Marty Machado (W6TOC), Assistant EC  
John Hestenes (NT6ET), Assistant EC  
Jef Albright (N5JEF), ARES member communicating from Auburn, CA

## **Methods**

The HF frequency chosen in advance for the test was 7214kHz, one of the standard HF frequencies used by the PC-ARES group. The W6SAR 2-meter repeater at Foresthill was chosen as the initial VHF repeater to test. While it was known that several 2-meter repeaters could be reached at the Hell Hole Reservoir the relative signal strengths were not known. The test effort was to identify and make a list of as many viable repeaters as possible and to determine their strength and quality.

In preparation before the tests the area was explored using Google Earth Pro (GEP) to develop a 3D appreciation of the terrain. In addition to 3D “flying” through the terrain the GEP software has a “Viewscape” function that reveals line-of-sight access up to about six miles. However, the radio horizon goes beyond the visual horizon and must be tested directly by radio methods.

First contact with Jef (N5JEF) in Auburn was done on an “every 15-minute” schedule starting at 12:15 on the 7214 kHz HF frequency at a stop along the road a few miles from Foresthill (Figure 4). This position was deep in the valley near the river and the HF connection was found to be good (i.e., “full quieting”). The W6SAR VHF contact was then confirmed by Marty W6TOC (Figure 5) and John NT6ET. Both 5-Watt HTs (hand held radios) and 100W mobile 2-meter radios performed well at this location. These two frequencies for HF and VHF were used as base frequencies for the rest of the test. The team then drove the rest of the way to the Hell Hole Reservoir and parked on the helipad (Figure 2a,b) near the dormitory (figure 3a). The Hell Hole boat launch ramp is nearby (Figure 3b).

The HF antenna, mounted on Fred Carey’s truck, was set up for NVIS (“Near Vertical Incident Skywave”) propagation where the radio signals bounce off the ionosphere and can reach distances between 30 and 400 miles over high terrain. An approximately 65 foot antenna wire extension was clipped on to the base of the vertical antenna and was stretched out between 2 and 6 feet off the ground (Figure 6). The radio was a Yaesu FT-857. A good quality tuner enables this radio to work the 80m through 6m amateur radio bands with good performance. This radio also works on the 2-meter and 70-cm bands. A separate TYT-brand radio was available for the 220 band.

## **Results**

The base VHF and 40-meter HF frequencies were first found to reach the Hell Hole helipad. An attempt using the 20-meter HF band was unsuccessful from this location (Figure 7). The following VHF repeaters were identified as strong candidates for future consideration, listed in roughly the order of strength of signal:

### **Strongest signals (all with “full quieting”):**

- (1) 147.195 (+) PL 123.0, N6ICW, a widely linked system, strongest.
- (2) 146.625 (-) PL 123.0, WB4YJT, Georgetown
- (3) 146.745 (-) PL 156.7, W6SAR, Foresthill

**Slightly weaker signals, but very usable:**

- (4) 146.640 (-) PL 156.7, W6SAR, Roseville (used often by PC-ARES)
- (5) 145.340 (-) PL 162.2, W6EK, Auburn (home repeater for PC-ARES)
- (6) 146.805 (-) PL 123.0, KA6GWY, Placerville (50W or more required)

**Usable signals:**

- (7) 147.240 (+) PL 123.0, NR7A, South Lake Tahoe
- (8) 145.310 (-) PL 151.4, KG6TZY, Nevada City/Grass Valley, a linked system

It was decided that these VHF repeaters were sufficient for the purposes of supporting PCWA when they are operational. In the case where they are not operational, or at locations where they could not be reached, then HF NVIS communications would be used on 40-meters during the day and on 80-meters at night. Other 2-meter repeaters may also be accessible but an exhaustive search was not done. Simplex VHF operations were not tested. Also not tested were the 220 MHz repeaters, UHF repeaters, packet digi-peaters and frequencies in the 50 MHz band.

The Yaesu FT-857 HF radio used was good at 80 W with full quieting with the strongest stations. A 5-watt HT hand-held radio signal received at Auburn through the Foresthill W6SAR repeater was down to 50% or less and was marginal (Figure 8).

