BEFORE THE HEARINGS EXAMINER
FOR THURSTON COUNTY

In the Matter of the Appeal of Chris Nubbe and Alison Baker
On behalf of Deschutes Neighborhood Group, Re: Verizon's August 7, 2018 Applicant's Response to Appellant's Dispositive Motion

No. APPL 18-106835 VE

Declaration of: Albert M. Manville, II, Ph.D., C.W.B. (to be Submitted by Appellant)

I, Albert M. Manville, II, Ph.D., C.W.B., declare as follows:

1. I make this declaration based on my personal knowledge, academic and field training, and professional experience as the former U.S. Fish and Wildlife Service (USFWS or Service) national agency lead on effects to protected migratory birds from human built structures, equipment and radiation. I am over the age of 18 and competent to testify to the matters herein.
2. I am the principal of Wildlife and Habitat Conservation Solutions, LLC, located in Falls Church, Virginia. I have been contracted by the Deschutes Neighborhood Group to analyze and assess likely impacts to migratory birds and other wildlife from the proposed siting of a Verizon Wireless (VW) cellular (cell) Wireless Communications Facility (WCF) near Yelm, Washington.
3. I am employed part-time as an Adjunct Professor for the Krieger School of Arts and Sciences, Advanced Academic Programs, Johns Hopkins University, Washington, DC campus. I retired from the Division of Migratory Bird Management, USFWS, in late June 2014, after working for USFWS for 17 years on avian-structural issues.
4. I submit the following testimony for the record.

I declare under penalty of perjury under the laws of the State of Washington that the foregoing is true and correct.

DATED: 13th of August of 2018, Falls Church, VA

Albert M. Manville, II, Ph.D., C.W.B.

8/13/2018

Testimony of Albert M. Manville, II, Ph.D., C.W.B., and Principal, Wildlife and Habitat Conservation Solutions, LLC, in regard to Applicant's Response to Appellant's Dispositive Motion (August 7, 2018) filed with the Hearings Examiner, Thurston County, for Thurston County Project 2015103966, Re: a Verizon Wireless Cellular (cell) Tower Wireless Communications Facility (WCF) at 16244 Vail Road SE, Yelm, WA 98597. Comments Submitted on Behalf of the Deschutes Neighborhood Group for the record.

Date: August 13, 2018

ISSUES REFUTED BY VERIZON WHICH NEED TO BE CLARIFIED OR CORRECTED FOR THE RECORD

Building Communication Towers Next or Adjacent to Wetlands

Avoiding Risk

Dr. Paul Kerlinger, Verizon's avian risk consultant, continues to dispute the considerable scientific evidence that supports increased risk from placing communication towers next to or adjacent to wetlands. Specifically, *"Applicant will present expert scientific evidence by Paul Kerlinger, Ph.D., based on the bird studies undertaken by the Applicant and Appellant, demonstrating that there will be no significant impacts to any such birds or interference with migratory flyways documented by state or federal agencies. See Attachment 3 (Avian Risk Assessment for the Verizon Wireless Vail Road Wireless Communications Facility, by Dr. Kerlinger, April 13, 2018)."* (Applicant's Response to Appellant's Dispositive Motion, August 7, 2018).

Quite to the contrary, there is substantial and highly credible scientific evidence of risk from human-built structures (e.g., communication towers, power lines, buildings, bridges and other structures) based on decades of research on many species of migratory birds in and around wetlands where many species tend to concentrate (i.e., to breed, nest, fledge, roost, feed, defend territories, stage and migrate). This risk (called a "taking" — i.e., the unpermitted injury, crippling loss and/or death of a protected migratory bird) results from the placement, operation and maintenance of a communication tower, including this proposed tower at 16244 Vail Road SE, Yelm.

On September 14, 2000, USFWS Director Jamie Clark sent a memo to all Service Regional Directors regarding Service Guidance on Siting, Construction Operation and Decommissioning of Communication Towers which Robert Willis and I co-authored for the Service earlier that year. In her memo, she stated that "*... all Service personnel involved in the review of proposed tower sitings and/or evaluation of impacts of towers on migratory birds should use the attached interim guidelines when making recommendations to all companies, license applicants, or licensees proposing new tower sitings. These guidelines were developed by Service personnel from research conducted in several eastern, midwestern and southern States, and have been refined through Regional review. They are based on the best information available at this time, and are the most prudent and effective measures for avoiding bird strikes at towers. We believe they will provide significant protection for migratory birds*" (p. 2 of Director Clark's memo; emphasis added).

