SUPPLEMENTAL REPORTS & COMMUNICATIONS I
Office of the City Clerk

City Council of the City of Napa
Regular Meeting

November 5, 2019

FOR THE CITY COUNCIL OF THE CITY OF NAPA:

EVENING SESSION:

14. ADMINISTRATIVE REPORTS:

14.A. Accommodation Agreement for Verizon Wireless Communications Small Cell Technology Equipment.

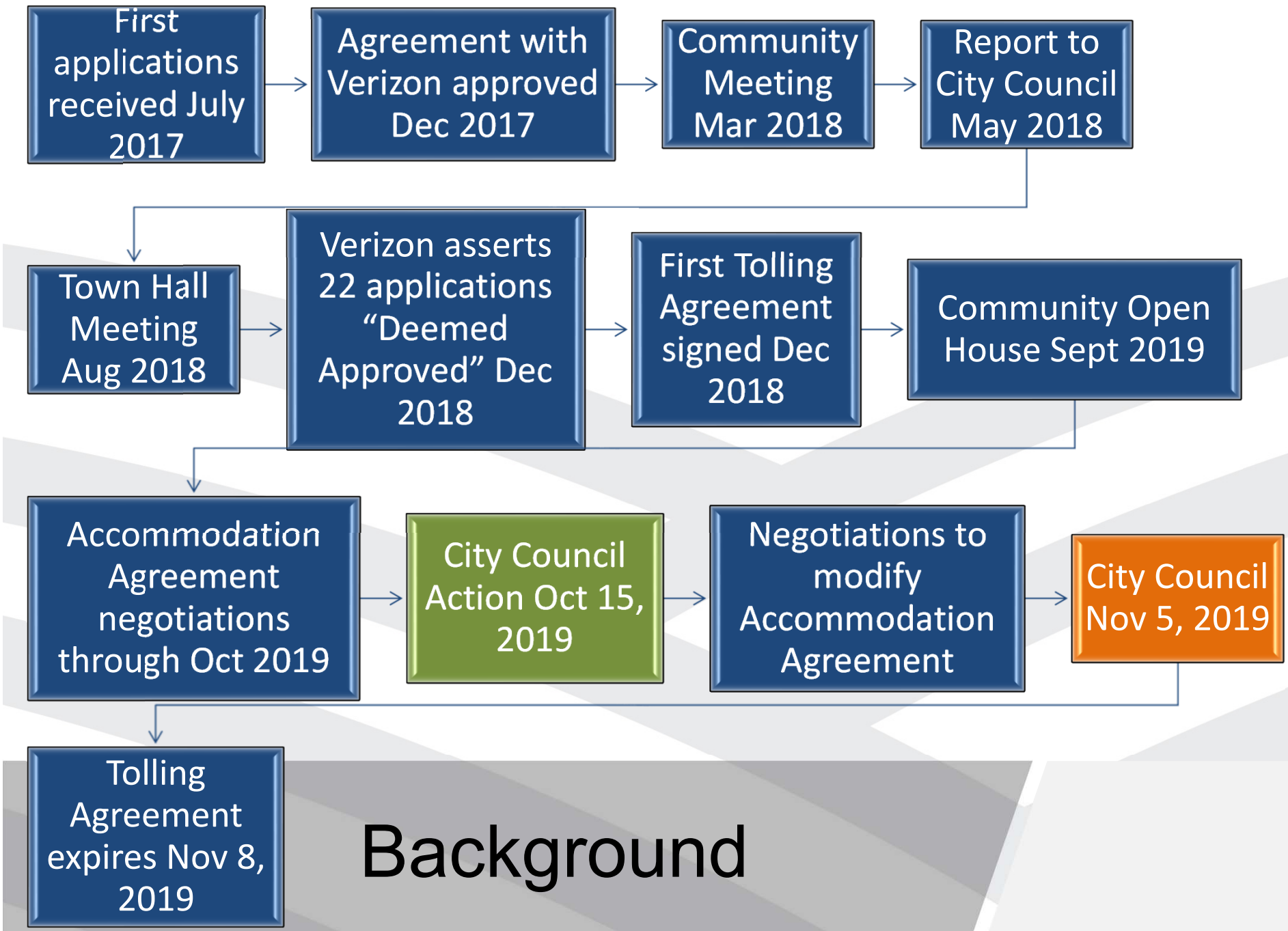
- PowerPoint Presentation by City Staff.
- Letter from Harbanas (Tony) Singh Sidhu, A-1-Food & Liquor, Inc. dated September 30, 2019.
- Letter from Davina Rubin dated October 28, 2019.
- Email with two attachments from Amy Martenson dated November 1, 2019.
- Email from Amy Martenson dated November 2, 2019.
- Email from Mike Coughlin dated November 3, 2019.
- Email from Lori Stelling dated November 3, 2019.
- Email from Kimberly Olson with five attachments dated November 4, 2019.
- Email from Ellie Marks dated November 4, 2019.
- Email from Karen Peters dated November 4, 2019.
- Email from Amy Martenson with links and two attachments dated November 4, 2019.
- Email from Amy Martenson with three photographs dated November 4, 2019.
- Email from Joelle Gallagher dated November 4, 2019.
- Email from Ross Hildebrand with one attachment dated November 4, 2019.
- Email from William F. Benham dated November 5, 2019.
- Email from Napa Valley Language Academy (NVLA) Principal, Alejandra Uribe, dated November 5, 2019.
- Email from Ross Hildebrand with one attachment dated November 5, 2019.
- Email from Shelly Monte dated November 5, 2019.
- Email from Charlotte Williams dated November 5, 2019.
- Email from Jason and Kelly McGrath dated November 5, 2019.
- Email with one attachment from Noah Davidson, 5G Awareness Now, dated November 5, 2019.
- Email from Sandra Booth dated November 5, 2019.
- Email from Lin Marie deVincent dated November 5, 2019.
- Letter from Ernest Schlobohm, President of Napa County Landmarks, Inc. dated November 5, 2019.
- Email with 69 slides containing video link from Paul McGavin dated November 5, 2019.
- Letter from Attorney, Harry V. Lehmann, dated November 5, 2019.

Accommodation Agreement for Verizon Wireless Communications Small Cell Technology Equipment

November 5, 2019

Presentation Overview

- Background
- Council Direction
- Changes to Agreement
- Recommendation


First applications received July 2017
Agreement with Verizon approved Dec 2017
Community Meeting Mar 2018
Report to City Council May 2018
Town Hall Meeting Aug 2018
Verizon asserts 22 applications "Deemed Approved" Dec 2018
First Tolling Agreement signed Dec 2018
Community Open House Sept 2019
Accommodation Agreement negotiations through Oct 2019
City Council Action Oct 15, 2019
Negotiations to modify Accommodation Agreement
City Council Nov 5, 2019
Tolling Agreement expires Nov 8, 2019
Background

Regulation of Small Cell Facilities

City is authorized to regulate placement, construction, and modification of small cell facilities within right of way based on safety and aesthetics

City's authority is substantially limited by state and federal laws:

- City cannot regulate facilities based on RF emissions
- City cannot effectively prohibit personal wireless service
- City cannot discriminate among providers of functionally equivalent services
- City must act on applications in short timeframes (60-90 days)

CITY OF NAPA

State and federal laws which preemptively limit City's authority to regulate (previous slide)

Applications submitted: 54 total; all 4G (22 of those in Verizon deemed approved letter)

City's Technical & Aesthetics Guidelines

- Sets preferred locations outside residential areas

Explanation of RF, small cell technology, and that RF is far under FCC limits

Improvements to aesthetic design

Benefits of negotiated Accommodation Agreement

October 15, 2019 Presentation Summary

- City cannot:
  - Prohibit
  - Delay reviews
  - Set RF requirements
  - Set criteria beyond carrier's technology

- City can adopt requirements for:
  - Aesthetics
  - Applications
  - Setting preference outside of residential areas
- City can support legislation allowing more local control
- City can hire an RF testing firm

Benefits of Accommodation Agreement

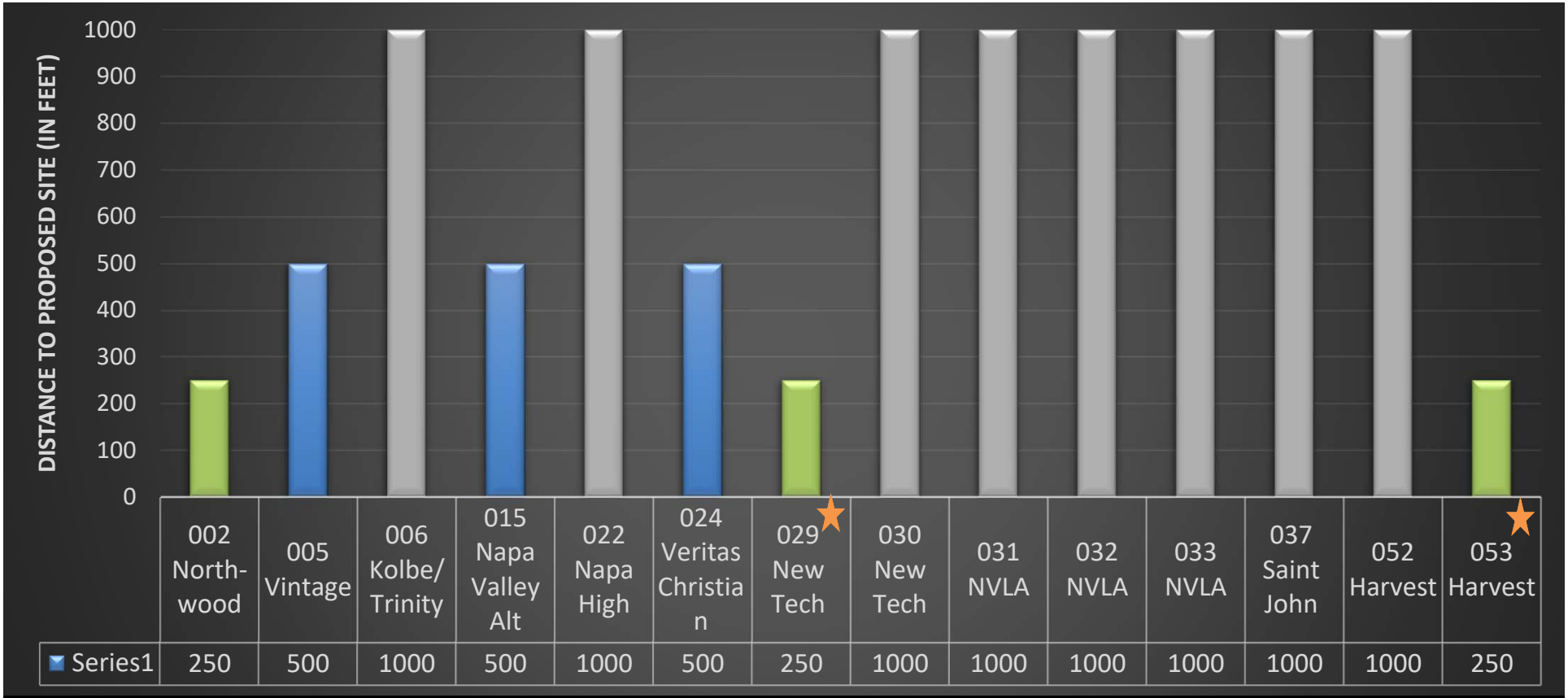
- Focuses initial installation of facilities in least disruptive manner to City residents
- Requires testing of the initial installation to demonstrate compliance with FCC Regulations
- Reduces number of sites for the initial installation and delays more applications
- Incorporates alternative locations and support structures
- Provides more city involvement for design

Council Direction

- Eliminate two sites near schools from the pilot program
- Include indemnification clause
- Extend the timelines for the City's issuance of encroachment permits
- Amend language for City approval of professional that will conduct radio frequency (RF) testing

<u>Conclusion</u>: All four modifications incorporated into proposed Accommodation Agreement (plus two additional sites removed from pilot program)

Review of Schools & Proposed Locations



- At 200-feet, RF level is approximately 1-2% of FCC limit. The 3 sites @ 250-feet from schools were removed from pilot program and added to delayed/pending lists. (★per Council Action)
- At 500-feet, coverage does not typically extend into buildings.
- At 1000-feet, the distance is well beyond coverage into buildings.

Changes to Agreement

Removes 2 sites from pilot program* per Council Action:

1746 Yajome Street (# 29)

2447 Old Sonoma (# 53)

Removes 2 sites from the pilot program* in addition to Council Action:

3898 Oxford Street (# 2) *similar distance from school*

1100 5th Street (# 43) *site closest to a building*

Extends all time periods for reviews

Adds language that Verizon will pay for the City to procure an independent peer review of the RF testing

Adds language confirming Verizon's indemnification obligations

*** Sites removed from pilot program are added to the delayed or pending lists**

Accommodation Agreement Terms

Delays 14 sites identified with specific concerns

Approves a pilot program of 28 sites

Requires RF testing of pilot program sites

Prohibits new application submittals until earlier of:

(i) all 28 sites are constructed, inspected and in compliance with regulations;

(ii) Minimum of 22 sites from pilot project constructed, inspected and in compliance with regulations, no earlier than August 15, 2020;

(iii) January 1, 2021, with all sites in construction or completed inspected and in compliance with regulations.

Recommendation

Authorize the City Manager to execute an Accommodation Agreement with GTE Mobilnet of California Limited Partnership, dba Verizon Wireless, for a pilot program to install small cell wireless communication equipment at 28 locations within the City's street right-of-way and setting parameters for the approval of future small cell applications, and determine that the actions authorized by this item are exempt from CEQA.

City Council Meeting
11/5/19
Supplemental I - 14.A.
Harbanas Singh Sidhu (Tony)

To: City of Napa
Steve Potter, City Manager
Julie Lucido, DPW Director
Mayor Techel, all Councilmembers

September 30, 2019

Re: New location of Verizon "small cell" tower next to my business

To Whom It May Concern:

I have been informed that the city of Napa and Verizon/CBR are planning a new cell tower to be installed in close proximity to my business. My safety and the safety of my employees and customers will be put at risk.

The City of Napa's Municipal Code includes provisions for the safety of its citizens. I ask that you enforce these regulations.

This definition of a "Nuisance Factor" applies. *8.16.020 Definitions*

"Nuisance factors" means any condition which causes one or more of the following: a detriment to the health or safety of surrounding persons or property; an attractive nuisance; substantially interferes with the reasonable enjoyment of property by neighbors; visual blight from public streets; reduces the aesthetic appearance of the neighborhood from public streets; is offensive to the senses from public streets; or detrimentally affects property in the surrounding neighborhood or community." 8.16.020 Definitions. Napa Municipal Code

I believe that this new location will negatively impact my business. The tower needs to be relocated away from businesses, schools or homes. The City should be considering realistic options for the future, like undergrounding of all utilities. Our recent emergency PGE power shut off is telling us to wake up!

Thank you.

Tony Sidhu

10-14-19

Davina Rubin...

[redacted]

Received by the City
Clerk's Department
Distributed to: PC
Mayor/Council
CM/ACM/CA/CC
D. Schmidt K. Lucido

CITY OF NAPA
CITY CLERK
2019 OCT 30 AM 10:37

City Council Meeting
11/5/19
Supplemental I - 14.A.
From: Davina Rubin

October 28th, 2019

Mayor Jill Techel
955 School Street
Napa, California 94559

Dear Mayor Techel,

My name is Davina Rubin. I have been a resident of Napa for 30 years, served on the Napa Child Care Planning Council, and am currently a Library Commissioner. We have met briefly on occasion, and I have supported you in every election.

I recently spoke before the City Council regarding the G4 - soon to become G5 - Verizon towers, and the plans to surround the city of Napa with them. I compared the Verizon Corporation to the tobacco industry, because I felt it was a valid illustration of how a company will not tell the truth about the dangers of their product or service, profit from the deceit, and leave victims in their wake.

The fires we have had flaring all through northern California are another example of the effects of a company's negligence and coverup, all so that they could meet their bottom line and pay their stockholders. PG&E officials went into the homes of people in Hinkley, California who were stricken with cancer, and told them that the water they were drinking was actually healthy for their children, and could not possibly be the cause of their cancers and other illnesses. This, while they knew the truth, and even tried to get an employee to destroy the evidence of their perfidy.

These examples are simply symptoms of the fact that profit is the product of corporations, and pleasing their stockholders is their main concern. Considerations like the safety and well-being of consumers of no interest, except if they cause lawsuits. Better to cover up the truth and move on.

Profit, stockholders, the bottom line - *that* is what drives Verizon. Not service. They know the truth, they have the studies. The difference here is that for years and years we may not see the effects, and by the time we do, it will be far too late. It will spoil the wonderful legacy you've given Napa.

Verizon's "gift" to Napa, I have heard, is that they are "allowing us" to choose the design of the towers. Really? That's the equivalent of allowing someone on Death Row to choose the color of his prison uniform.

Please, Mayor Techel, consider this carefully. I know you are worried about the lawsuits they threaten. That, too, is a money issue they count on. But if you stand up for the people of Napa, and gather all the proof you can about these EMF effects, you will win, Napa will win, and you will set the standard for the country.

Sincerely,

Davina Rubin

cc: Scott Sedgley, Vice Mayor of Napa
Doris Gentry, Napa City Council Member
Liz Alessio, Napa City Council Member
Mary Luros, Napa City Council Member

From: Amy Martenson
Sent: Friday, November 1, 2019 5:28 PM
To: Clerk <clerk@cityofnapa.org>
Cc: Mary Luros <mluros@cityofnapa.org>; Liz Alessio <lalessio@cityofnapa.org>; Jill Techel <jtechel@cityofnapa.org>; Doris Gentry <dgentry@cityofnapa.org>; Scott Sedgley <SSedgley@cityofnapa.org>; Steve Potter <spotter@cityofnapa.org>; Julie Lucido <jlucido@cityofnapa.org>; Don Schmidt <dschmidt@cityofnapa.org>
Subject: Re: Notification of small cells to residents was extremely flawed and needs to be examined

[EXTERNAL]

Dear Napa City Council:

I asked for and received copies of the “notification” of the small cell project to neighbors and am disappointed to have received what I thought I might receive: Verizon and City propaganda regarding the project. (See below.)

What I would expect (and hope to see in the future) is something from the City similar to what we get when a proposed rental is coming into the neighborhood: An official letter from the City factually describing the project.

For example, “Verizon proposes to place close proximity small cell antennas on telephone and utility poles at 32 locations in Napa."

I don’t consider the City and Verizon inviting the public to a meeting using biased language about “wireless service enhancements” or "the latest wireless tech coming to Napa” with “enhanced coverage, increased network capacity, faster data speeds, innovation for today and tomorrow, and investment in Napa” to be “notification,” unless it wants to balance that with the negatives— increased wireless radiation with associated health risks, reduced property values, and blight."

In addition, Verizon reps going door to door (I do not believe they covered all the locations that way) selling the project is likewise not “notification.”

If notification is a legal requirement, which I am sure it is, the process was flawed from the beginning.

There were so many missteps:

1. Not putting into place an emergency ordinance earlier on
2. Improper notification of the project
3. Not having the project go through the Planning Commission
4. Failure to respond in a timely manner to the permit requests
5. Not requiring what the City can in terms of CEQA/NEPA
6. A lack of explanation for why the City is considering the 20 beyond the 10 that Verizon has “deemed approved,” unless the City wanted to use those 20 to renegotiate some of the ten that are near schools and homes
7. The staff back up document for the Oct. 15 meeting, which does not acknowledge that the City CAN take into health effects in regulating these small cells per the 2019 California Supreme Court ruling.

It is not the public's fault that there have been many issues with the process. I hope the City Council will rectify that on behalf of the pubic at the Nov. 5th meeting.
Sincerely,
Amy Martenson

On Oct 31, 2019, at 9:47 AM, Clerk <clerk@cityofnapa.org> wrote:

Hi Amy,

The City of Napa is in receipt of your below October 29, 2019 request for records for "written notification regarding this project sent by the City to the residents near the proposed sites."

Attached is a copy of an email sent by Associate Engineer, Don Schmidt to residents on September 13, 2019 with an attached flyer from by Verizon. Also attached are photos of the door hangers that Verizon provided to properties in English and Spanish.

Please note that Verizon held the Community Meeting at the request of the City. Verizon went out door to door to notify properties of the both the proposed project and meeting. Our Associate Engineer, Don Schmidt, emailed the flyer distributed by Verizon as a courtesy to residents who have been vocal about the project. The City's noticing process for encroachment permits occurs when the permit has been issued and the work has been scheduled. The noticing of the proposed work takes place 2 weeks before the work begins in order to allow for the contractor to work with residents for access issues. Also, the new guidelines for small cells require noticing as part of the application process.

We trust that this satisfies your request and now consider it closed. If you have any questions, then please let me know.

Thank you,

Caitlin Saldanha
Deputy City Clerk
City of Napa – City Hall – City Clerk's Office
955 School Street, Napa, CA 94559
Phone (707) 258-7870
Email csaldanha@cityofnapa.org
Website www.cityofnapa.org

From: Don Schmidt
Subject: Verizon Small Cell Open House Notification
Date: Friday, September 13, 2019 4:25:00 PM
Attachments: image001.png
Napa Community Event Flyer.pdf
image002.png

Hello,

I just wanted to reach out to you as you have asked to be kept up to date on the possible small cell projects within the City of Napa. As residents who have voiced concerns over the project and have communicated with me and other staff members of the City, I wanted to send this out to you before it is posted to the City's website and other forms of media.

As the City continues to work with Verizon on how this project could possibly be implemented in Napa, we have asked them to have another community meeting with a larger group of residents. Verizon has agreed and will host the meeting, which we have just confirmed the date. The meeting will be held on September 24th from 5:30 p.m. to 7:30 p.m. at the Elks Lodge, the flyer is attached to the email. Verizon will be handing out flyers for the open house meeting door to door in areas with proposed small cell installations. The format will be similar to the initial meeting last year with booths set up for different aspects of the project. The City of Napa will have representatives present at the meeting to answer questions pertaining to issues within the City. If you have any questions or comments, please don't hesitate to reach out to me.

Thank you,

Don Schmidt, PE
Associate Engineer, Operations
Public Works Department, City of Napa
770 Jackson St, Napa, CA 94559
Phone (707) 257-9674
Email dschmidt@cityofnapa.org
Website www.cityofnapa.org

Visit our website for
up-to-date details on the drought
and ideas on how you can save water.

Connecting Napa

Join us for an open house to learn more about how you can benefit from the latest wireless tech coming to Napa

- **Enhanced coverage**
- **Increased network capacity**
- **Faster data speeds**
- **Innovation for today and tomorrow**
- **Investment in Napa**

Date: September 24, 2019

Time: 5:30PM-7:30PM

Location: 2840 Soscol Ave., Napa, CA 94558

More information at: https://improveyourwireless.com/napa

Verizon
Small Cell for Napa

4G

Dear Napa Neighbor,

Verizon Wireless representatives have been visiting residents in your neighborhood in order to invite you to a meeting about new wireless service enhancements through small cells to be attached to an existing utility or streetlight pole.

More information can be found at www.improveyourwireless.com/napa

Want to talk to our team?

Verizon Wireless will be hosting a
Community Outreach Meeting/Open House
Tuesday, September 24, 2019, 5:30 PM – 7:30 PM
Elks Lodge, 2840 Soscol Ave, Napa, CA 94558

If you'd like to contact us regarding this project, please call (925) 246-3212 or email us at projects@thecbrgroup.com.

Please reference ("Napa and Your Address")
And, if we did not get to chat, I'm sorry that I missed you.

THE CBR GROUP

Verizon
Small Cell for Napa

4G

Hola Vecinos de Napa,

Los representantes de Verizon Wireless han estado visitando a los residentes de su vecindario para describir maneras para mejorar el servicio inalámbrico. Esto seria a través de nuevas instalaciones Small Cell, pequeñas, que conectarán a un poste de servicio publico o poste de luz existente.

Para mas información vaya al sitio www.improveyourwirelss.com/napa. Le gustaria hablar con nuestro equipo?

Verizon Wireless patrocinará una junta para la comunidad el 24 de Septiembre 2019 de 5:30PM a 7:30PM en el Elk's Lodge, 2840 Soscol Avenue, Napa, CA 94558.

Si le gustaria hablar mas sobre este proyecto, favor de llamar al (925)246-3212 o mandar un correo electronico a projects@thecbrgroup.com.

THE CBR GROUP

City Council Meeting
11/5/19
Supplemental I - 14.A.
From: Amy Martenson

-----Original Message-----
From: Amy Martenson
Sent: Saturday, November 2, 2019 8:32 PM
To: Mary Luros <mluros@cityofnapa.org>; Liz Alessio <lalessio@cityofnapa.org>; Jill Techel <jtechel@cityofnapa.org>; Doris Gentry <dgentry@cityofnapa.org>; Scott Sedgley <SSedgley@cityofnapa.org>
Cc: Steve Potter <spotter@cityofnapa.org>; Julie Lucido <jlucido@cityofnapa.org>; Don Schmidt <dschmidt@cityofnapa.org>
Subject: Spa taken off the list but two schools and several residential areas left on???

Warning:
The sender of this message could not be fully validated. The message may not be from the sender/domain displayed.

_____

[EXTERNAL]

Dear Napa City Council:
I feel as though my emails are falling on deaf ears. Nevertheless I will try… I am shocked to see that a spa was taken off the list and meanwhile two schools and several other residential and mixed use areas were left on.
Where is the integrity in this process???
I am happy for Linda Price, one of the owners of the Napa River Inn and the Napa River Inn Spa. She is a good friend and I know she was concerned about the employees at the spa.
However, I know she was equally concerned about the one near Vintage and the low income housing project that she is working on that will be going in across the street, as we all should be.
And what about NVLA and all of the homes that are directly in front of other sites still on the list?
This process seems to be capricious with decisions being made on politics (I am sure that who Linda Price is was the deciding factor) rather than science and the public interest.
Our town is better than this.
We should be sticking together and protecting each other, not “saving” some of our residents as others are thrown under the bus.
Standing strong together through difficult times is what our community has always been out. I really hope we haven’t lost that quality.
Dealing with a bully like Verizon is no different than dealing with earthquakes or wildfires. We should be standing together in the face of this threat.
Money spent defending public health, property values, and the charm of our town is not “fiscally irresponsible.” It would be money well spent and is the morally responsible thing to do, and it is what the community is asking you to do.
Please listen to the public.
Sincerely,
Amy Martenson

From: Mike Coughlin
Sent: Sunday, November 3, 2019 9:19 PM
To: Jill Techel <jtechel@cityofnapa.org>; Scott Sedgley <SSedgley@cityofnapa.org>; Liz Alessio <lalessio@cityofnapa.org>; Mary Luros <mluros@cityofnapa.org>; Doris Gentry <dgentry@cityofnapa.org>
Cc: Steve Potter <spotter@cityofnapa.org>; Don Schmidt <dschmidt@cityofnapa.org>
Subject: Verizon Wireless Cellular Transmitters

[EXTERNAL]
Dear Council Members,

My name is Mike Coughlin. I'm a husband, parent, homeowner and resident of Napa since 1998. I'm also a public school administrator with Napa Valley Unified School District and have spent the majority of my educational career supporting students with significant educational and mental health challenges. I routinely parnter with Napa County Probation, Napa County Child & Family Behavioral Health, Napa County Child Welfare, Napa County Office of Education, ParentsCan, Aldea and many other public and private agencies. I also serve on the Juvenile Justice Commission. In her role as a foster parent, I have also partnered with Council Member Doris Gentry in her efforts to support youth in the child welfare system. As a citizen who has been a Verizon customer for many years, I'm writing this letter to voice my opposition to the proposed installation of "small cell" pole mounted transmitters.

While I understand there are significant complexities regarding federal regulations, I have a hard time envisioning how our city would endorse Verizon's initiative when 1.) there is no compelling reason to do so and 2.) there is a potential health risk to our citizens if we move in this direction. Let me cite the International Association of Fire Fighters position on the health effects from radio frequency radiation in fire department facilities from base stations for antennas and towers for the conduction of cell phone transmissions:

The International Association of Fire Fighters' position on locating cell towers commercial wireless infrastructure on fire department facilities, as adopted by its membership in August 2004, is that the IAFF oppose the use of fire stations as base stations for towers and/or antennas for the conduction of cell phone transmissions until a study with the highest scientific merit and integrity on health effects of exposure to low-intensity RF/MW radiation is conducted and it is proven that such sitings are not hazardous to the health of our members.

As I'm sure you are aware, this position led to the passage in California of AB57 and SB649 restricting cell towers from being located on or adjacent to a fire department facility. If the International Association of Fire Fighters and the state of California are collaborating to limit the exposure of cell phone towers on our first responders, and they are doing so due to concerns about potential health hazards, why would our City Council be willing to take such a risk with our other citizens when there is no compelling reason to do so? As stated in a recent article in the Napa Valley Register, "Published research on the health effects of wireless signals on health has reached conflicting conclusions. In 2011, a World Health Organization research paper declared electromagnetic fields to be a "possible" carcinogen, but the American Cancer Society disputes that." If there are conflicting conclusions concerning the health risks of wireless signals, why would we continue to expand the reach of these signals until there is clarity in this area? Again, why place the health of the people of Napa at risk when there is already state legislation acknowledging the potential harm of cell phone towers on public

employees? I understand that AB57 and SB694 may not state this explicitly but the bills were definitely generated as a result of the I.A.F.F.'s position.

As elected officials, and in my role as a school official, I believe our primary responsibility is to protect and safeguard the health and wellbeing of the city of Napa. In my view, "small cell" pole mounted transmitters present a health risk to the people of Napa and until that risk is addressed in a conclusive manner I don't see how we treat the citizens of our city any differently than the state of California is treating our first responders. And, in the end, if the health risks prove to be validated, than the decision made by this city council would have long term moral implications because its citizens voiced their concern to the council *prior* to the transmitters being put in place.

As for the Verizon corporation, I believe it also has an ethical responsibility to be a leader in addressing the concerns being raised by the I.A.F.F., the World Health Organization, and the people of our city. I believe Verizon should withdraw its proposal until the health impact of cell phone transmissions is fully understood. If these "small cell" towers are put in place, I will end my long tenure as a Verizons customer.

Thank you for your thoughtful consideration of this matter.

Sincerely,
Mike Coughlin

From: Lori Stelling
Subject: Fwd: Small Cell Tower Project Follow Up
Date: November 3, 2019 at 7:10:51 PM PST
To: Kit Long, Karen Peters

Hi Kit and Karen— Below is my last effort to impact council's decisions on the small cell towers. Mike will speak at Tuesday's council meeting. This is it. All is decided Tuesday. If you have time to even just write a very short note of opposition to council, I trust it will have an impact. xo Lori

Begin forwarded message:

From: Lori Stelling
Subject: Small Cell Tower Project Follow Up
Date: November 3, 2019 at 7:06:26 PM PST
To: jtechel@cityofnapa.org, "Sedgley, Scott" <ssedgley@cityofnapa.org>, Liz Alessio <lalessio@cityofnapa.org>, "Gentry, Doris" <dgentry@cityofnapa.org>, mluros@cityofnapa.org
Cc: spotter@cityofnapa.org, Don Schmidt <dschmidt@cityofnapa.org>

Dear Councilmembers,

I am writing to follow-up, once again, on the Verizon small cell tower project. I appreciated having had the opportunity to speak on October 15 and share my view that this project is a "preference", not a "need", and puts our community at risk of negative health effects, decreased property values, and the financial burden of potential future lawsuits towards the City by its residents. As I shared, my family currently has Verizon service, because it has excellent connectivity. We will cancel our Verizon service should small cell towers be placed near homes and schools.

I view this Tuesday's council meeting as a crucial juncture in the future health of our community. Many community members are not aware of the risk at hand. We have become a culture addicted to our technology, unable to use it wisely. Technology that is used wisely is of tremendous benefit! But, these small cell towers are NOT wise techonolgy. They cause harm. We already know this. What we don't know is just now much harm they will cause long-term.

I've read through the changes in the agreement and tried to understand them, to the best of my ability. I appreciate that it appears that you've removed 4 towers since October 15th. It is my hope that these were towers which were going to be placed near schools. I deeply appreciate any and all efforts you've made to keep small cell towers away from schools. I also know that children sleep throughout town, as do those, like me, with health conditions. I still question, "If we are protecting schools then why are we not also protecting children and the most vulnerable where they live?" I urge you to keep ALL small cell towers away from schools and homes.

I will be honest that my heart breaks for this entire predicament. If the city has the financial means to say no to this project, despite being taken to court, I urge you to have the courage to do so. I heard mentioned back on October 15 that the City of Hillsborough has done this and, knowing that they are a very affluent community, I wonder how they've done it and what we could learn from them? I would like to see you stall this project as long as possible and research as deeply as you can into the cost/benefit analysis of going to court now vs. being taken to court later by community residents who experience negative health effects and/or decreases in their property values due to these towers.

As I've shared previously, my family's home is "wired" not wireless. These towers take away my right to protect my family from EMF emissions. Thirty years from now, will we find that these toxins are the cigarette of our modern age? I, for one, do not want my home or my child to be a part of this risky experiment, especially when Verizon coverage is excellent in our community and this project is a preference and NOT a need.

The Federal goverment and the cellular companies are trying to bully our community into these 4G (soon to be 5G) rollouts, at our expense. We have the right to protect ourselves. Please do all you can.

Sincerely,
Lori Stelling
20 year Napa resident

From: Steve Potter <spotter@cityofnapa.org>
Sent: Monday, November 4, 2019 11:04 AM
To: Clerk <clerk@cityofnapa.org>
Subject: FW: 5G Please don't let this happen in Napa

From: Liz Alessio <lalessio@cityofnapa.org>
Sent: Monday, November 4, 2019 10:22 AM
To: Steve Potter <spotter@cityofnapa.org>
Subject: Fwd: 5G Please don't let this happen in Napa

Get Outlook for iOS

From: Kimberly Olson
Sent: Monday, November 4, 2019 8:58:13 AM
To: Liz Alessio <lalessio@cityofnapa.org>
Subject: 5G Please don't let this happen in Napa

[EXTERNAL]

Greetings,
I am a Ph.D. student looking at the effects of electromagnetic frequency upon living things. I have attached a few peer-reviewed, evidence-based papers for your information, and can provide more studies if you can use them. Please do not allow 5G to happen in Napa.

Kimberly Olson

Does Exposure to Environmental Radiofrequency Electromagnetic Fields Cause Cognitive and Behavioral Effects in 10-Year-Old Boys?

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The relationship between exposure to electromagnetic fields from non-ionizing radiation and adverse human health effects remains controversial. We aimed to explore the association of environmental radiofrequency-electromagnetic fields (RF-EMFs) exposure with neurobehavioral function of children. A subsample of 123 boys belonging to the Environment and Childhood cohort from Granada (Spain), recruited at birth from 2000 through 2002, were evaluated at the age of 9–11 years. Spot electric field measurements within the 100 kHz to 6 GHz frequency range, expressed as both root mean-square (S_{RMS}) and maximum power density (S_{MAX}) magnitudes, were performed in the immediate surrounds of childreńs dwellings. Neurocognitive and behavioral functions were assessed with a comprehensive battery of tests. Multivariate linear and logistic regression models were used, adjusting for potential confounders. All measurements were lower than reference guideline limits, with median S_{RMS} and S_{MAX} values of 285.94 and 2759.68 $\mu W/m^2$, respectively. Most of the cognitive and behavioral parameters did not show any effect, but children living in higher RF exposure areas (above median S_{RMS} levels) had lower scores for verbal expression/comprehension and higher scores for internalizing and total problems, and obsessive-compulsive and post-traumatic stress disorders, in comparison to those living in areas with lower exposure. These associations were stronger when S_{MAX} values were considered. Although some of our results may suggest that low-level environmental RF-EMF exposure has a negative impact on cognitive and/or behavior development in children; given limitations in the study design and that the majority of neurobehavioral functioning tasks were not affected, definitive conclusions cannot be drawn. Bioelectromagnetics. 37:25–36, 2016. © 2015 Wiley Periodicals, Inc.

Key words: RF measurements; exposure; power density; childhood; cognitive effects; behavior effects

INTRODUCTION

Environmental exposure to radio-frequency electromagnetic fields (RF-EMFs) has increased rapidly in recent years. Children are exposed to them in their daily activities, whether at home or in its surrounds, at school, or in parks, among other places [Ortega-Garcia et al., 2009; Urbinello et al., 2014]. Authors have pointed to the increased use of new technologies by children and teenagers, which can start at an early age, and to the rise in in utero exposure from this cause [WHO, 2005; Divan et al., 2008; Rosenberg, 2013]. There is particular concern about the potential effects of exposure to RF-EMF

Grant sponsors: Spanish Ministry of Health; grant numbers: FIS PI11/0610, FIS PI13/02406; Andalusia Regional Government, Consejería de Salud; grant number: SAS PI-0675-2010.

Conflict of interests: None.

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Received for review 13 November 2014; Accepted 4 December 2015

DOI: 10.1002/bem.21951
Published online in Wiley Online Library (wileyonlinelibrary.com).

on children [Bakker et al., 2011], who may be more vulnerable than adults, although this question remains under debate [van Rongen et al., 2009]. It has been proposed that children could be more sensitive to RF-EMF because they are still in a physiological and psychological development period [Kheifets et al., 2005; Schüz, 2005]. Studies investigating potential causal relationships between RF-EMF exposure and adverse health outcomes have mostly focused on childhood cancers [Calvente et al., 2010; Teepen and van Dijck, 2012] and brain neoplasms [Li et al., 2012]. There has been little exploration of its effects on behavioral problems [Divan et al., 2008, 2012; Thomas et al., 2010a,b; Guxens et al., 2013], or psychosocial risk [Sansone and Sansone, 2013]. In fact, research on the potential effects of exposure to RF-EMFs on neurobehavioral function in children is scant and has largely focused on the association between cell phone use and behavioral problems [Divan et al., 2008, 2012; Thomas et al., 2010b; Feychting, 2011; Guxens et al., 2013]. Findings from the Danish National Birth Cohort showed a positive and dose-dependent relationship between cell phone use by mothers during pregnancy and behavioral problems in their offspring [Divan et al., 2008, 2012; Sudan et al., 2013]; however, this association was not supported by others [Guxens et al., 2013]. This discrepancy may be attributable to differences in outcome reporting (e.g., by parents and/or teachers) or exposure assessment (typically based on questionnaires) or to the presence of unmeasured confounding factors.

A critical review of 41 studies addressing the effects of RF-EMF exposure on human cognitive development concluded that state-of-the-art methods have not been fully implemented in bio-electromagnetic research into the effects of RF-EMF on cognition [Regel and Achermann, 2011]. The lack of a standardized protocol for reliably assessing RF-EMF induced changes in neurobehavioral performance may in part explain discrepancies among studies on the cognitive and behavioral effects of exposure. The wide variety of findings may also be attributable to methodological differences (e.g., in sample size, study group composition, experimental design, exposure setup, exposure conditions, and/or selection bias) [Hareuveny et al., 2011].

The aim of this study was to explore the association of environmental RF-EMF exposure with the neurobehavioral function of boys belonging to the Spanish Environment and Childhood "Infancia y Medio Ambiente-INMA" mother–child cohort study, at the age of 9–11 years. Exposure in the immediate surrounds of the dwellings of their families was assessed with spot electric field measurements in the 100 kHz to 6 GHz frequency range.

