EOC Improved Roof Top Off Center Fed Dipole
June 1 2019 Data Capture

Version 1.0
June 4 2019
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Comments? Give me a ring!

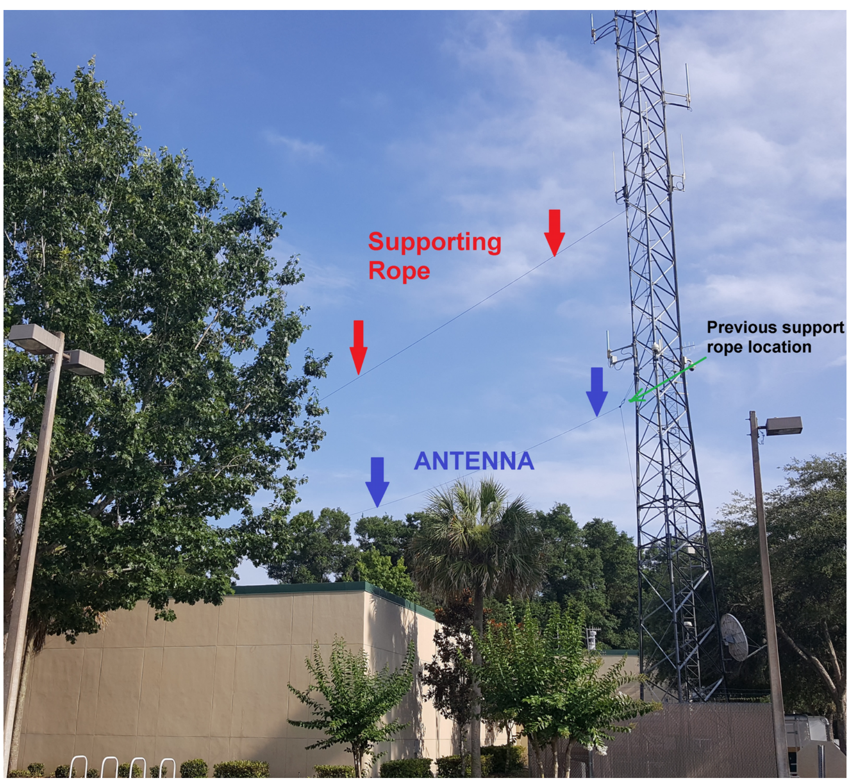
SUMMARY

A private company raised the off center fed Buckmaster dipole considerably higher off the EOC roof, by raising the attachments of the ropes to the Tower and adding a 2nd pulley.

These measurements were made to see what improvement was made to the function of the antenna as a result.

The results suggest that the antenna **now offers reasonable performance on at least one additional band (40 meters), which is of considerable importance for emergency backup communications, and likely on 30 meters as well as several SHARES frequencies.**

The digital end of 80 meters remains a problem, with several possible mitigations, and two simple experiments proposed to test them.



SWR Improvement

SWR measurements are a time-tested method of analyzing the appropriateness of the load an antenna offers to a transmitter. They can be made at a distance from the antenna, through transmission line with modest inaccuracy, while impedance measurements are significantly affected by transmission line length.

As before, measurements were made every MHz using a MFJ antenna analyzer. The reason for doing every MHz is that SHARES uses many different frequencies, not just the ham bands and we would like this antenna to be usable for SHARES state & federal communications. Generally, an SWR below 10:1 can be matched by an external tuner (though the losses in the coax may be significant) while an SWR below 3:1 can usually be matched by an internal tuner (or is of no consequence to an older, vacuum tube EMP-proof transmitter).

The off-center-fed Buckmaster design is not expected to have a good SWR for the 30 meter, 10 MHz band, due to the design.