Specifically on p. 4 of Director Clark's memo, in Service guideline #4, it was stated that, *"towers should* ***not*** *be sited in or near wetlands, other known bird concentration areas (e.g., State or Federal refuges, staging areas, rookeries), in known migratory or daily movement flyways, or in habitat of threatened or endangered species. Towers should* ***not*** *be cited in areas with a high incidence of fog, mist, and low ceilings"* (Attachment p. 4 of the Director's memo). In Service guideline #8 the following was recommended: *"If significant numbers of breeding, feeding, or roosting birds are known to habitually use the proposed tower construction site, relocation to an alternate site should be recommended"* (Attachment p. 5 of the Director's memo). To suggest as Dr. Kerlinger does that there will be "*no significant impacts to*

any such birds or interference with migratory flyways documented by state or federal agencies" is preposterous. By implementing these specific guidelines, USFWS believed their use would be key to avoiding or minimizing risk — steps necessary to avoid or minimize "take." As I stated in previous comments rebutting Dr. Kerlinger's risk assessment findings sent to Tony Kantas on May 17, 2018, a **"significant impact"** was agreed to and defined both by independent scientific experts serving on the Communication Tower Working Group which I chaired and by experts within the USFWS's Division of Migratory Bird Management which I represented as **"at least 3 bird deaths/tower/year"** (Manville testimony to Tony Kantas, Thurston County, May 17, 2018:4). Admittedly, this is a small number of annual bird deaths; the concerns, however, are over cumulative (nationwide) impacts resulting in an estimated 7+ million bird deaths/yr. in the U.S.

Revised 2013 USFWS Guidelines.

In 2013, on behalf of the Service, I updated the 2000 interim communication tower guidelines (Manville 2013) to include several additional recommendations based on previous more recent scientific findings on tower lighting (not applicable to the proposed Yelm Road tower), refined suggestions involving avoiding wetlands, buffers for Bald Eagles and other raptors, suggestions for specific types of security lighting, and consultation with members of the Research Subcommittee, Communication Tower Working Group. Most notable are three 2013 guidelines directly applicable to the proposed Vail Road tower. These include:

1. Guideline 4: *"The topography of the proposed tower site and surrounding habitat should be clearly noted, especially in regard to surrounding hills, mountains, mountain passes, ridge lines, rivers, lakes, wetlands, and other habitat types used by raptors, Birds of Conservation Concern, and state and federally listed species, and other birds of concern."*
2. Guideline 5: *"Towers should not be sited in or near wetlands, other known bird concentration areas (e.g., state or federal refuges, staging areas, rookeries, and Important Bird Areas), in known migratory, daily movement flyways, areas of breeding concentration, in habitat of threatened or endangered species, or key habitats of Birds of Conservation Concern (USFWS 2008). Disturbance can result in effects to bird populations which may cumulatively affect their survival. The Service has recommended some disturbance-free buffers, e.g., 0.5 mi around raptor nests during the nesting season, and 1-mi disturbance free buffers for Ferruginous Hawks and Bald Eagles during nesting season* [sic: based on studies] *in Wyoming (FWS WY Ecological Services Field Office, referenced in Manville 2007:23)."*
3. Guideline 9: *"If, prior to tower design, siting and construction, if it has been determined that a significant number of breeding, feeding and roosting birds, especially Birds of Conservation Concern (USFWS 2008), state or federally-listed bird species, and eagles are known to habitually use the proposed tower construction area, relocation to an alternate site is highly recommended."*

Current April 2018 USFWS Tower Guidelines.

The Service just updated the guidelines published in 2013 (Manville 2013) with new recommended best practices for communication towers (USFWS 2018). These include **virtually all** the recommendations published in 2013. Additionally, there is a new section on vegetation management, some new links to online tools for determining bird breeding seasons and professional contacts, and recent FCC and Federal Aviation Administration lighting changes. These guidelines are intended *"to replace all previous recommendations for communication tower construction and operation ... modified and updated from previous versions to incorporate the state of the science..."* (USFWS 2018:1).