MATERIALS AND METHODS

Study Population

The recruitment and characteristics of the study population were previously reported [Calvente et al., 2014, 2015]. Briefly, the study sample was drawn from the INMA cohort study, a population-based study in seven regions of Spain, which aims to explore the role of environmental pollutants in air, water, and diet during pregnancy and early childhood in relation to child growth and development. The INMA study protocol includes medical follow-ups of the children from birth through childhood as well as epidemiological questionnaires and biological sample collections. The present study included the INMA cohort set up in Granada (a province in Southern Spain). From October 2000 through July 2002, 668 mother–child pairs were recruited at delivery in the San Cecilio University Hospital of Granada (Spain) with the initial aim of investigating the association of chronic exposure to endocrine disrupting chemicals with urogenital malformations in newborn boys. The inclusion and exclusion criteria were published elsewhere [Freire et al., 2011]. When the children reached the age of 9–11 years (2011–2012), all families in the cohort were contacted and invited to participate in the new follow-up. Three hundred (44.9%) families gave their consent and completed an ad hoc questionnaire on their home environment, including a specific RF-EMF questionnaire. The follow-up also included assessment of the children's growth (by a single pediatrician) and neuropsychological and behavioral status (by a single psychologist). The study was approved by the Ethics Committee of San Cecilio University Hospital (Granada), and signed informed consent was obtained from the participants' families.

The setting of the INMA-Granada cohort is the health district of the San Cecilio University Hospital, including part of the city of Granada (236,000 inhabitants) and 50 towns and villages. Out of the 300 children/families enrolled in the study, the present work included the 123 (41%) families/dwellings for which outdoor RF-EMF measurements (surrounds of the dwellings) were finally carried out. Half of the dwellings (44.7%) were in an urban area (city of Granada), 45.5% in semi-urban areas (towns of $>$20,000 inhabitants in city residential belt), and 9.8% in rural areas ($<$20,000 inhabitants).

Environmental Exposure Assessment

Spot electric field measurements were performed in wideband mode between 2 and 4 p.m., recording the average measurement during 6-min periods according to national regulations. All measurements were considered to correspond to a far-field regime and free space. Measurements were made using a TS/001/UB Taoma base unit (Tecnoservizi, Rome, Italy) with a TS/004/EHF isotropic electric field probe. The frequency range analyzed was from 100 kHz to 6 GHz. The measurement range was from 0.2 to 340 V/m, and the quantification limit was 0.2 V/m (for the sum of all frequencies), well below even the most cautious guideline levels of the International Commission on Non-Ionizing Radiation Protection [ICNRP, 1998]. The probe incorporated a Global Positioning System (GPS) module and was equipped with sensors for recording temperature and humidity. The probe, connected to the base unit, was placed on an insulating tripod in the immediate surroundings of the dwelling (at a height of 1.45 m and at a mean distance of 2 m from childreńs houses), based on recommendations of the Institute of Electrical and Electronics Engineers for power frequency magnetic fields [IEEE, 1987]. RF-EMFs are usually expressed in terms of electric field or power density. In the present study, power density (S) magnitude was obtained from direct measurements, and the root mean-square of power density (S_{RMS}) and maximum power density (S_{MAX}) were calculated.

The most important sources of RF-EMF exposure to the general public are within the frequency range 100 kHz-6 GHz. Possible sources of RF-EMF exposure within this range include radio and TV stations and communication networks used by emergency services, the police, and transport management systems, among others (Supplementary Table 1).

Neuropsychological Measures

Neuropsychological function was evaluated with a comprehensive battery of tests at the Monitoring and Early Stimulation Unit of the San Cecilio University hospital by a neuropsychologist trained to administer the tests and interpret scores for the neuropsychological domains. Completion of these tests generally takes around 1 h, a sufficiently short period to sustain the attention of children of this age (9–11 years) and avoid fatigue.

Briefly, the cognitive battery includes [Pérez-Lobato et al., 2015]: (i) general cognitive intelligence, based on the composite Intelligence Quotient (IQ), assessed with the Kaufman Brief Intelligence Test (K-BIT); (ii) language, evaluated with the verbal scale of the K-BIT, which includes two subtests, verbal knowledge and general knowledge and riddles; (iii) attention, assessed with the Continuous Performance Test (CPT), which measures sustained and selective attention and impulsivity; (iv) verbal memory, evaluated with the Complutense-Spain Madrid Verbal Learning Test (TAVECI), which assesses different memory and learning processes, including immediate recall, short- and long-term recall, and recognition; (v) visual-motor coordination, assessed with part A of the Trail Making Test (TMT), which involves connecting consecutive numbers in an alternating sequence as quickly as possible; (vi) processing speed, measured by the sum of the results of two subtests (symbol search and coding) from the Wechsler Intelligence Scales for Children (WISC-IV); and (vii) executive function, divided into four components: (i) updating measures, with two components: working memory and verbal fluency; (ii) inhibition, with two components: the Spanish childreńs version of the Stroop Color and Word Test (STROOP), which measures cognition inhibition; and the go/no-go task, which measures motor inhibition, (iii) flexibility, measured by part B of the TMT, and (iv) abstract reasoning (matrix analogies test), measured with the non-verbal scale of the K-BIT.

Behavioral Problems

Behavioral function was evaluated with the Child Behavior Checklist (CBCL/6-18), a standardized parent report questionnaire. The CBCL provides eight syndrome scales grouped into three composite scales (Internalizing, Externalizing, and Total Problems), six DSM-IV oriented scales, and four competence scales, reported as both raw scores and sex- and age-normalized T-scores. Children with CBCL/6–18 T-scores $\geq$60 on internalizing or externalizing problem scales, T-scores $\geq$65 on diagnostic scales, and T-scores $\leq$30 on competence scales, were classified as normal or borderline/clinical cases, respectively.

Covariates

Information was gathered at the follow-up visit on parental and children socio-demographic characteristics, including marital status, maternal schooling (up to primary/secondary/university studies), smoking during pregnancy, and the age, weight, and height of the children, calculating their body mass index (BMI). Parents reported Wi-Fi coverage at home (yes/no) and whether their children had a cell phone (yes/no) and, if so, whether it was used (e.g., voice calls against the head, in speaker mode, or for data, etc.) or never used by the children. Rural and semi-urban areas were grouped together because they shared similar features

in terms of the number of emission sources and frequency ranges. Thus, the number of substations/antennas (bands) never exceeded one in the semi-urban or rural areas, whereas more than two were always observed in the urban areas. Nevertheless, the studied zones do not fully represent the birth cohort study area.

Out of the 123 participating children, 4 were excluded because of the presence of chronic disease, related to attention deficit hyperactivity disorder (ADHD) ($n = 1$), language disorder ($n = 1$), Asperger syndrome ($n = 1$), or spina bifida ($n = 1$). Data on RF-EMF exposure, covariates, and neuropsychological and behavioral test scores were finally available for 119 (96.75%) participants.

Statistical Analysis

Descriptive analysis of neuropsychological and behavioral test results yielded arithmetic means and standard deviations (SDs), median, minimum, maximum values, and 25th and 75th percentiles, stratified by median power density (above or below 285.9 $\mu W/m^2$). Frequencies for categorical variables were also calculated.

The Spearman correlation test was used for bivariate analyses of quantitative variables. The association between quantitative and categorical variables was analyzed with the Mann–Whitney test or Kruskal–Wallis test (for >2 variables), and the association between categorical variables with Pearson's χ^2 test.

Exposure to RF-EMFs (S_{RMS} and S_{MAX}) was categorized into two groups, using the median value as cut-off point, and was also analyzed in tertiles. Exposure could not be treated as a continuous variable because many values were below the limit of quantification [Calvente et al., 2015]. All models were adjusted for potential confounders, selected a priori on the basis of previous studies, including smoking during pregnancy, maternal schooling (up to primary/secondary /university studies), place of residence (urban/suburban-rural), and internet/Wi-Fi access at home. These covariates were selected using a backward procedure.

Neuropsychological test results were analyzed as continuous variables based on the raw scores, because standardized scores for the Spanish child population were not available for all tests. Behavioral test results were analyzed as continuous variables based on standardized scores for the Spanish population. Linear and logistic regression models were constructed to explore the association of RF-EMF exposure with neuropsychological and behavioral test scores. Logistic regression models were used to estimate the risk of obtaining scores above the 80th percentile (TMTA, TMTB) or below the 20th percentile (other tests) as a function of exposure levels. These percentiles were selected to enhance the detection of low or borderline/clinical performance, as proposed by Jacobson and Jacobson [2005]. Logistic models were also constructed to estimate the risk (OR; 95%CI) of obtaining borderline/clinical scores (as explained above) [Donders, 1969].

We assessed collinearity between independent variables, linearity of independent quantitative variables, and homoscedasticity of linear models. Significance level was set at $P \leq 0.05$, following recommendations for the evaluation of exposure-outcome relationships in the public health setting. Data analyses were performed using SPSS v20.0 (IBM, Chicago, IL) and R-Commander free software (R i386 3.0.1 version; http://www.r-project.org).

RESULTS

Table 1 shows characteristics of the study population by exposure category. The mean age ($\pm$ standard deviation) of the children was 9.89 ± 0.32 yrs; 25.21% of mothers had higher education and 44.54% primary schooling; 43.7% of participating families lived in urban areas; 24.79% of mothers reported smoking during pregnancy, and 89.3% had a stable partner. A cell phone was possessed by 97.5% of the children but only 6.0% of the children used it. At the time of the study, a higher percentage of fathers vs. mothers was employed (83.1% vs. 65.8%, respectively), and the percentage of families with a low income, defined according to the Organization for Economic Co-operation and Development (OECD), was 61.9% (data not shown).

Median S_{RMS} and S_{MAX} values in the immediate surrounds of the childreńs dwellings were 285.94 $\mu W/m^2$ and 2759.68 $\mu W/m^2$, respectively, with a range of 5.51–11559.55 $\mu W/m^2$ and 2.39–150001.06 $\mu W/m^2$, respectively. Maximum S_{RMS} and S_{MAX} values were 11559.55 $\mu W/m^2$ and 150001.06 $\mu W/m^2$, respectively. All measurements obtained were below the reference limit. The mean distance from the dwellings to mobile phone base stations/aerials emitting GSM 900 and GSM 1800 was 660.87 ± 717.48 m, with a minimum distance of 35 m and maximum of 5000 m; 50% of the dwellings were within 500 m.

Most of the children appeared highly motivated to complete the cognitive test battery and showed no inattention or fatigue symptoms. Mean (SD) standardized IQ score was 108.20 (11.80) points. No differences were found between the children with and without RF-EMF exposure measurements (119 vs.

TABLE 1. Characteristics of Study Population ($n = 119$)

	Mean ± SD	Min	Median	p25	p75	Max
Children age (years)	9.9 ± 0.3	9.0	9.8	9.7	10.0	11.2
Children BMI (Kg/m^2)	18.7 ± 3.3	13	19	16	21	29

		$S_{RMS} < 285.9$ (μW/m^2)	$S_{RMS} \geq 285.9$ (μW/m^2)	$S_{MAX} \leq 2759.68$ (μW/m^2)	$S_{MAX} > 2759.68$ (μW/m^2)
	n (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)
Smoking during pregnancy					
No	89 (75.2)	47 (53.4)	41 (46.6)	48 (54.5)	40 (45.5)
Yes	30 (24.8)	12 (41.4)	17 (58.6)	12 (41.4)	17 (58.6)
Maternal schooling					
Up to primary	53 (44.5)	27 (50.9)	26 (49.1)	23 (43.4)	30 (56.6)
Secondary studies	36 (30.2)	17 (47.2)	19 (52.8)	21 (58.3)	15 (41.7)
University studies	30 (25.2)	15 (50.0)	15 (50.0)	16 (53.3)	14 (46.7)
Place of residence					
Urban	52 (43.7)	28 (53.8)	24 (46.2)	31 (59.6)	21 (40.4)
Semi-urban/ rural	67 (56.3)	31 (46.3)	36 (53.7)	29 (43.3)	38 (56.7)
Have mobile phone*					
Yes	116 (97.5)	—	—	—	—
No	3 (2.5)	—	—	—	—
Use mobile phone*					
Yes	10 (8.4)	—	—	—	—
No#	109 (91.6)	—	—	—	—

BMI, body mass index (Kg/m^2); Mean, arithmetic mean; SD, standard deviation; p, percentile; Min, minimum; Max, maximum. *In reference to children; #No, never; S_{RMS}, Root mean-square power density; S_{MAX}, Maximum power density.

181 subjects) in cognitive or behavioral function scores or in parent characteristics. Supplementary Tables 2 and 3 exhibit raw cognitive function scores and standardized behavioral function scores according to the median RF-EMF exposure level. Figure 1 depicts the association between cognitive functions and some behavioral problems as a function of Power Density (S_{RMS} μW/m^2).

The association between RF-EMF exposure and cognitive functioning was examined using multivariable linear regression models. Unadjusted analysis showed a negative relationship between children in higher exposure areas ($S_{RMS} \geq 285.94$ μW/m^2) and several neuropsychological test scores in comparison to children in lower exposure areas, which was statistically significant for IQ ($P = 0.05$) and verbal expression and comprehension ($P = 0.03$). However, after adjustment for covariates (childs place of residence, maternal schooling, maternal smoking during pregnancy, and Wi-Fi), only verbal expression and comprehension remained significant (Table 2). The results for exposure in tertiles were consistent with the findings obtained with the dichotomous categorization of exposure in relation to verbal expression and comprehension (Supplementary Table 4). Multivariable logistic regression analysis of the association between RF-EMF exposure and cognitive functioning revealed a higher risk of worse flexibility [OR = 3.90; 95%CI = (1.37–12.95); $P = 0.01$] in the children with $S_{RMS} \geq 285.94$ μW/m^2 (data not shown).

Multivariable linear regression models were also used to examine the relationship between cognitive functioning and RF-EMF exposure considered as the maximum power density (S_{MAX}). As shown in Table 2, unadjusted analysis showed a negative relationship between children in higher exposure areas [$S_{MAX} \geq 2759.68$ μW/m^2 (median value)] and certain neuropsychological test scores in comparison to children in lower exposure areas ($S_{MAX} < 2759.68$ μW/m^2); this negative association was statistically significant for IQ score ($P = 0.03$) and verbal expression and

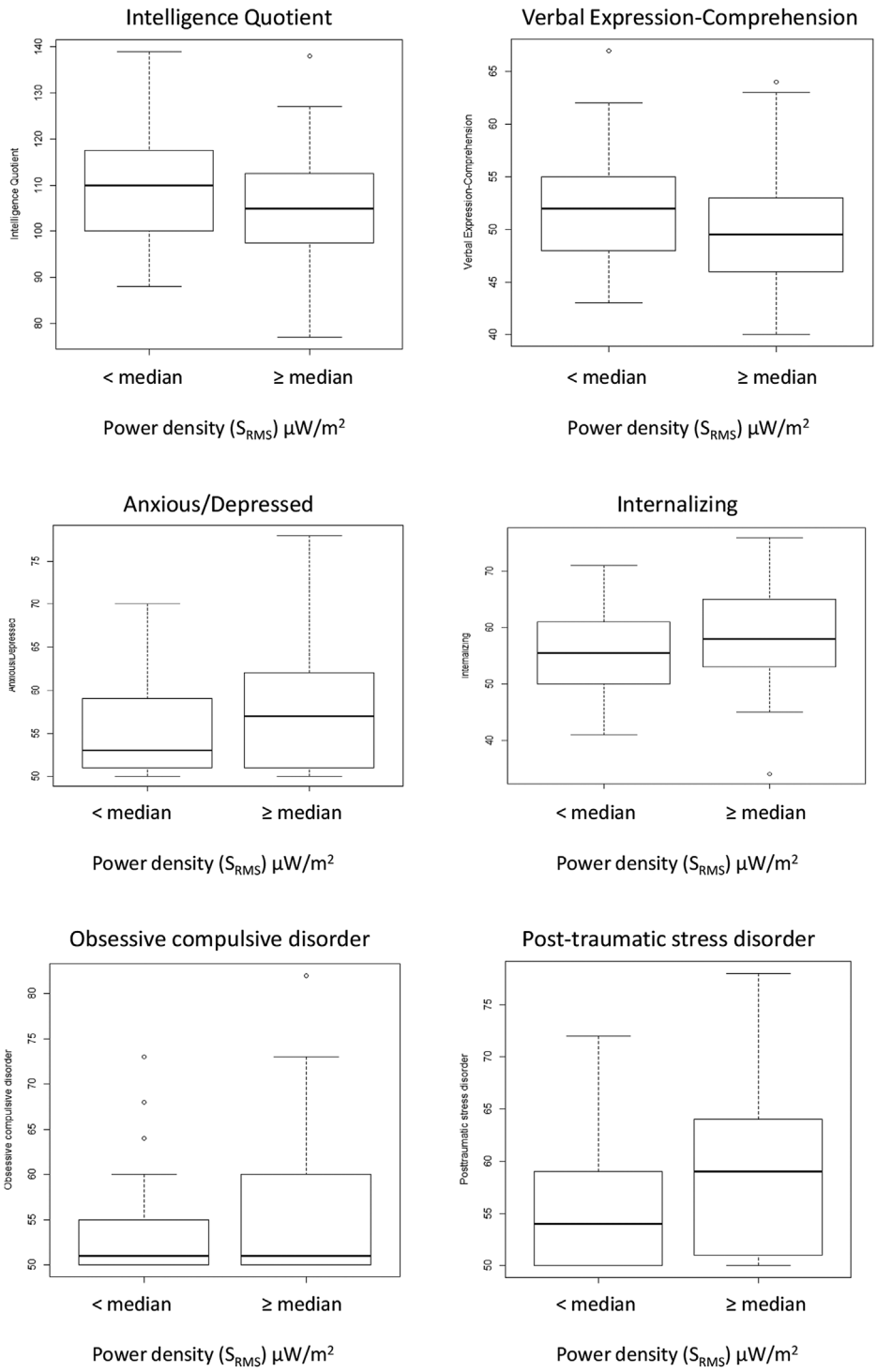

Figure 1. Association of Radiofrequency Electromagnetic Field [Root Mean Square Power Density (S_{RMS} μW/m^2)] exposure with two cognitive functions (IQ and verbal expression/comprehension) and some behavioral problems (anxious/depressed symptoms; internalizing symptoms, obsessive compulsive disorder, and post-traumatic stress disorder).

TABLE 2. Association Between RF-EMF Exposure Levels and Cognitive Development in Children From INMA-Granada Cohort ($n = 119$)

	$S_{RMS} \geq 285.9\ (\mu W/m^2)$						$S_{MAX} \geq 2759.68\ (\mu W/m^2)$					
	Crude model			Adjusted model			Crude model			Adjusted model		
	β	SE	P	β	SE	P	β	SE	P	β	SE	P
Intelligence quotient[a]	−7.83	4.03	**0.05**	−7.19	3.74	0.06	−11.03	3.96	**<0.01**	−8.49	3.77	**0.03**
Verbal expression and comprehension[a]	−2.08	0.94	**0.03**	−1.91	0.88	**0.03**	−2.76	0.92	**<0.01**	−2.34	0.88	**0.01**
Attention												
Impulsivity[b]	3.22	2.38	0.18	3.22	2.38	0.18	2.95	2.30	0.20	2.86	2.42	0.24
Attention Index[a]	−0.01	0.05	0.82	−0.01	0.05	0.80	−0.02	0.05	0.63	−0.02	0.05	0.74
Verbal memory[a]												
Short-term recall	−0.26	0.40	0.52	−0.35	0.41	0.38	−0.45	0.39	0.26	−0.50	0.41	0.22
Long-term recall	−0.10	0.43	0.82	−0.16	0.44	0.72	−0.54	0.43	0.21	−0.52	0.45	0.25
Visual-motor coordination[b]	1.68	1.89	0.38	1.45	1.90	0.45	1.92	1.89	0.31	1.18	1.93	0.54
Processing speed[a]	−0.68	2.30	0.77	−0.68	2.30	0.77	−2.97	2.24	0.19	−2.75	2.32	0.24
Executive functions												
Working memory[a]	0.29	0.47	0.54	0.29	0.47	0.54	0.02	0.49	0.96	0.23	0.48	0.63
Verbal fluency[a]	−0.48	0.74	0.51	−0.48	0.74	0.51	−0.23	0.71	0.75	−0.16	0.75	0.84
Impulsivity/inhibition												
Interference[a]	−0.53	0.99	0.60	−0.53	0.99	0.59	−0.41	0.96	0.67	−0.58	1.01	0.57
Hit rate[a]	<0.01	<0.01	0.56	<0.01	<0.01	0.56	<−0.01	<0.01	0.82	<0.01	<0.01	0.95
False-alarm rate[b]	<0.01	<0.01	0.65	<0.01	0.01	0.65	0.01	0.01	0.15	0.01	0.01	0.15
Flexibility[b]	12.35	6.42	0.06	11.42	6.63	0.09	12.61	6.41	**0.05**	10.70	6.73	0.12
Abstract reasoning[a]	−0.59	0.81	0.47	−0.59	0.81	0.47	−1.43	0.83	0.09	−1.06	0.82	0.20

β, linear regression coefficient; SE, standard error; RF-EMFs, radiofrequency electromagnetic fields given as power density (S); RMS, root mean-square; MAX, maximum. Adjusted for childs place of residence, smoking during pregnancy, maternal schooling and Wi-Fi. Direct scores were used for all tests.

Bolded values signify $P \leq 0.05$.

[a]Higher score indicates better cognitive function.

[b]Higher score indicates worse cognitive function.

comprehension ability ($P = 0.01$) in the adjusted model. The results for exposure in tertiles were consistent with those obtained for the dichotomous categorization of exposure in relation to internalizing and total problems and obsessive-compulsive and post-traumatic stress disorders (Supplementary Table 5). Multivariable logistic regression models revealed a significantly higher risk of a score < P20 in verbal expression and comprehension test in children from higher exposure areas (OR = 3.37; 95%CI = 1.34–9.08; $P = 0.01$) (data not shown).

The relationship between RF-EMF exposure and behavioral functioning was also explored. Unadjusted multivariable linear regression analysis showed that anxious-depressed behaviors, social problems, rule-breaking, total problems, obsessive compulsive disorder (OCD), and posttraumatic stress disorder (PTSD) were positively and significantly associated with higher ($S_{RMS} \geq$ median) vs. lower exposure (Table 3). When the model was adjusted for the childreńs place of residence, maternal schooling, maternal smoking during pregnancy, and Wi-Fi, the associations with anxious-depressed behaviors, social problems, OCD, and PTSD remained statistically significant (Table 3). No significant results were obtained in the multivariable logistic regression analysis (data not shown).

The relationship between S_{MAX} and behavioral functioning was examined with multivariable linear regression models. Adjusted analysis showed a positive association between children with $S_{MAX} \geq 2759.68\ \mu W/m^2$ and several behavior scores, which was statistically significant for anxious/depressed behaviors ($P < 0.01$), social problems ($P = 0.04$), rule-breaking ($P < 0.01$), aggressive behavior ($P = 0.04$), internalizing ($P = 0.05$), total problems ($P = 0.01$), anxiety problems ($P = 0.03$), ADHD ($P = 0.04$), conduct problems ($P = 0.02$), OCD ($P = 0.02$), and PTSD ($P = 0.01$). A negative association was found with school competence ($P = 0.04$) (Table 3).

Multivariable logistic regression analysis found no significant relationship between RF-EMF exposure (S_{MAX}) and behavioral functioning.

DISCUSSION

Environmental exposure to RF-EMF appeared to be associated with worse verbal expression/comprehension and with a few behavioral problems

TABLE 3. Association Between RF-EMFs Exposure Levels and Behavioral Tests in Children From INMA-Granada Cohort ($n = 119$)

	$S_{RMS} \geq 285.9\ (\mu W/m^2)$						$S_{MAX} \geq 2759.68\ (\mu W/m^2)$					
	Crude model			Adjusted model			Crude model			Adjusted model		
	β	SE	P	β	SE	P	β	SE	P	β	SE	P
Individual scores (typical scores)*												
Anxious/depressed	2.48	1.23	**0.05**	2.51	1.24	**0.05**	3.34	1.21	**0.01**	3.53	1.24	**0.01**
Withdrawn/depressed	1.89	1.28	0.14	1.78	1.30	0.17	1.80	1.28	0.16	1.68	1.32	0.21
Somatic complaints	0.91	1.16	0.44	0.62	1.13	0.58	1.04	1.16	0.37	0.52	1.15	0.65
Social problems	1.86	0.86	**0.03**	1.69	0.85	**0.05**	1.87	0.85	**0.03**	1.79	0.87	**0.04**
Thought problems	1.31	1.16	0.26	0.86	1.17	0.46	1.87	1.15	0.11	1.56	1.18	0.19
Attention problems	1.95	1.03	0.06	1.71	1.02	0.10	2.22	1.03	**0.03**	1.93	1.04	**0.07**
Rule Breaking	1.99	1.01	**0.05**	1.73	0.98	0.08	3.54	0.98	**<0.01**	3.01	0.97	**<0.01**
Aggressive behavior	1.52	1.04	0.15	1.28	1.04	0.22	2.59	1.02	**0.01**	2.22	1.04	**0.04**
Composite scores												
Internalizing problems	2.86	1.49	0.06	2.71	1.45	0.06	3.09	1.48	**0.04**	2.96	1.47	**0.05**
Externalizing problems	1.61	1.75	0.36	1.31	1.72	0.45	3.35	1.73	0.06	2.97	1.74	0.09
Total problems	3.22	1.58	0.04	2.87	1.52	0.06	4.17	1.56	**0.01**	3.83	1.53	**0.01**
DSM-oriented scales												
Affective problems	1.60	1.17	0.17	1.28	1.15	0.27	2.02	1.16	0.08	1.79	1.17	0.13
Anxiety problems	2.18	1.39	0.12	2.08	1.39	0.14	2.85	1.37	**0.04**	3.01	1.40	**0.03**
Somatic problems	-0.36	1.18	0.76	-0.62	1.12	0.58	0.36	1.18	0.76	-0.07	1.14	0.95
ADHD problems	1.62	1.07	0.13	1.24	1.05	0.24	2.65	1.05	**0.01**	2.20	1.06	**0.04**
Oppositional-defiant	0.97	0.95	0.31	0.73	0.94	0.44	1.60	0.94	0.09	1.37	0.95	0.15
Conduct problems	1.61	0.98	0.10	1.34	0.95	0.16	2.84	0.95	**<0.01**	2.28	0.95	**0.02**
Obsessive compulsive disorder	2.38	1.16	**0.04**	2.52	1.19	**0.04**	2.68	1.16	**0.02**	2.93	1.20	**0.02**
Posttraumatic stress disorder	3.23	1.21	**0.01**	2.87	1.19	**0.02**	3.54	1.21	**<0.01**	3.13	1.21	**0.01**
Competences												
School competence	−2.02	1.11	0.071	−1.83	1.10	0.10	−2.73	1.09	**0.01**	−2.35	1.11	**0.04**
Social competence	−0.81	1.51	0.592	−0.62	1.49	0.68	−0.34	1.51	0.82	0.07	1.52	0.96

* Typical scores were used for all tests. Internalizing problems include anxious/depressed, withdrawn/depressed, and somatic complains; externalizing problems include rule breaking and aggressive behavior; total problems include eight individual scores. Linear regression model adjusted for child's place of residence, smoking during pregnancy, maternal schooling, and Wi-Fi; β: linear regression coefficient; SE, standard error; RF-EMFs, radiofrequency electromagnetic fields are given as power density (S); RMS, root mean-square; MAX, maximum; DSM, diagnostic and statistical manual of mental disorders; ADHD, attention deficit hyperactivity disorder. Bolded values signify $P \leq 0.05$.

(internalizing and total problems, obsessive-compulsive and post-traumatic stress disorders) in the children in this study; however, the majority of neurobehavioral functioning tasks were not affected. Thus, children with higher exposure levels ($S_{RMS} \geq 285.9\ \mu W/m^2$) in the immediate surrounds of their dwellings had lower verbal expression/comprehension scores and higher behavioral and emotional problems, including anxious-depressed behaviors, OCD, and PTSD, in comparison to those in lower exposure areas levels ($S_{RMS} < 285.9\ \mu W/m2$). When exposure was measured as $S_{MAX,}$ similar results were observed for cognitive functions but worse results for internalizing and total behavior problems, finding lower IQ and school competence scores and higher ADHD and social and conduct problems (aggressive and rule-breaking behaviors) in children from higher ($S_{MAX} \geq 2759.68\ \mu W/m^2$) vs. lower exposure areas. The prevalence of total behavior problems was greater with higher exposure. Overall, 8.6% of the children were classified as borderline/clinical in the lower exposure group *vs*. 20.3% of those in the higher exposure group. Nevertheless, there are a number of issues that need to be critically considered.

In the present study, direct measurements of environmental exposure were conducted in the immediate surrounds of the children's dwellings. Most researchers have analyzed the association between RF-EMF exposure and effects on neurobehavioral function in children by considering self-reported cell phone use by pregnant mothers or children as proxies of exposure. Only a few studies have directly measured environmental or individual exposure, for example, with spot measurements or personal dosimeters [Barth et al., 2008; Berg-Beckhoff et al., 2009; Frei et al., 2010; Heinrich et al., 2010, 2011; Thomas et al., 2010].

Although it is difficult to compare results among studies, environmental exposure levels in the present study were within the range of RF levels described in Europe [Calvente et al., 2015]. Thus, mean Savg values were lower but median Savg values higher than those reported by Tomitsch and Dechant [2012, 2015]. Power density levels were also lower than those from mobile phone base station antennas measured by Abdel-Rassoul et al. [2007]. Moreover, all of measured exposure values in our study were several orders below current ICNIRP guideline limit [1998] recommended for the general population, in line with reports by Heinrich et al., [2010, 2011] and Thomas et al. [2010].

Few studies have investigated the possible adverse health effects of RF-EMF exposure in children, who may be more vulnerable than adults to EMF-NIR [Kheifets et al., 2005; Schüz, 2005]. For instance, the lower bone density and lesser amount of fluid in the brains of children *vs*. adults may result in a deeper cerebral absorption of larger amounts of RFs [Christ et al., 2010]. However, evidence that children are indeed more vulnerable to this exposure remains scant [Otto and von Mühlendahl, 2007; Leung et al., 2011; BioInitiative, 2012], and some studies have shown that effects in children did not differ from those in healthy adults [van Rongen et al., 2009; Croft et al., 2010; Segalowitz et al., 2010; Feychting, 2011; Valentini et al., 2011; Loughran et al., 2013]. The direct impact of RF exposure on neurodevelopment remains unknown, and the mechanisms that may be involved are poorly understood [Regel and Achermann, 2011; Loughran et al., 2013]; nevertheless, its negative health effects cannot be ruled out [Wiedemann and Schütz, 2011], and some scientific reports of adverse effects may indicate that a reduction in exposure is warranted as a preventive measure, especially for children [Hardell and Sage, 2008; Divan et al., 2010; Rosenberg, 2013; Redmayne, 2015].

Some cognitive effects of short-term experimental exposure to RF-EMF fields were previously reported in a meta-analysis that found small but significant pooled effects of RF exposure on attention and working memory [Barth et al., 2008]. A possible cognitive effect of mobile phone use was also investigated among Australian young adolescents (12–13 years), taking into account both total voice calls and short message service (SMS) messages made and received per week. Poorer accuracy of working memory, shorter response time on learning tasks, and poorer inhibitory function were observed among students with greater exposure [Abramson et al., 2009]. Nevertheless, the follow-up of participants at one year showed changes in reaction times but not in accuracy [Thomas et al., 2010b]. Finally, according to a critical review of 41 studies addressing the effects of RF-EMF exposure on human cognitive development, no specific cognitive task appears especially susceptible to RF EMF exposure [Regel and Achermann, 2011].

A possible association between measured exposure to RF-EMF fields and behavioral problems was investigated among Bavarian children and adolescents using personal dosimeters. The highest quartile of exposure was associated with overall behavioral problems for adolescents (OR 2.2; 95%CI 1.1–4.5) but not for children (1.3; 95%CI 0.7–2.6) [Thomas et al., 2010].

A study in Egypt based on power density values provided by the National Telecommunications Institute reported that adults living near mobile phone base stations and exposed to higher RF-EMF evidenced a significantly lower performance in attention and short-term auditory memory. However, the authors concluded that further research was required to establish a causal relationship between exposure to RF-EMF emitted by mobile phone base stations and neurobehavioral dysfunction [Abdel-Rassoul et al., 2007].

The strengths of our study include the direct measurement of environmental exposure to RF-EMF and the analysis of its relationship with cognitive and behavioral functioning in healthy school children, on which few published data are available. The children belonged to a prospective birth cohort that has been followed over ten years, yielding data on multiple covariates since birth. The programming, measurement, and analysis were performed by the same person, reducing the potential variability in measurements and improving the comparability of results; and the evaluation of neurodevelopment was performed by a single psychologist blinded to the RF exposure status of the children, using a wide battery of tests. There is no consensus on the most appropriate instruments for identifying cognitive and behavioral problems in children. We used a comprehensive battery of neuropsychological tests and behavioral assessments at the age of 9–11 years, a time window that allows a wide range of cognitive and behavioral functions to be examined with sensitive and specific tests [Ramos et al., 2013].

Ideally, exposure assessment combines personal dosimeter readings with exposure data on the multiple indoor and outdoor locations in which subjects spend time [Martens et al., 2015]. Personal dosimeters are considered to provide the best assessment of individual RF-EMF exposure, although this may be underestimated by these devices [Heinrich et al., 2010, 2011; Neubauer et al., 2010]. A relevant issue for the

present study design is that the utilization of personal dosimeters is especially challenging in children [Juhász et al., 2011]. We used spot measurements as a proxy of exposure because they did not rely on the compliance of our young study population and were less costly. Spot measurements have also been described as more accurate and less prone to bias in comparison to self-reported exposure [Heinrich et al., 2010], and Gryz et al. [2015] concluded that the uncertainty of exposure assessments was significantly higher with the use of a single exposimeter in comparison to spot measurements. Nevertheless, spot measurements outside the home have been described as inadequate surrogates of individual exposure [Martens et al., 2015], and this study limitation should be taken into account in interpreting our results.

The present findings should also be interpreted with caution because statistical significance was only reached for one cognitive function and a few behavioral tasks, which may be due to chance or to the performance of multiple comparisons. Furthermore, as the design of the study was cross-sectional and the exposure and neurodevelopment were only assessed at one time point, it is not possible to determine whether the RF-EMF exposure had affected cognitive function or whether these findings represented pre-existing cognitive and/or behavioral development. Other methodological limitations that need to be taken into consideration include the lack of control for potential confounders, for example, pubertal development or maturity of the child. In addition, the influence of individual variability in development may play a role in exposure-related effects, as highlighted by other authors [Croft et al., 2010, Segalowitz et al., 2010]. Our population only comprised boys; hence, these results cannot be extrapolated to girls, given the gender differences in social and cultural factors and their relationship to psychological disorders. Finally, it should also be taken into account that the observed effects on cognitive and behavioral abilities may have been mediated by other socio-cultural, economic, or genetic variables that were not controlled for in this study, such as breastfeeding, paternal psychological problems, or exposure to environmental contaminants, among others.

CONCLUSIONS

Some of the present findings may suggest that low-level environmental exposure to RF-EMFs has a negative impact on cognitive and/or behavioral development in children; however, given limitations in the study design and that the majority of neurobehavioral functioning tasks were not affected, definitive conclusions cannot be drawn. Further research is warranted to elucidate the potential risks of long-term exposure and to investigate the underlying mechanisms. A more standardized research approach is needed to reveal meaningful results on which risk assessment can be soundly based after evaluation of the relevance of any effects.

ACKNOWLEDGMENTS

The authors are grateful to all participating INMA families for their cooperation and to Richard Davies for editorial assistance. The funders had no role in the study design, data collection and analysis, decision to publish, or preparation of the manuscript. Confinanciado por Fondos Feder.

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PLOS ONE

RESEARCH ARTICLE

Increased aggression and reduced aversive learning in honey bees exposed to extremely low frequency electromagnetic fields

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Citation: Shepherd S, Hollands G, Godley VC, Sharkh SM, Jackson CW, Newland PL (2019) Increased aggression and reduced aversive learning in honey bees exposed to extremely low frequency electromagnetic fields. PLoS ONE 14 (10): e0223614. https://doi.org/10.1371/journal.pone.0223614

Editor: Adam G Dolezal, University of Illinois at Urbana-Champaign, UNITED STATES

Received: June 7, 2019

Accepted: September 24, 2019

Published: October 10, 2019

Data Availability Statement: All relevant data are within the manuscript and its Supporting Information files.

Funding: SS was funded by a Mayflower Studentship from the University of Southampton. The funder had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript. Publication of this article was funded in part by Purdue University Libraries Open Access Publishing Fund.

Abstract

Honey bees, *Apis mellifera*, are a globally significant pollinator species and are currently in decline, with losses attributed to an array of interacting environmental stressors. Extremely low frequency electromagnetic fields (ELF EMFs) are a lesser-known abiotic environmental factor that are emitted from a variety of anthropogenic sources, including power lines, and have recently been shown to have a significant impact on the cognitive abilities and behaviour of honey bees. Here we have investigated the effects of field-realistic levels of ELF EMFs on aversive learning and aggression levels, which are critical factors for bees to maintain colony strength. Bees were exposed for 17 h to 100 μT or 1000 μT ELF EMFs, or a sham control. A sting extension response (SER) assay was conducted to determine the effects of ELF EMFs on aversive learning, while an intruder assay was conducted to determine the effects of ELF EMFs on aggression levels. Exposure to both 100 μT and 1000 μT ELF EMF reduced aversive learning performance by over 20%. Exposure to 100 μT ELF EMFs also increased aggression scores by 60%, in response to intruder bees from foreign hives. These results indicate that short-term exposure to ELF EMFs, at levels that could be encountered in bee hives placed under power lines, reduced aversive learning and increased aggression levels. These behavioural changes could have wider ecological implications in terms of the ability of bees to interact with, and respond appropriately to, threats and negative environmental stimuli.

Introduction

Over the last 30 years there has been a decline in the numbers of the economically and ecologically important honey bee [1, 2]. Honey bee declines are part of a much larger global problem of pollinator declines [3] with major causes attributed to a combination of interacting, and mainly anthropogenically driven, environmental stressors including, habitat loss, pesticide exposure, pathogens and parasites [4]. Electromagnetic pollution is emerging as a lesser-

Competing interests: The authors have declared that no competing interests exist.

known abiotic environmental factor that has the potential to affect insect biology and thus may contribute to the environmental stress load that insects currently experience in global ecosystems [5, 6].

Extremely low frequency electromagnetic fields (ELF EMFs) are a specific type of non-ionising electromagnetic radiation in the frequency range 3–300 Hz that are emitted from anthropogenic devices. Pollution of the environment with ELF EMFs has increased dramatically in the last century, with a major source for ELF EMFs being power transmission lines [7]. ELF EMF exposure has recently been associated with a variety of different effects on insects including changes in developmental biology [8, 9], locomotor behaviour [6, 10], molecular biology [11, 12], and immune response [13].

Honey bees may be particularly at risk to ELF EMF pollution in the environment. At ground level, ELF EMF intensity under power transmission lines can reach 100 μT, while flying insects can be exposed to much higher levels close to conductors where ELF EMF levels can be over 1,000 μT [5]. Some studies suggest exposure to ELF EMFs from power lines may be stressful for honey bees [14, 15] whilst it has also been reported [16] that bees hived under power lines will readily abscond. Moreover, Greenberg et al. [17] found that bee hives exposed to power lines had increased motor activity, abnormal propolisation, reduced weight gain of hives, queen loss, impaired production of queen cells, decreased sealed brood and poor winter survival, leading to a federal US precaution to not store hives under power lines [18]. While these studies show no direct experimental evidence for ELF EMF effects on bees, they at least suggest that ELF EMF exposure may be a factor that contributed to, or caused, the stress responses of the bees observed in these studies.

In their environment bees are exposed to a variety of negative environmental stimuli and cues, which are also critical for bees to perceive and respond to, such as weather, toxins [19], or biotic threats such as colony diseases and parasites [20, 21], invading robber bees from other colonies [20] and predators [21–23]. How colonies respond to these environmental stresses is critical to their long-term fitness. Bees must be able to detect these negative stimuli [20], learn that they are associated with a negative effect [19], enact an appropriate aggressive response [22], and even communicate this information to other individuals [23]. For example, guard bees when confronted with a threat (e.g. predator or intruder) may enter the hive to release alarm pheromone by extruding their sting, raising their abdomen and fanning their wings [24, 25].