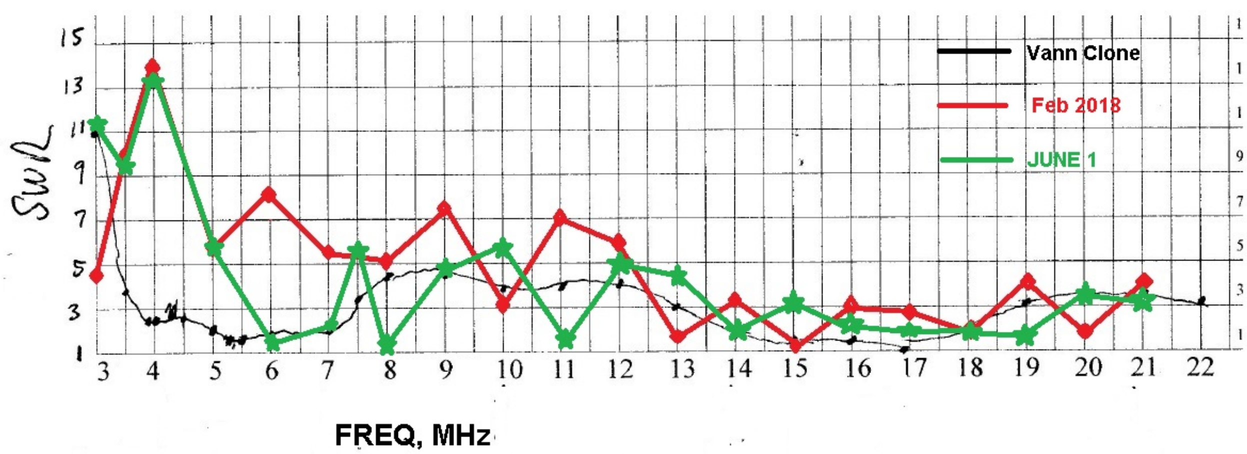


Figure 1: SWR plots from
(black line) Buckmaster clone built by Vann Chesney, hung from oak tree;
(red) EOC commercial Buckmaster in 2018, and
(green) measurements of the EOC commercial buckmaster after the antenna was raised off the roof and placed into inverted vee format.

The measurements every MHz show significant improvement in SWR above 5 MHz, with no significant improvement below 5 MHz.

Ryan Lee made **more sophisticated measurements** of the major amateur bands, with a more sophisticated measurement device which are incorporated here below;

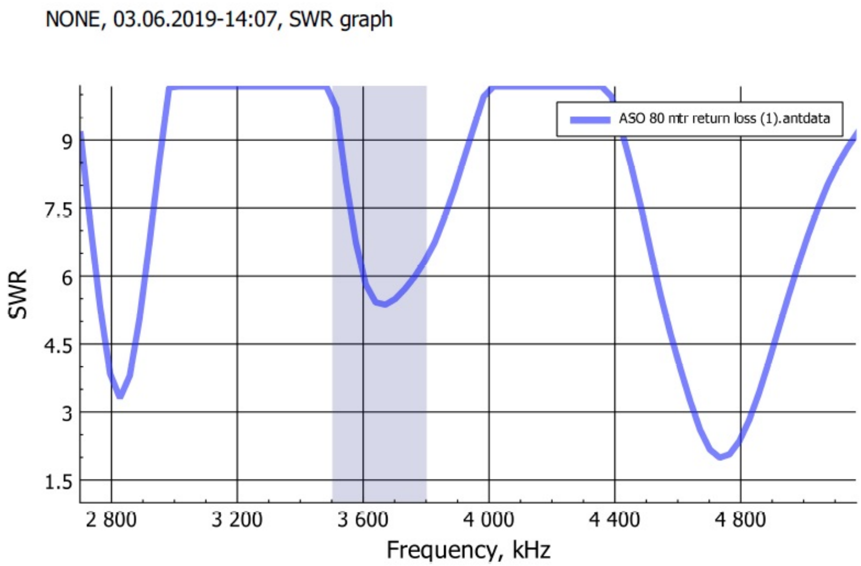


Fig 2: Ryan's 80 meter SWR measurements (requires a tuner)