Most notable are recommendations for applicants to *"contact the nearest FWS field office; towers should not be sited in or near wetlands, other known bird concentration areas (e.g., state or federal refuges, staging areas, rookeries, and Important Bird Areas; ... towers should avoid wetlands or other known bird concentration areas; ... establish a buffer zone around the nest and no activities will occur within that zone until nestlings have fledged ... (0.5 — 1 mile for hawks and eagles). The buffer should be a distance that does not elicit a flight response by the adult birds and can be 0.5 — 1 mile for hawks and eagles."*

The Service did recommend *"no activities within that* [buffer] *zone until nestlings have fledged"* which would effectively preclude construction, maintenance, and daily operation of the tower until Bald Eagles and other raptors have fledged their young. Bald Eagle nests are "active" (meaning territorial defense, stick placement and nest repair, egg laying, incubation, nestling feeding, and caring for young until chicks are fledged and actually leave the nest — a period that can run from winter into mid-summer depending on nest success, chick loss, and other variables).

Take Homes and Service 2007 Comments to FCC on Effects of Communication Towers to Migratory Birds

Virtually all the aforementioned conditions spelled out in USFWS guidelines in 2000, 2013 and 2018 regarding wetland risk and disturbance apply to the proposed Vail Road tower site. Clearly the Service has recognized for decades that structural risk to birds in or near wetlands is important and should be avoided by not building there and by selecting degraded, more developed areas (e.g., antenna farms, industrial parks, and other degraded areas of low risk to birds — referenced in all 3 sets of guidelines).

In official agency comments I authored submitted to the FCC by USFWS Acting Deputy Director Kenneth Stansell to Louis Peraertz, Esq. of the FCC's Wireless Telecommunications Bureau on February 2, 2007 (Manville 2007: 32 pages), the Service suggested that the FCC adopt our 2000 guidelines as part of an *"environmentally preferred industry standard"* (Manville 2007:25) which FCC did subsequently implement. FCC also used the 2013 guidelines as the "*preferred industry standard*."

Further, in USFWS comments to FCC, it was suggested that *"We recommend that FCC implement the Service's 2000 voluntary communication tower guidelines into rulemaking. The FCC would be responsible for informing license permit applicants of the guidelines, overseeing implementation of the guidelines, and would not depend on applicants independently contacting the Service for recommendations"* (Manville 2007:26). While FCC did not then nor have they now implemented Service guidelines into rulemaking, FCC strongly encouraged applicants and tower companies to use them, and FCC staff continue to work with Service representatives and tower developers to implement USFWS guidelines as seamlessly as possible today. It remains unclear why Dr. Kerlinger continues to dispute these risk findings and question the agency determinations and actions based on the best scientific evidence available.

Smith Ranch Wetlands Restoration Project

A significant, $1.6 million wetland restoration mitigation effort by the cities of Olympia, Lacey and Yelm was required in the last several years by the State in exchange for the water rights in and surrounding these wetlands. After completion, the floodplain area will essentially become a new, publicly owned wildlife refuge.

It is exciting to note that the Smith Ranch Wetlands Restoration Project continues to be developed and the new wetlands — adjacent to the proposed Verizon cell tower site — are being colonized in astonishingly quick ways by migratory birds and other wildlife. As recently as July 28, 2018, local landowner Alex Foster photo-documented the presence of Great Blue Herons, Gadwalls, Virginia Rails, and several species of upland songbirds using the site as the wetlands are filling. He intends to submit these photos for the hearing record. It is clear these new wetlands are providing important territorial, feeding, nesting, roosting and staging habitats for a growing list of migratory birds. However, increased bird presence will only elevate the risk of collisions with the proposed Verizon cell tower if it is built. It is also important to note that at the emergent wetland marsh around Lake Lawrence, the 2 other adjacent wetlands, and the surrounding woodland habitats, that at least one nesting pair of Bald Eagles (a species of State concern), Vaux's Swift (species of State concern, especially its nesting forested habitat), and a host of other migratory birds are present in and around this wetland area. The proposed Verizon communication tower 156-ft tall will extend ~ 54 ft above the forest canopy. This will only exacerbate collision risk, especially when fog, rain, winds and other inclement weather events impact birds flying at dawn, dusk, migrating at night,

and unable to effectively navigate in poor visibility during the daytime — conditions which frequently occur in and around the emergent wetlands. Additionally, the checkerspot butterfly (Federally Endangered), the Oregon spotted frog (Federally Threatened), and the Puget Oregonian snail (Federally proposed) may be present in the wetlands areas, further elevating construction and operation risks. Verizon has clearly failed to investigate let alone evaluate these growing risks.