Surprisingly little is known about aversive learning, and how it is affected by environmental stimuli, despite its importance in maintaining colony fitness. A sting extension response (SER) assay [26, 27] has been developed to study aversive learning in bees in which a conditioned stimulus (CS) (often olfactory) is applied and associated with an unconditioned stimulus (US) of a weak electric shock. Over repeated conditioning trials bees learn to associate the negative US with the CS. The SER assay can therefore provide valuable information in a controlled experimental environment of how potential stressors such as ELF EMFs can affect bees [28]. For example, SER has been used to investigate the impacts of the neonicotinoid insecticide imidacloprid on honey bee aversive learning [29]. In addition, intruder assays have been used to assess aggressive responses of honey bees, including to conspecifics [30–33]. Environmental stresses which could affect the ability of bees to learn about negative environmental cues, or respond appropriately to environmental cues, could therefore be detrimental to honey bee colony health.

Here we have used both the SER and intruder assays to determine whether short term exposure to ELF EMFs, at levels equivalent to those found at ground level under high-voltage transmission power lines, can affect aversive learning and aggression in honey bees. We have utilised these well-established assays in the laboratory where the levels of EMF exposure of

individual bees can be precisely controlled, and under consistent conditions free from stray fields and other confounding stimuli.

Materials and methods

Magnetic fields

Electromagnetic fields were generated with a custom-made Helmholtz coil [5] which produced homogenous 50 Hz sinusoidal AC electromagnetic fields with a range of field strength from ~10 μT—10,000 μT. Field strength (magnetic flux density) was measured with a Model GM2 Magnetometer (Alphalab Inc., USA). For control exposures no current was passed through the coil system. For SER experiments control, 100 μT and 1000 μT 50 Hz EMF treatments were applied, while for intruder assay experiments control and 100 μT ELF EMF treatments were used.

Animals

Honey bees were kept at the University of Southampton Highfield Campus apiary (50˚ 56' 10"N, 1˚ 23' 39"W) and experiments conducted from June-August, 2017. Foragers were identified by the pollen in their corbiculae and transported to an insectary in the Institute for Life Sciences at the University of Southampton, where they were immobilized on wet ice and transferred into appropriate containers for SER and Intruder Assay experiments.

Sting extension response assay

Bees were collected individually from 3 hives and harnessed in custom made SER cradles cut from Perspex, with a similar design to Vergoz et al. [27]. Bees were placed ventral side upwards in a metal fork of the cradle, such that the fork held the bee by the thorax, with prongs in place around the petiole and neck of the bee (Fig 1A). This fork also served as an electrode for an

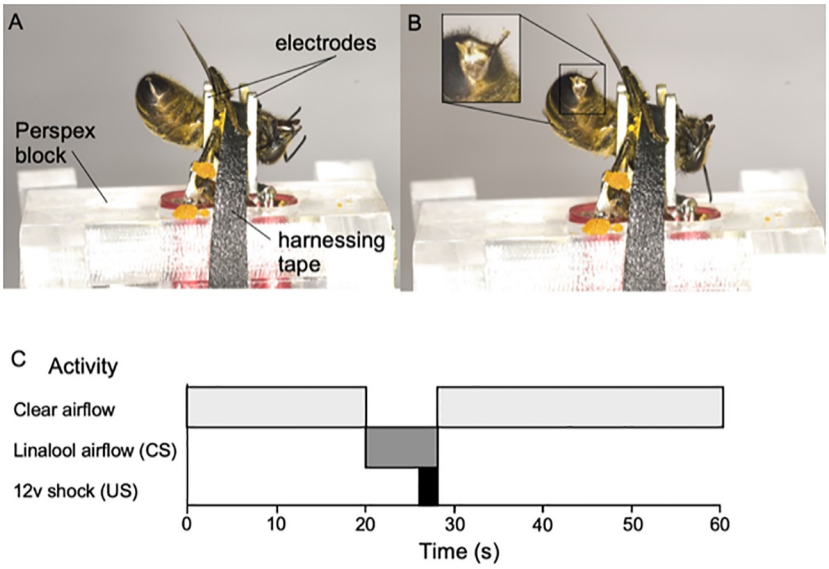

Fig 1. Sting extension response protocol. A) Harnessing of a bee in an SER cradle for EMF exposure. Tesa© tape was applied around the thorax to hold the bee between the fork prongs. B) Aversive sting extension response to the CS in SER conditioning trials. The inset shows the extended stinger in more detail. C) SER Timetable showing a representation of an individual conditioning trial. The bee was acclimatised to the arena for 20 s, before CS (linalool) application. After 6 s of CS, CS and US (12 V shock) were paired for 2 s, after which both CS and US were switched off. A further 32 s of clear airflow was allowed for odour to be removed from the arena.

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aversive shock stimulus during the SER assay (Fig 1B). Tesa© tape was then placed laterally across the cradle and between the prongs of the fork across the thorax to restrain the bee in the cradle. Bees were then fed to satiation with a 50% w/v sucrose solution and were then ready for overnight treatment (17 h).

An experimental arena (W × D × H = 60 × 45 × 55 cm) was used with an odour delivery system at one end and an extraction fan at the other to remove any odours from the arena. The odour delivery system allowed a constant airflow to be supplied to the arena. A clear airflow, and the CS, were delivered in separate channels in the multichannel system which joined via Teflon tubing before it discharged into the arena at a single release point. Electronic valves allowed the airflow to switch between CS and clear airflow channels. The CS used was 8 μl of 97% linalool (Sigma-Aldrich, UK) which was pipetted onto filter paper to be placed in the CS delivery channel. The channel with clear air was always open when no odour was delivered. To deliver the CS, airflow was switched from the clear air channel to the odour delivery channel such that bees were supplied with a constant airflow, and would associate any stimulus with the odour and not a change in airflow.

For SER experiments bees were exposed to control, 100 μT or 1000 μT EMFs for 17 h and following exposure SER trials began immediately. This treatment was chosen to represent a field-realistic scenario where bee hives are placed under transmission and where bees have been reported to show negative responses [17]. 357 bees completed the SER assay. An SER cradle containing a harnessed bee was placed into the experimental arena of the odour delivery system. Bees were exposed to a clear airflow for 20 s (Fig 1C). During this time the SER cradle was attached to a DC power-supply with a 12 V output. The airflow was then switched from clean air to linalool airflow, representing the CS. The CS lasted 8 s. For the final 2 s of the CS the bee was shocked at 12 V from the DC power supply, representing the unconditioned stimulus (US) thus pairing US and CS for 2 s. The US and CS finished at the same time (28 s into the trial). The clear airflow was then left on for 32 s with the bee in the arena to reinforce the association of the CS with the US and to allow the extractor to remove linalool from the arena. The length of one complete conditioning trial for a bee was 60 s (Fig 1C).

Conditioning trials were repeated 5 times for each individual bee with an inter-trial interval of 10 min. If a bee did not respond during linalool delivery or electric shock then a 'failed response' was recorded. Bees that failed to respond more than once in conditioning trials (n = 16, 4.5% of 357) were excluded from analyses. No bees exhibited a pre-learned aversive response to linalool in the first conditioning trial, and therefore no bees had to be excluded from analysis for this reason. After all exclusions were made, 341 bees remained that completed the SER assay for inclusion in statistical analyses (S1 Table).

If a bee responded only after the shock stimulus then a non-conditioned sting extension response was recorded (i.e. the bee responded to US but not CS). As in previous aversive learning studies responses to the conditioned stimulus have been described only when a bee extends its sting during the CS application, and are defined as a 'sting extension response' (Fig 1A and 1B). The proportions of conditioned sting extension responses over 5 trials were analysed to assess the effects of short-term ELF EMF exposure on aversive learning in honey bees.

This aversive learning approach therefore measures acquisition and short-term retention of information, and thus has comparability with the results of the intruder assay where bees encounter a new individual from a foreign hive.

Intruder assay

Bees were collected from 5 different hives in groups of 20 bees from the same hive of origin. Each group of 20 was split into 2 paired cohorts of 10 (S2 Table), and stored in separate petri

Table 1. Aggressive severity behavioural index used in the intruder assay adapted from Richard et al. [31].

Behaviour	Definition	Aggressive Severity Index
Aggressive antennation	Antennation directed towards the intruder or touching the intruder with antennae	1
Stalking	Follows and moves towards intruder for more than 5 seconds	1
Crawl over	Moves directly on top of the intruder	1
Antennation with mandibles open	Antennation directly towards the intruder with mandibles open	2
Biting	Uses mandibles to grasp the intruder	3
Abdomen flexion	The abdomen is flexed but the stinger is not extruded	4
Stinging attempts	The stinger is visibly extruded towards the intruder	5

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dishes fitted with 50% w/v sucrose feeders. For each pair of 10-bee cohorts (from the same hive of origin) 1 cohort was exposed to a 100 μT ELF EMF and the other exposed to control conditions (both at 22 ± 1˚C) for 17 h overnight. The intruder assay was conducted the next day.

The sample period for the intruder assay began when a forager bee from a 6th (and different) hive was introduced into each petri dish. Focal sampling of the 'intruder' bee was conducted continuously for 10 min to assess the behaviour of recipient bees towards the intruder. Behaviours were categorized on an aggressive severity index adapted from Richard et al. [31] (Table 1) and the aggressive severity indices summed for a full 10 min sample period to give an overall aggression score for that sample. In total 60 intruder assay samples were conducted (n = 30 per treatment, with 6 assays/treatment/hive).

Statistical analysis

Data were analysed in SPSS (v.24, IBM SPSS Inc.) and Graphpad Prism (v.7, Graph Pad Software Inc.). Where appropriate, homogeneity of variance and normality assumptions were tested. For all models assessing the effects of treatments on binomial SER data, binomial error structure and logit link function were used, and where appropriate pairwise contrasts with Bonferroni adjusted significance were used in *post-hoc* analyses.

To determine whether ELF EMF exposure or 'hive or origin' affected the initial aversive responsiveness of bees a generalized linear model (GLM) with 'EMF treatment' and 'hive of origin' as interacting factors was used. To analyse the effect of ELF EMF exposure on sting extension responses, a generalized mixed effect model (GLMM) was used with 'EMF treatment', 'hive of origin', and 'conditioning trial' as interacting factors. For GLMMs trial 1 was not included in analyses (i.e. trials 2–5 were used), as learning cannot occur in the first trial. For intruder assay analysis, aggression scores were totalled from each trial and data $\log_{10}$-transformed to satisfy normality assumptions for parametric statistical analyses. A two-way Repeated Measures ANOVA was conducted to determine the effects of 'EMF', and 'Hive of Origin' on log-transformed aggression score data, with data paired by their collection cohort. Data plotted in aggression score graphs is back-transformed.

Results

Sting extension response

ELF EMFs do not reduce the ability of bees to respond to aversive stimuli. To determine whether short-term exposure to EMF (control, 100 μT, or 1000 μT) affected the ability of bees to respond with an aversive extension of the sting, the proportions of bees which did not

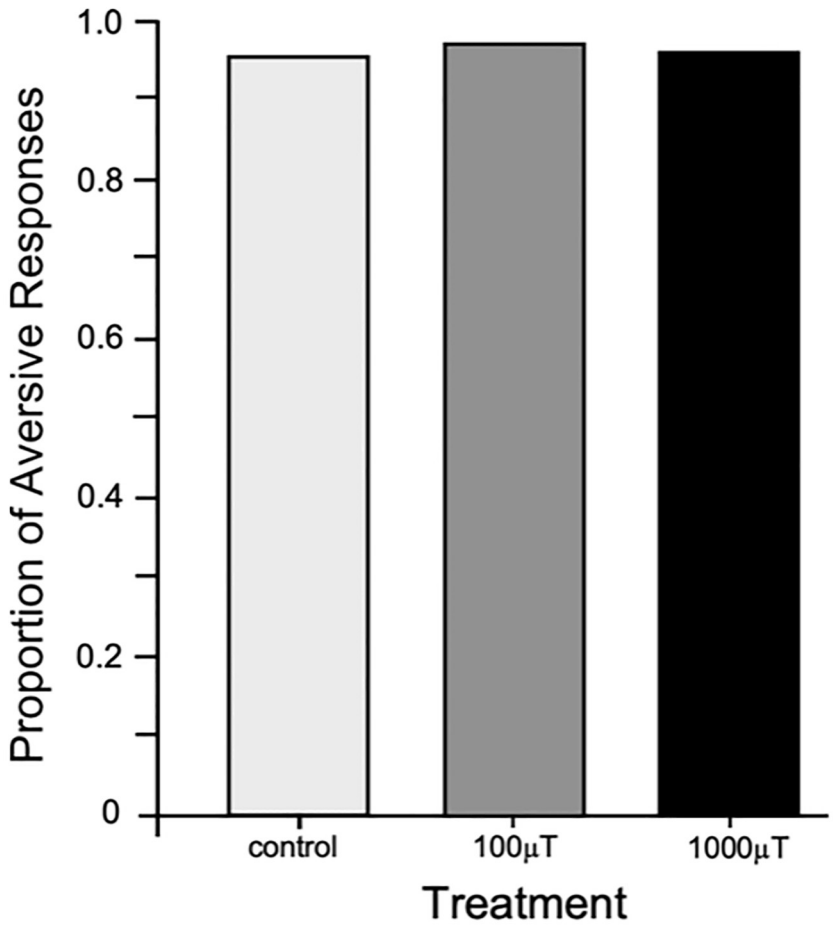

Fig 2. Aversive responses of honey bees in the SER assay. The effect of ELF EMF treatment on the proportion of aversive responsiveness to 12 V electric shock aversive stimuli. Exact proportions are plotted. Results show that ELF EMFs had no effect on the aversive responses of bees to electrical stimulation.

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fail to respond to the US (i.e. non-learned sting extension to an aversive stimulus) between each treatment were compared. After 17 h control exposure 95.0% of bees (n = 119) exhibited aversive responses (Fig 2), whereas 96.6% (n = 118) responded following exposure to 100 μT and 95.0% (n = 120) responded following exposure to 1000 μT EMFs. Thus, the initial aversive responsiveness of honey bees was not affected by any interaction between the ELF EMF 'treatment' or the honey bee 'hive of origin' (GLM, $\chi^2<0.001$, d.f. = 4, $P > 0.99$), nor were there any main effects of 'treatment' (GLM, $\chi^2<0.001$, d.f. = 2, $P > 0.99$) or 'hive of origin' (GLM, $\chi^2<0.001$, d.f. = 2, $P > 0.99$).

ELF EMFs reduce learning performance of the sting extension response. For control bees, and those exposed to 100 μT and 1000 μT ELF EMFs, the proportion of bees exhibiting a sting extension response increased with each conditioning trial (GLMM, $F_{3,1352} = 26.08$, $P < 0.0001$). For bees maintained under control conditions 29% showed SER after trial 3 while 50% showed SER after conditioning trial 5 (Fig 3). By contrast, after bees were exposed to 100 μT ELF EMFs only 12% of bees showed SER after trial 3 and 32% after trial 5. Following exposure to 1000 μT ELF EMFs 19% showed an SER after trial 3 and 27% after trial 5. EMF treatments were found to significantly reduce the proportions of SER in honey bees (GLMM, $F_{2,1352} = 15.01$, $P < 0.0001$). A greater proportion of control exposed bees exhibited SER than

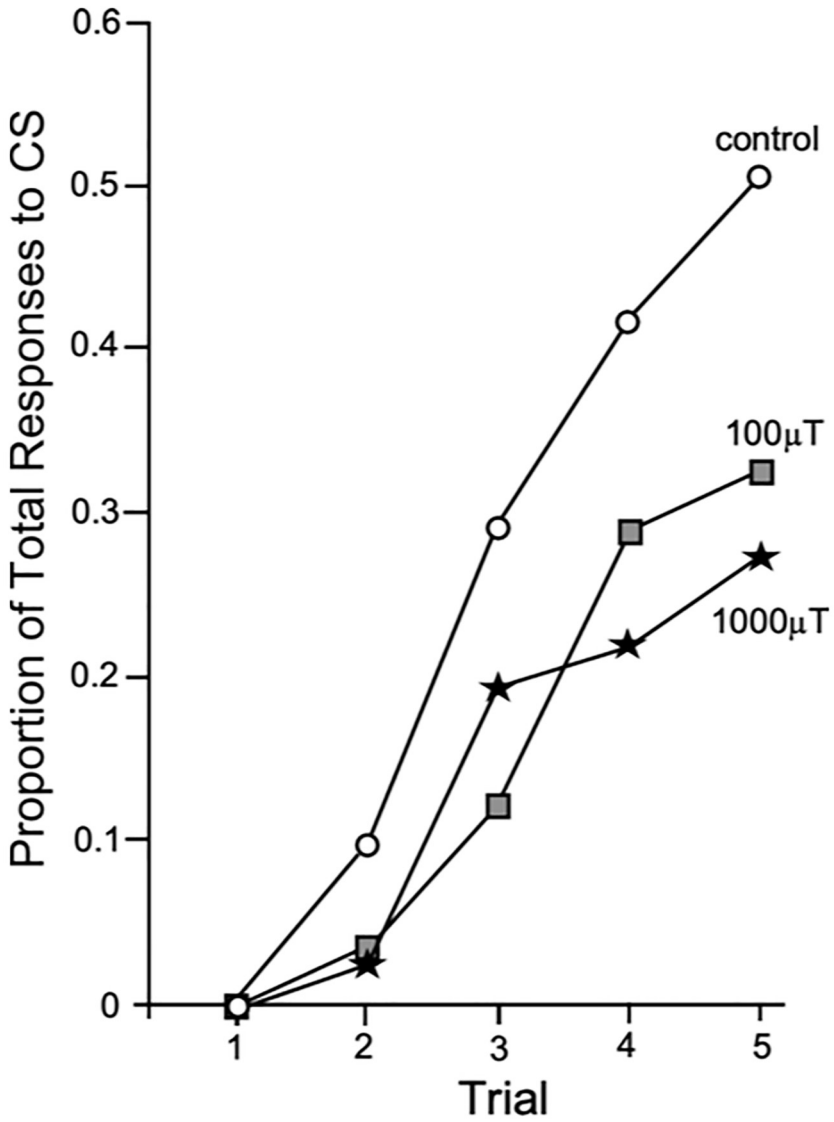

Fig 3. Effects of ELF EMFs on aversive learning in honey bees. Effect of short-term ELF EMF exposure on the proportion of aversive responses to the conditioned stimulus (linalool) for each of the trials. For each treatment the proportion of bees showing a learned response increased. The exact proportion of responses is plotted.

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both 1000 μT (Pairwise comparison, Bonferroni adjusted $P < 0.001$) and 100 μT (Pairwise comparison, Bonferroni adjusted $P = 0.001$) exposed bees. There was no *'treatment'* * *'trial'* interaction (GLMM, $F_{1,1352} = 0.82$, $P = 0.56$).

In this analysis of the effects of ELF EMF exposure on sting extension responses, hive of origin was removed as a factor to improve model fit as it was found to have no effect on the proportion of SER to the CS (GLMM, $F_{2,1328} = 0.17$, $P = 0.84$), nor any interaction with 'treatment' (GLMM, $F_{4,1328} = 1.38$, $P = 0.24$) 'conditioning trial' (GLMM, $F_{6,1328} = 0.24$, $P = 0.96$) or three-way interaction (GLMM, $F_{12,1328} = 0.33$, $P = 0.99$).

Intruder assay

Bees exposed to 100 μT ELF EMF exhibited greater aggressive behaviour to introduced bees, than bees not exposed to ELF EMFs (Fig 4). Bee cohorts which received a control treatment

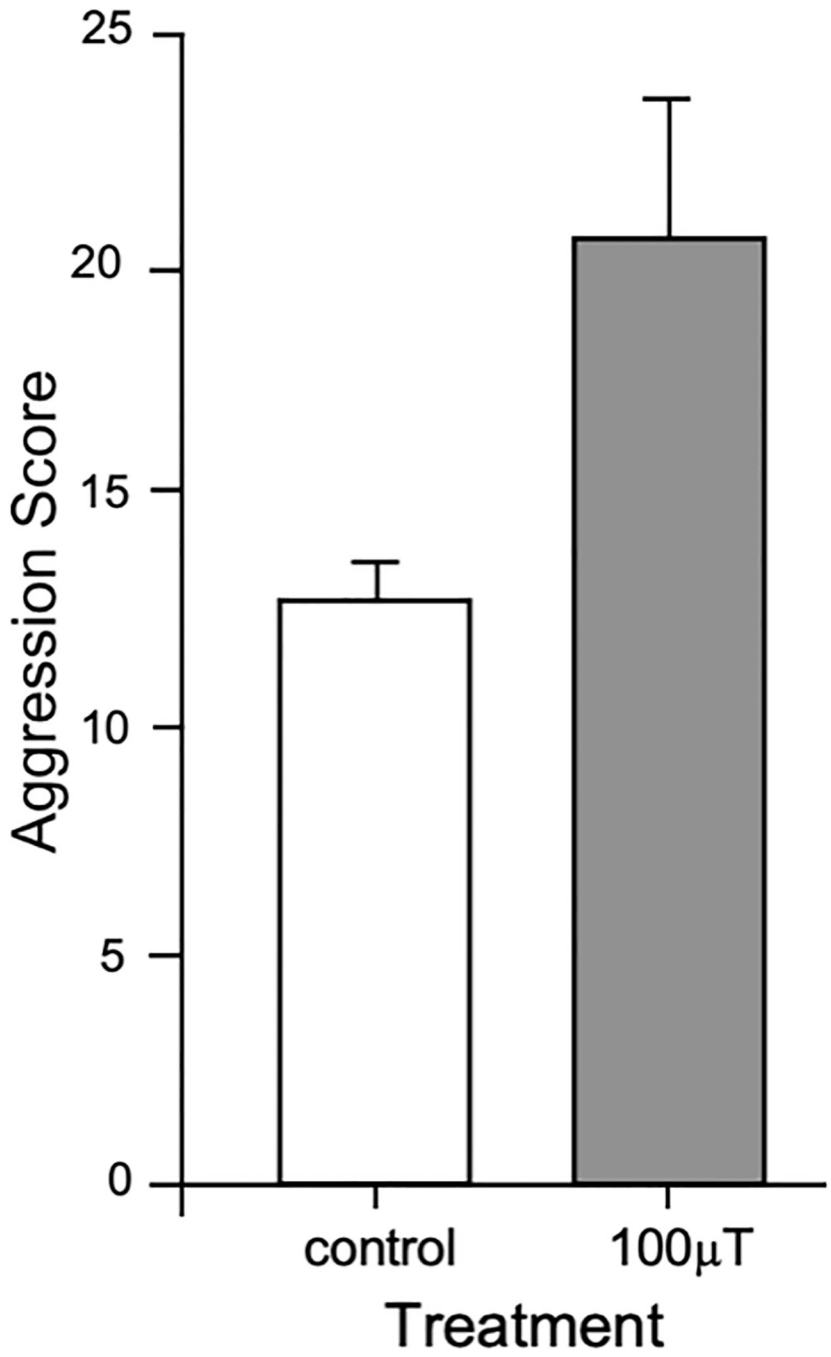

Fig 4. The effect of ELF EMFs on honey bee aggression levels. Exposure to a 100 μT ELF EMF significantly increased the Aggression Score. Mean ± SEM are shown. Statistical analyses were conducted on log-transformed data. Data plotted are reverse log-transformed from data used in statistical analysis.

https://doi.org/10.1371/journal.pone.0223614.g004

displayed an aggression score of 12.87 ± 1.69 (mean ± SEM) whereas bee cohorts exposed to 100 μT EMF exhibited a mean aggression score of 20.70 ± 2.14 (mean ± SEM, Standard Error of the Mean). EMF exposure significantly increased the average aggression scores across bees from all hives ($F_{1,25} = 11.42$, P = 0.0024). There was no impact of *Hive* ($F_{4,25} = 0.65$, P = 0.63) or any *Hive*EMF* interaction effect ($F_{4,25} = 0.75$, P = 0.56) on aggression score. This indicates

that short-term ELF EMF exposure, at levels that can be encountered at ground level or in proximity to a high voltage transmission power lines, led to an increase in aggressive behaviour of bees directed towards conspecifics.

Discussion

Short-term exposure to 50 Hz ELF EMFs reduced aversive learning performance and increased aggression at levels as low as 100 μT. This directly shows, for the first time, that short-term ELF EMF exposure at levels which can be encountered at ground level under high-voltage transmission power lines can affect honey bees, in terms of both their conditioning to negative stimuli, and the intensity of their aggressive behaviour.

In locusts ELF EMFs have been shown to affect neural circuits controlling limb movement and muscular force [6]. During the stinging response in honey bees the protraction of the tip of the abdomen, and the alternate sliding of barbed lancets of the stinging apparatus, are coordinated by four large abdominal muscles [34–36] whose activity are regulated by neural circuits in the terminal abdominal ganglion [22]. Given that a sting extension response was evoked by the US in over 95% of trials, it is unlikely that the effects on aversive learning were due to the effects of EMF at the neuromuscular level. Similarly, the effects of EMF were not due to changes in the sting extension motor pattern as bees could still extend their abdomens to electric shocks. Instead ELF-EMF induced reductions in SER performance are solely down to a reduced ability to learn the aversive stimuli, and not the motor pattern involved in responding to the stimuli.

The mechanisms underlying the effects of ELF EMFs on honey bee aversive learning and aggression may be diverse. While the neural pathways underlying appetitive learning in the honey bee brain are well characterised [37, 38], less is known of the neural architecture underlying aversive learning. The biogenic amines dopamine and octopamine have critical roles in associative learning in honey bees [39]. Vergoz et al. [27] for example, found that aversive learning is impaired after the injection of dopaminergic antagonists, and Jarriault et al. [40] found that dopamine was released in mushroom bodies in the honey bee brain after electric shock stimulation of the abdomen. These findings suggest that dopamine may have a key role in memory formation in honey bee aversive learning. Furthermore, the honey bee alarm pheromone has been shown to increase levels of the biogenic amines serotonin and dopamine, with increases in these amine levels being associated with increased likelihood of a bee to sting [41]. Some studies investigating the effects of EMF on invertebrates have suggested that increased biogenic amine levels lead to increases in behavioural activity [42, 43]. While no studies have yet analysed changes in dopamine levels following ELF EMF exposure, these previous studies suggest that biogenic amine levels may be a potential area to investigate to elucidate the underlying mechanisms of ELF EMF induced changes in insect behaviour. Moreover, ELF EMFs have been shown to have effects on neuronal signalling in insects [6], and therefore there is the potential for ELF EMF induced effects on dopaminergic neurons or other neural circuits which are involved in aversive learning pathways. ELF EMF induced changes in behaviour could also be underpinned by molecular changes such as gene expression. For example short-term ELF EMF exposure has been shown to increase heat-shock protein expression in locusts [6] and *Drosophila* [12].

The ecological implications of these effects are diverse. On the one hand the reduced ability to learn new negative stimuli could lead to an increased latency of honey bee colonies to respond to novel threats. Maliszewska et al. [10] found that short-term exposure of American cockroaches to 7,000 μT ELF EMFs increased the latency of responses to a negative heat stimulus. The increase in latency could clearly be detrimental to individuals in the ability to avoid

harmful environmental stimuli. On the other hand, we found that bees exposed to ELF EMFs showed increased aggression levels. Rittschof et al. [33] found that increased levels of aggression in honey bees are associated with greater resilience to environmental stresses and to immune challenge. However, direct short-term ELF EMF exposure at 2,000 μT in Lepidopteran larvae has been associated with changes in immune response parameters such as increased apoptotic-like hemocytes, reduced hemolyph total protein and reduced hemocyte cell count, which could suggest short-term ELF EMF exposures might lead to reduced resilience to immune challenge [13]. It is not known if ELF EMFs affect immune response in honey bees at field-realistic ELF EMF intensities, lower than those that have been studied with Lepidoptera, and thus it is not known if ELF EMF exposure would confer greater resilience to immune challenge alongside increased aggression levels in bees. In addition, in the environment if a bee perceives a negative stimulus a sting response often results in sting autonomy, with a rupture of the abdomen that causes the eventual death of the bee [44, 45]. Less aggressive responses to negative stimuli such as aggressive buzzing and flight bombardment can be successful methods of warding off threats in a manner that is less detrimental to a colony in terms of bee loss [25, 45]. The effects of environmental stressors and the consequences of increased aggression on this aversive decision making processes (other than increased sting autonomy) are not-known.

While it is unclear what the ecological consequences of increased aggression may be for bees exposed to ELF EMFs, the implications of reduced aversive learning performance are more distinct. It is imperative that honeybees are able to perceive, learn, and avoid threats in the environment [28, 39]. Reductions in the ability to learn about negative stimuli could have implications for the abilities of bees to deal with predatory/invader threats [20, 22], detecting/avoiding deleterious stimuli [19] and responding to negative stimuli that require action e.g. attacking/removing diseased individuals from the hive [20], all of which could have detrimental effects on bee colonies. Although it is not yet known how bees will actually respond in the field, it is clear that the reduction in aversive learning seen here with short-term 100 μT exposures could be detrimental to honeybees on an ecological level. A number of studies have described bee colonies failing that are hived under high-voltage transmission power lines, where EMF levels can reach 100 μT [14–17]. There is the possibility that with hives located under power lines, the long-term chronic exposure to ELF EMFs could continually reduce cognitive abilities both with regards to aversive and appetitive learning, potentially leading to some of the negative effects found in these studies.

Reductions in learning could be detrimental to individual and colony survivability. There are large potential ecological consequences for reduced ability to learn about aversive and appetitive stimuli for bees. Future studies should focus on whether there are ecological effects of ELF EMF exposure, with direct measurements of chronic EMF exposure under power lines, as well as determining what physiological/molecular processes may be affected by this kind of exposure. These effects may not be confined to managed honey bees as there may be much wider implications for wild bees and even other pollinators that require power line strips for critical habitat refuge [46–50]. The underlying mechanisms, as well as the potential ecological implications of ELF EMF pollution in the field must be further investigated to determine the effects of ELF EMF pollution on insect biology and ecology, including crucial pollination ecosystem services.

Supporting information

S1 Table. The number of bees in SER analyses (after exclusions) for each hive and treatment.
(DOCX)

S2 Table. The number of bees in intruder assay analyses for each hive and treatment.
(DOCX)

S1 Dataset. Datasets for A) SER data B) Aggression data.
(XLSX)

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Writing – original draft: Sebastian Shepherd, Philip L. Newland.

Writing – review & editing: Sebastian Shepherd, Georgina Hollands, Victoria C. Godley, Suleiman M. Sharkh, Philip L. Newland.

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NEUROLOGICAL RESEARCH, 2017
VOL. 39, NO. 2, 165–175
http://dx.doi.org/10.1080/01616412.2016.1252875

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Effects of repeated 9 and 30-day exposure to extremely low-frequency electromagnetic fields on social recognition behavior and estrogen receptors expression in olfactory bulb of Wistar female rats

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ABSTRACT

Objective: We investigated the short- and long-term effects of extremely low-frequency electromagnetic fields (EMF) on social recognition behavior and expression of α- and β-estrogen receptors (ER).

Methods: Rats were exposed to 60-Hz electromagnetic fields for 9 or 30 days and tested for social recognition behavior. Immunohistochemistry and western blot assays were performed to evaluate α- and β-ER expression in the olfactory bulb of intact, ovariectomized (OVX), and ovariectomized+estradiol (E2) replacement (OVX+E2).

Results: Ovariectomization showed impairment of social recognition after 9 days of EMF exposure and a complete recovery after E2 replacement and so did those after 30 days. Short EMF exposure increased expression of β-ER in intact, but not in the others. Longer exposure produced a decrease in intact but an increase in OVX and OVX+E2.

Discussion: Our findings suggest a significant role for β-estrogen receptors and a lack of effect for α-estrogen receptors on a social recognition task.

Abbreviations: EMF: extremely low frequency electromagnetic fields; ERs: estrogen receptors; OB: olfactory bulb; OVX: ovariectomized; OVX + E_2: ovariectomized + estradiol replacement; IEI: interexposure interval; β-ER: beta estrogen receptor; E_2: replacement of estradiol; GAPDH: glyceraldehyde-3-phosphate dehydrogenase; WB: Western blot; PBS: phosphate-buffer saline; PB: phosphate-buffer

ARTICLE HISTORY
Received 19 January 2016
Accepted 16 October 2016

KEYWORDS
Social recognition memory; EMF; olfactory bulb; α-estrogen receptors; β-estrogen receptors

1. Introduction

The influence of natural magnetic fields has accompanied mankind throughout evolution. Over the past few decades, with the introduction and use of manmade energy and the boom of electronic devices, human exposure to electromagnetic fields of different intensities and frequencies has increased. The most popular devices used are mobile phones and other wireless personal portable devices.

Because of the rapid growth of mobile technology and its influence on daily life, it is impossible to avoid the constant use of these devices. Some of them are in constant touch with the human body, some for a considerably long time. Thus, great concern has arisen about the effects of electromagnetic fields on the health of a population.[1–4] Currently, electromagnetic fields have been used to develop applied technologies for diagnosis and clinical therapy. The expansion of their use in therapeutics has raised concern because the interaction of electromagnetic fields with biological systems can modify a diversity of biological processes, including oxidative stress and proliferative response.[5–7]

Several authors have postulated that extremely low-frequency electromagnetic fields (EMF) provide a protective effect against oxidative damage either by enhancing mitochondrial activity,[8] or at a molecular level, by modifying the expression of proteins regulated by the transcription factor Nrf2.[9] Additionally, there are reports demonstrating slight effects of 50- and 60-Hz electromagnetic fields on most cognitive tasks and some performance tests, such as memory updating, time perception, simple reaction time, and figure perception.[10–12] Exposure to EMF has apparently opposite effects on learning and memory processes, probably by affecting neurotransmitter function.[12–14] However, the strength of electromagnetic fields used is also growing, which causes complex influences on the human body. In recent years, research on the potential

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damage of electromagnetic field exposure to the central nervous system has become a widely discussed issue. For instance, diseases such as Alzheimer (AD), which have become a serious health and socioeconomic issue, have been associated with EMF exposure. Cognitive and memory impairment is the main manifestation of Alzheimer, and epidemiological studies suggest that EMF might increase the risk of AD.[15–19]

Animal studies have investigated the effects of EMF on spatial learning and memory using either radial arm or water maze tasks. Most results indicate that EMF disrupts spatial cognition.[20]

The olfactory bulb has direct connections to the enorhinal cortex and the amydala, with these two structures being fundamental in the cognitive process of memory and learning, aside from the emotional regulation which scents are associated with.

The olfactory bulb is the main olfactory processing center. It is in the glomerular layer where synapsis coming from the olfactory epithelium, granular and plumed cells meet. The glomerular processed data are sent to the mitral cells whose axons are part of the olfactory tract and through which the signal is sent to the aforementioned structures.

The rats' olfactory bulb is a significant structure for learning and memory of cospecifics. It plays a fundamental role in the social recognition and intervenes in the recognition of familiar individuals and those who are not.[21]

With the bulb being significant in the learning and memory of social recognition, what we pretend in this study is not only to show the role that the expression of α and β ER plays over the regulated behavior by the OB, but also, to show how this behavior is affected according to the increase or decrease in the amount of receptors after EMF exposure.

This way, we will be able to know if there is a correlation between the amount of receptors and the improvement or worsening of the social recognition memory.

Although hippocampus and cortex are two structures involved in learning and memory processes, our objective was to study social recognition memory only, in which it is the olfactory bulb the one that plays the main role.[21]

In a previous report, using a social recognition task, we demonstrated that exposure to EMF for 9 days extended the duration of memory to 300 minutes in adult male rats.[21] Despite this understanding, most of the effects caused by EMF on living matter have not been fully explained.

The effects of exposure to EMF can be difficult to interpret because findings are often contradictory. Difficulties may arise because the effects are often imperceptible and depend on variables, such electromagnetic field intensity, duration of exposure, age of experimental animals, and their combinations.[20,22–25]

Ovarian hormones have a powerful influence on learning and memory.[26,27] In particular, the acquisition of spatial learning tasks appears to be impaired following replacement of estradiol (E_2).[28,29] Several studies show evidence that E_2 mediates socially motivated behaviors in rodents. Mice lacking a fully functional estrogen receptor (ER), α or β, showed modified social behavior,[30–32] whereas ERαKO mice avoided contact with conspecifics, and the time of social investigation was higher than that of WT animals. ERβKO mice showed impaired social recognition after repeated social exposure. It seems that α-ER and β-ER are involved in social recognition, as are progesterone and oxytocin.[33–36]

The presence of estrogen receptors in the olfactory bulb (OB) [37,38] suggests a possible role of these receptors in regulating social behavior in rats due to the significant participation of the OB in social recognition.

In a previous report,[39] we demonstrated that an ovariectomized animal with E_2 replacement and exposure to an EMF of 1 mT for 2 hours repeatedly for 9 days improves social recognition, and the animals were able to recognize familiar juvenile conspecifics in a second encounter 300 minutes after the first trial. In the present study, we used two juveniles, one familiar and one unfamiliar, in the third trial, and an IEI of approximately 60 minutes.

A large number of studies have analyzed the effect of EMF for short periods of time, but few have studied the effects of long-term repeated EMF exposure on learning and memory processes.

Given the contradictory reports on the effects of exposure to EMF for short or long periods, we used animals exposed to an alternating 60 Hz, 1 mT electromagnetic field repeatedly for 9 (repeated 9-d) and 30 days (repeated 30-d) to evaluate an olfactory memory task and the changes in the expression of the α- and β-ER in the OB in intact, ovariectomized (OVX), and OVX + E_2 replacement Wistar female rats.

2. Material and methods

2.1. Animals

The study was performed in accordance with the guidelines and requirements of the World Medical Association Declaration of Helsinki and those of the Ethical Committee of the Faculty of Medicine at Universidad Nacional Autónoma de México to minimize the number of animals used and their suffering.

The experimental conditions such as exposure to magnetic fields were chosen emulating similar exposure conditions of urban environment with the interaction of electronic devices that create electromagnetic fields of low frequency as electrodomestic appliances, cell phones, computers, and so on. For this reason, the frequency chosen to assess was 60 Hz, based on

methodology standardized by several authors and on previous publications from our lab.[21]

One hundred and twenty adult virgin female Wistar rats (3 months old), and 30 female juveniles (20–22 days old) were used as test *stimuli* in the social recognition task. Rats were adapted for seven days before the experiments at 22 ± 2 °C temperature room in an artificial light:dark cycle (12 hours:12 lights on at 08:00), with water and food *ad libitum*. All animals were grouped (four to five per cage). Adults weighed 248 g ± 13 g and juveniles weighed 71 ± 6 g. To minimize the number of juvenile animals used, they were rotated once for different groups. All 120 adult female rats were randomly divided into two groups; one group was exposed for 9 days, 2 hours/day, (60 animals), and the second group was exposed for 30 consecutive days, 2 hours/day (60 animals). Each group was subdivided into 6 groups of 10 rats each of intact virgins without EMF, an intact virgins exposed to EMF, ovariectomized (OVX) rats without EMF, OVX rats exposed to EMF, OVX + E_2 rats (17 β-estradiol (E_2), 25 μg/kg s.c., for 9 or 30 days) without EMF, and OVX + E_2 replacement rats exposed to EMF. The OVX, non-EMF and EMF groups were ovariectomized under general anesthesia (ketamine–Xylazine mixture, 15 mg/kg + 1 mg/kg ip) 15 days before the experimental procedure.

2.2. EMF exposure

Two time periods were assessed; one of short exposure (9 days) and one of long exposure (30 days), as previous studies from our lab [21] showed that at 9 days there were changes in the social recognition memory while to determine the long exposure time, we carried out a pilot program to analyze the effects of 30 as well as 60 days (data not shown).

We observed that after 30 days as well as after 60 days, there were no significant differences between the parameters being studied; therefore, we decided to show only the results of the 30-day time frame. Due to the differences found in the expression of the olfactory bulb receptors and the behavioral differences of these two time frames (9–30), we decided to analyze the behavior in the expression of receptors to Alpha and Beta estrogens aside from the behavioral differences.