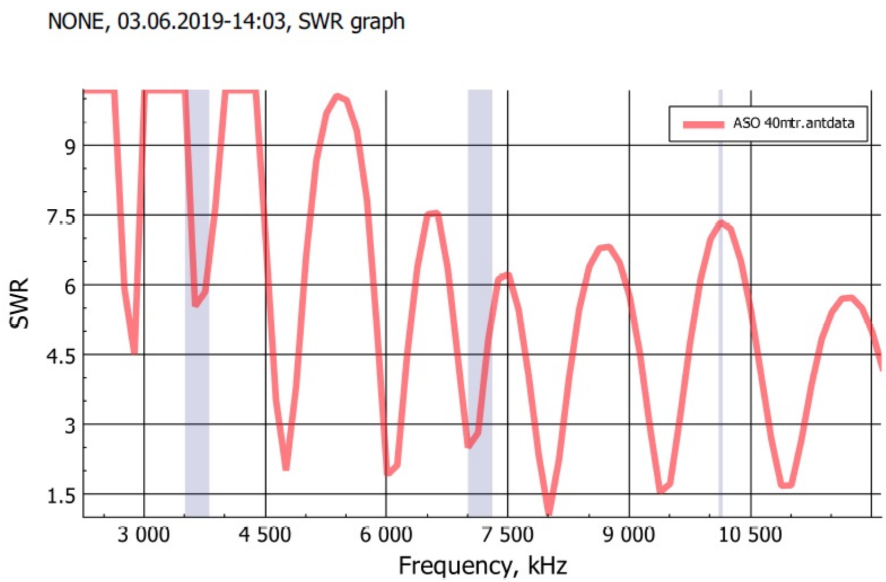


Figure 3: Ryan's measurements from 3 MHz through 11 MHz – note very useful SWR in the 40 meter band, and as expected, a higher SWR in the 30 meter band (10.1 MHz).

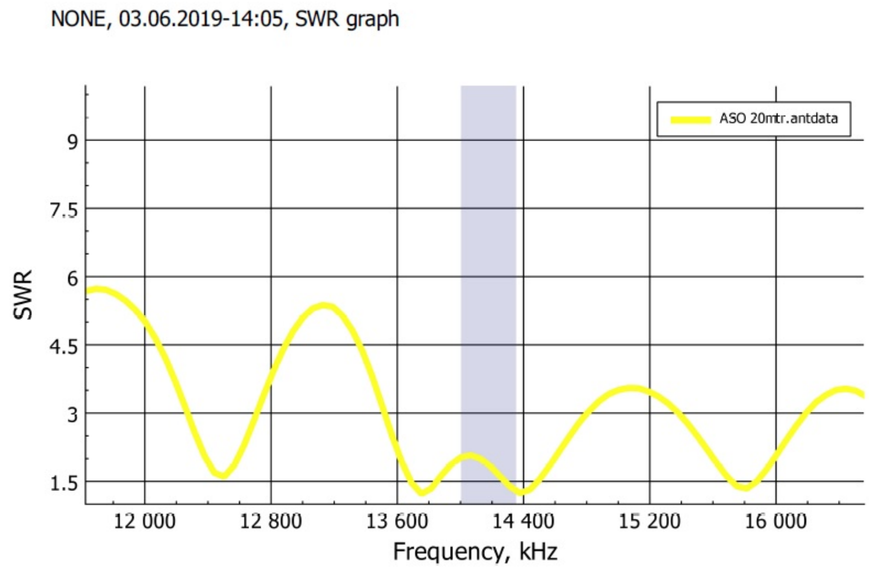


Figure 4. Ryan's measurements for the 20 meter (distance) ham band – **very good SWR**, possibly due to the fact the antenna now is a significant fraction of a wavelength above the roof.

SWR Conclusions: The Antenna now has quite workable SWR's above 5 MHz and with the EOC's antenna tuner, is usable on almost all ham and SHARES frequencies from a load-match standpoint. As a transmitting antenna, it should be quite functional on all bands.

Background Noise Improvement

Background noise measurements primarily measure the potential for the antenna to function well as a RECEIVING antenna.   High background noise will drown out distant signals.

Matching the previous measurement technique exactly, except for this time capturing average (ten samples), incoming signals from the raised antenna were captured on the same spectrum analyzer instrument in two configurations:
Blue: via tuner, set for 40 meters (as in previous measurement)
Purple: Directly from antenna