Impacts of Non-thermal, Non-ionizing Radiation from Cell Towers on Migratory Birds

Applicant's attorney misrepresented the impacts of radiation on migratory birds by stating that the hearings examiner is preempted from considering issues regarding the "*environmental effects of RF emissions*" (Applicant's Aug. 7, 2018 Response:11), citing the FCC's regulation — based on Section 704 of the 1996 Telecommunications Act (TCA) — implying that these wildlife effects cannot be presented in testimony. While it is true that county, city and state governments have been constrained in some ways by Section 704 of the TCA regarding discussions about radiation effects on human health and safety, there is nothing in the Act or its implementing regulations that prohibit discussion of impacts from radiation on wildlife. In fact, no agency or commission (i.e. FCC) has yet developed any radiation standards for wildlife exposure, including the licensing and regulatory rules and procedures of the FCC. It is also important to note, however, that for human exposures to RF at towers, the FCC has operating rules available to the public. These rules require that power to cell and other broadcast towers must be turned off when workers are on and/or climbing the towers — due to health impacts and safety concerns from the impacts of thermal and non-thermal radiation.

USFWS in coordination with the U.S. Commerce Department's National Telecommunications and Information Administration (NTIA) began a process in 2014 with which I was involved to include impacts from radiation as part of NTIA's National Environmental Policy Act (NEPA) review process, but that effort has since stalled. As I have stated in earlier testimony to Thurston County, impacts from radiation on migratory birds and other wildlife must be evaluated as part of the NEPA review process for cumulative effects analysis. None to date have been performed by Verizon or its consultants. I believe Washington State has similar State NEPA requirements.

While there are many recent published, peer-reviewed studies about impacts from non-thermal radiation on laboratory animals and wildlife — with new findings being published each month — laboratory studies conducted by DiCarlo et al. (2002) are extremely telling. T. Litovitz (2000 pers. comm.) and DiCarlo et al. (2002) irradiated chicken embryos using the standard 915 MHz cell phone frequency at durations of several hours per day. Most striking, they showed that radiation from extremely low levels (0.0001 the level emitted by the average digital cell phone) caused heart attacks and deaths in some embryos while controls were unaffected (DiCarlo et al. 2002). Impacts were based on extremely low, non-thermal effects — now being documented to impact DNA single strands and helices (Manville 2016b). Results of the DiCarlo et al. (2002) study have been replicated by Grigor'ev (2003), Xenos and Magras (2003), and others.

It is important to note that the entire thermal model and all FCC categorical exclusions for all the devices we see today, rests on the incorrect assumption that low-level, non-ionizing non-thermal radiation cannot cause DNA breaks because is it *"so low power"* (B. Levitt and H. Lai, Comments Filed Jointly to FCC, ET Docket No. 13-84, 2013). The evidence to the contrary is clear and growing in laboratory animals and wildlife. The implications — including from this proposed Verizon tower — are very troubling.

While field studies on wildlife, including wild birds, have yet to be conducted in North America, considerable **field research** has been conducted in Europe. For example, in field studies on wild birds in Spain, Balmori (2005) found strong negative correlations between levels of tower-emitted microwave radiation and bird breeding, nesting, roosting and survival in the vicinity of electromagnetic fields. He documented nest and site abandonment, plumage deterioration, locomotion problems, and death in Wood Storks, House Sparrows, Rock Doves, Magpies, Collared Doves, and other species. While these species had his-

torically been documented to roost and nest in these areas, Balmori (2005) did not observe these symptoms prior to construction and operation of the cell phone towers. Results were most strongly negatively correlated to proximity to antennas and Stork recruitment and survival. Twelve nests (40% of his study sample) were located within 200 m of the antennas and never successfully raised any chicks, while only 1 (3.3%), located further than 300 m, never had chicks. Strange behaviors were observed at Stork nesting sites within 100 m of one or several cell tower antennas. Those birds that the main beam impacted directly (i.e., electric field intensity/EFI > 2 V/m) included young that died from unknown causes. Within 100 m, paired adults frequently fought over nest construction sticks and failed to advance the construction of the nests with sticks falling to the ground while nests were being constructed. Balmori (2005) reported that some nests were never completed and the Storks remained passively in front of cellsite antennas. The electric field intensity was higher on nests within 200 m (2.36 ± 0.82 V/m) than on nests further than 300 m (0.53 ± 0.82 V/m). However, the EMF levels, including for nests < 100 m from the antennas, were not intense enough to be classified as thermally active. Power densities need to be at least 10 mW/cm2 to produce tissue heating of even 0.5 C (Bernhardt 1992). These troubling findings raise similar potential concerns over impacts from the Verizon tower.