Animals were exposed to an alternating 60 Hz, 1 mT electromagnetic field, using the same procedure described previously.[21,39] Briefly, the EMF exposure system consisted of a chamber with a pair of circular Helmholtz coils. Each Helmholtz coil is made of 180 turns with an internal diameter of 36 cm, which consists of double-wrapped coils of 18-gage copper wire. The Helmholtz coil pairs were symmetrically placed one on each side of the experimental area (50 × 50 × 18 cm) along the axis, separated by a distance equal to the radius of the coil and connected in parallel to reduce the total impedance of the wire to provide a uniform electromagnetic field. Coils were connected to a 120 V adjustable transformer. The magnetic flux was monitored with a handheld Gauss–Tesla meter.[21] EMF groups were placed daily in the exposure chamber for 2 hours (08:00 to 10:00), for 9 (repeated 9-d), or 30 consecutive days (repeated 30-d). The sham-exposed animals followed the same protocol, but with the coils turned off. The heat generated was adequately dissipated. All experiments were performed at 22–23 °C room temperature. Each group was divided immediately after the last exposure session. Ten animals from each group were used for social recognition memory test. Thereafter, five animals were used for immunohistochemistry, and the other five were for Western blot analysis.

2.3. Social recognition memory test

The social recognition procedure was similar to that described in our previous papers.[39,40] Briefly, using this protocol each adult rat was habituated to the test cage (50 × 50 × 42 cm) daily for 4 minutes. Each testing session consisted of a sequence of three independent 4-minute trials. The first trial was a habituation period for the adult rat to the test cage, the second trial was the first encounter between the adult and juvenile rat (social memory acquisition), and the third trial was a re-exposure to the familiar animal together with an unfamiliar juvenile *stimulus* animal introduced simultaneously into the test cage 60 minutes after the social memory acquisition trial (inter-exposure interval (IEI) of 60 minutes). The experimental groups were tested at the end of the repeated exposure to EMF (9 or 30 days). After each test, the cage was thoroughly cleaned. A video recording of investigatory behavior was used to assess the time spent by adult rats investigating the *stimulus* animal in the social recognition test. The data collected from the video recordings were transferred to a personal computer for offline analysis. Behaviors that were considered to be related to social recognition learning and memory were anogenital sniffing, closely following and pawing of the *stimulus* animal. A selective recognition memory was considered present if, first, there was a significant reduction in the mean duration time of exploration between the first two encounters with the *stimulus* juvenile, and second, if there was also a significantly greater investigation time for the novel juvenile in the third trial compared with that for the familiar juvenile.

2.4. Western blot analysis

After the social recognition test was finished, rats were decapitated, and the olfactory bulbs were homogenized in lysis buffer containing protease inhibitors

(Roche Applied Science, Indianapolis IN, USA). The quantification of proteins was determinate using the Bradford method with bovine serum albumin (BSA) as the standard curve. The proteins were resolved in

12% polyacrylamide gels and transferred to nitrocellulose membranes. After blocking with 5% dry skim milk in PBS-0.01% Tween, membranes were incubated overnight at 4 °C with the primary polyclonal antibodies rabbit anti-α-ER (HC-20, sc-543, Santa Cruz, Biotechnology) and rabbit anti-β-ER (05-824 Up State Millipore clone 68-4) diluted 1:100, and monoclonal anti-β-actin (SC-69879 mouse monoclonal antibody Santa Cruz Technologies) diluted 1:5000 was used as a loading control followed by a 2-hour incubation with horseradish peroxidase-conjugated secondary antibodies. Proteins were detected using ECL Western blotting reagents. Densitometry analysis was performed using Image MCID Analysis Software (Interfocus Imaging Ltd, Cambridge Rd, Linton Cambridge, UK), which yields an intensity value for each band in relative optical density units; WB densities were corrected with β-actin by a ratio of ER/β-actin. Both proteins were analyzed on the same membrane. The axis legends of the figures are expressed as ER/actin.

2.5. Immunohistochemistry

Immediately after the last EMF exposure, rats were anesthetized with pentobarbital (100 mg/kg) and perfused transcardially; first with phosphate-saline buffer (PBS pH 7.4) and then with 4% paraformaldehyde in a phosphate-buffer (PB, pH 7.4). Brains were dissected and postfixed in the same 4% paraformaldehyde for 20–22 hours. All fixed brains were rinsed in tap water, dehydrated with alcohol, and embedded in paraffin wax; sagittal 6-µm thick brain slices of the olfactory bulb were obtained. The immunohistochemical detection of α-ER and β-ER was performed with Starr Trek Universal HRP Detection (Biocare Medical, LLC Pike Lane Concord, CA, USA) following the manufacturer's instructions. The sections had their paraffin removed, were rehydrated, treated with a heat retrieval solution (Biocare Medical, Concord, CA, USA), and then placed in an electric pressure cooker (decloaking chamber; Biocare Medical LLC Pike Lane Concord, CA, USA) for 5 minutes. Slides were incubated with 3% hydrogen peroxide in PBS (pH 7.4) for 20 minutes. For antibody detection, the protocol supplied by Biocare Medical (Starr Trek Universal HRP Detection Kit) was used. Slides were incubated with α-ER (HC-20 sc-543, lot D2611, Santa Cruz, Biotechnology) and β-ER (05-824 clone 68-4 lot JBC 1377993 Cell Signal) primary antibodies diluted 1:500 in PBS containing 2% BSA and 0.1% Tween 20. The binding reaction was visualized using the Betazoid DAB Chromogen Kit (Biocare Medical, Pike Lane Concord, CA, USA). The immunohistochemical negative controls included the omission of the primary antibody. The slides were examined under a Leica DM1000 microscope and images were digitally captured with an Image Manager Leica IM500 camera. Representative section images (20×) were taken for immunopositive cell counts. The cell count readings from the mitral and granular cell layers of the olfactory bulb were measured in a 300 × 300 micron area using Image MCID Analysis Software (Interfocus Imaging Ltd, Cambridge Rd, Linton Cambridge, UK). The percentage of immunopositive cells was obtained by counting immunopositive cells over total cells divided by 100. Three different measurements (anterior, dorsal and ventral in the sagittal slice) of each slide were averaged for each animal analyzed.

2.6. Locomotor activity

Locomotor activity was measured as previously described,[21] by recording the number of line crossings in an open-field apparatus. The open field apparatus was a 50 × 50 cm test cage with a white floor divided into 9 squares (16.6 × 16.6 cm each). The locomotor activity reported was measured during the first encounter on the test day of each rat. The summation of all line crossings is termed the total activity count.

2.7. Statistical analysis

The data from each test were analyzed separately. Locomotor activity was analyzed using a one-way ANOVA. Behavioral data obtained during the social recognition task were expressed as ratios [investigation times of unfamiliar/(unfamiliar + familiar)], a three way ANOVA was performed. Because ratios violate the homogeneity of variance assumption required by parametric statistics, the duration of social investigation ratios were arcsine-transformed prior to analysis ([arcsine $\sqrt{\text{ratio}}$].[26] Social investigation times were recorded for each animal and then these values were averaged and transformed according to the experimental group.

ANOVA with repeated measures for trials with EMF and hormones status factors were followed by a *post hoc* Tukey's test. A similar analysis was performed for estrogens receptor data and immunohistochemistry. Statistical significance was established at $^{*}p < 0.05$ $^{**}p < 0.01$, $^{***}p < 0.001$ unless otherwise was indicated (SPSS program, SPSS Inc, Chicago, IL).

3. Results

3.1. Behavior

Exposure to EMF for a repeated 9 or 30 days did not affect locomotor activity (ANOVA, F5, 48 = 0.22, $p > 0.05$). Additionally, hormonal status did not have an effect on the locomotor activity (ANOVA, F5, 48 = 0.23, $p > 0.05$). The lack of an EMF effect on locomotor activity was also supported in the social recognition test during the first encounter with the familiar subject (Data not shown).

The effect of EMF exposure over 9 days, 2 hours daily, on the social recognition test with an IEI of 60 minutes

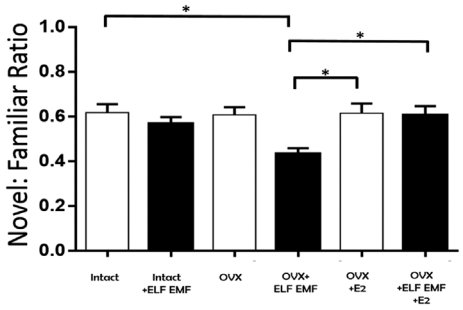

Figure 1. Olfactory memory acquisition.
Notes: Ratios of time investigating for the familiar juvenile rat to the unfamiliar juvenile rat. Adult female rats were tested with a 60-minute IEI. Control groups (white columns) of adult animals that were not exposed to EMF were investigated in three groups: intact, ovariectomized [OVX] and ovariectomized with hormonal replacement [OVX + E_2]. Animals exposed to EMF for 9 days (2 hours/day) are shown in the black columns and were investigated in three groups: intact, ovariectomized [OVX] and ovariectomized with hormonal replacement [OVX + E_2]. $n = 10$, $^*p < 0.05$.

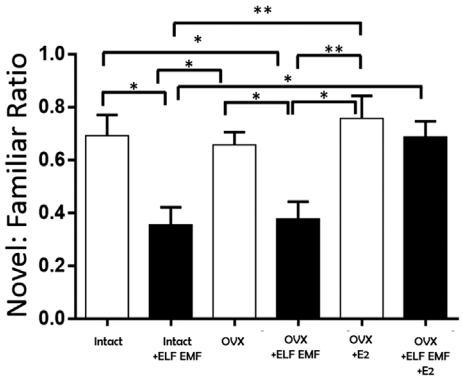

Figure 2. Olfactory memory acquisition.
Notes: Ratios of time investigating for the familiar juvenile rat to the unfamiliar juvenile rat. Adult female rats were tested in 60 minutes IEI. Control groups (white columns) of adult animals that were not exposed to EMF, as investigated in three groups: intact, ovariectomized and ovariectomized with hormonal replacement. Animals exposed to EMF for 30 days (2 hours/day) are shown in the black columns, as investigated in three groups: intact, ovariectomized and ovariectomized with hormonal replacement. $n = 10$, $^*p < 0.05$, $^{**}p < 0.01$.

is shown in Figure 1, as a novel/familiar ratio. The [OVX + EMF] group was the only group in which a significant decrease in the novel/familiar ratio was observed, compared with those of the intact, [OVX + E_2] and [OVX + EMF + E_2] groups ($p < 0.05$), which means that animals increase the investigation time for the familiar juvenile in the third encounter; animals were unable to distinguish between the familiar juvenile odor from the unfamiliar juvenile odor.

To analyze the effect of repeated 30-day exposure of EMF on olfactory memory, animals were tested in the social recognition task (Figure 2), following the same procedure as that in the 9-day exposure to EMF (continued exposure to 30 days, 2 hours/day); the results were expressed as a novel/familiar ratio. The most significant effect of the EMF exposure for 30 days, 2-hour daily, was a decrease in the ratio in the [intact] and [OVX] groups compared with that of the other groups with and without exposure to EMF ($p < 0.05$–0.01), see Figure 2. An impairment of social recognition behavior was observed in these two groups, as the animals were unable to discriminate, in the third trial, the familiar juvenile conspecific odor from the unfamiliar. The exposure of intact animals to EMF over 30 days produced impairment in the social recognition test as shown in Figure 2. This result suggests that chronic EMF exposure produces impairment, that is, an adverse effect on the social recognition behavior. It is likely that chronic exposition to EMF affects the normal balance of free radicals in the organism that subsequently develop an imbalance in the rate of production of superoxide anion (O_2^-) molecules and hydroxyl radicals (OH), among others, modifying the normal pathways for the elimination of these substances.[41] Excessive production of free radicals affects the process of learning and memory.[19,42] When ovariectomized animals were exposed to EMF [OVX + EMF] group over 30 days, an impairment of the social recognition behavior was also present, similar to that in [intact + EMF] group. Long-term EMF exposure in intact or ovariectomized animals impairs social recognition behavior; compared with that of the control groups without EMF exposure, a decrease was observed in the novel familiar ratio ($p < 0.05$). When ovariectomized animals with hormonal replacement were exposed to EMF [OVX + EMF + E_2] group, an increase in the novel/familiar ratio was observed. However, no significant differences were observed between this group and the [OVX + E_2] without EMF group ($p > 0.05$). Again, the effect of EMF requires the presence of estrogens. The analysis of the protein expression of α and β estrogen receptors in all three groups exposed to EMF, showed a significant decrease in α estrogen receptors expression in the [OVX + EMF] group compared with that of [OVX + EMF + E_2] group ($p < 0.05$), see Figure 3(A), which is compatible with the impairment observed in the social recognition test of the [OVX + EMF] group. Likewise, the [OVX + EMF + E_2] group showed an increase in α-ER expression, which could explain the increase in the novel/familiar ratio observed in this group.

3.2. Biochemical assays

Additionally, a decrease in the protein expression of β-ER was observed in the [OVX] group, as shown in Figure 4(D), and also a decrease was observed in the OB cells with immunohistochemistry labeling (see Figure 4(E) and (F)). These results indicate a significant role for estrogens in the EMF-mediated improvement in short-term memory. On the other hand, no effect was observed for the protein expression of α-ER, as measured by Western blot between [intact] and [OVX] group, see Figure 4(A). Whereas, the OVX + EMF + E_2 group showed a significant increase in the protein expression of α-ER compared with the OVX and intact + EMF groups ($p < 0.001$ and 0.01, respectively). Increased

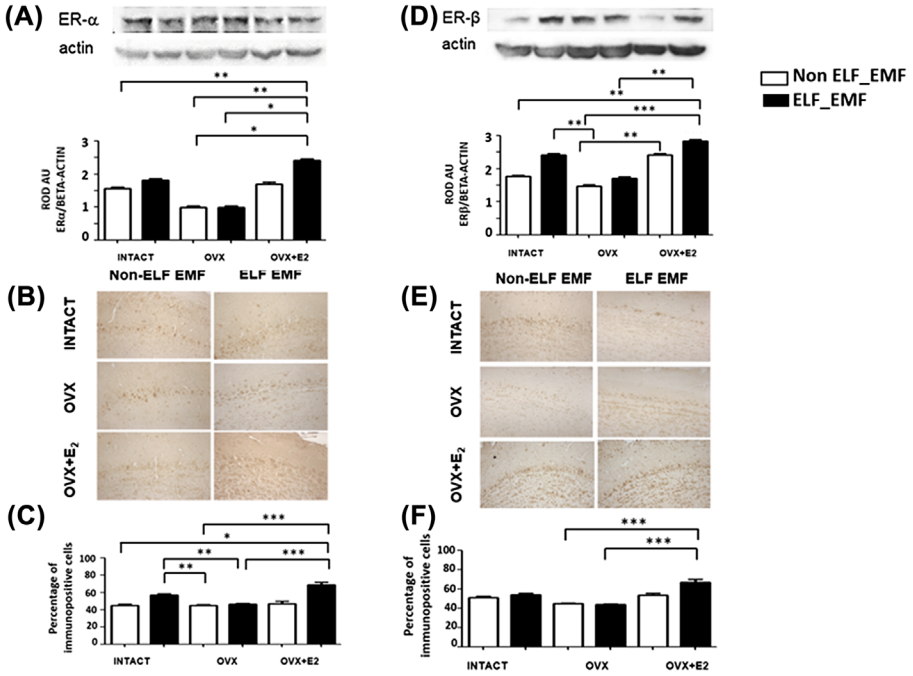

Figure 3. Effect of EMF exposure for 30 days on alpha and beta-estrogen receptor expression.

Notes: Effect of repeated 30-day exposure to EMF on estrogen receptor protein expression (α and β) in the rat olfactory bulb of adult female rats. Left side, α-ER expression was analyzed by a Western blot assay using actin as a loading control (A). The graph shows the results of the α-ER expression in arbitrary units (columns are mean ± SE). Control groups without exposition to EMF are shown in the white columns. Animals expose to EMF (30 days, 2 hours/day) are shown in the black columns. (B) Show are representative photomicrographs of immunolabeled cells in the OB of all groups. (C) Shown are the results of immunohistochemistry in arbitrary units. Right side, β-ER was analyzed in a Western blot assay (D) using actin as a loading control. The graph shows the results of the β-ER expression in arbitrary units. Control groups without exposition to EMF are shown in the white columns. Animals exposed to EMF (30 days, 2 hours/day) are shown in the black column. (E) Shown are representative photomicrographs of immunolabeling of all groups. (F) Shown are the results of immunohistochemistry in arbitrary units. $*p < 0.05$; $**p < 0.01$ and $***p < 0.001$. Columns are mean ± SE. $*p < 0.05$; $n = 5$. Bars in C and F are 50 µm.

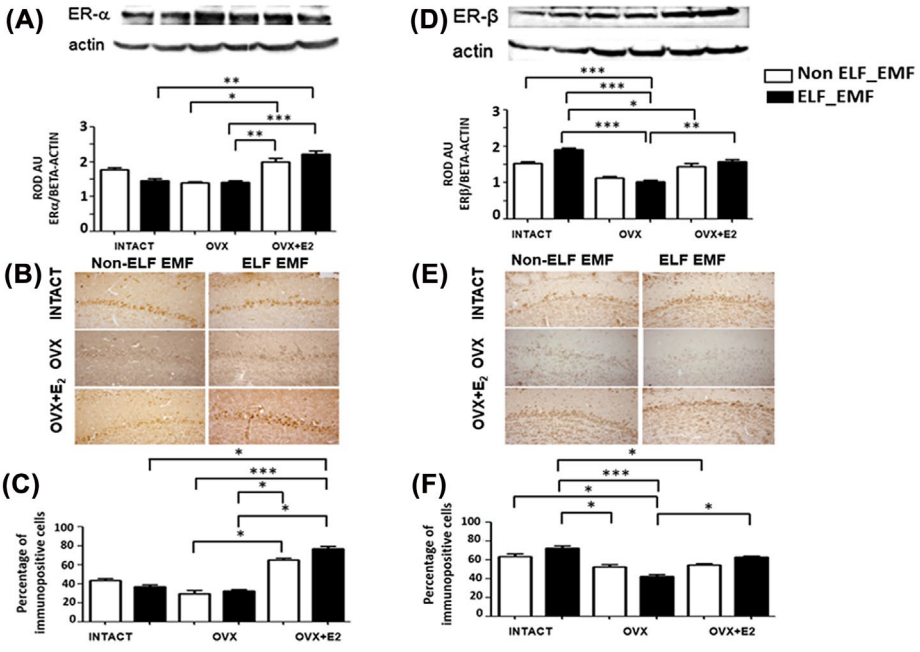

Figure 4. Effect of EMF exposure for 9 days on alpha and beta-estrogen receptor protein expression.

Notes: Effect of repeated 9-day exposure to EMF on estrogen receptor protein expression (α and β) in the rat olfactory bulb of adult female rats. Left side, α-ER was analyzed by a Western blot assay using actin as a loading control (A). The graph shows the results of the α-ER expression in arbitrary units (columns are mean ± SE). Control groups without exposure to EMF (white columns). Animals exposed to EMF (9 days, 2 hours/day) are shown in the black columns. (B) Representative photomicrographs of immunolabeled cells of the OB of all groups. (C) Shown are the results of immunohistochemistry in arbitrary units. Right side, β-ER was analyzed by a Western blot (D) using actin as a loading control. The graph shows the results of β-ER expression in arbitrary units. Control groups without exposure to EMF are shown in the white columns. Animals exposed to EMF (9 days, 2 hours/day) are shown in the black columns. (E) Shown are representative photomicrographs of immunolabeling in all groups. F. Shown are the results of immunohistochemistry in arbitrary units. $*p < 0.05$; $**p < 0.01$ and $***p < 0.001$. $n = 5$. Bars in B and E are 50 µm.

immunohistochemistry labeling of OB cells was also observed for α-ER. In summary, these results suggest that EMF requires the presence of hormones to improve memory processes. These results support our previous findings [39] showing the effect of EMF on the improvement in social recognition memory in [OVX] female rats under hormonal replacement due to a higher expression of ER, mainly α-ER, in a [OVX + EMF + E_2] group.

An increase in α-ER expression was also observed in the photomicrographs, as shown in Figure 3(B) and (C). A similar increase in α-ER expression that was observed in the [OVX + EMF + E_2] group was also identified for β-ER expression (Figure 3(D)), as revealed by a corresponding increase in immunohistochemistry, see Figure 3(E) and (F). The [OVX + EMF] group showed significantly less expression of α and β-ER expression compared with that of the [OVX + EMF + E_2] group ($p < 0.05$ and $p < 0.001$, respectively). The immunohistochemical analysis confirmed the Western blot results, showing a significant decrease ($p < 0.001$) in the immunoreactivity of α and β-ER, as shown in the photomicrographs and graphs (Figure 3(B)–(F)).

4. Discussion

These results suggest that the effect of EMF is estrogen-dependent.

Hlinak [43] was the first researcher to demonstrate the role of E_2 in social recognition behavior, which was dependent on the integrity of the olfactory bulb.

Tang et al. [44] have demonstrated that estrogen replacement in ovariectomized mice can preserve social recognition for at least 24 hours. Many other researchers have demonstrated the significant role of ovarian hormones on learning and memory processes. [27,45–49,50–52]

In a previous paper,[39] we demonstrated a potential memory-enhancing effect of exposure to EMF in female rats and its dependence on estrogens using an IEI of 300 minutes. Animals showed a significant reduction in the mean investigation time during the second encounter. OVX animals without E_2 replacement exposed to EMF did not show significant differences between the first and second encounters. These results clearly showed that in absence of sexual hormones,

EMF produced an impairment of short social recognition memory (IEI of 30 minutes). However, when the IEI is enhanced to 300, the ovariectomized animals with repeated 9-d exposure to EMF and with E_2 replacement showed an improvement in social recognition memory. In our previous study,[39] (see Figure 1), we used an IEI of 30 minutes and no change in the social recognition was observed during exposure to EMF. Other researchers [53] also used an IEI of 30 minutes and did not find any impairment in the social recognition memory in intact female rats; the same result was obtained even if the IEI was 180 minutes. On the other hand, Hlinak [43], using an IEI of 30 minutes in ovariectomized animals, found that animals were able to identify the juvenile that had met shortly before.

Exposure to EMF for 9 days enhances social recognition memory only in intact animals or those ovariectomized with E_2 replacement. In this study, we used 60 minutes as the IEI, which made the short memory more transient.[43] This could explain why OVX animals showed impairment in the social recognition behavior, but as soon as they received estrogen, a complete recovery was observed. These findings are also supported by an increase in α and β-ER expression in the olfactory bulb. As a consequence, estrogens could be a determining key to preserve social recognition memory. Recently, Reyes-Guerrero et al. [54], reported an increase in β-ER during the diestrus phase of the estrus cycle, and a decrease during the estrous phase in female rats exposed to EMF for 9 days. In this report, we found an increase in the α-ER expression in OVX + E2 exposed to EMF for 9 days, which could be the equivalent to estrus phase, and a decrease in β-ER expression in OVX rats exposed to EMF (diestrus phase). Undoubtedly, both ERs participate in social recognition memory.

Another learning process affected by estrogens is spatial memory, which depends mainly on the hippocampus.[55–57] For instance, Sandstrom and Williams reported that E_2 increases excitatory connectivity in the hippocampus and improves the retention of spatial memory in ovariectomized rats.[58].

Recently, Liu et al. reported a positive effect on spatial learning and memory in the Morris water-maze test in male animals after chronic exposure to EMF (four weeks).[35] However, according to our results, repeated 30-d exposure to EMF impairs social recognition behavior in intact and in ovariectomized animals. But, if the OVX animals received an E_2 replacement, then a complete recovery was observed. In male animals no fluctuation in hormone level has been reported, as is observed in female subjects [59] during the estrus cycle; thus, it is possible that EMF has a different effect in males than in females.

The role of estrogens in social recognition has been the object of several studies with inconsistent results. [33,30–32,34, 60–62]. It is possible that the action of estradiol on α- and β-ER is different. For instance, we found that repeated 9-d exposure to EMF in OVX + E2 animals increased the expression of α-ER and β-ER. These results are supported by immunohistochemistry data. Ovariectomized animals without hormonal replacement exposed to EMF for 9 or 30 days showed impairment in social recognition behavior, as observed by the novel/familiar ratio, and the expression of α and β-ER protein. Once again, these data support the key role of estrogens in social recognition behavior. Somewhat unexpectedly, the OVX + E_2 group exposed to EMF for

30 days showed an improvement in the social recognition test, which could be explained for the increase in the α and β-ER expressions. In contrast, the intact animals exposed to EMF, mainly for 30 days, did not show an increase in ER; these results could explain the impairment in the social recognition test.

Several studies have suggested that α-ER plays a critical role in reproductive behavior,[28] whereas β-ER appears to be involved in cognitive processes.[27,28,48] Recent studies have shown that there is synergistic and antagonistic interaction between both ERs in determining cognitive and reproductive functions.[28] Our results support the important role of α-ER in the social recognition test.

On the other hand, a synergistic action associated with ER is the production of the neuropeptide oxytocin, which is involved in social recognition behavior.[26]

In a recent paper, Spiteri et al. [32] showed that α-ER in the medial amygdala and ventromedial hypothalamus plays an important role in social recognition, as deficient social recognition is observed in α-ER knockout mice. Likewise, Sánchez-Andrade and Kendrick [33] using also α- and β-ER knockout mice demonstrated that an impairment of social recognition memory was detected mainly in α-ER knockout mice, whereas β-ER knockout mice showed no significant deficits in the social recognition memory at 24 hours. The authors concluded that α-ER is more important for social memory formation, mainly in female animals than in males.

The fact that the distribution of α- and β-ER has different patterns in the brain could explain their different roles in cognitive processes. For instance, the number of β-ER in hippocampus is higher than that of α-ER.[37] This could explain why β-ER knockout mice show difficulty in finding the submerged escape platform in a Morris water maze,[28] suggesting that β-ER is actively involved in spatial memory formation.[35] On the other hand, α-ER mediates several aspects of reproductive behavior because α-ER is more abundant in the medial preoptic nucleus, ventromedial hypothalamic nucleus, and arcuate nucleus,[62] which are structures related to sexual behavior. Olfactory structures such as the OB, the anterior olfactory nucleus, the piriform and the entorhinal cortexes also have a higher expression of β-ER mRNA,[37,38] and social recognition memory is dependent on olfactory signals.[43,63]

Our results showed that repeated 9-d exposure to EMF seems to be more effective for α-ER expression in OVX + E2 animals, compared with that in intact and OVX groups, as seen in Figure 4. In the case of β-ER, the ovariectomized animals exposed to EMF showed a decrease in the protein expression compared with that in intact and OVX + E_2, groups ($p < 0.01$ and $p < 0.05$, respectively); impairment in the social recognition test was also observed.

Similar results regarding α-ER were observed with β-ER in the three groups exposed to EMF over 30 days. The OVX group exposed to EMF over 30 days showed less protein expression and OVX + EMF + E2 group showed higher expression of α-ER. If the exposure to EMF was longer, then another process would take place, such as a decrease in cholinergic transmission, inflammation processes, an increase in oxidative stress (increases in ROS, NOS and lipid peroxidation), and possibly, a reduction in the oxidative defense system.[64,65] These data support the social recognition impairment in intact and OVX groups that we report here in our results.

Further experiments are required to explain the deleterious or beneficial effects of EMF on cognitive processes. However, we do show evidence for a possible correlation between repeated 30-d exposure to EMF and alterations in social behavior associated with modifications in estrogen receptors expression in the OB.

Both Western blot and immunohistochemistry results support the social recognition test.

5. Conclusions

Our approach was in regards to social recognition memory as it mainly depends on the olfactory bulb. Up to date, all factors modulating this behavior are unknown. The data shown in this study indicate that the amount of receptors to Alpha and Beta estrogens may be modified by the repeated exposure to a low-frequency magnetic field and this modification in the receptors correlates with changes in the olfactory behavior. Hence, our major finding was that such receptors have a significant role in the regulation of olfactory memory. This turns more evident when showing such behavior at the increase in expression of receptors through the administration of estrogens, protecting neurons from the deleterious effects observed after repeated exposure to magnetic fields.

Our findings suggest a significant role of α and β-estrogen receptors in a social recognition task after repeated 9-day EMF exposure. Moreover, a repeated 30-day exposure reduced the expression of α-estrogen receptors in ovariectomized and intact animals. On the other hand, ovariectomized animals treated with estrogens showed an improvement in the social recognition test.

5.1. Limitations

Our model is based on other studies of neuroprotection by 17 Beta estradiol.[29,39,43,45] However, it is important to consider that in our experimental model to avoid the natural hormone cycle, we did not measure serum estradiol concentrations between intact and experimental groups, which were different. In order to corroborate this, it is necessary to carry out further studies.

Contributors

CBM conducted the statistical analysis, behavior tests, and experimental design. VAA conducted the immunohistochemical experiments. EMA wrote the manuscript and Western blot experiments; BMM performed behavior tests; OMG conducted the Western blot experiments; RGG wrote the manuscript and experimental design.

Acknowledgments

We are grateful to doctor David Elias Viñas for his technical assistance with the EMF generator equipment, and Mrs Josefina Bolado for editing the English version of the manuscript.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the DGAPA-UNAM [grant number 202302].

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Journal of Lasers in Medical Sciences

J Lasers Med Sci 2016 Spring;7(2):120-125

Original Article

http://www.journals.sbmu.ac.ir/jlms

doi 10.15171/jlms.2016.20

Effects of 3 Hz and 60 Hz Extremely Low Frequency Electromagnetic Fields on Anxiety-Like Behaviors, Memory Retention of Passive Avoidance and Electrophysiological Properties of Male Rats

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Published online 27 March 2016

Abstract

Introduction: The effects of electromagnetic fields on biological organisms have been a controversial and also interesting debate over the past few decades, despite the wide range of investigations, many aspects of extremely low frequency electromagnetic fields (ELF/EMFs) effects including mechanism of their interaction with live organisms and also their possible biological applications still remain ambiguous. In the present study, we investigated whether the exposures of ELF/EMF with frequencies of 3 Hz and 60 Hz can affect the memory, anxiety like behaviors, electrophysiological properties and brain's proteome in rats.

Methods: Male rats were exposed to 3 Hz and 60 Hz ELF/EMFs in a protocol consisting of 2 cycles of 2 h/day exposure for 4 days separated with a 2-day interval. Short term memory and anxiety like behaviors were assessed immediately, 1 and 2 weeks after the exposures. Effects of short term exposure were also assessed using electrophysiological approach immediately after 2 hours exposure.

Results: Behavioral test revealed that immediately after the end of exposures, locomotor activity of both 3 Hz and 60 Hz exposed groups significantly decreased compared to sham group. This exposure protocol had no effect on anxiety like behavior during the 2 weeks after the treatment and also on short term memory. A significant reduction in firing rate of locus coeruleus (LC) was found after 2 hours of both 3 Hz and 60 Hz exposures. Proteome analysis also revealed global changes in whole brain proteome after treatment.

Conclusion: Here, some evidence regarding the fact that such exposures can alter locomotor activity and neurons firing rate in male rats were presented.

Keywords: ELF/EMFs; Locomotion; Memory; Locus Coeruleus.

Introduction

The effects of electromagnetic fields on biological organisms have been a controversial and also interesting debate over the past few decades, because modern civilization is overwhelmed by a broad range of electromagnetic fields, including extremely low frequency electromagnetic fields (ELF/EMF). Numerous investigations, from monitoring changes at molecular levels to the behavioral aspects, have been carried out in vitro and in vivo in order to illustrate different effects of ELF/EMF e.g., its impacts on cells,[1] hormones,[2-6] neurophysiological properties and sleep,[7,8] biochemical factors and metabolism,[9-11] pathology,[12,13] DNA damages and chromosome abnormalities,[14-19] reproduction and development,[20] and cancer.[21-23] On the other hand, the fact that central nervous system (CNS) as a very complicated electrochemical system may be influenced by electromagnetic fields attracts many researches interests. Vázquez-García et al reported that exposure to 60 Hz ELF/EMF can improves social recognition in male rats.[24] Cognitive performance in attention can be reduced in the presence of 50 Hz EMF according to a previous study.[25] In addition, high intensity electromagnetic can induce de-

Please cite this article as follows: Rostami A, Shahani M, Zarrindast MR. Effects of 3 Hz and 60 Hz extremely low frequency electromagnetic fields on anxiety-like behaviors, memory retention of passive avoidance and electrophysiological properties of male rats. *J Lasers Med Sci.* 2016;7(2):120-125.doi:10.15171/jlms.2016.20.

pression or metabolic disturbances.[26] It is also suggested that the exposure of 50 Hz ELF-MFs can cause oxidative stress-based nervous system pathologies associated with ageing[27] and increase blood brain barrier permeability.[28] Marchionni et al has reported that 50/60 Hz magnetic field can modify the firing rate of rat sensory neurons.[29] It has been shown that the cholinergic activity in the frontal cortex and hippocampus of the rat decreases immediately after exposure to 60 Hz magnetic field with different intensities[30] and 50 Hz ELF-EMF exposure can increase in vivo neurogenesis.[31] Zecca et al[12] reported that prolonged exposure to ELF/EMF increases the level of μ-opioid receptors in the rat brain. Some researchers reported that ELF-EMF altered the anxiety-like behavior in rats.[32,33] Despite the wide range of investigations, many aspects of ELF/EMFs effects including mechanism of their interaction with live organisms and also their possible biological applications still remain ambiguous.

In the present study, we followed the hypothesis that brain is a chemo-electromagnetic system that can be influenced by ELF/EMFs and some functional properties of the brain could be changed by these exposures. So, in order to investigate some of these possible consequences of ELF/EMFs exposures, we carried out a series of experiments including behavioral tests, electrophysiological properties and proteome analysis of the rat's brain exposed to 3 and 60 Hz ELF/EMF to show some possible interactions of these fields with brain functions. The selected frequencies (3 and 60 Hz) correspond to the delta and beta waves of brain, respectively.

Methods

Animals

A total of 113 adult Wistar rats (200-250 g) from the same colony were used. Animals were kept in groups of five in each cage with free access to food supplies and were maintained on an artificial light cycle (12 hours OFF: 12 hours ON, lights on at 7:00 AM) and room temperature (23 ± 2°C). Each animal was caged individually for 5 minutes before locomotion and stress test. All the experiments were conducted during the ON phase of the light cycle (9:00 AM to 4:00 PM). The study was performed according to institutional guidelines for animal care and use.

ELF/EMF Exposure System

Electromagnetic field was generated with ELF/EMF generator which was calibrated using a digital gauss meter (Magna MG-701, Magna Co. Ltd, Tokyo, Japan). The antenna of the generator was placed at the center of an aluminum mesh shielded room with dimensions of 1.5×2×2 m. This room was used as animal exposure room. Four groups of rats were placed in their usual plastic cages without any metallic cover and exposed to ELF/EMF with frequencies of 3 Hz and 60 Hz and intensity of 4 mT for 2 h/day (9:00 to 11:00 AM) consisting of 2 exposure periods of 4 days separated with a 2 days interval. The center of each cage was placed at a distance of 40 cm from effective radiative surface of the antenna on a wooden stage with a distance of 50 cm from the ground (Figure 1). Sham exposed animals were maintained for an equal period of time inside the exposure room with the generator off. Experiments were carried out at relatively constant room temperature (23 ± 2.0°C).

For electrophysiological recording, each animal group was exposed to either 3 Hz or 60 Hz for 2 hours in the electrophysiological set up.

Anxiety-Like Behaviors

The method used here has been well explained previously.[34] In this study, 60 animals were randomly divided in 3 experimental groups as sham, 3 Hz exposure and 60 Hz exposure. The plus-maze test was a wooden, cross-shaped maze consisting of four arms arranged in the 'plus' sign shape. Two across arms have no side or end walls (open arms; 50×10 cm) and the two other arms had side walls and end walls, but were open on top (closed arms; 50×10×40 cm). At the center of the apparatus where four arms intersect, there was a square platform of 10×10 cm. The maze was elevated to a height of 50 cm. In order to increase total arm entries, 5 minutes prior to maze testing rats were placed in a wooden test arena (50×50×35 cm) facing the close arm. One and two weeks after the exposure period, the effects of exposure to the 3 Hz and 60 Hz ELF/EMF were determined in the plus-maze test. The percentage of open arm entries and open arm time that are introduced as the standard anxiety indices was calculated as follows: (*a*) %OAT (the ratio of times spent in the open arms to total times spent in any arms × 100); (*b*) %OAE (the ratio of entries into open arms to total entries × 100). Total crossing of each entries by forepaws were measured as a relative pure index of locomotor activity.

Retention Test of Passive Avoidance Learning

The dark box and lighted box with the same measures (20×20×20 cm) are the main compartments of the passive avoidance apparatus. The boxes are separated by a guillotine door (8×8 cm). The lighted box was illuminated with a lamp (60 W, positioned above the apparatus). The floor of the dark compartment was made of stainless steel (0.5 cm diameter) separated by a distance of 1 cm. Intermittent electric shocks (50 Hz, 5 seconds), 1.5 mA intensity were delivered to the grid floor of the dark compartment

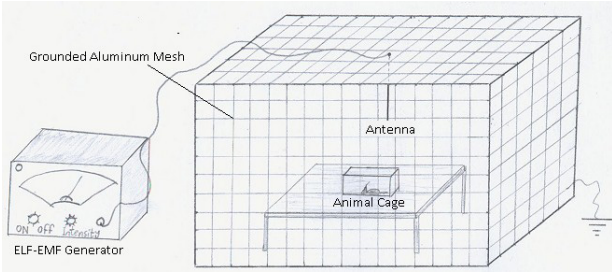

Figure 1. Irradiation setup in which ELF-EMF generator is shown on the left and its antenna is entered into aluminum cage from its ceiling to expose animals in their home-cage.

by an isolated stimulator.

A total of 30 rats were randomly divided to the groups of sham, 3 Hz and 60 Hz exposure and allowed to habituate to the laboratory environmental conditions 1 hour prior to each training or testing sessions. All training tests were performed between 08:00 AM and 14:00 PM. During training, each animal was kept in the lighted box; 10 seconds later the door between the compartments was opened and the latency to enter the dark (shock) compartment with all four paws was recorded. The criterion for excluding animals from the experiment was waiting more than 100 seconds to cross to the other side. Once the animal crossed all four paws to the next compartment, the door was closed and a 1.5 mA foot shock was administered for 5 seconds. Then animal was removed from the apparatus and returned to its home cage.

In order to determine long term memory, a retention test was performed 24 hours after training. The experiment was carried out similarly to the acquisition trial, except that the guillotine door did not close when the rat entered the dark compartment and the shock was not applied to the grid floor. If animal remained in a light compartment and did not cross within 300 seconds to the dark compartment, (where the foot shock had been given) the session was ended and score of 300 was assigned.

Electrophysiological Recording

The method used in the present study is similar to the method described previously.[35] Briefly, a total of 23 animals were anesthetized with urethane (1.2-1.5 g/kg body weight, i.p. injection) and were placed in a stereotaxic instrument. Body temperature was maintained at 35.5–36.88°C by a thermistor-controlled heating pad. A 2 mm diameter hole in the skull above LC (according to the atlas of Paxinos) was drilled, and the dura was reflected. Glass micropipette (2–4 mm tip diameter, 2–10 MΩ impedance) filled with 2% pontamine sky blue dye in 0.5M sodium acetate was used to obtain extracellular recording from individual neurons which was stereotaxically advanced into locus coeruleus (LC). Unit activity was amplified by a microelectrode amplifier (Nihon Kohden Co Ltd, Tokyo, Japan) and displayed continuously on a storage oscilloscope (Tektronix Co Ltd, TDS1000-EDU, Beaverton, OR, United States) as unfiltered and filtered (300 Hz–3 kHz band pass) signals, and also monitored with an audio monitor. Action potentials were isolated from background activity with a window discriminator (WPI) which generated output pulses for signals that crossed a lower voltage gate, peaked below an upper voltage gate. The discriminator output signals were linked to a computer for online data collection. The output signals were saved as number of output signals as spikes in unit of time. The unit activity was calculated by computer as an average frequency.