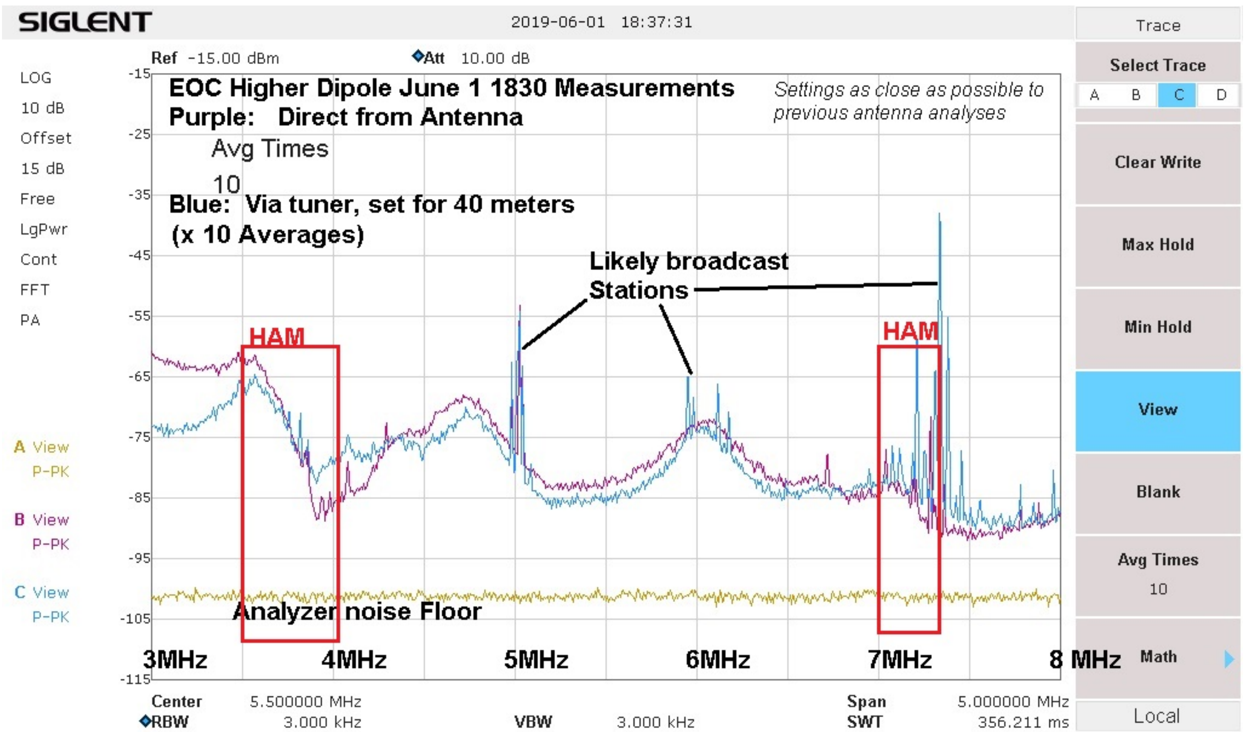


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Figure 5.   **Signals from the raised EOC antenna,** direct (purple) and through a tuner tuned for 40 meters (blue) on June 1 at 6:30 PM.   This time, there are observable signals!

Analysis: Noise in the 80 meter band is poor in the lower end, but improves significantly in the higher end. Exactly why, isn't immediately obvious.   **Noise in the 40 meter band is now similar to that observed in a residential antenna**.   The 60 meter band now appears usable also.   Noise is still high in several lower-frequency SHARES ranges, but probably workable in higher frequency ranges.