Balmori and Hallberg (2007) and Everaert and Bauwens (2007) found similar strong negative correlations among male House Sparrows and electromagnetic radiation in their studies. In another review, Balmori (2009) reported health effects to birds which were continuously irradiated. They suffered long-term effects including reduced territorial defense posturing, deterioration of bird health, problems with reproduction, and reduction of useful territories due to habitat deterioration. These same conditions will also be present at the Vail Road site, possibly producing the same effects (i.e., "takes").

There are other potential effects on birds which need to be evaluated before tower siting is permitted. Engels et al. (2014) investigated ***"electromagnetic noise"*** emitted everywhere humans use electronic devices including from cell phones and their towers. While prior to their study on European Robins, no *"noise effect"* had been widely accepted as scientifically proven, the authors in this double-blind experiment were able to show that migratory birds are unable to use their magnetic compass in the presence of urban electromagnetic noise. The magnetic compass is integral to bird movement and migration. Several other more recent scientific studies replicate Engels et al. (2014) findings. The findings clearly demonstrated a non-thermal effect on European Robins and clearly serves as a predictor for effects to other migratory birds including those in North America.

Birds may also be attracted to cell towers, compounding impacts of collisions and radiation. In a cutting-edge study, Beason and Semm (2002) demonstrated that microwave radiation used in cell phones produces non-thermal responses in several types of neurons of the nervous system of Zebra Finches. The brain neurons of anesthetized birds were tested with a 900 MHz carrier, modulated at 217 Hz. Stimulation resulted in changes in the amount of neural activity by more than half of the brain cells with most (76%) of the responding cells increasing their rates of firing by an average 3.5-fold as opposed to controls — a clearly definitive study showing non-thermal effects. The other responding cells exhibited a decrease in their rates of spontaneous activity suggesting potential effects to humans using hand-held cell phones affecting sleep (Borbely et al. 1999). The Beason and Semm (2002) theoretical model could also help explain why birds **may be attracted to cell towers**, an important theoretical premise that they previously hypothesized in regard to Bobolinks (Semm and Beason 1990).

Efficacy of Proposed Bird Hazing Structures on Top of the Monopole Cell Tower

Verizon and its consultants have been attempting to develop an Osprey bird-hazing and nest-deterrent device that would be placed atop the proposed 156-ft. monopole (a so-called "bird-be-gone" nest deterrent structure; Slide 25, Appellant's Dispositive Motion).

As the Service's lead representative serving on the Avian Power Line Interaction Committee (APLIC) for 17 years, as a co-author of the 2005 Service/APLIC Avian Protection Plan Guidelines, co-author of *Sug-*

gested Practices for Avian Protection on Power Lines: State of the Art in 2006 (Edison Electric Institute), co-author of *Reducing Avian Collisions with Power Lines: State of the Art in 2012* (EEI); and recipient of the 2016 Morley Nelson Conservation Service Award by APLIC for my work as a Federal wildlife biologist with the electric utility industry, I have a detailed understanding of which deterrent devices (including on structures other than power poles) work and which do not. These assessments are based on field evaluation, testing, monitoring, and collaboration with other agency and industry colleagues and private vendors.

Migratory birds — including Ospreys, Red-tailed Hawks, Bald Eagles and many songbird species — are very adaptable, and frequently use well-intentioned and well designed deterrent devices for purposes opposite those intended. Based on field evaluation and critique, the vast majority of nesting and perching deterrents do **not**, in fact, work as intended. APLIC presented many "short courses" on Avian Power Line Interactions — generally several each year to which I was invited to present. In our "short course" presentations (e.g., PowerPoint slides) and in its peer-reviewed publications, APLIC purposely included photographs of nest deterrents which completely failed. These, for example, included an Osprey nest on a power pole with plastic spikes (APLIC 2006, Fig. 6.27:128), a Red-tailed Hawk nest on a pole with triangle perch discouragers (APLIC 2006, Fig. 6.25:128), an Osprey nest on a pole with plastic owl intended to haze the birds (APLIC 2006, Fig. 6.26:128), and an Osprey nest on a dead end pole with nest discourager (APLIC 2006, Fig. 6.23:127), among numerous others. A copy of Figures 6.23, 6.25, 6.26 and 6.27 is included in the Appendix of this document.