Statistical Analysis

Anxiety like behavior data were expressed as mean ± SE and data were analyzed using SPSS 16 (SPSS/PC Inc., Chicago, IL, USA). After verifying the normality and homogeneity of variables, analysis of variance (ANOVA) was performed with a 95% CI ($P<0.05$) and differences between experimental groups at this level were considered statistically significant.

The obtained single unite recording results are expressed as mean ± SE. Firing rates before and after exposures were compared using student's paired *t* test and for multiple comparisons, one-way ANOVA was used with Tukey post hoc ($P<0.05$).

Results

Anxiety Like Behavior

Figure 2 shows the effects of ELF/EMF exposure at the above mentioned exposure protocol on anxiety like parameters in the elevated plus maze tested 1 and 2 weeks after the exposures. One-way ANOVA analysis revealed that ELF/EMF with frequencies of 3 Hz and 60 Hz exposure did not alter percentage open arm time and percentage open arm entries in neither 3 Hz nor 60 Hz exposed groups ($P>0.05$) (Figure 2A and 2B), but indicated a significant decrease in locomotor activity immediately after

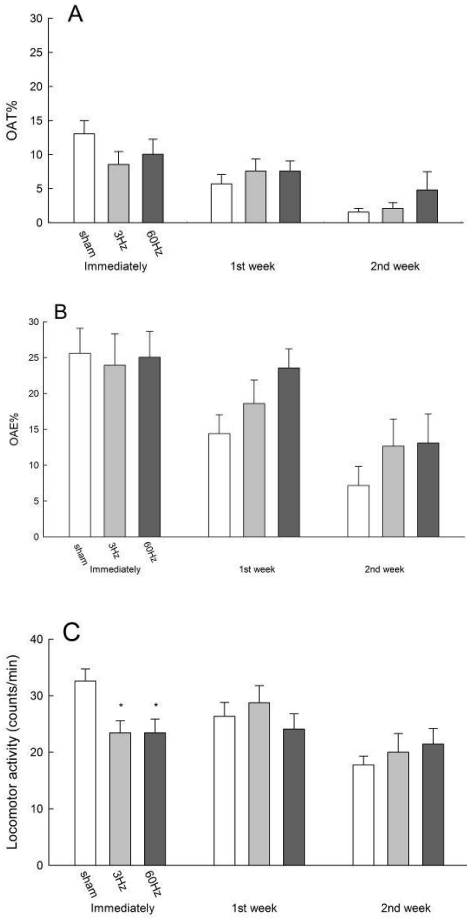

Figure 2. The effects of 3 and 60 Hz ELF/EMF whole body exposure of two groups of rats for the selected exposure protocol on anxiety-like behavior. The test was performed 1 and 2 weeks after exposures. Each bar is mean ±SE of 20 animals. Percentage open arm time (A), percentage open arm entries (B) or locomotor activity (C). *$P<0.05$.

the exposures in both 3 Hz and 60 Hz groups ($P<0.05$) in comparison with sham group. According to these findings, relatively long exposure of both 3 Hz and 60 Hz ELF/EMF can alter locomotor activity but have no effect on anxiety.

Memory Retention

In order to investigate the impacts of 3 Hz and 60 Hz ELF/EMF exposures on long term memory, animals were subjected to retention test of passive avoidance learning test. As illustrated in Figure 3, exposure at applied exposure protocol had no significant effect on retention memory in male rats tested by passive avoidance apparatus ($P>0.05$).

Electrophysiology

In these experiments, we examined whether ELF/EMF exposure can affect neural activity of LC.

Effects of 3 Hz Exposure on Unit Activity of LC

After isolating each LC unit and determining the stability of its firing rate, anesthetized animals were subjected to 3 Hz ELF/EMF exposure for a period of 2 hours which was adjusted in the extracellular recording cage. As it is shown at Figure 4, the overall unit activity of a total of 14 isolated neurons in LC decreased significantly immediately after 2 hours whole body exposure of 3 Hz ELF/EMF ($P<0.05$) compared with its pre-exposure unit activity. In fact, statistical analyses revealed that 8 out of 14 nuclei showed a significant decrease in firing rate after 2 hours exposure of 3 Hz ELF/EMF ($P<0.01$).

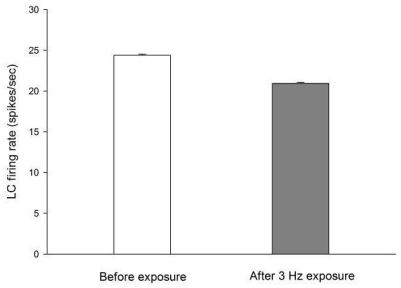

Figure 3. The effects of 3 and 60 Hz ELF/EMF whole body exposure of two groups of rats for selected protocol (9:00 to 11:00 AM) on memory retention. The test was performed immediately after exposures. Each column represents the mean ±SE of data acquired from 10 rats ($P>0.05$).

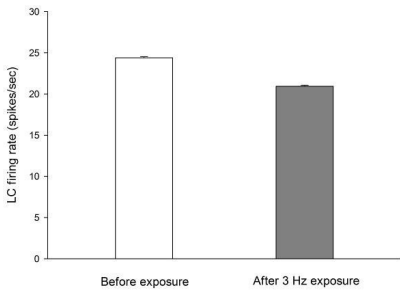

Figure 4. The average of LC neurons activity before and after 2 hours exposure to 3 Hz ELF/EMF.

Effects of 60 Hz Exposure on Unit Activity of LC

In order to investigate effect of 60 Hz on LC activity, a procedure similar to 3 Hz exposure was carried out. At the end of 2 hours exposure, a significant decrease was found in LC's neurons total activity compared to pre-exposure neurons activity (Figure 5). In fact, 5 out of 9 nuclei showed a significant decrease in the firing rate ($P<0.01$). These results indicate that short time exposure of both 3Hz and 60Hz ELF/EMFs can suppress LC neurons unit activity significantly immediately after 2 hours exposure (Figure 6).

Proteome Analysis

Immediately after exposures, rat brains were extracted and protein extraction was performed. At the end of 3 Hz ELF/EMF exposure at selected protocol and using 2-DE technique, proteome analysis of rat's whole brain revealed changes in the expression of some proteins. In fact, primary proteomics analysis showed that the expression of 43 proteins changed in 3 Hz exposed group compared with sham group. Among these proteins, expression of 27 proteins were suppressed in the exposed group while 10 new proteins were expressed (data are not presented here).

Body Weight and Mortality

No significant change in body weight was observed 6 months after the 3/60 Hz exposures. Furthermore, no clinical disorders or mortality have been recorded during the 6 months monitoring after 3/60 Hz exposures.

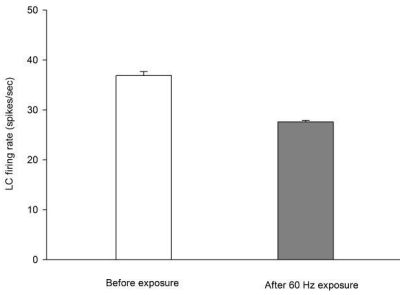

Figure 5. The average of LC neurons activity before and after 2 hours exposure to 60 Hz ELF/EMF.

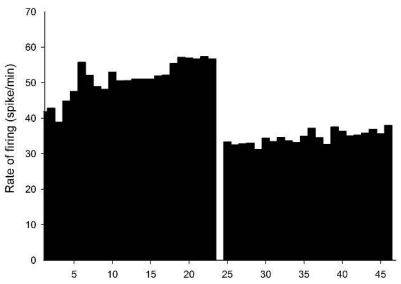

Figure 6. A typical unit activity of LC neuron in response to 2 hours exposure to 3 Hz ELF/EMF. A significant decrease in the unit activity of LC occurred after 3 Hz ELF/EMF exposure (The gap between two series of spikes in each graph represents 2 hours exposure time).

Discussion

Effects of ELF/EMF on biological systems have been the subject of debate over past few decades. Many studies revealed that ELF/EMF exposures can alter some animal behaviors.[24,25,32,33] Since most of behaviors are controlled by different brain's nuclei and neurotransmitter systems, it seems that ELF/EMFs do not interact with all part of CNS or at least do not affect all parts of it in the same way. In the present study, effects of ELF/EMF exposure with frequencies of 3 Hz and 60 Hz on anxiety like behaviors, long term memory and unit activity of LC were studied. The results mainly indicated: (1) A decrease in locomotor activity following exposure to both 3 Hz and 60 Hz ELF/EMF while other parameters of anxiety like behaviors did not alter; (2) A decrease in unit activity of LC after 2 hours exposure to these frequencies.

The first result shows that the locomotor activity of rats can be affected by exposure to 3 Hz and 60 Hz ELF/EMF while other parameters of anxiety like behaviors stayed unchanged (Figure 2). Alteration in locomotor activity is in contradiction with findings of some researchers that reported no change in locomotor activity of rats after exposure to ELF/EMF.[24,26] On the other hand, a significant decrease in swim speed of exposed animal to 60 Hz MF tested by water-maze was reported[36] which can be in accordance with our findings.

In order to shed light on some aspects of this finding, the unit activities of LC was measured following both 3 Hz and 60 Hz exposures. Second finding indicates that the unit activity of LC decreased significantly after exposure of these two frequencies (Figures 4 and 5) which can confirm the effects of ELF/EMF exposures on the brain and the probable following change of its activity.

LC contains a large aggregation of noradrenergic (NE) neurons and has wide projections throughout the brain. So, it can influence the activity of many brain areas and modulate different basic behavioral and physiological processes, such as sleep, waking, and arousal.

According to its function, it can be expected that decrease in LC nucleus activity after exposure to ELF/EMF resulted in some lassitude in exposed animals and causes the following decrease in locomotor activity.

The mechanism by which ELF/EMF exposures can alter locomotion activity could also be explained partly by some reports showing that the number of opioids receptors[37] and overall activity of this system could be increased following ELF/EMF exposures,[38] which can lead to increase or decrease in performance depending on the site of its activation. Activation of this system can decrease the activity of cholinergic system in hippocampus and frontal cortex which is related to learning and arousal. Furthermore, Opioids peptides can decrease the level of noradrenalin in the brain and thus have some negative effects on amygdale which can lead to some depressant effects. A change in the mood of the animal may explain the observed decreasing locomotor activity in exposed animals.

According to some reports, ELF/EMF can improve social recognition (short term memory) in rats[24,39] while Trimmel et al reported a reduction in memory performance following 50Hz EMF exposure.[25] According to our findings, exposure of the animals to ELF/EMF with either frequencies of 3 Hz or 60 Hz had no effect on long term memory (Figure 3). Electromagnetic fields might alter short term memory and have mild or no effects on long term memory. However, testing long term memory using some techniques milder than passive avoidance is inevitable.

On the other hand, our results showed that exposure to ELF/EMF can alter the patterns of protein expression in rat's whole brain. In fact, now almost all researchers accepted that EMFs can alter gene expression and protein synthesis in living organism. From this point of view, one should consider that proteins widely define the functions of an organism, so any change in proteome caused by EMFs can alter the cell or organism's behavior. It is highly suggested to investigate the effects of ELF/EMFs on different animal tissues using omics technologies (e.g., proteomics) in order to elucidate the pathways involved in living organism's responses to these exposures.

Conflict of Interest

The authors declare no conflict of interest, financial or other exist.

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CHILD DEVELOPMENT

Child Development, January/February 2018, Volume 89, Number 1, Pages 129–136

The title for this Special Section is **Contemporary Mobile Technology and Child and Adolescent Development**, edited by Zheng Yan and Lennart Hardell.

See D. R. Grimes and D. V. M. Bishop, "Distinguishing Polemic From Commentary in Science: Some Guidelines Illustrated With the Case of Sage and Burgio (2017)", https://doi.org/10.1111/cdev.13013

Electromagnetic Fields, Pulsed Radiofrequency Radiation, and Epigenetics: How Wireless Technologies May Affect Childhood Development

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Mobile phones and other wireless devices that produce electromagnetic fields (EMF) and pulsed radiofrequency radiation (RFR) are widely documented to cause potentially harmful health impacts that can be detrimental to young people. New epigenetic studies are profiled in this review to account for some neurodevelopmental and neurobehavioral changes due to exposure to wireless technologies. Symptoms of retarded memory, learning, cognition, attention, and behavioral problems have been reported in numerous studies and are similarly manifested in autism and attention deficit hyperactivity disorders, as a result of EMF and RFR exposures where both epigenetic drivers and genetic (DNA) damage are likely contributors. Technology benefits can be realized by adopting wired devices for education to avoid health risk and promote academic achievement.

Electromagnetic fields (EMF, including extremely low-frequency [ELF] or power frequency fields) and radiofrequency radiation (RFR) produce biologically relevant signals at very low intensity levels (Funk, Monsees, & Ozkucur, 2009; Sage, 2015; Sage & Carpenter, 2012; Sage, Hardell, & Carpenter, 2015) that have become increasingly common the everyday life of a child (Duggan, 2013; Lenhart, 2015). In today's world, nearly everyone is exposed to two types of EMFs: (a) ELF EMF from electrical and electronic appliances and power lines, and (b) RFR from wireless devices such as cell phones and cordless phones, cellular antennas and towers, and broadcast transmission towers. The term EMF is used here when referring to all EMF in general and the terms ELF or RFR when referring to the specific type of exposure. This review article profiles new evidence on the possible role of epigenetics as one cause of neurodevelopmental and neurobehavioral problems now widely seen in childhood development, including abnormal states and functional changes similar to autism and attention deficit hyperactivity disorder (ADHD), which can occur with exposure to EMF and RFR. Epigenetics refers to heritable changes in gene expression that do not involve changes to the underlying DNA sequence in response to environmental changes and have evolved to provide a more precise and stable control of gene expression and genomic regulation. Today, epigenetics equates to all information

[Correction made on June 13, 2017, after first online publication on May 15, 2017: This article has been recategorized as a Special Section Commentary.] [Article updated on December 21, 2017: Author Conflict of Interest disclosure statement has been added.]

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 0009-3920/2018/8901-0013
DOI: 10.1111/cdev.12824

heritable during cell division other than by the DNA sequence. It not only provides control of gene expression but also provides means of interaction between the environment and the genome.

Several new lines of scientific evidence are synthesized to document how EMF and RFR present in wireless technologies can trigger epigenetic changes that can negatively affect childhood development, including mobile phones and Wi-Fi emissions at levels to which the fetus and young children may be exposed by use of wireless devices. Adverse health and developmental impacts in children coupled with growing reliance on mobile technologies by children, expansion of wireless educational technologies into school programs, and evidence that such technologies may hinder rather than promote academic achievement strongly suggest a reappraisal of wireless (mobile technology) applications.

Exposure and Impacts of EMF and RFR on Adults

A comprehensive review of the scientific literature indicates that chronic exposure to even very low levels can result in biological effects that can result in diminished capacity to grow and develop normal neurologic, immune, and metabolic functions, and result in serious health and learning impairments and chronic disease (Sage & Carpenter, 2012). In adults, the evidence points to increased cancer and neurodegenerative diseases (chronic degenerative and inflammatory diseases). Fertility and reproductive harm is rather consistently documented in men with damage to the DNA of sperm and deterioration of the testes (Sage & Carpenter, 2012, sections 1 and 18). Overall, the scientific evidence is suggesting that chronic exposure to wireless emissions can have detrimental effects on the fetus, infant, young child (Aldad, Gan, Gao, & Taylor, 2012; Divan, Kheifets, Obel, & Olsen, 2008, 2012), and adolescent in terms of neurological development, memory, learning, attention, concentration, behavior problems, and sleep quality (Carter, Rees, Hale, Bhattacharjee, & Paradkar, 2016). Maskey and Kim (2014) report that 835 MHz cell phone radiation exposure of very young mice can result in subsequent deficiencies in learning and language processing, disruption of brain-derived neurotrophic factor in critical windows of brain development and sensory processing, and in behavioral changes (anxiety, risk taking). Where autism spectrum conditions (ASCs) and ADHD are concerned, there is a striking similarity in effects documented from EMF/RFR exposure and those expressed in ASCs and ADHD as comprehensively reviewed in Herbert and Sage (2013a, 2013b). Mobile phone radiation exposures commonly experienced today by children wireless devices are capable of producing neurological and cognitive effects (impairments) congruent with those often exhibited in ASCs and ADHD. EMF/RFR exposures can also result in epigenetic changes in DNA expression that can impair normal functioning, without causing direct damage to DNA but simply affecting how well DNA functions are carried out (mitochondrial metabolism, production of proteins and immune cells, etc.). New epigenetic studies on mobile phone emissions support this evidence (Dasdag et al., 2015a, 2015b).

The "electronic environment" has massively changed in the last 3 decades since wireless technologies have become deeply embedded in the lives of children. Exposures relevant to children include cell and cordless phone radiation, Wi-Fi-enabled devices like wireless iPads and other wireless tablets, wireless laptops, electronic baby monitors, and surveillance devices, among other sources. Exposure levels from these sources can result in biological effects that with chronic exposure be reasonably presumed to result in adverse health harm (Sage & Carpenter, 2009, 2012). The U.S. National Toxicology Program (NTP) recently released results of the largest animal toxicity study on cancer ever performed. NTP reports a statistically significant, dose–response increased risk for malignant glioma (brain cancer) as well as precancerous lesions in male rats exposed to as low as 1.5 W/kg, below the current public safety limit, and to which children using mobile phones and wireless tablets will be exposed (Wyde et al., 2016). These results occur in the same cell types that develop cancer in human studies (Hardell, Carlberg, & Hansson Mild, 2013; Hardell & Carlberg, 2014). These brain tumor studies indicate an increased risk of deadly glioma with use of mobile phones and cordless (wireless) phones, with the highest risk for the young who use mobile phones before the age of 20 years. World Health Organization studies from 13 countries report increased brain cancer risks; and RFR was classified as a possible human carcinogen in 2011 (Baan et al., 2011; Cardis et al., 2011; Interphone Study Group, 2010, 2011).

The Kaiser Family Foundation (Rideout, Foehr, & Roberts, 2010) sets media use among 8- to 18-year-olds at more than 7.5 hr a day or 54 hr a week. Kaiser's report says too much screen time is linked to violent behavior, poor school performance, lower reading scores, sleep pattern disturbances, being overweight, and consumption of junk food. Limits on screen time are echoed by the American Academy of Pediatrics (Block, 2012). Pew

Table 1
Radiofrequency (RF) Power Density and Specific Absorption Rate (SAR) Levels Reported to Cause Tissue Damage, Changes in Health Status, Neurological Function, Cognition, and Behavior Problems

Study	RF power density ($\mu W/cm^2$)	Reported health impacts
Zwamborn et al. (2003)	0.13	Anxiety, hostility, impaired cognition
Navarro et al. (2003)	0.01–0.11	Fatigue, headaches, sleeping problems
Oberfeld et al. (2004)	0.01	Sleep and concentration disruption, fatigue and cardiovascular problems
Hutter et al. (2006)	0.05–1.0	Headache, sleep, concentration problems, other neurological problems
Thomas et al. (2008)	0.005–0.04	Headaches and concentration difficulties with short-term cell phone radiation
Kundi and Hutter (2009)	0.05–0.1	Headaches, cardiac symptoms, fatigue, sleep and concentration disruption, and other impairments
Heinrich et al. (2010)	0.003–0.02	Headache, irritation, and concentration difficulties in schoolchildren and adolescents (8–17 years old) with short-term exposure to base-station level radiofrequency radiation
Thomas et al. (2010)	0.003–0.02	Conduct and behavioral problems in schoolchildren and adolescents (8–17 years old) exposed to short-term cell phone radiation
Mohler et al. (2010)	0.005	Sleep disturbances in adults with chronic cell phone tower exposure
Buchner and Eger (2011)	0.006–0.01	Significant impact on stress hormones especially in children and chronically ill adults
Avendano et al. (2012)	0.5–1.0	Decreased sperm viability and DNA breakage in human sperm with 4 hr exposure to Wi-Fi from laptop in wireless mode
Sage and Carpenter et al. (2012)	0.00034–0.07	DNA damage, impaired sperm quality, motility, and viability from cell phones on standby mode and wireless laptop use
	SAR	
Tas et al. (2014)	0.0369 W/kg[a] 2.023 W/kg[b]	Degeneration of testes tissues with 900 MHz cell phone radiation (3 hr per day exposure for 12 months)
Atasoy et al. (2013)	0.091 W/kg[a]	Damaged DNA and reduced DNA repair at levels that comply with 802.11 g Wi-Fi public safety limits
Dasdag et al. (2015a)	0.0369 W/kg[a] 2.023 W/kg[b]	Lowered microRNA activity in brain (3 hr per day exposure for 12 months)
Akdag et al. (2016)	141.4 μW/kg[a] 7127 μW/kg[b]	DNA damage in testes by comet assay (24/7 exposure for 12 months—900 MHz cell phone radiation)
Dasdag et al. (2015b)	141.4 μW/kg[a] 7127 μW/kg[b]	Lowered microRNA activity in brain (24/7 exposure for 12 months—2.45 GHz Wi-Fi radiation)

[a]Whole body. [b]Max SAR.

Research Center (Duggan, 2013) reports 50% of cell owners download apps to their phones, 48% listen to music, video calling has tripled since 2011, and texting has massively increased in volume. Pew Research Center also reports that in teens, 58% own or have access to a tablet (wireless device). Nearly 75% of teenagers own or have access to a smartphone, and another 25%–30% have a basic cell (wireless) phone. Ninety-four percent of teens go online daily or more often. Twenty-four percent of teens report being online constantly (Lenhart, 2015).

RFR levels are associated with adverse health impacts at exposure levels common with use of wireless devices and Wi-Fi classroom installations and nearby cell towers, and have been linked to impairments in learning, memory, attention, concentration, and behavior. As shown in Table 1, the exposure levels reported to cause adverse changes in neurological function and tissue damage are much lower than current public safety limits. These exposure levels interfere with sleep and can lead to headaches, seizures, fatigue, mental confusion and burnout, immune disruption, and sperm damage. Pediatric use of wireless devices in a study of 350 very young children in urban, low-income minority populations is profiled by Kabali et al. (2015), who reported that 96.6% used mobile devices before the age of 1 year. The use of wireless devices by small children means exposure to very high levels of pulsed RFR from the wireless signals and also to the ELF EMF from the battery switching (Sage, Johansson, & Sage, 2007).

Khurana et al. (2010) reported exposure levels of 0.05–0.1 $\mu W/cm^2$ at distances < 500 m to cell towers increased risk of adverse neurobehavioral symptoms or cancer in 8 of 10 epidemiological

studies. Cell tower microwave radiation exposure on average ranges from 0.05 to 0.1 $\mu W/cm^2$, which has been shown to be associated with increased risk for neurological and sleep disorders (Hutter, Moshammer, Wallner, & Kundi, 2006). In school classrooms, or at home where wireless routers are installed, the cumulative RFR exposure from use of wireless devices, Wi-Fi, and wireless utility meters can add to cell tower exposures, so children may be exposed to 10 times or more what a cell tower delivers at several hundred meters distance.

Exposure and Impacts of EMF and RFR on Children and Adolescents

Consequences on Mental Health, Stress, and Anxiety

The exposure of the developing fetus by use of wireless devices (e.g., iPads, smartphones, and wireless laptop computers) has already raised scientific questions about what health and developmental impacts may result to the child (Aldad et al., 2012). Children born of mothers who used cell phones during pregnancy develop more behavioral problems by the time they have reached school age than children whose mothers did not use cell phones during pregnancy. Children whose mothers used cell phones during pregnancy had 25% more emotional problems, 35% more hyperactivity, 49% more conduct problems, and 34% more peer problems. The odds ratio for higher overall behavioral problems was 1.8 (1.45–2.23) in children with both prenatal and postnatal exposures to cell phones (Divan et al., 2008, 2012). Hensinger (2015) presents evidence from Germany on the negative influences of digital learning and the failure of educational technologies, particularly Wi-Fi-enabled classrooms and digital devices. He details problems of information overload, stress, and addiction factors in digital multitasking, the loss of learning abilities, student privacy and online surveillance, and wireless health effects at Wi-Fi frequencies (around 2450 MHz).

Evidence for Addictive Behavior

Roberts, Yaya, and Manolis (2014) present extensive evidence of heavy use of wireless devices and profile negative aspects of this emerging technology on students, indicating behaviors consistent with classical addiction. Paz de la Puente and Balmori (2007) note the evidence supports cell phone use to be physically addictive rather than a habituation or dependency. Henry Lai previously documented that RFR activated the endogenous opioid system of the brain, which is the part of the brain which responds to drugs, alcohol, and opioid painkillers (Lai, Carino, Horita, & Guy, 1992; Lai, Carino, & Singh, 1997; Lai, Carino, Wen, Horita, & Guy, 1991; Lai, Horita, & Guy, 1994). A significant dose–response relationship was observed between the number and duration of voice calls made on cell phones and ADHD risk among children exposed to lead in their environment (Byun et al., 2013). Addictive behavior is described in young people who have extensive use of wireless devices (Moeller, 2010; Roberts et al., 2014).

Electronic Learning and Global Decline in Academic Performance

Perhaps most important are the reported effects on learning and academic achievement. The Organisation for Economic Co-operation and Development (OECD) promotes policies that will improve the economic and social well-being of people around the world. In 2015, OECD published a 64-country report on global student achievement and technology that concluded there were no appreciable improvements in student achievement in reading, mathematics, or science in the countries that had invested heavily in information technology for education. The German Federal Ministry of Science and Research, the European Union, and the Deutsche Telecom AG provided digital notebooks (tablets) to 1,000 schoolchildren and tracked their academic performance (Schaumburg, Prasse, Tschackert, & Blomeke, 2007). They found students with notebooks had neither better grades nor better learning achievement, and tended to be less attentive.

Child Development Disruption Congruent With ASCs and ADHD

Electromagnetic radiation from chronic exposure to wireless technologies is associated with many adverse biological effects that can result in diminished capacity to grow and develop normal neurologic, immune, and metabolic functions, and result in serious health and learning impairments and chronic disease. Many of the behavioral and biological characteristics seen in autism are similar or identical to those produced by typical daily exposures to cell and cordless phone radiation, cell towers, baby monitors, wireless tablets, Wi-Fi, and other sources of pulsed electromagnetic radiation, and these are extensively profiled by Herbert and Sage (2013a, 2013b). EMF and RFR exposures appear to contribute to chronically disrupted homeostasis that is consistent with many key symptoms of autism and

impaired cognitive functioning. Critical pathways that are known to be sensitive include electrophysiology and bioenergetics of cells, neural synchrony and brainwave activity, brain inflammation, oxidative damage from free-radicals, pathological leakage of critical separations between gut–blood or blood–brain barriers, disrupted mitochondrial and immune functions, and depleted glutathione reserves. Disruption of neural synchrony by RFR exposure may be the key factor in disrupted memory and learning. Altered brainwave activity can interfere with memory formation and impair sleep, which is fundamental to memory retention. Leone et al. (2014) provide crucial data on epigenetic modulation of adult hippocampal neural stem cells with 50 Hz ELF exposure, offering both physical evidence of improved neurogenesis in the hippocampus, and a plausible (epigenetic) mechanism of action.

Epigenetics as a Plausible Biological Mechanism for EMF/RFR Effects

The study of epigenetics (the regulation of genes by environmental influences) is an appropriate tool to identify the causes of pathological changes in human embryonic and fetal development, leading to adverse developmental changes in the genome (Burgio & Migliore, 2015). The *epigenome* may be defined as a molecular and systemic network that interacts not only within itself, with its DNA, but also with the exterior world; and *epigenetics* as the study of heritable changes in gene activity that are not caused by changes in the DNA sequence. The *environment* should be considered as a *continuous flow of information* coming from outside and reaching the epigenome, causing it to activate and to continuously change its molecular and three-dimensional structure. Epigenetics gives us a critical missing dimension that shows the monumental influence the environment (meaning here the environmental exposures to EMF and RFR such as that from mobile phones and other wireless technologies) can have on how the genes are regulated and how genes express themselves in neurological development. When outside environmental signaling goes awry, impairments and diseases can occur at any age but are worse for the developing child. This is particularly damaging during fetal programming (Burgio & Migliore, 2015). The best evidence is provided by studies of histone modification, chromatin remodeling (or condensation), and microRNAs. EMF and RFR exposures studying DNA methylation, histone modification, and microRNA may be useful in the future to study epigenetics.

MicroRNA

Evidence for an epigenetic cause of damage, that is, modulation of microRNA, is presented by Dasdag et al. (2015a, 2015b) in new studies on 900 MHz cell phone radiation and 2450 MHz Wi-Fi levels of exposure. Dasdag et al. (2015b) report that very low-intensity Wi-Fi exposures over a year-long period (24 hr per day) at 141.4 μW/kg (whole body specific absorption rate [SAR]) and a maximum SAR of 7127 μW/kg lowered activity of microRNAs in the brain of adult rats. Van den Hove et al. (2014) previously reported miR-107 as epigenetically regulated miRNA linked to Alzheimer's disease and correlated with changes in neuronal development and neuronal activity.

Histone Modification

The role of histones in epigenetics revolves around how DNA chains are organized (and can be disorganized to disrupt critical biological functioning). Studies of protein folding (and misfolding) and the disabling effect of misfolded proteins on protein and enzyme expression indicate that low-intensity exposures to EMF and RFR may change protein conformation (Bohr & Bohr, 2000). Disrupting or misfolding of proteins can disrupt fundamental metabolic, growth, and cell signaling. Disruption can result from abnormal environmental signals (e.g., circadian rhythm disruption that interferes with sleep, healing, and cancer surveillance) that, in turn, disrupt how living tissues self-regulate, create overload of the system, and loss of adaptive capacity.

Chromatin Remodeling

A series of studies have reported very low-intensity microwave radiation (nonthermal) can decrease DNA repair foci (repair centers for DNA within cells) where double-strand DNA breaks would normally go for DNA repair. Inhibition of DNA repair may lead to increased risk of cancers. Belyaev, Markova, Hillert, Malmgren, and Persson (2009) suggest it is due to the inability of these damaged DNA fragments to reach DNA repair proteins because the underlying chromatin structure has been altered by microwave radiation exposure. Belyaev and Markova have provided studies reporting that microwave (RFR) exposure inhibits DNA repair (Markova, Hillert, Malmgren, Persson, & Belyaev, 2005; Belyaev et al., 2009). Microwave radiation reduces the ability of cells, in particular of human stem cells, to repair DNA damage, and

these microwave effects were observed down to 10^{-14} μW/cm^2 with 20–40 min duration to 10^{-19} μW/cm^2 at 1 hr exposure; or many thousands of times lower than wireless devices and Wi-Fi exposures produce in normal use. Poor repair of double-strand DNA breaks may lead to cancer.

Conclusion

Public health implications of wireless technologies are enormous because there has been a very rapid global deployment in homes, education, transportation, and healthcare in the last 2 decades. Even a small risk from chronic use wireless technologies may have a profound global health impact. Impacts on the fetus via parental exposures to wireless devices preconception and during in utero development, infant rearing (baby monitors, wireless surveillance, Wi-Fi routers, DECT cordless phones, etc.), and childhood preschool and academic environments all may contribute in incremental ways to a perpetually saturated habitat of wireless emissions, and health impacts from the chronic, stressful body burden of EMF and RFR.

The wide array of pathophysiological effects of EMF and RFR exposures from wireless sources do not require "the breaking of molecular bonds" as done by ionizing radiation in order for physiologically damaging effects to occur. Epigenetic mechanisms alone can change fetal development in profound ways, disrupting health by causing changes in gene activation and expression without change in gene sequences. Environmental epigenetic influences in the fetal and neonatal development (i.e., epigenetic regulation of genes rather than direct genetic effects by gene mutation) have been plausibly established to cause pathophysiological changes that can result in altered neurological development. Symptoms of neurodevelopmental problems in children like retarded memory, learning, cognition, attention, and behavioral aberrations that are similarly expressed in autism and ADHD have been reported in numerous scientific studies to occur as a result of EMF and RFR exposures, where epigenetic drivers are the most likely causes, and persistent exposures contribute to chronic dysfunction, overwhelming adaptive biological responses.

Electronic educational technologies have not resulted in better academic achievement globally and lend support to scientific studies showing adverse health and developmental impacts (OECD, 2015). Reductions in preventable exposures to EMF and RFR should be a top public health and school district priority. Technology benefits can be realized by adopting wired devices for education to avoid health risk and promote academic achievement. Wider recognition that epigenetic factors are a plausible mechanism for EMF/RFR to regulate expression of DNA and thus impact child development is a critical need. Whether future research can identify safe levels of wireless exposures is unknown, but further investigation of epigenetic markers related to EMF/RFR exposure in child development and disease is warranted.

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Sent: Monday, November 4, 2019 11:28 AM
To: Jill Techel <jtechel@cityofnapa.org>; Doris Gentry <dgentry@cityofnapa.org>; Liz Alessio <lalessio@cityofnapa.org>; Mary Luros <mluros@cityofnapa.org>; Scott Sedgley <SSedgley@cityofnapa.org>
Cc: Steve Potter <spotter@cityofnapa.org>
Subject: Fwd: yes, perfect, thank you

[EXTERNAL]
Dear Mayor and City Council Members,

As Director of the California Brain Tumor Association I am writing to implore upon you to nact a Small Cell Ordinance that truly protects public health, the environment, aesthetics and property values.

Please keep so-called small cell antennas out of residential areas and away from schools.

I became involved in this 11 years ago as my husband had a brain tumor attributed, more likely than not, to cell phone radiation. Since testifying to the United States Congress and appearing on many national television shows I have heard from thousands affected either by cell phones or from living or working near a cell tower. Young people are dying and this technology certainly does not belong next to their bedrooms or near their schools. Please see attached study that was declassified by the CIA a few years ago.

The FCC, FDA and the CTIA are working together using the tobacco playbook: addict them, lie to them, war game excellent science, buy media and leave the mess for the next generation. Please do not contribute to this debacle.

My colleagues and I do not advocate to abandon cell phones or wireless technology but we understand the intense corruption and collusion between the CTIA, FDA and FCC. We want any form of wireless to be as safe as possible and currently it is not. And certainly we must maintain the beautiful aesthetics of Napa and consider property value decline. Fiber optics into the premises is a viable solution.

Hundreds of excellent independently funded studies have linked wireless radiation at levels far below the current FCC guidelines to deleterious health effects. **The current FCC guidelines do not protect human health or the health of the environment.**

Small cells have been activated in some areas of Sacramento and Los Angeles. Residents in nearby homes have become ill almost immediately- especially children. The symptoms are similar to that of the American Embassy workers in the Chinese and Cuban embassies. who know it was RF directed at them.

Please stand up to this industry and the FCC. You all have loved ones and I doubt you would want them exposed to this possible carcinogen in your homes 24/7. Based on the science available now scientists on the WHO/ IARC panel who classified radio-frequency electromagnetic fields as possibly carcinogenic to humans based on an increase in lethal brain tumors associated with mobile phone use- **state that now they would classify it as probable or absolute.**

I am attaching an updated legislative briefing book. **Please review it - it speaks the truth. Industry does not.** If you have questions please feel free to reach out. If I do not have the answer I can find the person for you who does. I am out of town or I would be at your meeting tonight. Thank you.

Sincerely,

Ellie Marks
California Brain Tumor Association

City Council Meeting
11/5/19
Supplemental I - 14.A.
From: Karen Peters

From: Karen Peters
Sent: Monday, November 4, 2019 12:42 PM
To: Jill Techel <jtechel@cityofnapa.org>; Scott Sedgley <SSedgley@cityofnapa.org>; Liz Alessio <lalessio@cityofnapa.org>; Doris Gentry <dgentry@cityofnapa.org>; Mary Luros <mluros@cityofnapa.org>
Cc: Steve Potter <spotter@cityofnapa.org>; Don Schmidt <dschmidt@cityofnapa.org>
Subject: Small Cell Tower Project

[EXTERNAL]
Dear Council members,
I am writing to ask you to choose the health and well-being of our community over the greed of Verizon. I urge you to keep all small cell towers away from schools and homes.
Thank you.
Karen Peters

From: Amy Martenson
Sent: Monday, November 4, 2019 8:32 PM
To: Clerk <clerk@cityofnapa.org>
Cc: Val Wolf; Devra Dallman; Gary Orton; Chris Malan; Inda S. Shirley; Mary Luros <mluros@cityofnapa.org>; Liz Alessio <lalessio@cityofnapa.org>; Jill Techel <jtechel@cityofnapa.org>; Doris Gentry <dgentry@cityofnapa.org>; Scott Sedgley <SSedgley@cityofnapa.org>; Julie Lucido <jlucido@cityofnapa.org>; Steve Potter <spotter@cityofnapa.org>
Subject: Petition Signatures and Comments Against Verizon Accommodation Agreement Attached (Please add to public record)

[EXTERNAL]

Dear Napa City Clerk:
538 signatures with 31 comments were gathered in a week and a half (from October 24th to November 4th, 2019) in response to the petition described below.
Please add this email (including the links to the supporting documents) and the attached two documents with the petition signatures and comments to the public record for Agenda Item 14A for the Tuesday, November 5th Napa City Council meeting.
Sincerely,
Amy Martenson and Valerie Wolf
Napa County Progressive Alliance Co-Chairs

Petition Link: http://chng.it/qkVtB4QDSG

Petition Text:

At the October 15th Napa City Council meeting, Council members discussed an agreement with Verizon to install 32 "pilot" small cell antennas near homes, schools, and businesses throughout Napa.

Council member Doris Gentry was against all of them, and Council member Liz Alessio, wanted the number reduced, especially taking the ones near schools off the list.

Vice Mayor Scott Sedgley wanted a stronger indemnity clause for the City but otherwise expressed support for the agreement along with Mayor Jill Techel and Council member Mary Luros. Unless we can change one of their minds, those three will vote for a slightly modified agreement at the November 5th City Council meeting.

These small cell antennas only have good reception within 500 feet, so the ultimate plan is one every 500 feet. Because the City cannot discriminate among providers, if the City allows Verizon to install them, they will have to allow other service providers to do the same. The result will be an enormous increase in our residents' exposure to wireless radiation, which hundreds of scientific studies have linked to serious negative health effects. This is the wrong path for our town to go down.

FCC rules passed in 2018 virtually took away cities' ability to regulate small cell antennas at the federal level. However, an unanimous 2019 California Supreme Court ruling stated that while cities cannot ban them outright, they can regulate their location, so they do not "incommode [or disturb] the public use of the road," for example if they "generate noise, cause negative health consequences, or create safety concerns," wrote Justice Corrigan who authored the opinion.

We need our local representatives to stand up for our community, and at the very least say "NO" to the 16 proposed sites that are in residential and mixed use areas to protect us in our schools and in our homes. That would leave 16 in commercial and industrial areas, which are more than enough for a "pilot."

change.org

Napa County Progressive Alliance

Recipient: Jill Techel, Scott Sedgley, Mary Luros, Liz Alessio, Doris Gentry

Letter: Greetings,

Keep Verizon Small Cell Antennas out of Residential Areas in Napa!