Snow was encountered on the road (Figure 9) between Hell Hole Reservoir and the French Meadows Reservoir (Figure 10). There is an area for a helipad at this reservoir (Figure 11). The Mosquito Road to Foresthill was deep in snow so the team returned to Foresthill by way of the Hell Hole road.

**Discussion**

Eight 2-meter amateur band repeaters were identified that can be reached from the Hell Hole helipad location. These are of sufficient number and quality to make amateur radio feasible as an auxiliary capability for redundant communications for the PCWA. Several repeaters are part of linked repeater systems.

In general, 100W mobile radios are needed on 2-meters for communications from the Hell Hole Reservoir to nearby 2-meter repeaters. The transmission from 5 Watt HT's is weaker and would be problematic during emergencies although reception on an HT at Hell Hole is adequate. On the other hand HTs might be useful in some cases for more local communications.

In the case of unexpected events where 2-meter repeaters are unavailable for communications the use of HF NVIS operations on 40-meters is viable and reliable during daytimes. At night, when the 40-meter band is unavailable, the 80-meter band would be used. The 20-meter band is unusable because of propagation characteristics that cause signals to skip past the desired reception location. HF communications on 40-meters are viable at the other power houses along the rivers but 2-meter communications is considered to be less viable or totally unavailable from those locations.

It is recommended that the PCWA consider installing up to three amateur radio stations :

- (1) A base station at the PCWA office in Auburn
- (2) A base station at the Hell Hole reservoir, possibly using the dormitory facilities.
- (3) A mobile station for itinerant use at several accessible positions, including along access roads and at other power houses.

Each station should have both HF and 2-meter radios and associated antennas. HF radios will be required for communications with the other power houses since they are in deep valleys at the rivers. The choice of particular hardware would be resolved by the time a proposal is submitted for the April Homeland Security grant application deadline.

It is also recommended that 3 or 4 of the PCWA personnel be identified who would be trained for a FCC Amateur Radio Technician or General license. A General license is required to operate on HF bands. The Technician license is sufficient for 2-meter operations. The PC-ARES group can provide training and can arrange for exams with FCC-qualified examiners.

PC-ARES personnel can also be made available to operate amateur radios at PCWA facilities during real emergencies. It is particularly useful for rapid deployment to have the antenna systems permanently pre-established and tested along with the associated radios. PC-ARES personnel can also bring their own radios and antennas, if needed, but rapid deployment and the start of operations is faster if the antenna systems are already in place.

It is recommended that joint exercises be considered with PC-ARES and PCWA to explore and establish baseline expectations, capabilities and training. These exercises could be scheduled for almost any time frame and are independent of the Homeland Security grant process.

One person at PCWA should be identified as the primary contact for PC-ARES and as the lead person responsible on any proposal for funds to PCWA coming through the Homeland Security grant process. PC-ARES personal will be available for proposal writing.

## **Conclusions**

HF and 2-meter communications using amateur radio between PCWA power houses at Hell Hole Reservoir, other power houses, and the PCWA office in Auburn is viable for redundant radio communications. Three amateur radio systems have been recommended for consideration for a more permanent capability for on-going use and for rapid deployment during emergencies. Joint exercises of PCWA with PC-ARES are recommended.