Based on my professional expertise and opinion, the "bird-be-gone" Osprey nest deterrent will **not** preclude Osprey nesting (these birds are ingenious at making an inhospitable nest structure work for them). Further, even if the structure does deter Osprey, other birds may exploit the platform, possibly even Bald Eagles given their need to exploit the tallest structure in the surrounding wetland. It is highly likely that other raptors, songbirds and other avifauna would also exploit this deterrent for purposes of nesting. Both thermal and non-thermal radiation impacts could affect any nesting birds and their offspring, as well as entanglement problems, all resulting in "takings."

Conclusions and Recommendations

- While the proposed VW WCF is relatively short (156 ft AGL), unguided and unlit (at least on the tower), it will extend approximately 54 ft above the tree canopy, significantly elevating collision risk, especially during nighttime inclement weather events when birds are moving/migrating and during instances of daytime high fog episodes. Inclement weather is a significant issue at the site. Migratory birds have been documented killed by collisions with unlit monopole and lattice towers < 200 ft AGL, sometimes in significant numbers of hundreds of birds/cell tower/night (e.g., W. Evans cited in Manville 2007:7). These are facts documented in the literature, in official agency comments, and by leading scientific experts.

- Tall structures adjacent to and surrounding wetlands create high risk habitats for migratory birds. Asserting that they are not fails to be base findings on scientific fact and on decades of research and action by USFWS and other Federal and State agencies and NGOs to "avoid or minimize take."

- USFWS voluntary communication tower guidelines — including the most recent April 2018 version — have been ignored by Verizon.

- The Smith Ranch Wetlands Restoration Project is turning out to be an incredible success for waterbirds, waterfowl, wading birds, songbirds and others — and it is still being constructed. However, a VW cell tower will only exacerbate risk to these and other birds if allowed to be built adjacent to this new wetland.

- The effects of low level radiation are of growing concern and have not been addressed by Verizon or the County. The effects of radiation from field studies conducted on wild birds near cell towers in Europe are troubling, as are the results from studies on laboratory animals here in North America and elsewhere.

- "Electromagnetic noise" and possible bird-radiation attraction to cell towers needs considerable further investigation — including through NEPA analysis. It was not.

- The "bird-be-gone" nest deterrent device will likely fail, allowing Ospreys, Bald Eagles, hawks, songbirds and other avifauna to exploit the platform — and subsequently be negatively affected by the radiation as a result.

In conclusion, for all the reasons I stated above — including those previously stated on the record in earlier testimony — I recommend that the Thurston County Hearings Examiner reject this VW tower application.

Respectfully submitted,

8/13/2018

Albert M. Manville, II, Ph.D., C.W.B.
Wildlife and Habitat Conservation Solutions, LLC

LITERATURE CITED

Avian Power Line Interaction Committee (APLIC). 2006. Suggested practices for avian protection on power lines: the state of the art in 2006. Edison Electric Institute, APLIC, and the California Energy Commission. Washington, DC, and Sacramento, CA. 207 pp.

Avian Power Line Interaction Committee (APLIC). 2012. Reducing avian collisions with power lines: the state of the art in 2012. Edison Electric Institute and APLIC, Washington, DC. 159 pp.

Balmori, A. 2005. Possible effects of electromagnetic fields from phone masts on a population of White Stork (*Ciconia ciconia*). Electromagnetic Biology and Medicine 24:109-119.

Balmori, A., and O. Hallberg. 2007. The urban decline of the House Sparrow (*Passer domestics*): a possible link with electromagnetic radiation. Electromagnetic Biology and Medicine 26:141-151.

Balmori, A. 2009. Electromagnetic pollution from phone masts. Effects on wildlife pathophysiology. Electromagnetic Fields (EMF) Special Issue, 16 (2-3): 191-199.

Beason, R.C., and P. Semm. 2002. Responses of neurons to amplitude modulated microwave stimulus. Neuroscience Letters 333 (2002):175-178. Bernhardt, J.H. 1992. Non-ionizing radiation safety: radiofrequency radiation, electric and magnetic fields. Phys. Med. Biol. 37 (1992): 80–84.

Bernhardt, J.H. 1992. Non-ionizing radiation safety: radiofrequency radiation, electric and magnetic fields. Phys. Med. Biol. 37 (1992): 80–84.

Borbely, A.A., R. Huber, T. Graf, B. Fuchs, E. Gallmann, and P. Achermann. 1999. Pulsed high-frequency electromagnetic field affects human sleep and sleep electroencephalogram. Neurosci. Lett. 275 (1999): 207–210.