Signatures

Name	Location	Date
Amy Martenson	Napa, CA	2019-10-24
Valerie Wolf	Napa, CA	2019-10-24
Gary Orton	Napa, CA	2019-10-24
Inda S. Shirley	Napa, CA	2019-10-24
Kit Long	Napa, CA	2019-10-24
Julie A Landberg	Napa, CA	2019-10-24
Neil Watter	Napa, CA	2019-10-24
Dixie Larson	Napa, CA	2019-10-25
stephanee adams	napa, CA	2019-10-25
Catheeine George	Napa, CA	2019-10-25
Hanna Landini	Napa, CA	2019-10-25
Nancy Green	Napa, CA	2019-10-25
Karen McNair	Orange, CA	2019-10-25
Cheri Piscia-Nichols	Napa, CA	2019-10-25
Marlene Lenz	Napa, CA	2019-10-25
Debra Homan	Napa, CA	2019-10-25
Maureen Theunissen	Napa, CA	2019-10-25
Alfonso Olguin	Napa, CA	2019-10-25
Danielle Alleven	Napa, CA	2019-10-25
Jennifer Klauer	Napa, CA	2019-10-25

Name	Location	Date
Dana Alba	San Jose, CA	2019-10-25
Rory Kandel	Yountville, CA	2019-10-25
Alex Coakley	Napa, CA	2019-10-25
Lisa Runyon	napa, CA	2019-10-25
Michelle Pramuk	Napa, CA	2019-10-25
victoria curry	Napa, CA	2019-10-25
Jacqueline Jack	Napa, CA	2019-10-25
Nancy McCoy-Blotzke	Napa, CA	2019-10-25
Rob Miller	San Jose, CA	2019-10-25
Rusty Cohn	Napa, CA	2019-10-25
Carolyn Loomis	Napa, CA	2019-10-25
Karla Newton	Southern Pines, NC	2019-10-25
Sandra Booth	Napa, CA	2019-10-25
Sharon Parham	Napa, CA	2019-10-25
Crystal Malinowski	Napa, CA	2019-10-25
Jason Kishineff	American Canyon, CA	2019-10-25
Lorna Turner	Napa, CA	2019-10-25
Mindy Harp	Napa, CA	2019-10-25
Julie Mineau	Napa, CA	2019-10-25
Shirley Knight	Napa, CA	2019-10-25
Eve Ryser	Napa, CA	2019-10-25
Katie Lucier	US	2019-10-25

Name	Location	Date
Anastasia Wiggin	Napa, CA	2019-10-25
Dotty Hopkins	Napa, CA	2019-10-25
Holly Gerenser	Napa, CA	2019-10-25
Lori Stelling	Napa, CA	2019-10-25
Michelle Lane	Napa, CA	2019-10-25
Julie Gerien	Napa, CA	2019-10-25
Lin Marie deVincent	Sonoma, CA	2019-10-25
Charlotte Williams	Calistoga, CA	2019-10-25
Seanna Murray	Napa, CA	2019-10-25
Samantha Holland	Napa, CA	2019-10-25
g matix	Tracy, US	2019-10-25
Maria Quezada	Baldwin Park, US	2019-10-25
Chris Gerenser	Napa, CA	2019-10-25
Michelle Montgomery	Napa, CA	2019-10-25
Tiffany Holloran	Napa, CA	2019-10-25
Donna Laba	Napa, CA	2019-10-25
Robin Rowe	Napa, CA	2019-10-25
Charlie Toledo	Napa, CA	2019-10-25
Anne Reilley	St. Helena, CA	2019-10-25
Chris Padowan	Napa, CA	2019-10-25
Kristi Cantrell	Napa, CA	2019-10-25
Karen Peters	Napa, CA	2019-10-25

Name	Location	Date
lilly florio	Sumter, US	2019-10-25
Cooper Cipolla	Mesa, US	2019-10-25
Deborah Dash	Napa, CA	2019-10-25
Nigg Boii	Lancaster, US	2019-10-25
Amelia Johnnie	Frisco, US	2019-10-25
Roshell Andrade	Arlington, US	2019-10-25
Julie Oliver	Napa, CA	2019-10-25
Kathryn Shea	Napa, CA	2019-10-25
Pamela Jackson	Napa, CA	2019-10-25
Ruby McDaniel	Napa, CA	2019-10-25
Kim Brown	Napa, CA	2019-10-25
Cristal Date	Napa, CA	2019-10-25
Kellie Anderson	Angwin, CA	2019-10-25
Linda Price	Napa, CA	2019-10-25
Cindy Clark	Napa, CA	2019-10-25
Gerry Turgeon	Calistoga, CA	2019-10-25
Morgan Griffith	Napa, CA	2019-10-25
Karyn Bettinelli	Napa, CA	2019-10-25
rachel andreis	Windsor, US	2019-10-25
Taryn Graves	Windsor, CA	2019-10-25
Elizabeth Champion	Napa, CA	2019-10-25
Crystal Olivares	Napa, CA	2019-10-25

Name	Location	Date
Carol Lane	San Francisco, CA	2019-10-25
John Mautner	Napa, CA	2019-10-25
Ellen Sabine	Napa, CA	2019-10-25
Andrea Deering	Napa, CA	2019-10-25
Debbie Duffy	Napa, CA	2019-10-25
Gail Garaventa	Napa, CA	2019-10-25
Christa Steinrok	Napa, CA	2019-10-25
Renee Cazares	Napa, CA	2019-10-25
Bruno Marcotulli	Santa Monica, US	2019-10-25
Gina Moreno	Napa, CA	2019-10-25
Tara Grant	Napa, CA	2019-10-25
Ty Smith	Mesa, US	2019-10-25
Landon Watson	New Kent, US	2019-10-25
Katy Vest	Irving, US	2019-10-25
Jennifer Hopkins	Napa, CA	2019-10-25
Kathleen Herrera	Sonoma, CA	2019-10-26
Tammy Horvath	Meridian, ID	2019-10-26
Claudia Martinez	Napa, CA	2019-10-26
Sheree Moorhead	Napa, CA	2019-10-26
Jennifer Alexander	Napa, CA	2019-10-26
Karina Berge	Napa, CA	2019-10-26
Corazon Manayan	American canyon, CA	2019-10-26

Name	Location	Date
Christopher Berge	Napa, CA	2019-10-26
Nicole Paltrineri	Napa, CA	2019-10-26
Anne Giosso	Napa, CA	2019-10-26
Courtney Shelfo	Napa, US	2019-10-26
Karen Lynch	Naps, CA	2019-10-26
Janet Becker	Napa, CA	2019-10-26
Julie Giovannoni	Napa, CA	2019-10-26
Lauren Becker	Burlingame, CA	2019-10-26
Eddie Berengue	Napa, CA	2019-10-26
Lucretia Marcus	Sonoma, CA	2019-10-26
Rebecca Freschi	Napa, CA	2019-10-26
Carly Gill	Napa, CA	2019-10-26
Cheryl Holt	Napa, CA	2019-10-26
Katie Assereto	Napa, CA	2019-10-26
Bright Michael	Napa, CA	2019-10-26
Carolyn Rasmusen	Napa, CA	2019-10-26
Olivia Delaney	Napa, CA	2019-10-26
Lisa Alexander	Doha, Qatar	2019-10-26
MARYLOU KLAUER	Gilroy, CA	2019-10-26
Maria García	Napa, CA	2019-10-26
Andrew Pinelli	Napa, CA	2019-10-26
Tammy Duda	Napa, CA	2019-10-26

Name	Location	Date
Erica conway	Napa, CA	2019-10-26
Brittany Bowman	Napa, CA	2019-10-26
Marie Ryan	San Francisco, CA	2019-10-26
Nicole Hill	Napa, CA	2019-10-26
Teresa Levin	Napa, CA	2019-10-26
lauren nicholsen	Saint Helena, CA	2019-10-26
Judith ohrt	napa, CA	2019-10-26
Devin Brown	Napa, CA	2019-10-26
Lindsey Gochenouer	San Jose, CA	2019-10-26
Darci Hill	Napa, CA	2019-10-26
Deborah Johnson	Encinitas, CA	2019-10-26
Yolanda Oram	Pomona, CA	2019-10-26
Dennis Berge	Napa, US	2019-10-26
Jaime Ortega	Napa, CA	2019-10-26
Carol Nagle	Napa, CA	2019-10-26
Erin Askim	Napa, CA	2019-10-26
Trinity Baker	Mcdonough, US	2019-10-26
Kara Scoggins	Yountville, CA	2019-10-26
Rita Gutierrez	Calistoga, CA	2019-10-26
Devra Dallman	San Francisco, CA	2019-10-26
Caroline Wiegardt	San Mateo, CA	2019-10-26
Lissa Gibbs	Napa, CA	2019-10-26

Name	Location	Date
Chaim potter	Napa, CA	2019-10-26
Stacy Hall	Napa, CA	2019-10-27
Robin Wenzel	Napa, US	2019-10-27
TAHSEEN MOHAMMED	Jajpur, India	2019-10-27
Laura Michels	Napa, CA	2019-10-27
Tristan Vongkeomany	Danbury, US	2019-10-27
Kristen Kincaid	Napa, CA	2019-10-27
Aimee Diskin	Napa, CA	2019-10-27
Shellie Rice	Napa, CA	2019-10-27
Natalie Holliday	Pickerington, US	2019-10-27
Trinity Lawrence	Fort Worth, US	2019-10-27
Renaya Florence	New York, US	2019-10-27
Kennedy Mitchell	Decatur, US	2019-10-27
Kai Roper	Mesa, US	2019-10-27
Rey Gutierrez	Miami, US	2019-10-27
Yabkal Teshome	Pataskala, US	2019-10-27
Karen & Frank Reynolds	Joplin, MO	2019-10-27
kaylee hoang	Dallas, US	2019-10-27
Terry's Parker	Jacksonville, US	2019-10-27
Elius Edwards	Phoenix, US	2019-10-27
Lindsay Buffington	Napa, CA	2019-10-27
Nicole Brzezniak	Mesa, US	2019-10-27

Name	Location	Date
Charis Holt	Jacksonville, US	2019-10-27
emma rizzo	Chicago, US	2019-10-27
Eizabeth Debonis	Napa, CA	2019-10-27
Whitney Farris	Napa, CA	2019-10-27
Madeleine Gomez	American Canyon, CA	2019-10-27
Toni Stephens	Napa, CA	2019-10-27
Ashley Alva	US	2019-10-27
Lollie Kuhl	Whittier, CA	2019-10-27
Tucker Nelson	Mcpherson, US	2019-10-28
Macy Bui	Austin, US	2019-10-28
Shyann Kolpin	Lebanon, US	2019-10-28
Ella G	Mesa, US	2019-10-28
Abhimanyu Paryani	Austin, US	2019-10-28
fernanda juarez	Phoenix, US	2019-10-28
Zane Bennett	Lebanon, US	2019-10-28
brandon benitez	Indian Trail, US	2019-10-28
Jacqueline Gaitan	Napa, CA	2019-10-28
Sophia Nuttall	Orlando, US	2019-10-28
Nora Ahued	Houston, TX	2019-10-28
Armani Martin	Nashville, US	2019-10-28
Ruben Sesmas	Scotsdale, US	2019-10-28
Angel Romero	Arlington, US	2019-10-28

Name	Location	Date
Luke Casey	Lake In The Hills, US	2019-10-28
Isabel Mason	Mansfield, US	2019-10-28
Ralph Romero jr	Orlando, US	2019-10-28
Greg Wood	Chandler, US	2019-10-28
Corey Lackie	Orlando, US	2019-10-28
mason lambert	Cedar Rapids, US	2019-10-28
Chaylee Ray	Yukon, US	2019-10-28
Adrys Marte	Duluth, US	2019-10-28
Michele Kayfez	Napa, CA	2019-10-28
Amanda Eaton	Hayward, CA	2019-10-28
Amy StRk	Napa, CA	2019-10-28
Karly Michie	Napa, CA	2019-10-28
Michelle Ruiz	Napa, CA	2019-10-28
Jennifer Rulon	Corona Del Mar, US	2019-10-28
V Struven	Napa, CA	2019-10-28
Beverly Rowland	Spirit Lake, IA	2019-10-28
Liliana Acuna	Santa Ana, US	2019-10-28
Andrew Church	Napa, CA	2019-10-28
Dianna Mckenzie	Kapaa, HI	2019-10-28
Christian Baray	Phoenix, US	2019-10-28
Gabriel Zarate	Chandler, US	2019-10-28
Mackenzie Spencer	Chandler, US	2019-10-28

Name	Location	Date
Ayla Petersen	Reno, US	2019-10-28
MARIANA BOICA	CITRUS HEIGHTS, CA	2019-10-28
Chris Lingle	Concord, CA	2019-10-28
Nikki Marek	Napa, CA	2019-10-28
Rebecca G	Napa, CA	2019-10-28
Morgan Carr	Napa, CA	2019-10-28
Suchi Dasika	Napa, CA	2019-10-28
Lilly Shapiro	Colorado Springs, US	2019-10-28
Jovan Rosario	Ruskin, US	2019-10-28
Jeremiah Jacobs	Fort Worth, US	2019-10-28
J B	Chicago, US	2019-10-28
Ethan Stallings	West Covina, US	2019-10-28
Lamar Diggs	Glendale, US	2019-10-28
Hawaii Gardner	Altamonte, US	2019-10-28
Maureen Bose	Napa, CA	2019-10-28
Caryn Cass	Napa, CA	2019-10-28
Kara Littlejohn	San Francisco, CA	2019-10-28
Katherine Jalaty	Napa, CA	2019-10-28
Amanda Carder	Napa, US	2019-10-28
Hank Kaspar	Napa, CA	2019-10-28
Kelly McGrath	Napa, CA	2019-10-28
Amelia Bridgford	Napa, CA	2019-10-28

Name	Location	Date
greg matsumoto	Napa, CA	2019-10-28
Stephanie Mathis	Napa, CA	2019-10-28
Aurora Heitman	Napa, CA	2019-10-28
Julie Gerien	Napa, CA	2019-10-28
Magda Martine	Napa, CA	2019-10-28
Paul Magda	Napa, CA	2019-10-28
Jan Hanson	Napa, CA	2019-10-28
Susan Jakab	Napa, CA	2019-10-28
PATRICIA ANN FACCHINI	Emeryville, CA	2019-10-28
Elaine Herrick	Napa, CA	2019-10-29
Juliet Hoban	Napa, CA	2019-10-29
Ron Stinnett	Loja, Ecuador	2019-10-29
Norine Combest	Napa, CA	2019-10-29
Kasey Browne	cold spring, US	2019-10-29
Bruce Fenton	Leonídio, Greece	2019-10-29
Marla Tofle	Leonídio, Greece	2019-10-29
Jason McGrath	Napa, CA	2019-10-29
Val Martinez	Greensboro, US	2019-10-29
Miguel Garcia	Charlotte, US	2019-10-29
Paul Phillips	Cleveland, US	2019-10-29
doodlebob bob	Norman, US	2019-10-29
William Benham	3 Camelia Dr. Napa, CA	2019-10-29

Name	Location	Date
Brian Velasquez	Elgin, US	2019-10-29
Michael Ceballos	Avondale, US	2019-10-29
Michelle Sabangan	Phoenix, US	2019-10-29
Sheylin Reyes	McMinnville, US	2019-10-29
Monica Serrato	Fort worth, US	2019-10-29
Skyler Dina	Riverview, US	2019-10-29
Adrienne German	Olympia, US	2019-10-29
karen ponce	Arlington, US	2019-10-29
Kevin Sarmento	Napa, CA	2019-10-29
peyton feldman	New Port Richey, US	2019-10-29
ELLIOT SHUMAN	DUBLIN, US	2019-10-29
dylan forsythe	Joliet, US	2019-10-29
Suzana Aba	San Diego, US	2019-10-29
Yuliana Herrera	Phoenix, US	2019-10-29
h w	San Diego, US	2019-10-29
Lindsay Suarez	Corona, US	2019-10-29
Cloey Bolado	Corona, US	2019-10-29
Carlos Gutierrez	Phoenix, US	2019-10-29
David Benitez	Santa Barbara, US	2019-10-29
Jarred Sitton	Sacramento, US	2019-10-29
Carlos Hopper	San Diego, US	2019-10-29
Luciano Dimarco	Bethesda, US	2019-10-29

Name	Location	Date
khadijah kumte	columbia, US	2019-10-29
Noah Smith	Temecula, US	2019-10-29
Autumn Moya	Corona, US	2019-10-29
kirsten lewis	Liberty, US	2019-10-29
thomas hixson	Napa, CA	2019-10-29
danai rodriguez	Phoenix, US	2019-10-29
Shelly Price	Rocky Mount, US	2019-10-29
Roney Boteo	Tucson, US	2019-10-29
Victoria Hale	Tucson, US	2019-10-29
Jane Sharitim	Whittier, US	2019-10-29
DeAngelo Saavedra	Albuquerque, US	2019-10-29
Fabian Ramirez	Sun City, US	2019-10-29
Connor Kopas	Los Angeles, US	2019-10-29
Jeannalys Pelaez	Tampa, US	2019-10-29
Kylie Cope	North Ridgeville, US	2019-10-29
amanda dixon	Plainfield, US	2019-10-29
Carter Pollak	Fishers, US	2019-10-29
Brandon Moreno Solorio	Sylmar, US	2019-10-29
Randy Jennings	El Paso, US	2019-10-29
Raymond Membribes	Hialeah, US	2019-10-29
Cassie Randall	San Bernardino, US	2019-10-29
Jacob Jaurigui	Los Angeles, US	2019-10-29

Name	Location	Date
Toby Rogers	Fort Wayne, US	2019-10-29
nicholas hathaway	Norman, US	2019-10-29
Chris Aguilera	Atlanta, US	2019-10-29
Thomas Muaki	Concord, US	2019-10-29
Rane Nevin	Camas, US	2019-10-29
marina jimenez	New York, US	2019-10-29
Cooper Cox	Medford, US	2019-10-29
Brooklyn Clinesmith	Kansas City, US	2019-10-29
Victor Pena	Arlington, US	2019-10-29
Gavin Lising	Placentia, US	2019-10-29
Brisa Gomez	Columbia, US	2019-10-29
Maria Garcia	US	2019-10-29
valerie lima	Oklahoma City, US	2019-10-29
giø lopez	corona, US	2019-10-29
Lenny Adames	Copiague, US	2019-10-29
Tyson Warner	Sandy, US	2019-10-29
Weston Hory	Manhattan Beach, US	2019-10-29
No School	Phoenix, US	2019-10-29
Victoria Holland	Mozelle, US	2019-10-29
Sebastian Selders	Austin, US	2019-10-29
Lily Aguirre	Tampa, US	2019-10-29
Dj Carr	Miami, US	2019-10-29

Name	Location	Date
What's for lunch ???	Lacey, US	2019-10-29
Jake Mathews	Seattle, US	2019-10-29
Heather Whitlock	Napa, CA	2019-10-29
Arianne Boies	San Jose, CA	2019-10-29
Faith Tenderheart	Topeka, US	2019-10-29
Jason Zalamea	Pico Rivera, US	2019-10-29
bella guida	Cave Spring, US	2019-10-29
Kiajera Childress	Chino Hills, US	2019-10-29
Jamie Nelson	Santa Barbara, US	2019-10-29
Bella Rosemaire Crosland Bell	Eastvale, US	2019-10-29
Cristian Greenwood	Seattle, US	2019-10-29
Amir Sheikh	Oviedo, US	2019-10-29
Alberto Galvez	Tacoma, US	2019-10-29
Jacelyn Gallegos	US	2019-10-29
Victoria Omosowon	Arligton, US	2019-10-29
Jackson Edwards	Indianapolis, US	2019-10-29
Ashton La tour	Tucson, US	2019-10-29
Angelo Marquez	Bonita, US	2019-10-29
Alex Arambulo	Corona, US	2019-10-29
Jacob Bourque	Tujunga, US	2019-10-29
Litzy Adame	San Antonio, US	2019-10-29
Madi Glasgow	Lewisberry, US	2019-10-29

Name	Location	Date
Adam Kaluba	Cincinnati, US	2019-10-29
Harry Bratzler	Philadelphia, US	2019-10-29
Bill Nguyen	Oklahoma City, US	2019-10-29
Santiago Ramirez	Sylmar, US	2019-10-29
Carson Wagner	Miami, US	2019-10-29
Jazmine Peres	Albuquerque, US	2019-10-29
Skylar Walter	Philadelphia, US	2019-10-29
Jasmine Barraza	Columbus, US	2019-10-29
Brian Fernandes	Needham, US	2019-10-29
Joshua Picker	Austin, US	2019-10-29
Melanie Guerrero	Los An, US	2019-10-29
Anna Dinkel	Napa, CA	2019-10-29
Deb Herrin	Marietta, US	2019-10-29
Mike Coughlin	Napa, CA	2019-10-29
Rachael Clark	Napa, CA	2019-10-29
Marguerite Lucas	Napa, CA	2019-10-29
Carole Sterling	Carlsbad, US	2019-10-29
Marguerite Barrett	West Bloomfield, MI	2019-10-29
Karen Olson	Napa, CA	2019-10-29
Jeanne Mitchell	Fremont, CA	2019-10-30
Laurie Bruhns	Chino Hills, CA	2019-10-30
Dan Lynch	Napa, CA	2019-10-30

Name	Location	Date
Tanya Dixon	Ypsilanti, MI	2019-10-30
Sarah Peyton	Napa, CA	2019-10-30
Lee Seronello	Napa, CA	2019-10-30
Barbara Noll	Napa, CA	2019-10-30
LISA Stockon	Napa, CA	2019-10-30
Skilar Byrd	Tacoma, US	2019-10-30
triston gerret	Seattle, US	2019-10-30
Ryan Theberge	Torrance, US	2019-10-30
Alan Gallarza	Colorado Springs, US	2019-10-30
Laisha Lazu	Temecula, US	2019-10-30
isabel weiss	Redondo Beach, US	2019-10-30
kambrie clawson	fresno, US	2019-10-30
Mercedes De la rosa	Phoenix, US	2019-10-30
tyler laforce	Huntington Beach, US	2019-10-30
chloe woodcock	Corinth, US	2019-10-30
Declan Sullivan	Torrance, US	2019-10-30
Lorenzo Aedo	Gressy, Switzerland	2019-10-30
Kelly Schumann	Napa, CA	2019-10-30
Denise Mitchell	Detriot, MI	2019-10-30
Michon Verwer	Napa, CA	2019-10-30
Jeni Olsen	Napa, CA	2019-10-30
Lee Niemiec	Greenville, MI	2019-10-30

Name	Location	Date
Nicole Hughes	Napa, CA	2019-10-30
Katherine Briggs	Napa, CA	2019-10-30
Caden McCullough	Bermuda Dunes, US	2019-10-30
derick umana	las vegas, US	2019-10-30
Shereen Samnani	Spring, US	2019-10-30
Wilson Thornton	Winston-salem, US	2019-10-30
Jason Hoyes	Asheville, US	2019-10-30
rudi johnson	Salt Lake City, US	2019-10-30
Eric Astorga	Tucson, US	2019-10-30
Joelle Gallagher	Napa, CA	2019-10-30
Evan Attwood	Windsor, CA	2019-10-30
Elizabeth Lemert	Sonoma, CA	2019-10-30
Christin Hayes	Napa, CA	2019-10-30
Donna Antraccoli	Napa, CA	2019-10-30
Gianna Talerico	Bradenton, US	2019-10-30
Andrew Collis	Atlanta, US	2019-10-30
Mario Bedoya	Tucson, US	2019-10-30
emily taylor	methuen, US	2019-10-30
Mike Cock	La Quinta, US	2019-10-30
Adolfo Erives	Leander, US	2019-10-30
Mimi Stewart	New York, US	2019-10-30
evie rogers	Lenexa, US	2019-10-30

Name	Location	Date
Adnan Muric	Rochester, US	2019-10-30
Walter Aponte	Annandale, US	2019-10-30
Malay Frederick	Sanford, US	2019-10-30
Ivy Perez	Jacksonville, US	2019-10-30
Daniel Prewitt	Winston-salem, US	2019-10-30
Rachel Williams	Memphis, US	2019-10-30
Timmy Woods	Exeter, US	2019-10-30
Aaliyah Romeus	Orlando, US	2019-10-30
Hannah Rose	Chicago, US	2019-10-30
Max Ziomek	Chicago, US	2019-10-30
Berny Hill	Miami, US	2019-10-30
Eric Flores	Memphis, US	2019-10-30
Ada Elci	Springfield, US	2019-10-30
Lucas Andtbacka	New York, US	2019-10-30
alyssa zimmerman	Lake Worth, US	2019-10-30
Alina Barrera	Gilbert, US	2019-10-30
Nathan Van Atta	Alexandria, US	2019-10-30
tannis olson	bellevue, US	2019-10-30
Constant Lavelle	West Fargo, US	2019-10-30
Sufyan Elhammali	Marietta, US	2019-10-30
Christopher Jones	Charlotte, US	2019-10-30
Tony..... Just Tony	Austin, US	2019-10-30

Name	Location	Date
Bret Cudd	Napa, CA	2019-10-30
Gerry Gossett	US	2019-10-30
michele floyd	Corona, CA	2019-10-31
Karen Kiely	Strawberry, CA	2019-10-31
sandra sultan	Napa, CA	2019-10-31
Jennifer Collins	Napa, CA	2019-10-31
Chloe Meeks	Napa, CA	2019-10-31
Alexandre Dasilva	Somerville, US	2019-10-31
Lyneen Bell	Napa, CA	2019-10-31
Erika Alvord	Napa, CA	2019-10-31
Carlos Pavao	Napa, CA	2019-10-31
Joan Foresman	Napa, CA	2019-10-31
Marie Pulliam	Napa, CA	2019-10-31
Lilianna Cardenas	Fresno, US	2019-11-01
Isabelle Quigley	orem, US	2019-11-01
Gurmehardeep Singh	Lewis Center, US	2019-11-01
leah petersen	Chicago, US	2019-11-01
Yohana Maza	Houston, US	2019-11-01
jason Green	Woodbridge, US	2019-11-01
Edwin Escobar	Prince William, US	2019-11-01
Matthew Huskins	Asheville, US	2019-11-01
amya bolling	Pocono Summit, US	2019-11-01

Name	Location	Date
Dominic Bradford	Parkton, US	2019-11-01
Ningjia Zhai	纽约, US	2019-11-01
Anthony Lee	Woodbridge, US	2019-11-01
Grace Brown	Lawrenceville, US	2019-11-01
karen williamson	Scranton, US	2019-11-01
Cayden Huxley	Cleveland, US	2019-11-01
Lilly Wilson	Westfield, US	2019-11-01
Sebastian Alhuay	Germantown, US	2019-11-01
amy siever	damascus, US	2019-11-01
Lynette Estrella	Napa, CA	2019-11-01
Callum Breen	Hertfordshire, UK	2019-11-01
Julia Winiarski	Napa, CA	2019-11-01
Kevin Hanson	Oak Brook, US	2019-11-01
joey berg	Spokane, US	2019-11-01
Maria Rodriguez	Hollister, US	2019-11-01
Nathen Tellers	San Diego, US	2019-11-01
Jasper Gaut	Henderson, US	2019-11-01
Jayden Jimenez	San Tan Valley, US	2019-11-01
Clorissa Miller	Commerce Township, US	2019-11-01
Crystal Cordero	Phoenix, US	2019-11-01
Mireya Mendez	Fresno, US	2019-11-01
Alexia English	Glasgow, US	2019-11-01

Name	Location	Date
Piper Pfeuffer-Ferguson	Cantonment, US	2019-11-01
Gail Randol	Napa, CA	2019-11-01
Ew No	Fuck off, US	2019-11-01
Roxanne Perez	US	2019-11-01
Virgene Link	Anacortes, US	2019-11-02
Kathy Boyd	Napa, CA	2019-11-02
Ashanti Carranza	Fremont, US	2019-11-02
Ava H	Miami, US	2019-11-02
aaliyah broyles	Calhoun, US	2019-11-02
Susan Pighini Schmutz	US	2019-11-02
Sean Mulligan	Napa, CA	2019-11-02
Marina Mulligan	Napa, CA	2019-11-02
Raleigh koritz	Saint Paul, MN	2019-11-02
Jonathan Ponce	Oxnard, US	2019-11-02
Sheryl Hayworth	Orinda, CA	2019-11-02
Sarah Collins	Jackson, US	2019-11-02
Guadalupe Herrera	Napa, CA	2019-11-03
Toni Hagearty	Worcester, US	2019-11-03
Kim Owen	Napa, CA	2019-11-03
Kimberley Sullivan	Vacaville, CA	2019-11-03
Monette Shirley	Redwood City, CA	2019-11-03
maria flynn	napa, CA	2019-11-03

Name	Location	Date
Mary Wilson	Knoxville, TN	2019-11-03
Sharyn Barthes	Napa, CA	2019-11-03
William Rogers	Napa, CA	2019-11-03
Marco Garcia	Napa, CA	2019-11-03
SIERRA JOHNSON	Napa, CA	2019-11-03
Richard Pernice	Honolulu, HI	2019-11-03
Amanda Krueger	Napa, CA	2019-11-03
Melissa Dingler	Napa, CA	2019-11-03
Elaine Gomez	Napa, CA	2019-11-03
Joshua Cavagnaro	Napa, CA	2019-11-04
Alexandra Rogers	Napa, CA	2019-11-04
Brad Seiter	Napa, CA	2019-11-04
Linda Brown	Napa, CA	2019-11-04
Leonie Rusin	Napa, CA	2019-11-04
Suzanne Bauman	Napa, CA	2019-11-04
Sharon Powers	Nashville, TN	2019-11-04
Leonidez Manansala	Napa, CA	2019-11-04
Amarnath Kolla	San Jose, US	2019-11-04
Katharina Persaud Persaud	Napa, CA	2019-11-04
Alicia Fernandez	Napa, CA	2019-11-04
Donna Ghiringhelli	Napa, CA	2019-11-04
Myiah Early	Seneca, US	2019-11-04

Name	Location	Date
Echo Schatz	Ashland, US	2019-11-04
Greg Boothroyd	Napa, CA	2019-11-04
Michelle & Sfara	Napa, CA	2019-11-04
Johanna Finney	Oakland, CA	2019-11-04
Nick Gleiter	San Francisco, CA	2019-11-04
C. Foster	Napa, CA	2019-11-05
Pilar Grenier	El Paso, US	2019-11-05
reinette senum	nevada city, CA	2019-11-05

change.org

Napa County Progressive Alliance

Recipient: Jill Techel, Scott Sedgley, Mary Luros, Liz Alessio, Doris Gentry

Letter: Greetings,

Keep Verizon Small Cell Antennas out of Residential Areas in Napa!

Comments

Name	Location	Date	Comment
Amy Martenson	Napa, CA	2019-10-24	"Because I care about my health and the health of my community."
Valerie Wolf	Napa, CA	2019-10-24	"These polluting devices do not belong near humans"
stephanee adams	napa, CA	2019-10-25	"Limit 5g!"
victoria curry	Napa, CA	2019-10-25	"No just no....has to be a better way"
Eve Ryser	Napa, CA	2019-10-25	"There is no certainty that these small cell towers are safe. The density they aspire to is one tower every 500 feet throughout the valley. It's reckless to approve this infrastructure expansion without knowledge that it will not put our citizens at risk."
Charlotte Williams	Calistoga, CA	2019-10-25	"Because I'm not sure that small cell technology is safe and I don't believe it should be placed near people until it is proven to be completely safe. I also do not like the idea that it may be used as a surveillance device. Creepy!!!!"
Michelle Montgomery	Napa, CA	2019-10-25	"We have no idea what 5g does to us. Studies show that it changes our DNA and is quite possibly killing our birds and insects."
Charlie Toledo	Napa, CA	2019-10-25	"Wireless technology is harmful esp. To children's growing brains...let's not find out how harmful "continuous contact" is..."
Kellie Anderson	Angwin, CA	2019-10-25	"Thus technology is not safe in our neighborhoods."
Nicole Hill	Napa, CA	2019-10-26	"Because we are not guinea pigs and should not take a chance on adding harmful devices to our community, which scientists warn will be detrimental to the human body."
Carol Nagle	Napa, CA	2019-10-26	"Independent research shows serious health issues associated with the wireless radiation from cell towers (including cancer, neurological damage, and DNA damage). Children's brains are affected the most. Rushing forward with this dangerous technology is irresponsible and self destructive. At the very least, we must not allow these towers to be placed near schools and residences, where the radiation is impacting us 24/7."
Chaim potter	Napa, CA	2019-10-26	"The health of my family, our community and our environment are at risk with 5g networks - there is plenty of evidence to show these should not be installed."
Whitney Farris	Napa, CA	2019-10-27	"Protecting our community!"
Andrew Church	Napa, CA	2019-10-28	"The people should have a say!!!"
Chris Lingle	Concord, CA	2019-10-28	"Cell phone towers dont belong where children live"
Amanda Carder	Napa, US	2019-10-28	"Based on the research I have done I beleive these units will cause health issues and have no place on our city streets. This is appalling that we would even consider placements near schools

Name	Location	Date	Comment
			where are children would be exposed to them. People! Please do your research!!! The only people saying that these are safe are the companies benefiting from them! When are we going to learn?"
Karen Olson	Napa, CA	2019-10-29	"Please City Council look at more research before endangering the citizens."
LISA Stockon	Napa, CA	2019-10-30	"There is so much clear research to show that these are dangerous to human and environmental health. They should especially be kept away from anywhere children live/play/attend school, but really, they are a hazard to us all."
Jeni Olsen	Napa, CA	2019-10-30	""Numerous recent scientific publications have shown that EMF affects living organisms at levels well below most international and national guidelines. Effects include increased cancer risk, cellular stress, increase in harmful free radicals, genetic damages, structural and functional changes of the reproductive system, learning and memory deficits, neurological disorders, and negative impacts on general well-being in humans." ~cited from emfscientist.org"
Jennifer Collins	Napa, CA	2019-10-31	"Bottom line...if the science isn't settled on the safety of these, they have absolutely no right being put up, especially near any schools or neighborhoods"
Carlos Pavao	Napa, CA	2019-10-31	"It causes cancer!!"
Sheryl Hayworth	Orinda, CA	2019-11-02	"Why would any city agree to the installation of these new towers, without solid proof they are safe?"
Shirley Knight	Napa, CA	2019-11-02	"5G would be dangerous for the community and is unnecessary."
maria flynn	napa, CA	2019-11-03	"Keep cel towers away from residential areas."
Mary Wilson	Knoxville, TN	2019-11-03	"Negative health consequences!!!! They steal clean air, clean water, unadulterated food, and now HEALTH."
Amanda Krueger	Napa, CA	2019-11-03	"The safety of our kids!"
Melissa Dingler	Napa, CA	2019-11-03	"I have researched 5G and don't want the harmful technology anywhere near mine, or anyone else's home or children!!"
Leonie Rusin	Napa, CA	2019-11-04	"Leonie Rusin"
Suzanne Bauman	Napa, CA	2019-11-04	"Suzanne BaumanNO! one has the right to force toxic radiation on us or our environment! This is a crime against humanity! Just say NO!"
Sharon Powers	Napa, CA	2019-11-04	"Children are still growing and putting this near schools and homes is unconsiousable. Cancer is preventable. Research is there. Stop. We don't need this. Please"
reinette senum	nevada city, CA	2019-11-05	"I won't be visiting Napa if 5G goes in... and I will encourage everyone I know to do the same!"

There are more than 1,000 scientific studies conducted by independent researchers from around the world concerning the biological effects of RF radiation. Here we present some of the most recent.

I. Effects On Fetal And Newborn Development

1. Mother's Exposure to Electromagnetic Fields Before and During Pregnancy is Associated with Risk of Speech Problems in Offspring. Zarei, S., et al. Journal of Biomedical Physics and Engineering 9(1):61-68 (2019).
2. Prenatal Exposure to Extremely Low Frequency Magnetic Field and Its Impact on Fetal Growth. Ren, Y., et al. Environmental Health (2019).
3. The Effects of Radio Frequency Radiation on Mice Fetus Weight, Length and Tissues. Alimohammadi, I., et al. Data in Brief 19:2189-2194 (2018).
4. Effects of Prenatal Exposure to WiFi Signal (2.45 GHz) on Postnatal Development and Behavior in Rat: Influence of Maternal Restraint. Othman, H., et al. Behavioral Brain Research 326: 291-301 (2017).
5. Exposure to Magnetic Field Non-Ionizing Radiation and the Risk of Miscarriage: A prospective Cohort Study. Li, De-Kun, et al. Scientific Reports (2017).
6. Postnatal Development and Behavior Effects of In-Utero Exposure of Rats to Radiofrequency Waves Emitted From Conventional WiFi Devices. Othman, H., et al. Environmental Toxicology and Pharmacology 52:239-247 (2017).
7. Lasting Hepatotoxic Effects of Prenatal Mobile Phone Exposure. Yilmaz, A., et al. The Journal of Maternal-Fetal & Neonatal Medicine 30(11): 1355-1359 (2017).
8. Multiple Assessment Methods of Prenatal Exposure to Radio Frequency Radiation from Telecommunication in the Mothers and Children's Environmental Health (MOCEH) Study. Choi, Ha, et al. International Journal of Occupational Medicine and Environmental Health 29(6):959-972 (2016).
9. The Use of Signal-Transduction and Metabolic Pathways to Predict Human Disease Targets from Electric and Magnetic Fields Using in vitro Data in Human Cell Lines. Parham, Portier, et al. Frontiers in Public Health (2016).
10. A Review on Electromagnetic Fields (EMFs) and the Reproductive System. Asghari, Khaki, et al. Electronic Physician 8(7):2655-2662 (2016).
11. Genotoxicity Induced by Foetal and Infant Exposure to Magnetic Fields and Modulation of Ionising Radiation Effects. Udroiu, Antoccia, et al. PLoS One (2015).
12. Oxidative Stress of Brain and Liver is Increased by Wi-Fi (2.45 GHz) Exposure of Rats During Pregnancy and the Development of Newborns. Çelik, Ömer, et al. Journal of Chemical Neuroanatomy 75(B):134-139 (2015).
13. Neurodegenerative Changes and Apoptosis Induced by Intrauterine and Extrauterine Exposure of Radiofrequency Radiation. Güler, Göknur, et al. Journal of Chemical Neuroanatomy 75(B):128-133 (2015).