Figures

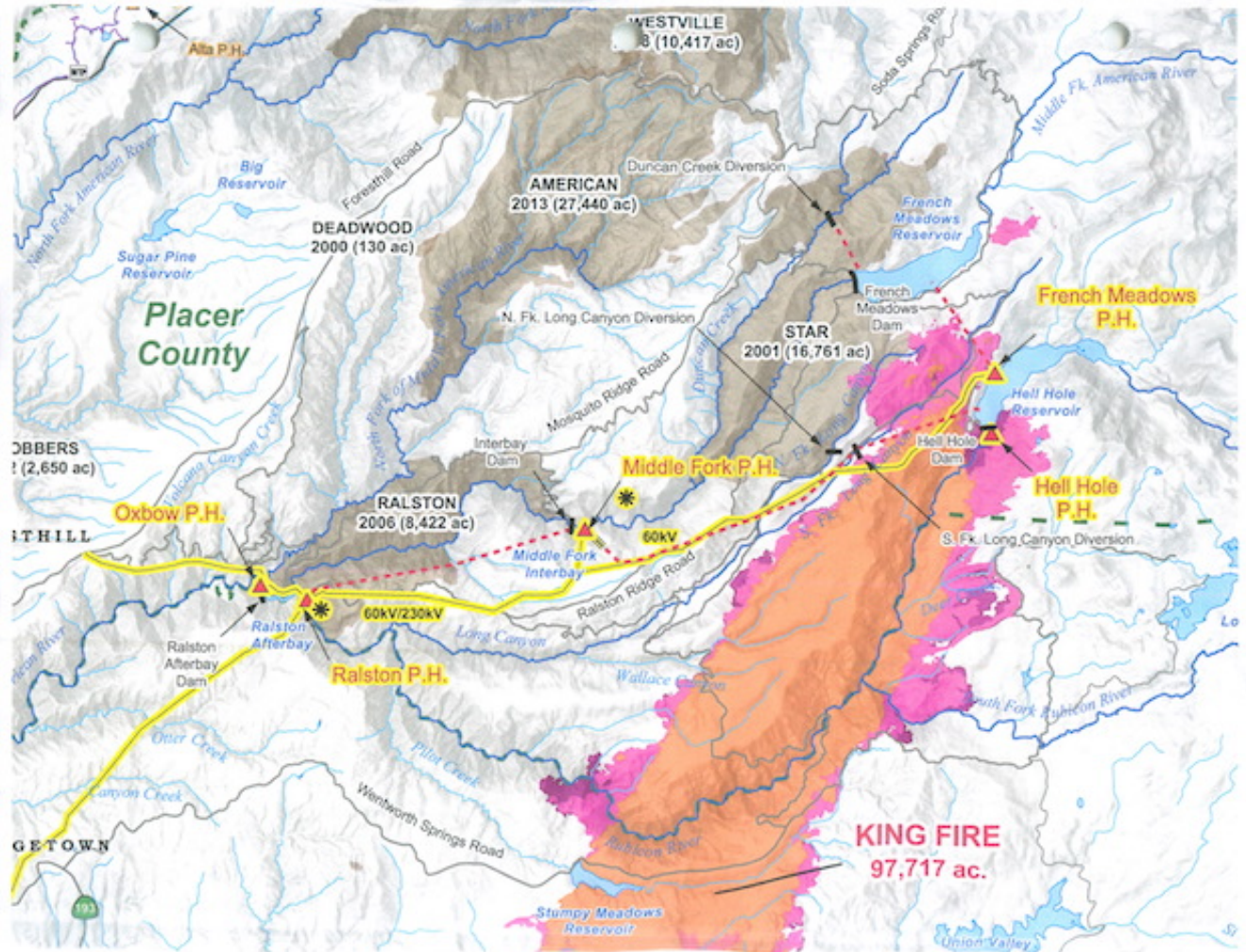


Figure 1. Map of Hell Hole Area and PCWA facilities after the 2014 King Fire.



Figure 2. At Hell Hole Helipad. (a) Dormitory in background. (b) Looking South.

*HF and VHF at Hell Hole Reservoir*



**Figure 3. (a) Dormitory at Hell Hole.**



**(b) Hell Hole Reservoir near boat launch ramp.**



**Figure 4. Fred KF7QVB. First HF contact.**



**Figure 5. Marty W6TOC. First VHF contact.**



**Figure 6. HF Antenna 65' extension.**



**Figure 7. Fred KF7QVB testing HF to Auburn, CA.**



**Figure 8. John NT6ET. HT on VHF.**

**Figure 9. Road snow between Hell Hole and French Meadows**



**Figure 10. French Meadows Reservoir**

**Figure 11. French Meadows Helipad**