DiCarlo, A., N. White, F. Guo, P. Garrett, and T. Litovitz. 2002. Chronic electromagnetic field exposure decreases HSP70 levels and lowers cytoprotection. Journal Cellular Biochemistry 84: 447-454.

Engels, S., N-L. Schneider, N. Lefeldt, C.M. Hein, M. Zapka, A. Michalik, D. Elbers, A. Kittel, P.J. Hore, and H. Mouritsen. 2014. Anthropogenic electromagnetic noise disrupts magnetic compass orientation in a migratory bird. Nature 509 (May 15, 2014). doi:10.1038/nature13290.

Everaert, J., and D. Bauwens. 2007. A possible effect of electromagnetic radiation from mobile phone base stations not he number of breeding House Sparrows (*Passer demesticus*). Electromagnetic Biology and Medicine 26:63-72.

Grigor'ev, I. 2003. Biological effects of mobile phone electromagnetic field on chick embryo (risk assessment using the mortality rate). Radiats Biol Radioecol 43(5):541-3.

Levitt, B.B., and H. Lai. 2013. Comments Filed Jointly to the Federal Communications Commission, ET Docket No. 13-84, 2013.

Manville, A.M., II. 2007. Comments of the U.S. Fish and Wildlife Service submitted electronically to the FCC on 47 CFR Parts 1 and 17, WT Docket No. 03-187, FCC 06-164, Notice of Proposed Rulemaking, "Effects of Communication Towers on Migratory Birds." February 2, 2007. 32 pp.

Manville, A.M., II. 2013. U.S. Fish and Wildlife Service (USFWS) revised guidelines for communication tower design, siting, construction, operation, retrofitting, and decommissioning — Suggestions based on previous USFWS recommendations to FCC regarding WT Docket No. 03-187, FCC 06-164, Notice of Proposed Rulemaking, "Effects of Communication Towers on Migratory Birds," Docket No. 08-61, FCC's Antenna Structure Registration Program, and Service 2012 Wind Energy Guidelines. Division of Migratory Bird Management, Arlington, VA. 5 pp.

Manville, A.M., II. 2016a. Impacts to birds and bats due to collisions and electrocutions from some tall structures in the United States: wires, towers, turbines and solar arrays — state of the art in addressing the problems. Chap 20, pp 415-442, *In* F.M. Angelici (editor), Problematic Wildlife: a Cross-Disciplinary Approach, Springer International Publishing, Switzerland. DOI 10.1007/978-3-319-22246-2_20

Manville, A.M., II. 2016b. A Briefing Memorandum: What We Know, Can Infer, and Don't Yet Know about Impacts from Thermal and Non-thermal Non-ionizing Radiation to Birds and Other Widlife — for Public Release. July 14: 12 pp.

Semm, P. and R.C. Beason. 1990. Responses to small magnetic variations by the trigeminal system of the bobolink, Brain Res. Bull. 25: 735–740.

United States Department of Interior. 2014. ER 14/0001-14/0004. Letter to Mr. Eli Veenendaal, Natl. Telecommunications and Information Administration, US Dept. Commerce. Signed by W.R. Taylor, Director Office of Environmental Policy and Compliance, Office of Secretary, DOI. February 7, 8 pp, in the public arena.

U.S. Fish and Wildlife Service. 2008. Birds of Conservation Concern 2008. United States Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, VA. 85 pp. (http://www.fws.gov/migratorybirds/>).

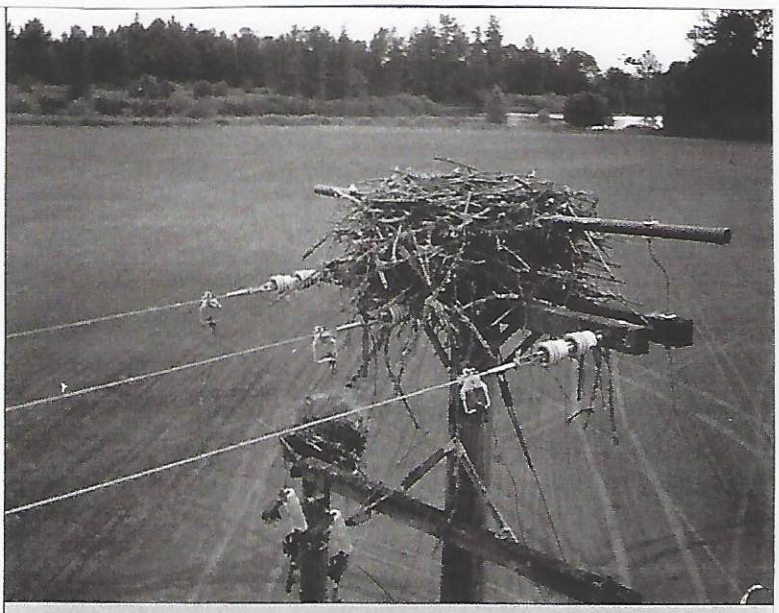
U.S. Fish and Wildlife Service. 2018. Recommended Best Practices for Communication Tower Design, Siting, Construction, Operation, Maintenance, and Decommissioning. Migratory Bird Program, USFWS, Falls Church, VA. April. 6 pp.