14. Maternal Exposure to a Continuous 900-MHz Electromagnetic Field Provokes Neuronal Loss and Pathological Changes in Cerebellum of 32-Day-Old Female Rat Offspring. Odaci, Ersan, et al. Journal of Chemical Neuroanatomy 75(B):105-110 (2015).
15. Different Periods of Intrauterine Exposure to Electromagnetic Field: Influence on Female Rats' Fertility, Prenatal and Postnatal Development. Alchalabi, Aklilu, et al. Asian Pacific Journal of Reproduction 5(1):14-23 (2015).
16. Use of Mobile Phone During Pregnancy and the Risk of Spontaneous Abortion. Mahmoudabadi, Ziaei, et al. Journal of Environmental Health Science and Engineering 13:34 (2015).
17. Oxidative Mechanisms of Biological Activity of Low-Intensity Radiofrequency Radiation. Yakymenko, et al. Electromagnetic Biology and Medicine 34(3):1-16 (2015).
18. Effects of Prenatal 900 MHz Electromagnetic Field Exposures on the Histology of Rat Kidney. Ulubay, et al. International Journal of Radiation Biology 91(1):35-41 (2015).
19. The Effect of Exposure of Rats During Prenatal Period to Radiation Spreading from Mobile Phones on Renal Development. Bedir, et al. Renal Failure 37(2):305-9 (2014).
20. Dosimetric Study of Fetal Exposure to Uniform Magnetic Fields at 50 Hz. Liorni, et al. Bioelectromagnetics 35(8):580-97 (2014).
21. Influence of Pregnancy Stage and Fetus Position on the Whole-Body and Local Exposure of the Fetus to RF-EMF. Varsier, et al. Physics in Medicine and Biology 59(17):4913-26 (2014).
22. Autism-Relevant Social Abnormalities in Mice Exposed Perinatally to Extremely Low Frequency Electromagnetic Fields. Alsaeed, et al. International Journal of Developmental Neuroscience 37:58-6 (2014).
23. Pyramidal Cell Loss in the Cornu Ammonis of 32-day-old Female Rats Following Exposure to a 900 Megahertz Electromagnetic Field During Prenatal Days 13–21. Bas, et al. NeuroQuantology Volume 11, Issue 4: 591-599 (2013).
24. The Effects of 900 Megahertz Electromagnetic Field Applied in the Prenatal Period on Spinal Cord Morphology and Motor Behavior in Female Rat Pups. Odaci, et al. NeuroQuantology Volume 11, Issue 4: 573-581 (2013).
25. Fetal Radiofrequency Radiation Exposure From 800-1900 MHz-Rated Cellular Telephones Affects Neurodevelopment and Behavior in Mice. Aldad, Gan, et al. Scientific Reports 2(312) (2013).
26. Cranial and Postcranial Skeletal Variations Induced in Mouse Embryos by Mobile Phone Radiation. Fragopoulou, Koussoulakos, et al. Pathophysiology 17(3):169-77 (2010).
27. Dysbindin Modulates Prefrontal Cortical Glutamatergic Circuits and Working Memory Function in Mice. Jentsch, et al Neuropsychopharmacology 34, 2601–8 (2009).
28. Stress Signalling Pathways that Impair Prefrontal Cortex Structure and Function. Arnsten, A. F. National Review of Neuroscience 10, 410–22 (2009).
29. Maternal Occupational Exposure to Extremely Low Frequency Magnetic Fields and the Risk of Brain Cancer in the Offspring. Li, Mclaughlin, et al. Cancer Causes & Control 20(6):945-55 (2009).
30. Reproductive and Developmental Effects of EMF in Vertebrate Animal Models. Pourlis, A.F. Pathophysiology 16(2-3):179-89 (2009).
31. Prenatal and Postnatal Exposure to Cell Phone Use and Behavioral Problems in Children. Divan, Kheifets, et al. Epidemiology19(4):523-29 (2008).
32. Effects of Prenatal Exposure to a 900 MHz Electromagnetic Field on the Dentate Gyrus of Rats: A Stereological and Histopathological Study. Odaci, et al. Brain Research 1238: 224–229 (2008).
33. Exposure to Cell Phone Radiation Up-Regulates Apoptosis Genes in Primary Cultures of Neurons and Astrocytes. Zhao, et al. Science Digest 412: 34–38 (2007).
34. Cell Death Induced by GSM 900-MHz and DCS 1800-MHz Mobile Telephony Radiation. Panagopoulos, et al. Mutation Research626, 69–78 (2006).
35. Ultra High Frequency-Electromagnetic Field Irradiation During Pregnancy Leads to an Increase in Erythrocytes Micronuclei Incidence in Rat Offspring. Ferreira, Knakievicz, et al. Life Sciences 80(1):43-50 (2006).
36. Attention-Deficit Hyperactivity Disorder. Biederman, J. & Faraone, S. V. Lancet 366, 237–248 (2005).
37. Attention-Deficit/Hyperactivity Disorder: An Overview of the Etiology and a Review of the Literature Relating to the Correlates and Lifecourse Outcomes for Men and Women. Brassett-Harknett, A. & Butler, N. Clinical Psychology Review 27,188–210 (2005).

II. Effects On Young Children

1. Electromagnetic Fields, Pulsed Radiofrequency Radiation, and Epigenetics: How Wireless Technologies May Affect Childhood Development. Sage, C. & Burgio, E. Child Development (2017).
2. Prospective Cohort Analysis of Cellphone Use and Emotional and Behavioural Difficulties in Children. Sudan, M, et al. Journal of Epidemiology and Community Health (2016).

3. Why Children Absorb More Microwave Radiation than Adults: The Consequences. Morgan, Kesari, et al. Journal of Microscopy and Ultrastructure 2(4):196-204 (2014).
4. Epidemiological Characteristics of Mobile Phone Ownership and Use in Korean Children and Adolescents. Byun, Yoon-Hwan, et al. Environmental Health and Toxicology 28 (2013).
5. A Prospective Study of In-Utero Exposure to Magnetic Fields and the Risk of Childhood Obesity. Li, De-Kun, et al. Scientific Reports 2.540 (2012).
6. Exposure to Extremely Low-Frequency Magnetic Fields and the Risk of Childhood Cancer: Update of the Epidemiological evidence. Schüz and Joachim. Progress in Biophysics and Molecular Biology 107(3):339-42 (2011).
7. Cell Phone Use and Behavioural Problems in Young Children. Divan, Kheifets, et al. Journal of Epidemiol Community Health 66(6):524-9 (2010).
8. Mobile Phones, Radiofrequency Fields, and Health Effects in Children-Epidemiological Studies. Feychting, Maria. Progress in Biophysics and Molecular Biology 107(3):343-348 (2010).
9. Exposure to Radio-Frequency Electromagnetic Fields and Behavioral Problems in Bavarian Children and Adolescents. Thomas, Silke, et al. European Journal of Epidemiology 25(2):135-41 (2009).
10. The Sensitivity of Children to Electromagnetic Fields. Repacholi, et al. Deventer. Journal of Pediatrics 116(2):303-313 (2005).

III. Brain Tumors

1. Simulation of The Incidence of Malignant Brain Tumors in Birth Cohorts That Started Using Mobile Phones When They First Became Popular in Japan. Sato, Y., Kojimahara, N., and Yamaguchi, N. Bioelectromagnetics 40(3): 143-149 (2019).
2. Report of Final Results Regarding Brain and Heart Tumors in Sprague-Dawley Rats Exposed From Prenatal Life Unitl Natural Death to Mobile Phone Radiofrequency Field Representative of a 1.8 GHz GSM Base Station Environmental Emission. Falcioni, L, et al. Environmental Research (2018).
3. Exposure to Cell Phone Radiofrequency Changes Corticotrophin Hormone Levels and Histology of The Brain and Adrenal Glands in Male Wistar Rat. Shahabi, S., et al. Iranian Journal of Basic Medical Sciences 21:1269-1274 (2018).
4. Brain Tumours: Rise in Glioblastoma Multiforme Incidence in England 1995-2015 Suggests an Adverse Environmental or Lifestyle Factor. Philips, A., et al. Journal of Environmental and Public Health (2018).
5. The 2100 MHz Radiofrequency Radiation of a 3G-Mobile Phone and the DNA Oxidative Damage in Brain. Sahin, Ozgur, et al. Journal of Chemical Neuroanatomy 75(B):94-98 (2016).
6. Mobile Phone and Cordless Phone Use and the Risk for Glioma - Analysis of Pooled Case- Control Studies in Sweden 1997-2003 and 2007-2009. Hardell and Carlberg. PathoPhysiology 22(1):1-13 (2015).
7. Mobile Phone Radiation Causes Brain Tumors and Should Be Classified as a Probable Human Carcinogen. Morgan, Miller, et al. International Journal of Oncology 46:1865-1871 (2015).
8. Mobile Phone Use and Brain Tumours in the CERENAT Case-Control Study. Coureau, Bouvier, et al. Occupational & Environmental Medicine 71(7):514-22 (2014).
9. Use of Mobile Phones and Cordless Phones is Associated with Increased Risk for Glioma and Acoustic Neuroma. Hardell, Carberg, et al. PathoPhysiology 20(2):85-110 (2013).
10. Mobile Phones and Head Tumours: A Critical Analysis of Case-Control Epidemiological Studies. Levis, Minicuci, et al. Open Environmental Sciences 6(1):1-12 (2012).
11. On the Association Between Glioma, Wireless Phones, Heredity and Ionising Radiation. Carlberg and Hardell. PathoPhysiology19(4):243-252 (2012).
12. Mobile Phones and Head Tumours. The Discrepancies in Cause-Effect Relationships in the Epidemiological Studies - How Do They Arise? Levis, Minicuci, et al. Environmental Health 10:59 (2011).
13. Indications of Possible Brain Tumour Risk in Mobile-Phone Studies: Should We Be Concerned? Cardis and Sadetzki. Occupational & Environmental Medicine 68:169-171 (2011).
14. Estimating the Risk of Brain Tumors from Cell Phone Use: Published Case-Control Studies. Morgan, LL. Pathophysiology 16(2-3):137-147 (2009).
15. Cell Phones and Brain Tumors: A Review Including the Long-Term Epidemiologic Data. Khurana, Teo, et al. Surgical Neurology72(3):205-14 (2009).
16. Epidemiological Evidence for an Association Between Use of Wireless Phones and Tumor Diseases. Hardell, Carlberg, et al. PathoPhysiology 16(2-3):113-122 (2009).
17. Histopathological Examinations of Rat Brains After Long-Term Exposure to GSM Mobile Phone Radiation. Grafström, Gustav, et al. Brain Research Bulletin 77(5):257-63 (2008).
18. Mobile Phone Use and the Risk of Acoustic Neuroma. Lonn, Ahlbom, et al. Epidemiology 15(6):653-659 (2004).

IV. Parotid Gland Tumors

1. Influence of Handheld Mobiles on Parotid: A Cohort Study. Ranjitha, G., et al. Journal of Indian Academy of Oral Medicine & Radiology 29:254-258 (2017).
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IN THE SUPREME COURT OF CALIFORNIA

T-MOBILE WEST LLC et al.,
Plaintiffs and Appellants,
v.
CITY AND COUNTY OF SAN FRANCISCO et al.,
Defendants and Respondents.

S238001

First Appellate District, Division Five
A144252

San Francisco City and County Superior Court
CGC-11-510703

April 4, 2019

Justice Corrigan authored the opinion of the court, in which Chief Justice Cantil-Sakauye and Justices Chin, Liu, Cuéllar, Kruger, and Groban concurred.

T-MOBILE WEST LLC v. CITY AND COUNTY OF SAN FRANCISCO

S238001

Opinion of the Court by Corrigan, J.

By ordinance the City and County of San Francisco (the City) requires wireless telephone service companies to obtain permits to install and maintain lines and equipment in public rights-of-way. Some permits will not issue unless the application conforms to the City's established aesthetic guidelines. Plaintiffs assert a facial challenge urging that (1) the ordinance is preempted by state law and (2) even if not preempted, the ordinance violates a state statute. The trial court and the Court of Appeal rejected both arguments. We do likewise.

I. BACKGROUND

Plaintiffs are telecommunications companies. They install and operate wireless equipment throughout the City, including on utility poles located along public roads and highways.[1] In January 2011, the City adopted ordinance No.

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[1] The plaintiffs named in the operative complaint were T-Mobile West Corporation, NextG Networks of California, Inc., and ExteNet Systems (California) LLC. T-Mobile West Corporation has also appeared in this litigation as T-Mobile West LLC. NextG Networks of California, Inc. has also appeared as Crown Castle NG West LLC and Crown Castle NG West Inc. (*T-Mobile West LLC v. City and County of San Francisco* (2016) 3 Cal.App.5th 334, 340, fn. 3 (*T-Mobile West*).)

12-11 (the Ordinance),[2] which requires "any Person seeking to construct, install, or maintain a Personal Wireless Service Facility in the Public Rights-of-Way to obtain" a permit. (S.F. Pub. Works Code, art. 25, § 1500, subd. (a).) In adopting the Ordinance, the board of supervisors noted that the City "is widely recognized to be one of the world's most beautiful cities," which is vital to its tourist industry and an important reason that residents and businesses locate there. Due to growing demand, requests from the wireless industry to place equipment on utility poles had increased. The board opined that the City needed to regulate the placement of this equipment to prevent installation in ways or locations "that will diminish the City's beauty." The board acknowledged that telephone corporations have a right, under state law, "to use the public rights-of-way to install and maintain 'telephone lines' and related facilities required to provide telephone service." But it asserted that local governments may "enact laws that limit the intrusive effect of these lines and facilities."

The Ordinance specifies areas designated for heightened aesthetic review. (See S.F. Pub. Works Code, art. 25, § 1502.) These include historic districts and areas that have " 'good' " or " 'excellent' " views or are adjacent to parks or open spaces.

Not all plaintiffs install and operate the same equipment, but there is no dispute that they are all " 'telephone corporation[s],' " as that term is defined by Public Utilities Code section 234, nor that all of the equipment in question fits within the definition of " 'telephone line' " in Public Utilities Code section 233. All unspecified statutory references are to the Public Utilities Code.

[2] The Ordinance was codified as article 25 of the San Francisco Public Works Code.

(*Ibid.*) The Ordinance establishes various standards of aesthetic compatibility for wireless equipment. In historic districts, for example, installation may only be approved if the City's planning department determines that it would not "significantly degrade the aesthetic attributes that were the basis for the special designation" of the building or district. (S.F. Pub. Works Code, art. 25, § 1502; see also *id.*, §§ 1508, 1509, 1510.) In "view" districts, proposed installation may not "significantly impair" the protected views.[3] (S.F. Pub. Works Code, art. 25, § 1502.)

Plaintiffs sought declaratory and injunctive relief. The operative complaint alleged five causes of action, only one of which is at issue.[4] It alleges the Ordinance and implementing regulations are preempted by section 7901 and violate section 7901.1. Under section 7901, "telephone corporations may construct . . . telephone lines along and upon any public road or highway, along or across any of the waters or lands within this State, and may erect poles, posts, piers, or abutments for supporting the insulators, wires, and other necessary fixtures of their lines, in such manner and at such points as not to incommode the public use of the road or highway or interrupt

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[3] The Court of Appeal discussed other provisions of a previous enactment of the Ordinance that are not in issue here. (*T-Mobile West, supra*, 3 Cal.App.5th at pp. 340-341.) We review the current version of the Ordinance. (*Kash Enterprises, Inc. v. City of Los Angeles* (1977) 19 Cal.3d 294, 306, fn. 6.)

[4] Plaintiffs' first, second, fourth, and fifth causes of action are not before us. The first cause of action was resolved in plaintiffs' favor by summary adjudication. The second was dismissed by plaintiffs before trial. The fourth was resolved in City's favor by summary adjudication. And the fifth was resolved in plaintiffs' favor after trial.

the navigation of the waters."[5] According to plaintiffs, section 7901 preempted the Ordinance to the extent it allowed the City to condition permit approval on aesthetic considerations.

Section 7901.1 sets out the Legislature's intent, "consistent with Section 7901, that municipalities shall have the right to exercise reasonable control as to the time, place, and manner in which roads, highways, and waterways are accessed." (§ 7901.1, subd. (a).) But section 7901.1 also provides that, to be considered reasonable, the control exercised "shall, at a minimum, be applied to all entities in an equivalent manner." (§ 7901.1, subd. (b).) Plaintiffs alleged the Ordinance violated subdivision (b) of section 7901.1 by treating wireless providers differently from other telephone corporations.

The trial court ruled that section 7901 did not preempt the challenged portions of the Ordinance and rejected plaintiffs' claim that it violated section 7901.1. The Court of Appeal affirmed. (*T-Mobile West*, *supra*, 3 Cal.App.5th at pp. 339, 359.)

II. DISCUSSION

A. Section 7901 Does Not Preempt the Ordinance

1. Preemption Principles

Under the California Constitution, cities and counties "may make and enforce within [their] limits all local, police, sanitary, and other ordinances and regulations not in conflict with general laws." (Cal. Const., art. XI, § 7.) General laws are those that apply statewide and deal with matters of statewide

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[5] This case does not involve the construction or installation of lines or equipment across state waters. Thus, we limit our discussion to lines installed along public roads and highways, which we refer to collectively as public roads.

concern. (*Eastlick v. City of Los Angeles* (1947) 29 Cal.2d 661, 665.) The "inherent local police power includes broad authority to determine, for purposes of the public health, safety, and welfare, the appropriate uses of land within a local jurisdiction's borders." (*City of Riverside v. Inland Empire Patients Health & Wellness Center, Inc.* (2013) 56 Cal.4th 729, 738 (*City of Riverside*); see also *Big Creek Lumber Co. v. County of Santa Cruz* (2006) 38 Cal.4th 1139, 1151 (*Big Creek Lumber*).) The local police power generally includes the authority to establish aesthetic conditions for land use. (*Ehrlich v. City of Culver City* (1996) 12 Cal.4th 854, 886; *Disney v. City of Concord* (2011) 194 Cal.App.4th 1410, 1416.)

"[L]ocal legislation that conflicts with state law is void." (*City of Riverside, supra,* 56 Cal.4th at p. 743, citing *Sherwin-Williams Co. v. City of Los Angeles* (1993) 4 Cal.4th 893, 897.) A conflict exists when the local legislation " ' " 'duplicates, contradicts, or enters an area fully occupied by general law, either expressly or by legislative implication.' " ' " (*Sherwin-Williams*, at p. 897.) Local legislation duplicates general law if both enactments are coextensive. (*Ibid.*, citing *In re Portnoy* (1942) 21 Cal.2d 237, 240.) Local legislation is contradictory when it is inimical to general law. (*Sherwin-Williams*, at p. 898, citing *Ex parte Daniels* (1920) 183 Cal. 636, 641-648.) State law fully occupies a field "when the Legislature 'expressly manifest[s]' its intent to occupy the legal area or when the Legislature 'impliedly' occupies the field." (*O'Connell v. City of Stockton* (2007) 41 Cal.4th 1061, 1068 (*O'Connell*), citing *Sherwin-Williams*, at p. 898.)

The party claiming preemption has the burden of proof. (*Big Creek Lumber, supra,* 38 Cal.4th at p. 1149.) "[W]hen local government regulates in an area over which it traditionally has

exercised control, such as the location of particular land uses, California courts will presume" the regulation is not preempted unless there is a clear indication of preemptive intent. (*Ibid.*, citing *IT Corp. v. Solano County Bd. of Supervisors* (1991) 1 Cal.4th 81, 93.) Ruling on a facial challenge to a local ordinance, the court considers the text of the measure itself, not its application to any particular circumstances or individual. (*San Francisco Apartment Assn. v. City and County of San Francisco* (2016) 3 Cal.App.5th 463, 487, citing *Pieri v. City and County of San Francisco* (2006) 137 Cal.App.4th 886, 894, which in turn cites *Tobe v. City of Santa Ana* (1995) 9 Cal.4th 1069, 1084.)[6]

2. Analysis

Section 7901 provides that telephone corporations may construct lines and erect equipment along public roads in ways and locations that do not "incommode the public use of the road." We review the statute's language to determine the scope of the rights it grants to telephone corporations and whether, by

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[6] There is some uncertainty regarding the standard for facial constitutional challenges to statutes and local ordinances. (*Today's Fresh Start, Inc. v. Los Angeles County Office of Education* (2013) 57 Cal.4th 197, 218.) Some cases have held that legislation is invalid if it conflicts in the generality or great majority of cases. (*Guardianship of Ann S.* (2009) 45 Cal.4th 1110, 1126.) Others have articulated a stricter standard, holding that legislation is invalid only if it presents a total and fatal conflict with applicable constitutional prohibitions. (*Ibid.*; see also *Tobe v. City of Santa Ana*, *supra*, 9 Cal.4th at p. 1084.) We need not settle on a precise formulation of the applicable standard because, as explained below, we find no inherent conflict between the Ordinance and section 7901. Thus, plaintiffs' claim fails under any articulated standard.

granting those rights, the Legislature intended to preempt local regulation based on aesthetic considerations. These questions of law are subject to de novo review. (*Bruns v. E-Commerce Exchange, Inc.* (2011) 51 Cal.4th 717, 724; *Farm Raised Salmon Cases* (2008) 42 Cal.4th 1077, 1089, fn. 10.)

The parties agree that section 7901 grants telephone corporations a statewide franchise to engage in the telecommunications business.[7] (See *Western Union Tel. Co. v. Visalia* (1906) 149 Cal. 744, 750 (*Visalia*).) Thus, a local government cannot insist that a telephone corporation obtain a *local* franchise to operate within its jurisdiction. (See *Visalia*, at p. 751; see also *Pac. Tel. & Tel. Co. v. City & County of S. F.* (1959) 51 Cal.2d 766, 771 (*Pacific Telephone I*).) The parties also agree that the franchise rights conferred are limited by the prohibition against incommoding the public use of roads, and that local governments have authority to prevent those impacts.

Plaintiffs argue section 7901 grants them more than the mere right to operate. In their view, section 7901 grants them the right to construct lines and erect equipment along public roads so long as they do not obstruct the path of travel. The necessary corollary to this right is that local governments cannot prevent the construction of lines and equipment unless the installation of the facilities will obstruct the path of travel. Plaintiffs urge that the Legislature enacted section 7901 to promote technological advancement and ensure a functioning, statewide telecommunications system. In light of those

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[7] In this context, a franchise is a "government-conferred right or privilege to engage in specific business or to exercise corporate powers." (Black's Law Dict. (10th ed. 2014) p. 772, col. 2.)

objectives, they contend that their right to construct telephone lines must be construed broadly, and local authority limited to preventing roadway obstructions.

Preliminarily, plaintiffs' argument appears to rest on the premise that the City only has the power to regulate telephone line construction based on aesthetic considerations if section 7901's incommode clause can be read to accommodate that power. That premise is flawed. As mentioned, the City has inherent local police power to determine the appropriate uses of land within its jurisdiction. That power includes the authority to establish aesthetic conditions for land use. Under our preemption cases, the question is not whether the incommode clause can be read to permit the City's exercise of power under the Ordinance. Rather, it is whether section 7901 divests the City of that power.

We also disagree with plaintiffs' contention that section 7901's incommode clause limits their right to construct lines only if the installed lines and equipment would obstruct the path of travel. Contrary to plaintiffs' argument, the incommode clause need not be read so narrowly. As the Court of Appeal noted, the word " 'incommode' " means " 'to give inconvenience or distress to: disturb.' " (*T-Mobile West*, *supra*, 3 Cal.App.5th at p. 351, citing Merriam-Webster Online Dict., available at <http://www.merriam-webster.com/dictionary/incommode> [as of April 3, 2019].)[8] The Court of Appeal also quoted the definition of "incommode" from the 1828 version of Webster's Dictionary. Under that definition, "incommode" means " '[t]o

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[8] All Internet citations in this opinion are archived by year, docket number, and case name at <http://www.courts.ca.gov/38324.htm>.

give inconvenience to; to give trouble to; to disturb or molest in the quiet enjoyment of something, or in the facility of acquisition.' " (*T-Mobile West*, *supra*, 3 Cal.App.5th at p. 351, citing Webster's Dict. 1828—online ed., available at <http://www.websterdictionary1828.com/Dictionary/incommode> [as of April 3, 2019].) For our purposes, it is sufficient to state that the meaning of incommode has not changed meaningfully since section 7901's enactment.[9] Obstructing the path of travel is one way that telephone lines could disturb or give inconvenience to public road use. But travel is not the sole use of public roads; other uses may be incommoded beyond the obstruction of travel. (*T-Mobile West*, at pp. 355-356.) For example, lines or equipment might generate noise, cause negative health consequences, or create safety concerns. All these impacts could disturb public road use, or disturb its quiet enjoyment.

Plaintiffs assert the case law supports their statutory construction. For example, *City of Petaluma v. Pac. Tel. & Tel. Co.* (1955) 44 Cal.2d 284 (*Petaluma*) stated that the "franchise tendered by [section 7901] . . . [is] superior to and free from any grant made by a subordinate legislative body." (*Id.* at p. 287; see also *Pacific Telephone I*, *supra*, 51 Cal.2d at p. 770; *County of Inyo v. Hess* (1921) 53 Cal.App. 415, 425 (*County of Inyo*).)

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[9] The predecessor of section 7901, Civil Code section 536, was first enacted in 1872 as part of the original Civil Code. (*Anderson v. Time Warner Telecom of California* (2005) 129 Cal.App.4th 411, 419, citing *Sunset Tel. and Tel. Co. v. Pasadena* (1911) 161 Cal. 265, 273.) Civil Code section 536 contained the "incommode" language, as did its predecessor, which was adopted as part of the Statutes of California in 1850. (Stats. 1850, ch. 128, § 150, p. 369.)

Similarly, *Pac. Tel. & Tel. Co. v. City of Los Angeles* (1955) 44 Cal.2d 272 (*City of Los Angeles*), held that the "authority to grant a franchise to engage in the telephone business resides in the state, and the city is without power to require a telephone company to obtain such a franchise unless the right to do so has been delegated to it by the state." (*Id.* at pp. 279-280.)

But these cases do not go as far as plaintiffs suggest. Each addressed the question whether a telephone corporation can be required to obtain a local franchise to operate. (See *Pacific Telephone I*, *supra*, 51 Cal.2d at p. 767; *Petaluma*, *supra*, 44 Cal.2d at p. 285; *City of Los Angeles*, *supra*, 44 Cal. 2d at p. 276; *County of Inyo*, *supra*, 53 Cal.App. at p. 425.) None considered the distinct question whether a local government can condition permit approval on aesthetic or other considerations that arise under the local police power. A permit is, of course, different from a franchise. The distinction may be best understood by considering the effect of the denial of either. The denial of a franchise would completely bar a telephone corporation from operating within a city. The denial of a permit, on the other hand, would simply prevent construction of lines in the proposed manner at the proposed location.

A few published decisions have tangentially addressed the scope of the inherent local police power to regulate the manner and location of telephone line installations. Those cases cut against plaintiffs' proposed construction.

In *Pacific Tel. & Tel. Co. v. City & County of San Francisco* (1961) 197 Cal.App.2d 133 (*Pacific Telephone II*), the City argued it could require a telephone corporation to obtain a local franchise to operate within its jurisdiction because the power to grant franchises fell within its police power. (*Id.* at p. 152.) The

court rejected the City's argument, reasoning that the phrase " 'police power' has two meanings, 'a comprehensive one embracing in substance the whole field of state authority and the other a narrower one including only state power to deal with the health, safety and morals of the people.' " (*Ibid.*) "Where a corporation has a state franchise to use a city's streets, the city derives its rights to regulate the particular location and manner of installation of the franchise holder's facilities from the narrower sense of the police power. Thus, because of the state concern in communications, the state has retained to itself the broader police *power of granting franchises*, leaving to the municipalities the narrower police *power of controlling location and manner of installation*." (*Ibid.*, italics added.)

This court, too, has distinguished the power to grant franchises from the power to regulate the location and manner of installation by permit. In *Visalia*, *supra*, 149 Cal. 744, the city adopted an ordinance that (i) authorized a telephone company to erect telegraph poles and wires on city streets, (ii) approved the location of poles and wires then in use, (iii) prohibited poles and wires from interfering with travel on city streets, and (iv) required all poles to be of a uniform height. (*Id.* at pp. 747-748.) The city asserted its ordinance operated to grant the company a " 'franchise,' " and then attempted to assess a tax on the franchise. (*Id.* at p. 745.) The company challenged the assessment. It argued that, because the ordinance did not create a franchise, the tax assessment was invalid. (*Id.* at pp. 745-746.) We concluded the ordinance did not create a local franchise. (*Id.* at p. 750.) By virtue of its state franchise, "the appellant had the right, of which the city could not deprive it, to construct and operate its lines along the streets of the city." (*Ibid.*) "[N]evertheless it could not maintain its poles and wires

in such a manner as to unreasonably obstruct and interfere with ordinary travel; and the city had the authority, under its police power, to so regulate the manner of plaintiff's placing and maintaining its poles and wires *as to prevent unreasonable obstruction of travel.*" (*Id.* at pp. 750-751, italics added.) "[T]he ordinance in question was not intended to be anything more . . . than the exercise of this authority to regulate." (*Id.* at p. 751)[10]

Plaintiffs argue the italicized language above shows that local regulatory authority is limited to preventing travel obstructions. But the quoted language is merely descriptive, not prescriptive. *Visalia* involved an ordinance that specifically prohibited interference with travel on city streets, and the court was simply describing the ordinance before it, not establishing the bounds of local government regulatory authority. Moreover, the *Visalia* court did not question the propriety of the ordinance's requirement that all poles be a uniform height, nor suggest that requirement was related to preventing obstructions to travel. Thus, *Visalia* does not support the conclusion that section 7901 was meant to restrict local government power in the manner plaintiffs suggest. The "right of telephone corporations to construct telephone lines in public rights-of-way is not absolute." (*City of Huntington Beach v. Public Utilities Com.* (2013) 214 Cal.App.4th 566, 590 (*City of Huntington Beach*).) Instead, it is a " 'limited right to use the highways . . . only to the extent necessary for the furnishing of services to the

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[10] *Visalia* interpreted a predecessor statute, Civil Code section 536, which was repealed in 1951 and reenacted as section 7901. (Stats. 1951, ch. 764, pp. 2025, 2194, 2258 [reenacting Civ. Code, former § 536 as Pub. Util. Code, § 7901].)

public.' " (*Ibid.*, quoting *County of L. A. v. Southern Cal. Tel. Co.* (1948) 32 Cal.2d 378, 387; see also *Pacific Tel. & Tel. Co. v. Redevelopment Agency* (1977) 75 Cal.App.3d 957, 963.)[11]

Having delineated the right granted by section 7901, we now turn to its preemptive sweep. Because the location and manner of line installation are areas over which local governments traditionally exercise control (*Visalia, supra*, 149 Cal. at pp. 750-751), we presume the ordinance is not preempted absent a clear indication of preemptive intent. (*Big Creek Lumber, supra*, 38 Cal.4th at p. 1149.) Plaintiffs put forth a number of preemption theories. They argue the Ordinance is contradictory to section 7901. At oral argument, they asserted the Legislature occupied the field with section 7901, the terms of which indicate that a paramount state concern will not tolerate additional local action. And in their briefs, many of plaintiffs' arguments were focused on what has been labeled, in the federal context, as obstacle preemption.

"The 'contradictory and inimical' form of preemption does not apply unless the ordinance directly requires what the state

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[11] The Ninth Circuit has addressed this issue twice, coming to a different conclusion each time. In *Sprint PCS Assets v. City of Palos Verdes Estates* (9th Cir. 2009) 583 F.3d 716, the Ninth Circuit found no conflict between section 7901 and a local ordinance conditioning permit approval on aesthetic considerations. (*Palos Verdes Estates*, at pp. 721-723.) In an unpublished decision issued three years earlier, the Ninth Circuit had reached the opposite conclusion. (*Sprint PCS v. La Cañada Flintridge* (9th Cir. 2006) 182 Fed.Appx. 688, 689.) Due to its unpublished status, the *La Cañada Flintridge* decision carries no precedential value. (*T-Mobile West, supra*, 3 Cal.App.5th at p. 355, citing *Bowen v. Ziasun Technologies, Inc.* (2004) 116 Cal.App.4th 777, 787, fn. 6.)

statute forbids or prohibits what the state enactment demands." (*City of Riverside, supra,* 56 Cal.4th at p. 743, citing *Big Creek Lumber, supra,* 38 Cal.4th at p. 1161.) "[N]o inimical conflict will be found where it is reasonably possible to comply with both the state and local laws." (*City of Riverside,* at p. 743.) As noted, section 7901 grants telephone corporations the right to install lines on public roads without obtaining a local franchise. The Ordinance does not require plaintiffs to obtain a local franchise to operate within the City. Nor does it allow certain companies to use public roads while excluding others. Any wireless provider may construct telephone lines on the City's public roads so long as it obtains a permit, which may sometimes be conditioned on aesthetic approval. Because section 7901 says nothing about the aesthetics or appearance of telephone lines, the Ordinance is not inimical to the statute.

The argument that the Legislature occupied the field by implication likewise fails. Field preemption generally exists where the Legislature has comprehensively regulated in an area, leaving no room for additional local action. (See, e.g., *American Financial Services Assn. v. City of Oakland* (2005) 34 Cal.4th 1239, 1252-1257; *O'Connell, supra,* 41 Cal.4th 1061, 1068-1074.) Unlike the statutory schemes addressed in *American Financial* and *O'Connell,* section 7901 does not comprehensively regulate telephone line installation or provide a general regulatory scheme. On the contrary, section 7901 consists of a single sentence. Moreover, although the granting of telephone franchises has been deemed a matter of statewide concern (*Pacific Telephone I, supra,* 51 Cal.2d at p. 774; *Pacific Telephone II, supra,* 197 Cal.App.2d at p. 152), the power to regulate the location and manner of line installation is generally a matter left to local regulation. The City is not attempting to

regulate in an area over which the state has traditionally exercised control. Instead, this is an area of regulation in which there are " 'significant local interest[s] to be served that may differ from one locality to another.' " (*Big Creek Lumber*, *supra*, 38 Cal.4th at p. 1149.)

City of Riverside, *supra*, 56 Cal.4th 729, is instructive. There, the question was whether state statutes designed to enhance patient and caregiver access to medical marijuana preempted a local zoning law banning dispensaries within a city's limits. (*Id.* at pp. 737, 739-740.) An early enactment had declared that physicians could not be punished for recommending medical marijuana and that state statutes prohibiting possession and cultivation of marijuana would not apply to patients or caregivers. (*Id.* at p. 744.) A subsequent enactment established a program for issuing medical marijuana identification cards and provided that a cardholder could not be arrested for possession or cultivation in permitted amounts. (*Id.* at p. 745.) We concluded that the "narrow reach of these statutes" (*ibid.*) showed they did not "expressly or impliedly preempt [the city's] zoning provisions" (*id.* at p. 752).

Preemption was not implied because the Legislature had not tried "to fully occupy the field of medical marijuana regulation as a matter of statewide concern, or to partially occupy this field under circumstances indicating that further local regulation will not be tolerated." (*City of Riverside*, *supra*, 56 Cal.4th at p. 755.) While state statutes took "limited steps toward recognizing marijuana as a medicine," they described "no comprehensive scheme or system for authorizing, controlling, or regulating the processing and distribution of marijuana for medical purposes, such that no room remains for local action." (*Ibid.*) Moreover, there were significant local

interests that could vary by jurisdiction, giving rise to a presumption against preemption. (*Ibid.*)

Similarly, here, the Legislature has not adopted a comprehensive regulatory scheme. Instead, it has taken the limited step of guaranteeing that telephone corporations need not secure a local franchise to operate in the state or to construct local lines and equipment. Moreover, the statute leaves room for additional local action and there are significant local interests relating to road use that may vary by jurisdiction.

Finally, plaintiffs' briefing raises arguments that sound in the theory of obstacle preemption. Under that theory, a local law would be displaced if it hinders the accomplishment of the purposes behind a state law. This court has never said explicitly whether state preemption principles are coextensive with the developed federal conception of obstacle preemption. (See, e.g., *Great Western Shows, Inc. v. County of Los Angeles* (2002) 27 Cal.4th 853, 867-868; cf. *City of Riverside*, *supra*, 56 Cal.4th at pp. 763-765 (conc. opn. of Liu, J.).) But assuming for the sake of argument that the theory applies, we conclude there is no obstacle preemption here.

The gist of plaintiffs' argument is that section 7901's purpose is to encourage technological advancement in the state's telecommunications networks and that, because enforcement of the Ordinance *could* hinder that purpose, the Ordinance is preempted. But no legislation pursues its objectives at all costs. (*Pension Ben. Guar. Corp. v. LTV Corp.* (1990) 496 U.S. 633, 646-647.) Moreover, the Legislature made clear that the goal of technological advancement is not paramount to all others by including the incommode clause in section 7901, thereby leaving room for local regulation of telephone line installation.

Finally, we think it appropriate to consider the Public Utilities Commission's (PUC) understanding of the statutory scheme. In recognition of its expertise, we have consistently accorded deference to the PUC's views concerning utilities regulation. The PUC's "interpretation of the Public Utility Code 'should not be disturbed unless it fails to bear a reasonable relation to statutory purposes and language.' " (*Southern California Edison Co. v. Peevey* (2003) 31 Cal.4th 781, 796, quoting *Greyhound Lines, Inc. v. Public Utilities Com.* (1968) 68 Cal.2d 406, 410-411.) Here, the PUC has made determinations about the scope of permissible regulation that are on point.

The state Constitution vests principal regulatory authority over utilities with the PUC, but carves out an ongoing area of municipal control. (Cal. Const., art. XII, § 8.) A company seeking to build under section 7901 must approach the PUC and obtain a certificate of public necessity. (§ 1001; see *City of Huntington Beach*, *supra*, 214 Cal.App.4th at p. 585.) The certificate is not alone sufficient; a utility will still be subject to local control in carrying out the construction. Municipalities may surrender to the PUC regulation of a utility's relations with its customers (§ 2901), but they are forbidden from yielding to the PUC their police powers to protect the public from the adverse impacts of utilities operations (§ 2902).

Consistent with these statutes, the PUC's default policy is one of deference to municipalities in matters concerning the design and location of wireless facilities. In a 1996 opinion adopting the general order governing wireless facility construction, the PUC states the general order "recognize[s] that primary authority regarding cell siting issues should continue to be deferred to local authorities. . . . The [PUC's] role continues to be that of the agency of last resort, intervening only

when a utility contends that local actions impede statewide goals . . . ." (*Re Siting and Environmental Review of Cellular Mobile Radiotelephone Utility Facilities* (1996) 66 Cal.P.U.C.2d 257, 260; see also *Re Competition for Local Exchange Service* (1998) 82 Cal.P.U.C.2d 510, 544.)[12] The order itself "acknowledges that local citizens and local government are often in a better position than the [PUC] to measure local impact and to identify alternative sites. Accordingly, the [PUC] will generally defer to local governments to regulate the location and design of cell sites . . . ." (PUC, General order No. 159-A (1996) p. 3 (General Order 159A), available at <http://docs.cpuc.ca.gov/PUBLISHED/Graphics/611.PDF> [as of April 3, 2019].)

The exception to this default policy is telling: the PUC reserves the right to preempt local decisions about specific sites "when there is a clear conflict with the [PUC's] goals and/or statewide interests." (General Order 159A, *supra*, at p. 3.) In other words, generally the PUC will not object to municipalities dictating alternate locations based on local impacts,[13] but it will step in if statewide goals such as "high quality, reliable and widespread cellular services to state residents" are threatened.

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[12] In its 1996 opinion adopting general order No. 159-A, the PUC left implicit the portions of the statutory scheme it was applying. In its 1998 opinion, the PUC clarified the respective regulatory spheres in response to arguments based on sections 2902, 7901, 7901.1 and the constitutional provisions allocating authority to cities and the PUC. (See *Re Competition for Local Exchange Service*, *supra*, 82 Cal.P.U.C.2d at pp. 543–544.)

[13] Among the PUC's express priorities regarding wireless facility construction is that "the public health, safety, welfare, and zoning concerns of local government are addressed." (General Order 159A, *supra*, at p. 3.)

(General Order 159A, at p. 3.) Contrary to plaintiffs' view of the respective spheres of state and local authority, the PUC's approach does not restrict municipalities to judging only whether a requested permit would impede traffic. Instead, the PUC accords local governments the full scope of their ordinary police powers unless the exercise of those powers would undermine state policies.

Plaintiffs argue our construction of section 7901, and a decision upholding the City's authority to enforce the Ordinance, will "hinder the roll-out of advanced services needed to upgrade networks [and] promote universal broadband" and will "stymie the deployment of 5G networks, leaving California unable to meet the growing need for wireless capacity created by the proliferation of . . . connected devices." This argument is premised on a hypothetical future harm that is not cognizable in a facial challenge. (*Pacific Legal Foundation v. Brown* (1981) 29 Cal.3d 168, 180; see also *Arcadia Unified School Dist. v. State Dept. of Education* (1992) 2 Cal.4th 251, 267.)

In sum, neither the plain language of section 7901 nor the manner in which it has been interpreted by courts and the PUC supports plaintiffs' argument that the Legislature intended to preempt local regulation based on aesthetic considerations. The statute and the ordinance can operate in harmony. Section 7901 ensures that telephone companies are not required to obtain a local franchise, while the Ordinance ensures that lines and equipment will not unreasonably incommode public road use.[14]

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[14] We dispose here only of plaintiffs' facial challenge and express no opinion as to the Ordinance's application. We note, however, that plaintiffs seeking to challenge specific

B. The Ordinance Does Not Violate Section 7901.1

Plaintiffs next contend that, even if not preempted, the Ordinance violates section 7901.1 by singling out wireless telephone corporations for regulation. Section 7901.1 provides in relevant part that, consistent with section 7901, municipalities may "exercise reasonable control as to the time, place, and manner" in which roads are "*accessed*," and that the control must "*be applied to all entities in an equivalent manner*." (§ 7901, subds. (a), (b), italics added.)