Residential antenna comparison measurement

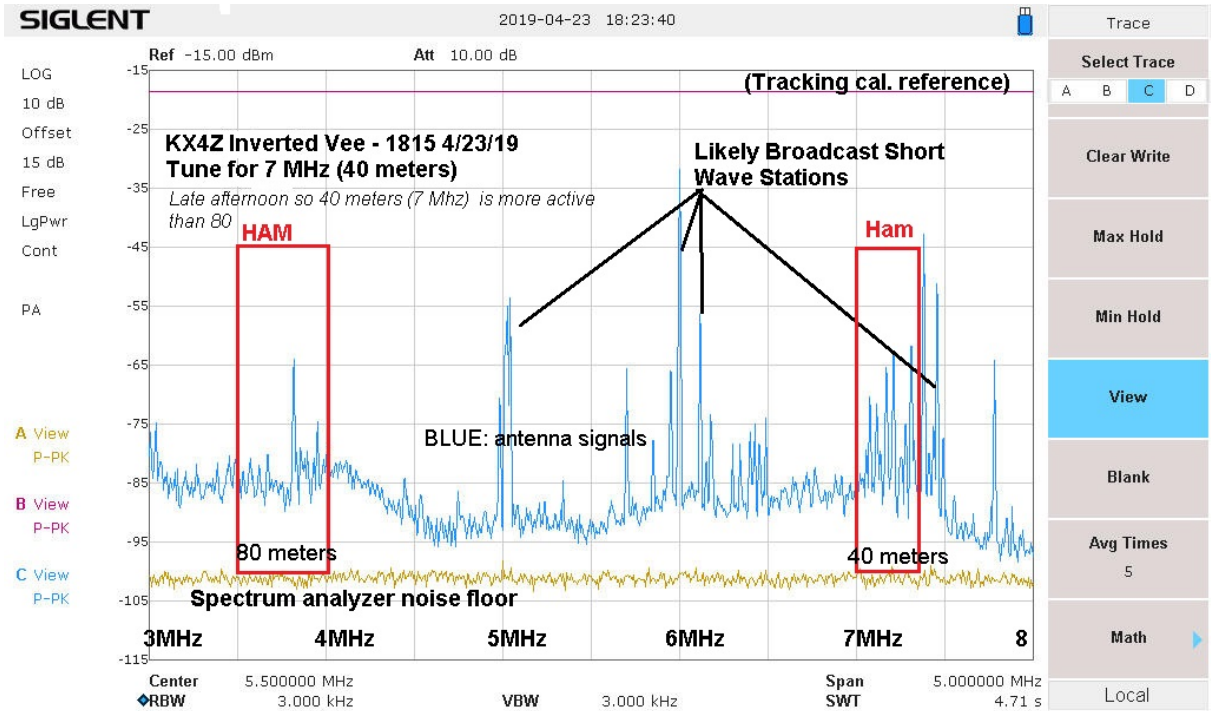

Figure 6: Comparison signals received by a residential antenna also tuned for 40 meters. Vast numbers of signals are seen, both in amateur bands and broadcast regions. Noise in the 80 and 40 meter amateur bands is approximately -85 dBm.

PAST MEASUREMENT with EOC antenna when lower to the roof:

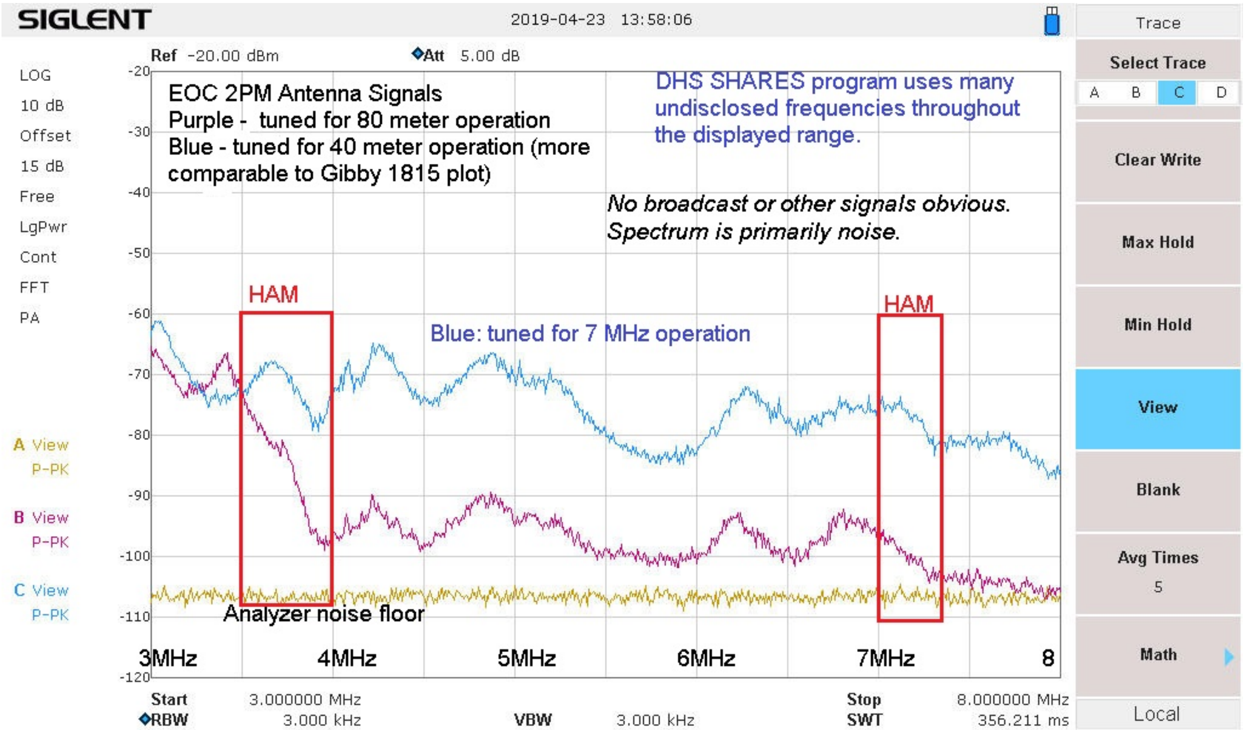

Figure 7: Signals received by EOC antenna **prior to raising it further off the roof.** Extensive NOISE, no obvious intelligent signals. Noise in the 80 meter amateur band is in the -70 dB range, and in the 40 meter ham band, in the -75 dB range (when antenna is tuned for 40 meter operation)

It's pretty obvious that there has been considerable improvement in the EOC antenna by raising it off the roof!

Functional Assessment: Ryan Lee was also **able to capture National Weather Service (WEFAX) digital weather broadcasts using the antenna, from the New Orleans station:**

New Orleans (NMG) 4317.9, 8503.9, 12789.9, 17146.4(1200-2045z) kHz
(see: https://www.nws.noaa.gov/os/marine/radiofax.htm)

However, Station NMG operates with **4 kW of radiated power.**[1] This is 16 dB stronger than most digital amateur radio stations (which are typically 100 W due to the difficulties of making a linear

1 https://en.wikipedia.org/wiki/NMG_(radio_station)

amplifier transition quickly enough from receive to transmit) and thus it overcomes a good bit more of the noise in the lower frequencies on this antenna.

TENTATIVE CONCLUSION

1. The EOC antenna now seems to have reasonable performance (both transmitting and receiving) for frequencies above 5 MHz. This should allow good connections for backup emergency communications during the daytime.
2. Performance in the digital (lower) end of the 80 meter band is still poor due to external noise pickup. This will primarily impact in-state digital, night-time connections.
3. It is possible that performance in the voice (higher) end of the 80 meter band is usable, which is probably due to the characteristics of the external noise combined with the near-field effects and the specific physical distance of the antenna above the roof. This may make connection to the North Florida ARES emergency net (3.950 MHz LSB) possible.

Band (Frequency range)	Nighttime Emergency Usage and Likelihood of Success	Daytime Emergency Usage and Likelihood of Success
80 meter low end	Digital connections inside the state at night	(generally unusable due to d-layer ionospheric sun-induced absorption)
80 meter high end	Voice connections inside the state at night	Voice connections inside the state in early morning and dusk
30 meter digital	(not yet tested)	(not yet tested)
40 meter band	Digital and voice connections in the eastern USA at night	Digital and voice connections in the regional Southeast during the day
20 meter band	West Coast digital and voice communications beginning of the night	> 1000 mile communications digital and voice during the day.

FURTHER MITIGATION

80 Meter Low End Mitigation.
The low end of 80 meters is an important band at night-time during sunspot minimum years (now). It allows regional digital connections to stations in Florida, Georgia and Alabama. Those

communications are difficult to impossible in the 40 meter band due to the ***critical frequency*** phenomenon of the ionosphere during night-time loss of solar radiation.   The observed noise level in the 3.5-3.6 MHz digital end of the band is still quite severe (-62 dBm, 20 dB stronger than expected), such that an incoming signal is reduced to 1/100th to readability that a typical residential station has.

Possible mitigations include:

1. SHARES frequencies that are slightly above the 4 MHz frequency will experience lower noise interference and may suffice (if the station acquires a PACTOR modem, the only protocol allowed in the SHARES system)

2. National Guard – may have access to frequencies in the 4-5 MHz range that may function.

3. Utilize very low-throughput, low bandwidth solutions for very terse messages (< 100 characters) such as JS8Call or PSK31.

4. Add an additional antenna further back on the EOC property, farther away from the building, in the Oak trees or near other non-radio facilities on the complex, where previous measurements suggest the noise level may be significantly less.

Suggested ARES Experiments:

1. Attempt SHARES connection to the State EOC during dusk, evening and dawn using SHARES frequencies, with a loaned PACTOR modem or system. Expected time required: a few hours of access.

2. Using a slingshot, pull up a test antenna among the oak trees south of the EOC building on the EOC property, just inside the fence. (Such antennas were actually installed temporarily as a Saturday exercise a year or more ago, but sophisticated measurements were not possible them). Measure the noise background on the test antenna.   Expected time required: 2 hours.