Xenos, T.D, and I.N. Magras. 2003. Low power density RF radiation effects on experimental animal embryos and foetuses *In*: P. Stavroulakis (Ed.), Biological Effects of Electromagnetic Fields, Springer, 579-602.

APPENDIX

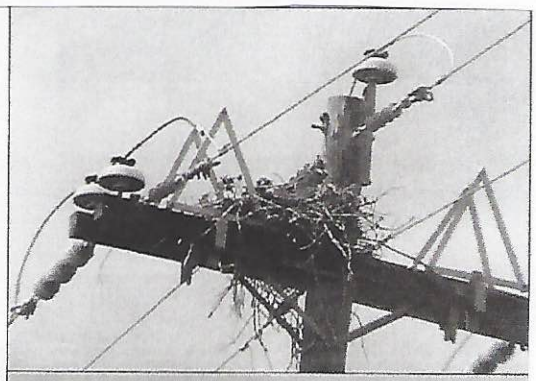
Osprey and Red-tailed Hawks nesting on power poles with nest and perch deterrents previously installed to discourage bird use — all which failed to work.

Figures 6.23, 6.25, 6.26, and 6.27 (with photo credits included), *Suggested Practices for Avian Protection on Power Lines: the State of the Art in 2006*. Pier Final Project CEC-500-2006-022, Avian Power Line Interaction Committee, Edison Electric Institute and California Energy Commission, Washington, DC and Sacramento, CA: pp. 127-128



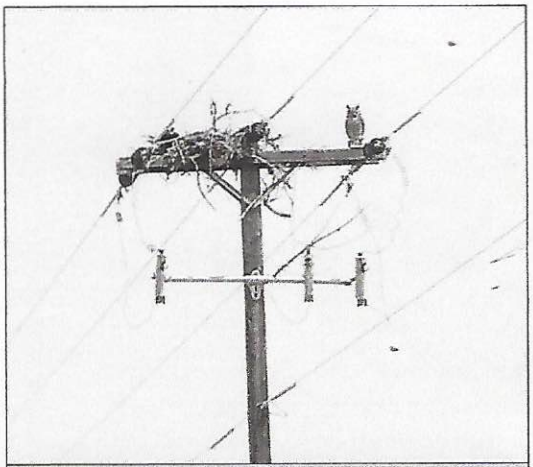
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FIGURE 6.23: A segment of plastic pipe was installed on a dead-end pole in Oregon to discourage osprey nesting. However, the osprey pair continued nest construction after the pipe was installed.



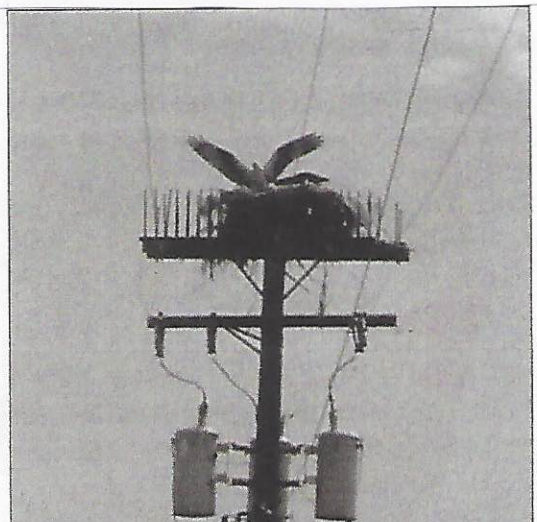
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FIGURE 6.25: Red-tailed hawk nest on pole with triangle perch discouragers.



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FIGURE 6.26: Osprey nest constructed on pole with plastic owl intended to haze birds.



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FIGURE 6.27: Osprey nest on pole with plastic spikes.