Before trial, the parties stipulated to the following facts. First, that the City requires all utility and telephone corporations, both wireless and non-wireless, to obtain temporary occupancy permits to "access" public rights-of-way during the *initial* construction and installation of equipment facilities. These permits are not subject to aesthetic review. Second, that the City requires only wireless telephone corporations to obtain site-specific permits, conditioned on aesthetic approval, for the *ongoing* occupation and maintenance

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applications have both state and federal remedies. Under state law, a utility could seek an order from the PUC preempting a city's decision. (General Order 159A, *supra*, at p. 6.) Thus, cities are prohibited from using their powers to frustrate the larger intent of section 7901. (*Pacific Telephone II*, *supra*, 197 Cal.App.2d at p. 146.) Under federal law, Congress generally has left in place local authority over "the placement, construction, and modification of personal wireless service facilities" (47 U.S.C. § 332(c)(7)(A)), but it has carved out several exceptions. Among these, a city may not unduly delay decisions (47 U.S.C. § 332(c)(7)(B)(ii)) and may not adopt regulations so onerous as to "prohibit or have the effect of prohibiting the provision of wireless services" (47 U.S.C. § 332(c)(7)(B)(i)(II)). If a city does so, a wireless company may sue. (*Sprint PCS Assets v. City of Palos Verdes Estates*, *supra*, 583 F.3d at p. 725.)

of equipment facilities in public rights-of-way. The trial court and the Court of Appeal held that section 7901.1 only applies to *temporary* access to public rights-of-way, during initial construction and installation. Because the parties had stipulated that the City treats all companies equally in that respect, the lower courts found no violation of section 7901.1.

Plaintiffs argue the plain language of section 7901.1 does not limit its application to temporary access to public rights-of-way. Rather, the introductory phrase, "consistent with section 7901," demonstrates that section 7901.1 applies to both short- and long-term access. Plaintiffs also suggest that the legislative history of section 7901.1 supports their position, and that the lower courts' interpretation of section 7901.1 "results in an incoherent approach to municipal authority."

Plaintiffs' arguments are unpersuasive. Section 7901.1 allows cities to control the time, place, and manner in which roads are "accessed." (§ 7901.1, subd. (a).) As the competing arguments demonstrate, the "plain meaning of the word 'accessed' is ambiguous." (*T-Mobile West*, *supra*, 3 Cal.App.5th at p. 358.) It could refer only to short-term access, during the initial installation and construction of a telephone equipment facility. But it could also refer to the longer term occupation of public rights-of-way with telephone equipment. (*Ibid.*) Though it would be odd for a statute authorizing local control over *permanent* occupations to specifically allow for control over the "time" of such occupations, the statute's plain language does not render plaintiffs' construction totally implausible.

However, the legislative history shows that section 7901.1 only deals with temporary access to public rights-of-way. "This bill is intended to bolster the cities['] abilities with regard to

construction management . . . ." (Sen. Rules Com., Off. of Sen. Floor Analyses, 3d reading analysis of Sen. Bill No. 621 (1995–1996 Reg. Sess.) as amended May 3, 1995, p. 3, italics added.) Before section 7901.1's enactment, telephone companies had been taking the "extreme" position, based on their statewide franchises, that "cities [had] absolutely no ability to control construction." (Assem. Com. on Utilities and Commerce, Rep. on Sen. Bill No. 621 (1995–1996 Reg. Sess.) as amended July 7, 1995, p. 2.) Section 7901.1 was enacted to "send a message to telephone corporations that cities have authority to manage their construction, without jeopardizing the telephone [corporations'] statewide franchise." (Sen. Rules Com., Off. of Sen. Floor Analyses, 3d reading analysis of Sen. Bill No. 621 (1995–1996 Reg. Sess.) as amended May 3, 1995, p. 3.) Under section 7901.1, cities would be able to "plan maintenance programs, protect public safety, minimize public inconvenience, and ensure adherence to sound construction practices." (Assem. Com. on Utilities and Commerce, Rep. on Sen. Bill No. 621 (1995–1996 Reg. Sess.) as amended July 7, 1995, p. 2.)

To accept plaintiffs' construction of section 7901.1, we would have to ignore this legislative history. (*T-Mobile West*, *supra*, 3 Cal.App.5th at p. 358.) Contrary to plaintiffs' argument, construing section 7901.1 in this manner does not render the scheme incoherent. It is eminently reasonable that a local government may: (1) control the time, place, and manner of temporary access to public roads during construction of equipment facilities; and (2) regulate other, longer term impacts that might incommode public road use under section 7901. Thus, we hold that section 7901.1 only applies to temporary access during construction and installation of telephone lines

and equipment. Because the City treats all entities similarly in that regard, there is no section 7901.1 violation.

III. DISPOSITION

The judgment of the Court of Appeal is affirmed.

CORRIGAN, J.

We Concur:

CANTIL-SAKAUYE, C. J.
CHIN, J.
LIU, J.
CUÉLLAR, J.
KRUGER, J.
GROBAN, J.

See next page for addresses and telephone numbers for counsel who argued in Supreme Court.

Name of Opinion T-Mobile West LLC v. City and County of San Francisco

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Unpublished Opinion
Original Appeal
Original Proceeding
Review Granted XXX 3 Cal.App.5th 334
Rehearing Granted

Opinion No. S238001
Date Filed: April 4, 2019

Court: Superior
County: San Francisco
Judge: James J. McBride

Counsel:

Wiley Rein, Joshua S. Turner, Matthew J. Gardner, Megan L. Brown, Meredith G. Singer; Davis Wright Tremaine, Martin L. Fineman, T. Scott Thompson and Daniel P. Reing for Plaintiffs and Appellants.

Janet Galeria; Jenner & Block, Scott B. Wilkens, Matthew S. Hellman, Adam G. Unikowsky, Erica L. Ross and Leonard R. Powell for the Chamber of Commerce of the United States of America, the California Chamber of Commerce, the San Francisco Chamber of Commerce, the Bay Area Council and the Silicon Valley Leadership Group as Amici Curiae on behalf of Plaintiffs and Appellants.

Mayer Brown, Hans J. Germann, Donald M. Falk and Samantha Booth for Pacific Bell Telephone Company and AT&T Mobility, LLC, as Amici Curiae on behalf of Plaintiffs and Appellants.

Crowell & Moring, Emily T. Kuwahara and Colin Proksel for American Consumer Institute Center for Citizen Research as Amicus Curiae on behalf of Plaintiffs and Appellants.

Wilkinson Barker Knauer, Christine M. Crowe and Craig E. Gilmore for CTIA-The Wireless Association and the Wireless Infrastructure Association as Amici Curiae on behalf of Plaintiffs and Appellants.

Dennis J. Herrera, City Attorney, Yvonne R. Meré, Chief of Complex and Affirmative Litigation, Christine Van Aken, Chief of Appellate Litigation, William K. Sanders, Erin B. Bernstein and Jeremy M. Goldman, Deputy City Attorneys, for Defendants and Respondents.

Rutan & Tucker, Jeffrey T. Melching and Ajit Singh Thind for League of California Cities, California State Association of Counties, International Municipal Lawyers Association and the States of California and Nevada Chapter of the National Association of Telecommunications Officers and Advisors as Amici Curiae on behalf of Defendants and Respondents.

Counsel who argued in Supreme Court (not intended for publication with opinion):

Joshua S. Turner
Wiley Rein
1776 K Street, N.W.
Washington, D.C. 20006
(202) 719-7000

Jeremy M. Goldman
Deputy City Attorney
1 Dr. Carlton B. Goodlett Place, Room 234
San Francisco, CA 94102-4682
(415) 554-6762

From: Amy Martenson
Sent: Monday, November 4, 2019 10:40 PM
To: Clerk <clerk@cityofnapa.org>
Cc: Mary Luros <mluros@cityofnapa.org>; Liz Alessio <lalessio@cityofnapa.org>; Jill Techel <jtechel@cityofnapa.org>; Doris Gentry <dgentry@cityofnapa.org>; Scott Sedgley <SSedgley@cityofnapa.org>; Steve Potter <spotter@cityofnapa.org>; Julie Lucido <jlucido@cityofnapa.org>; Don Schmidt <dschmidt@cityofnapa.org>
Subject: Questions/Comment for the 11-5-19 City Council meeting (Please place this email and photos in the public record for Item 14A)

[EXTERNAL]

Dear Napa City Council:

I hope the following questions will be answered at tomorrow night's meeting:

1. After the October 15th meeting, why was Site 43 at 1100 5th St. moved from the agreed list to the pending list? What was the basis for that decision?
2. Why, after the October 15th meeting, were certain schools (Northwood Elementary, River/Harvest Middle, and New Tech High) moved off the agreed list and other schools (Vintage High and Napa Valley Language Academy) stayed on?
3. Why, after the October 15th meeting, was Site 22 moved from 2300 Jefferson St. in front of Sleep City up a block to 1141 Lincoln Ave. in front of the Siam Thai House?
4. Why, after the October 15th meeting, was Site 58 at 100 Coombs moved away from the metal pole in front of Lixit to a telephone pole in front of the A-1 Store?
5. In questions 3 and 4, when sites were moved away from one business and closer to another was the latter business notified, so they could participate in the public process?

Lastly, I am attaching three photos to show how close (less than 15 feet) some of these poles are in this case to businesses, but in other cases homes and schools.

A 2005 US Court of Appeals 9th Circuit case (MetroPCS v. City and County of San Francisco) ruled that cities can deny permits for wireless antennas if there is "no significant gap in coverage" and that if there is a gap, cities can require that carriers close it using the "least intrusive means."

Local residents made Verizon calls at all of the proposed locations showing no significant gap in coverage. However, even if there was one, placing antennas in close proximity to homes, schools, and businesses would not be "least intrusive." Here is a link to that case: https://caselaw.findlaw.com/us-9th-circuit/1406360.html

In addition, the April 2019 California Supreme Court ruling stated that cities can regulate wireless antennas, not only based on aesthetics but also based on health and safety concerns. Here is a link to that case: https://cases.justia.com/california/supreme-court/2019-s238001.pdf?ts=1554397275&fbclid=IwAR12ThVG9fUumYGaRhG6X4NwAEbhF3mTiSAQjxnXtO6djFT-swnd1o8UOoY

The FCC does not have the jurisdiction to override these court cases, providing the City of Napa with the legal basis to deny these permits to protect the health, safety, and welfare of its residents.

Since the City Council has been made aware of the health risks associated with wireless radiation, approving permits that are in close proximity to where people live, work, and go to school would be an act of gross negligence, making City Council members liable for any ill health effects residents experience as a result. (Here is a link to the scientific studies again: https://www.americansforresponsibletech.org/scientific-studies)
Sincerely,
Amy Martenson

Site 28 at 1616 Jefferson St. (Pending list)

Site 22 at 1141 Lincoln Ave. (Agreed list)

Site 29 at 1746 Yajome St. (Delayed list)


8-5

City Council Meeting
11/5/19
Supplemental I - 14.A.
From: Joelle Gallagher

From: Joelle Gallagher
Sent: Monday, November 4, 2019 8:06 PM
To: Jill Techel <jtechel@cityofnapa.org>; Liz Alessio <lalessio@cityofnapa.org>; Mary Luros <mluros@cityofnapa.org>; Doris Gentry <dgentry@cityofnapa.org>; Steve Potter <spotter@cityofnapa.org>; Scott Sedgley <SSedgley@cityofnapa.org>
Subject: Item 14.A Accommodation Agreement for Installation of Verizon Wireless Communications Small Cell Technology Equipment

[EXTERNAL]

Dear Mayor Techel, Vice-Mayor Sedgley and Councilmembers Alessio, Luros, and Gentry,

As a City of Napa resident deeply concerned about the health, safety and welfare of our community members, especially our children, I ask that you carefully weigh the benefits vs. the risks of the installation of Verizon's small cell wireless transmitters throughout Napa.

As you may know, the International Association of Firefighters called for a moratorium on cell towers on or near fire stations in 2004. "Research on health effects of radiofrequency radiation was gathered by the IAFF and presented to their Division of Occupational Health, Safety and Medicine. The extensive review included a large body of international science showing evidence of non-thermal effects of radiofrequency radiation emitted from wireless devices and cell towers. This review, along with their own observations and study, prompted the IAFF to write a detailed amended IAFF Resolution No. 15, dated August 2004, to prohibit cell towers from being placed on their fire stations."
https://mdsafetech.org/2019/09/28/firefighters-fighting-fires-and-now-cell-towers/

In addition, California's AB57 gave firefighter stations a legal exemption from cell tower placement on their facilities. If we question the safety of these small cell installations in the vicinity of our fire stations, we should certainly question their safety near our schools and in our neighborhoods.

You are also probably aware that a 2018 study, examining the neurologic effects on children, aged 13-16, in schools with nearby cell towers, revealed significant declines in cognitive scores; surely, cause for serious concern. https://journals.sagepub.com/doi/10.1177/1557988318816914

As we charge ahead to create "smart" cities, we must fully understand the health implications of new technologies, and never sacrifice health and safety for speed and convenience.

Thank you for your thoughtful discussion of this important issue.

Joelle Gallagher

City Council Meeting
11/5/19
Supplemental I - 14.A.
From: Ross Hildebrand

From: Ross Hildebrand
Sent: Monday, November 4, 2019 10:51 PM
To: Jill Techel <jtechel@cityofnapa.org>; Doris Gentry <dgentry@cityofnapa.org>; Liz Alessio <lalessio@cityofnapa.org>; Mary Luros <mluros@cityofnapa.org>; Scott Sedgley <SSedgley@cityofnapa.org>; Steve Potter <spotter@cityofnapa.org>
Subject: 5G

[EXTERNAL]

Please read the attachment before Nov 5 meeting. Thank you, Ross Hildebrand.

TO: Napa City Council Prepared for Nov 5, 2019

I AM ROSS HILDEBRAND, RETIRED NETWORK ENGINEER FROM SACRAMENTO. At UOP and UC Davis, I was trained in plant and animal biology, human physiology, and chemistry. Additionally, I have extensive training in electronics, and networked communications. I designed, implemented, and was tech support for networks upwards of 25,000 devices for the State of California, Sacramento county and city, as well as the likes of Delicato Vineyards, Hewlett Packard, Wells Fargo, and Bank of America.

WHAT WE KNOW ABOUT 5G SO FAR:

>DUE TO ITS SHORTER WAVELENGTH, 5G implementation calls for an antenna every 500 feet, typically on light poles at the same height as 1 and 2 story homes. If you are in an unlucky house, the antenna might be right outside your child's window, possibly as close as 20 - 60 feet away.

>PROPERTY VALUES are already DROPPING 20% on homes near cell towers.

>FIBER is just as fast as 5G; Google's backbone is fiber, Comcast offers 2 Gig.

>IN 2017, 180 SCIENTISTS AND DOCTORS around the world called for a 5G moratorium.

>5G CAN CAUSE a long list of mysterious symptoms from headaches to cancer; where trial installations have begun, these are already affecting sacramento citizens.

>BLOOD CELLS, DNA, Blood cells, the brain-blood barrier, sperm, and eggs are compromised by microwave frequencies.

HOW THIS HAPPENS IS **ALREADY KNOWN**!!

MECHANISM CAUSING HARM: The waves do not interfere with DNA directly (ionizing waves do that), however they dramatically increase free radicals in the body past the body's natural capabilities to counteract them. Low level radio-frequency radiation creates an electrical charge across cells, and that causes the cell to produce stress products, including free radicals. Like iron filings in a magnetic field, it influences the orientation of polar molecules, leaving the non-polar ones. It accelerates the decomposition of water into its constituent ionic compounds, dangerously and notably including hydroxide OH-, by causing the polar molecules to clump together and increase their friction against each other, causing a physical tearing of the molecules.

=====

AS IS POLICY IN EUROPE, it is the duty of those in public office NOT to wait until the worst fears are realized. If, for this Council, there was no description of health risks, then there was no full disclosure; you were mislead and your contract should be rendered invalid.

As you consider this subject, please remember as in sports, to keep your *eye on the ball*. We have heard such expressions as “value proposition”, “provide capacity and speed”, “diversify the economic base”, “attract high wage technology, etc. These are admiral goals, and any proper public servant would seek them out; but please realize, they are also sales presentation spin to get you to sign something. They have taught you what you want, and then offered it to you with information omitted. Also, the accuracy with which instruments measure RF at the antenna or from x feet away near a house, while important, are a distraction to this conversation. They do not represent keeping your *eye on the ball*. The “ball” in this case is simply and ONLY, whether 5G technology is dangerous for human health.

Dr. Bushberg, renown expert on RF radiation with an incredible biography, told us in Sacramento, as I am sure the Council expected, that the 5G being deployed was safe and conformed to government standards. Actually, he provided zero studies addressing long term cellular level and DNA level damage from microwave exposure. *Eye on the ball*. In fact, there is some professional disagreement regarding Dr. Bushbergs defense of the IEEE (Institute of Electrical and Electronics Engineers) methods in setting its RF human exposure safety standards (Dr Polak statement, item R 6045-50). It is understood that both RF intensity and accumulation are factors, and that the latter, while occurring with X-Rays, is not thought significant with 5G; however, as described in the “Mechanism causing harm” statement above, it is now apparent that continuous 24 x 7 x 365 RF exposure, even at the so called FCC “safe limits”, has the same/similar harmful effect as accumulation.

The capabilities of 5G technology are impressive, but it is not clear that the FCC or other government standards will protect us from harm. It has been demonstrated, by the CATO Institute and by Harvard University, that these are captured agencies serving their own interests. The former chair of the FCC, Tom Wheeler, who was behind the big push for 5G technology, was also the former head of the Cellular Telecommunications Industry Association (CTIA).

A caring person cannot, in good conscience, ignore the references listed below. The number of PhD scientists from around the world who have studied 5G cellular level damage is extensive, their work is independent, duplicated, and not funded by a telecom stakeholder.

I would also remind everyone that this is not about “value propositions”, “capacity and speed”, “diversity of an economic base”, or “attracting high wage technology”. It’s not even about the inverse square law, or a 50 fold safety factor recommended. This is about previously unrecognized 5G dangers to human health at the cellular/DNA level: ALL humans, everywhere, in cars, in homes, in schools, and at work.

If you sign an Accommodation Agreement, installing any equipment near residences.. how will you choose which homes? Poor folks? Uneducated? Just asking.

Eye on the ball.

I request this become part of the public record.

Please find the time, where you will not be interrupted, to read each of these highlighted sites:

Global Research **31,291** signatories as of January 11, 2019; International Appeal: Stop 5G on Earth and in Space

$25 million dollar study Wireless Technology Causes Cancer and DNA Damage; Scientific Evidence Enough for Class 1 Human Carcinogen-Scientists Demand 5G Moratorium

Journal of Microscopy & Ultrastructure Effects of electromagnetic fields exposure on the antioxidant defense system.

Thank you for reading all of the links provided.

I request this become part of the public record.

- Ross Hildebrand

City Council Meeting
11/5/19
Supplemental I - 14.A.
From: Bill Benham

From: Bill Benham
Sent: Tuesday, November 5, 2019 3:30 AM
To: Steve Potter <spotter@cityofnapa.org>
Subject: Cell Towers

[EXTERNAL]
Steve,

My family and I have made Napa our home for nearly fifty years. We currently own three homes in Napa [redacted] I am opposed to allowing companies to put their cell towers in our residential neighborhoods. More testing must be completed to ensure our safety.

William F. Benham Jr.

Bill Benham CHST

City Council Meeting
11/5/19
Supplemental I - 14.A.
From: Alejandra Uribe

From: Alejandra Uribe
Sent: Tuesday, November 5, 2019 6:13:33 AM
To: Liz Alessio <lalessio@cityofnapa.org>
Subject: Proposed Cell tower at NVLA

[EXTERNAL]

I hope this email finds you well.

It came to my attention that Verizon is proposing to install a cell antenna near NVLA. I believe this was the case for other school sites, but now it is only the proposal for Vintage and NVLA. I urge you to stop this activity. As we all know, the closer the cell tower, the more harmful it is. The RF radiation from cell phone towers can damage the body causing many kinds of potential health problems such as headaches, memory loss, cardiovascular stress, birth defects and various types of cancer. Nor do I want this for my students, their families, NVLA staff, the neighborhood, or myself.

I urge you to advocate on behalf of our students, who are the future of our community and our country. We need to do what's right to protect and create a physical and emotional environment that is conducive to learning.

Our students and staff deserve the best environment.

Thank you for your time.

Alejandra Uribe, Principal
Napa Valley Language Academy

City Council Meeting
11/5/19
Supplemental I - 14.A.
From: Ross Hildebrand

From: Ross Hildebrand
Sent: Tuesday, November 5, 2019 8:09 AM
To: Jill Techel <jtechel@cityofnapa.org>; Doris Gentry <dgentry@cityofnapa.org>; Liz Alessio <lalessio@cityofnapa.org>; Mary Luros <mluros@cityofnapa.org>; Scott Sedgley <SSedgley@cityofnapa.org>; Steve Potter <spotter@cityofnapa.org>
Subject: Lin Marie deVincent

Warning:
The sender of this message could not be fully validated. The message may not be from the sender/domain displayed.

[EXTERNAL]

Please add to the public record:

>5G deployment is referred to as “small cell” technology for a reason. The higher frequency frequency requires antennas to be low and close, e.g. about every 500 - 600 feet apart, at the level of a 2 story home.

If you are being told the new deployment on lamp posts is OK because it’s really 4G, this is very suspicious because 4G antennas are typically high, and far apart. The topology is wrong and there may be some wool being pulled over someone’s eyes.

>Unless you do not consider your DNA, sperm and eggs, as part of the environment, you definitely <u>want</u> CEQA and NEPA to be appraised of the biological issues, and you <u>want</u> them to protect you.

Just because this slows down the deployment process, and just because it is a hot topic politically, does not make it any less true. The FCC should not require you to jeopardize health of Napa citizens.

Please add to the public record

-Ross Hildebrand

City Council Meeting
11/5/19
Supplemental I - 14.A.
From: Shelly Monte

From: Shelly Monte
Subject: Cell Towers Please Read To Council
Date: November 5, 2019 at 8:06:00 AM PST
Cc: Mary Luros <mluros@cityofnapa.org>

[EXTERNAL]

Dear Mary,
Rarely do I reach out on local issues. I feel our trust in government matters should fall into the hands of those we have elected.

Rather that email each council member on the topic of tower installation and it's well documented health threats; I ask you to share this email with the mayor and other council members. I understand a vote is scheduled for later today.

I urge you and all others voting on the topic of cell tower installation to weigh, with gravity, the burden of health degradation these towers will most likely cause Napa residents.

Technology is essential, we no longer live in the dark ages, but what benefit is it if it crumbles the very ground of life by its threats to our health.

I urge all of you to consider your vote toward the benefit of our quality of life through the responsibility to our health. I urge you to vote no on this issue or to table it until you acquire more information that will convince you of its dangers. I ask that we agree to "live" with what we currently have to operate with for now.

Please vote no.
Thank you Mary and all members of our council and to our mayor.

Sincerely,
Shelly Euser

City Council Meeting
11/5/19
Supplemental I - 14.A.
From: Charlotte Williams

From: Charlotte Williams
Sent: Tuesday, November 5, 2019 11:16 AM
To: Jill Techel <jtechel@cityofnapa.org>; Scott Sedgley <SSedgley@cityofnapa.org>; Doris Gentry <dgentry@cityofnapa.org>; Liz Alessio <lalessio@cityofnapa.org>; Mary Luros <mluros@cityofnapa.org>; Steve Potter <spotter@cityofnapa.org>
Cc: Napa Vision 2050
Subject: Comments on 5G

[EXTERNAL]

Dear Napa City Council,

Napa Vision 2050 submits the following comment on the proposed 32 small cell towers on your agenda for tonight's meeting:

We urge you to make use of the precautionary principle* and delay approval of these small cell towers until this city council can assure its constituents that small cell, specifically 5G, is safe technology for residents, their animals and area wildlife.

*https://www.newworldencyclopedia.org/entry/Precautionary_principleThe **precautionary principle** is the concept that establishes it is better to avoid or mitigate an action or policy that has the plausible potential, based on scientific analysis, to result in major or irreversible negative consequences to the environment or public even if the consequences of that activity are not conclusively known, with the burden of proof that it is not harmful falling on those proposing the action. It is a major principle of international environmental law and is extended to other areas and jurisdictions as well...

Sincerely,

--
Charlotte Helen Williams
president, Napa Vision 2050

City Council Meeting
11/5/19
Supplemental I - 14.A.
From: Kelly McGrath

From: Kelly McGrath
Sent: Tuesday, November 5, 2019 12:43 PM
To: Steve Potter <spotter@cityofnapa.org>
Subject: Small Cell Tower

[EXTERNAL]
Good afternoon Mr. Potter,

As residents of Napa we are reaching out to you in hopes you will give thoughtful consideration to be an opposition voice in the advancement of the 5G antennas under consideration to be installed in the City of Napa.

We strongly urge you to consider a stance barring 5G antennas from being installed in residential zones, park lands, and most importantly - school zones. If approved, myself and our two children will spend five days a week at sites that Verizon has indicated their 5G antennas to be installed. This is of great concern to all of us.

There are clearly many members of our Napa community who have been vocal and consistent in voicing concerns with this contract that warrants a pause and deeper look into what Napa is agreeing to. We greatly appreciate your attention to this matter.

Regards,
Jason & Kelly McGrath

City Council Meeting
11/5/19
Supplemental I - 14.A.
From: Noah Davidson

From: 5GAwarenessNow
Sent: Tuesday, November 5, 2019 1:14 PM
To: Jill Techel <jtechel@cityofnapa.org>; Doris Gentry <dgentry@cityofnapa.org>; Liz Alessio <lalessio@cityofnapa.org>; Mary Luros <mluros@cityofnapa.org>; Scott Sedgley <SSedgley@cityofnapa.org>; Steve Potter <spotter@cityofnapa.org>; Harry Lehmann; Lin Marie Devincent; Shellie Rice; Val Wolf; Amy Martenson>; katya miller
Cc: Darin Arcolino <DArcolino@cityofsacramento.org>; Maria MacGunigal <mmacgunigal@cityofsacramento.org>; Amy Williams <AWilliams@cityofsacramento.org>; Mindy Cuppy <MCuppy@cityofsacramento.org>; Howard Chan <HChan@cityofsacramento.org>; Dennis M. Rogers <dmrogers@cityofsacramento.org>; Mayor Steinberg <mayorsteinberg@cityofsacramento.org>; Angelique Ashby <AAshby@cityofsacramento.org>; Allen W. Warren <AWarren@cityofsacramento.org>; Rick Jennings <RJennings@cityofsacramento.org>; Jeff S. Harris <JSHarris@cityofsacramento.org>; Steve Hansen <SHansen@cityofsacramento.org>; Jay Schenirer <JSchenirer@cityofsacramento.org>; Lawrence R. Carr <LCarr@cityofsacramento.org>; clerk <clerk@cityofsacramento.org>; Eric Guerra <EGuerra@cityofsacramento.org>; dcovill; aogilvie; cc: Patti Lewkowitz; MG ; Eric Windheim; Roark Vane; Susana Alcala Wood; Lynette Scalora-Palacios; Hannah McMahon; pamela marquez; Aaron McMahon
Subject: 5G in Napa

[EXTERNAL]
[Please add this email and its attachments to the public record. Thank you.]

To the esteemed Mayor Jill Techel and the rest of Napa City Council,

Hello, my name is Noah Davidson. I am reaching out to you regarding tonight's meeting in which you will be voting on a contract with Verizon to begin implementation of the 5G antenna network in Napa.

I live in Sacramento California where 5G is currently being rolled out. I can tell you first hand that 5G represents a direct assault on the health, the property, and the rights of all people who are unfortunate enough to have one of these cell antennas installed near their home.

In late December, Verizon installed a "small" cell antenna just 45 from my sister's home. The antenna was installed at roughly the same height as our second story and because the antenna has a 360 degree radiation pattern, it is emitting directly into my young nieces' bedroom. About a month after installation, both of my nieces started experiencing cold/flu like symptoms as well as sleep disturbances, and occasional headaches. These problems persisted for two months straight, until we hired local expert Eric Windheim to help us with the situation. He measured the amount of RF radiation inside my nieces' bedroom and found exposure to be 4.6% of the FCC limit, the highest readings he has ever measured

indoors. He suggested we move the children into a back room and install shielding on the walls facing the antenna to block some of the radiation from coming into the home. A week after taking these steps, my nieces' symptoms went away and, for the most part, have not returned.

4.6% of the FCC limit may sound low, but it is actually extremely high compared to exposure from other wireless devices, and especially compared to previous generation antennas. Exposure in my nieces' room is so high because the antenna is so close to the bedroom, particularly on the vertical axis. These antennas emit out horizontally, and now that they are being installed lower to the ground, exposure from these new generation antennas is much higher than exposure from previous generation antennas typically installed 50-200 feet above ground level. You do not have to take my word on this; measurements presented by the City of Sacramento at the September 3rd City Council meeting show this very clearly. I have done an analysis of these measurements here: https://imgur.com/a/r8TRdJP

Since March, I have done everything in my power to get the antenna removed. The City of Sacramento, Verizon, the FCC, and my federal representatives have all been unwilling to help at all. They also have not provided any evidence that the radiation we are being subjected to is safe. I know it is not safe because we have already been harmed, but I figured they would be able to provide me with some evidence to support their claims that the antenna is harmless. No such evidence has been provided. The only assurance of safety we have been given is that the antenna is compliant with FCC guidelines. The FCC guidelines are extremely outdated and only consider the thermal effects of non-ionizing radiation. The FCC guidelines are not a guarantor of safety, they are a guarantor that we will not be cooked. This is explained best in a 2002 letter from the U.S. Environmental Protection Agency which states "the generalization by many that the [FCC] guidelines protect human beings from harm by any or all mechanisms is not justified." https://ehtrust.org/wp-content/uploads/4c0f61dc30c3d6bb27d90f53a57c616e.pdf

I have organized a group of concerned Sacramento residents who are demanding that the city amend its cell antenna ordinance to keep these antennas away from residential dwellings. Unfortunately, Sacramento has largely ignored our communications and refused to answer basic questions regarding the 5G roll-out that they are subjecting us to against our will. I have had some degree of involvement with other cities, and I can say that all of these other cities have handled the situation much better than the City of Sacramento, who has essentially sold out their constituents and given free rein to the wireless industry to deploy their 5G network with practically zero restrictions and with practically zero public outreach. Most Sacramento residents still have no idea that a cell antenna has been installed or will be installed just feet from their home. It is truly shameful.

I should also add that these antennas have brought no measureable benefit to the public. Roughly 600 antennas have been installed since the 5G roll-out began in October of 2018, covering roughly only 10%-20% of Sacramento residents with 5G service. https://www.lightreading.com/mobile/5g/analyst-maps-verizon-5g-in-sacramento-finds-pretty-sparse-coverage/d/d-id/749216 Thousands more antennas will need to be installed to reach 100% coverage, especially when you consider other carriers will want to install their own antenna networks. The antennas have not unlocked any amazing new technological advancements. The technology that will utilize these antenna networks, i.e., self-driving cars and IOT, are many years away from being widely available or adopted. I do not even know a single person who has 5G phone or internet service. We are being bombarded with unprecedented levels of microwave radiation inside our homes, against our will, for no benefit to anyone except the wireless industry who gets to build their data collecting (for which no party ever obtained consent from the public) antenna network on the cheap and the City of Sacramento who received millions of dollars of "investment" from Verizon and AT&T. https://5gawarenessnow.com/verizon-sacramento-master-licencing-agreement/ The secretive public-private partnership between the wireless industry and the City of Sacramento is a transparent abuse of the health and the rights of all Sacramento residents in favor of corporate profits shared with the City of Sacramento and it is an unacceptable way to govern any locality.

I have watched some of the October 15th Napa City Council meeting and have read this recent article in the Napa Valley Register. https://napavalleyregister.com/news/local/napa-council-to-weigh-verizon-deal-on-small-cell-transmitters/article_889ba219-ff54-5c79-8e9d-e88d947e7abf.html#tracking-source=home-top-story-2 This information leads me to believe that the Napa City Council is under the impression that local governments have no ability to regulate "based on health effects." YOU DO NOT NEED TO REGULATE ON THE BASIS OF HEALTH EFFECTS! Any policy you implement that keeps the antennas away from homes or reduces the number of antennas installed, has the effect of reducing microwave radiation exposure and therefore minimizing the negative health effects of that exposure, regardless of the basis of said regulation. Napa has already negotiated the number of antennas to be installed lower than what Verizon was requesting. That means you have already reduced exposure and reduced negative health consequences. The basis of these regulations is completely irrelevant to the effect; it is only relevant to the wireless industry who will be quick to come after you if you state that the regulations you wish to implement are designed specifically to avoid negative health consequences.

The simplest solution to this problem is to amend your cell antenna ordinance to include a setback from any residential dwelling. In Sacramento we are requesting 1,000 feet. Other cities have implemented smaller distances. This is highly defensible as an aesthetic

regulation; you do not want to destroy the unique character of Napa neighborhoods with dozens of ugly cell antennas. https://imgur.com/l49g3uR Other California cities, including our neighboring city of Elk Grove, have recently implemented policy that effectively keeps these new antennas away from homes and other "vulnerable" areas. I have attached an overview of some of these cities ordinances that keep antennas away from homes. I highly suggest you review this document and if you have not done so already, reach out to these cities and ask for guidance in amending Napa's cell antenna ordinance to be more protective. Without a protective ordinance the wireless industry can run roughshod over you.

You are the last and only line of defense between the wireless industry and your constituents. You have a sworn duty to protect the City of Napa from the health problems, the property devaluation, and the trampling of our basic human rights that are all caused by these cell antennas. Failing to do so is failing to uphold your sworn duties and oaths to the U.S. and California constitutions. I recommend the Council vote to delay this agreement with Verizon to a later date and in the meantime adopt an urgency ordinance that imposes a residential setback. It is the most simple, protective, and legally defensible option you have at your disposal. Thank you.

Noah Davidson

[10/14/2019]

Dear City Council and Staff,

The purpose of this correspondence is to provide the City of Sacramento with examples of actions taken by other cities that focus on keeping cell antennas away from homes, and when possible, the stated purpose for doing so. We recommend that the City of Sacramento keep cell antennas away from homes. The examples are from the cities of Petaluma, Mill Valley, Calabasas, Sonoma and Elk Grove.

These actions are strictly protected by federal law 47 U.S. Code § 332 (c)(7)(A), Preservation of local zoning authority, and in the case of California cities, by the California Supreme Court decision TMobile West v City and County of San Francisco, S238001, April 4, 2019, which expressly upholds a city's *"**inherent local police power includes broad authority to determine, for purposes of the public health, safety, and welfare, the appropriate uses of land within a local jurisdiction's borders**."* https://law.justia.com/cases/california/supreme-court/2019/s238001.html

Please also note that ANY action taken by the city that has the effect of limiting the number of antennas installed or increasing the mandated distance from one antenna to another or the distance from an antenna to a home necessarily reduces exposure from the antennas, whether or not "environmental effects" form the basis of said action.

Keeping cell antennas away from homes is highly defensible as a purely aesthetic argument. No one should have to look outside their window and see an imposing cell antenna staring back at them. https://imgur.com/a/r8fA4e0 Keeping cell antennas away from homes is even more defensible when you consider that the above referenced California Supreme Court decision defined aesthetic considerations to include "*negative health consequences*" and "*safety concerns*." "*For example, lines or equipment might generate noise, cause negative health consequences, or create safety concerns. All these impacts could disturb public road use, or disturb its quiet enjoyment.*" (TMobile West v San Francisco, p. 9) The antenna outside my Sister's home has caused negative health consequences, including headaches, difficulty sleeping and the anxiety caused by our extremely high exposure. Additionally, the antennas are without a doubt causing health and safety concerns for **many** Sacramento residents, as clearly evidenced by the residents that have spoken out against these antennas.

Please note that requiring a minimum distance of 500, or even 1,500 feet, from any residence DOES NOT "prohibit or have the effect of prohibiting the provision of personal wireless services." This is most clearly evidenced by statements from Verizon's own CEO as well as Verizon's own product demonstrations that clearly show their 5G antennas, which have the shortest range, work very well (provide near 1GB download speeds, near max) at ranges of

2000-3000 feet. http://www.keepcellantennasawayfromourelkgrovehomes.org/range-of-a-5g-cell-antenna/

CNBC Interviewer:

> "Can you get through trees? Can you get through leaves? Can you actually get somewhere were you don't need cell sites every, you know 25 feet from my house?"

Verizon CEO Lowell McAdam:

> "Yeah well those were some of what I call the myths of millimeter wave . . . ."
>
> "When we went out in these 11 markets, we tested for well over a year so we could see every part of foliage, every storm that went through. We have now busted the myth that it has to be line-of-sight. It does not. We busted the myth that foliage will shut it down. I mean that was back in the days when a pine needle would stop it. That does not happen.
>
> And the 200 feet from a home? We're now designing the network for over 2,000 feet from transmitter to receiver, which has a huge impact on our capital need going forward. So those myths have disappeared."

4G antennas have an even greater range, well over a mile.

The City of Sacramento should also note that none of these ordinances have been challenged in court, further evidence that the city does indeed have the authority to regulate the use of the public rights of way in the manner that these cities have.

City of Petaluma, CA. Ordinance No. 2662 N. C.S.
http://www.keepcellantennasawayfromourelkgrovehomes.org/wp-content/uploads/2018/10/Petaluma-Ordinance-2662-N.C.S.-09_10_2018.pdf

This ordinance is very short and very simple. The city recognized that residential areas are no place for cell antennas and passed regulations to keep them at least 500 feet away from homes.

14.44.095 Small Cell facilities - Basic Requirements

Small Cell facilities as defined in Section 14.44.020 of this chapter may be installed, erected, maintained and/ or operated in any commercial or industrial zoning district where such antennas are permitted under this title, upon the issuance of a minor conditional use permit, so long as all the following conditions are met:

A. The Small Cell antenna must connect to an already existing utility pole that can support its

weight.

B. All new wires needed to service the Small Cell must be installed within the width of the existing

utility pole so as to not exceed the diameter and height of the existing utility pole.

C. All ground - mounted equipment not installed inside the pole must be undergrounded, flush to

the ground, within three (3) feet of the utility pole.

D. Each Small Cell must be at least 1, 500 feet away from the nearest Small Cell facility.

E. Aside from the transmitter/ antenna itself, no additional equipment may be visible.

F. Each Small Cell must beat least 500 feet away from any existing or approved residence. (pg. 5-6)

Stated purpose of actions:

WHEREAS, in order to protect the general welfare of citizens of Petaluma, the City Council intends to update the PMC and IZO to limit the siting of small cell facilities within the scope of existing laws; and
WHEREAS, Section 25.010 of the City' s IZO provides in pertinent part that no amendment that regulates matters listed in Government Code Section 65850, which matters include the use of buildings and structures, shall be made to the IZO unless the Planning Commission and City Council find the amendment to be in conformity with the City' s General Plan and consistent with the public necessity, convenience and general welfare in accordance with Section 25. 050(8) of the IZO; and… (pg. 2)

2. In accordance with Section 25. 050(B) of IZO, the proposed amendments are consistent with the public necessity, convenience and welfare in that they:

a. Ensure Petaluma' s land use and zoning regulations provide safe and appropriate locations where installation of Small Cell Facilities is appropriate;
b. Comply with 47 U. S. C. Section 332(C) (7) and California Public Utilities Code sections 7901 and 7901.1 which permit local regulation of telecommunication facilities;
c. Provide for buffers to prevent Small Cell Facilities from having negative visual impacts on residential land uses. (pg. 2-3)

City of Mill Valley, CA. Ordinance No. 1304
http://www.keepcellantennasawayfromourelkgrovehomes.org/wp-content/uploads/2019/07/Mill-Valley-Signed-Ord_1304.pdf

The Mill Valley ordinance is a bit more complex and imposes two regulatory actions that we suggest be employed by the city of Sacramento. Like the City of Petaluma, Mill Valley recognized that cell antennas do not belong near homes and outright restricts placement of cell antennas in residentially zoned areas. For areas where cell antennas are allowed, Mill Valley created an ordered list of preferred locations and configurations.

20.73.040 Wireless Telecommunications Facility Permit Required (pg. 11)

A. Permit required. No wireless telecommunications facility shall be located or modified within the City on any property, including the public right-of-way, without the issuance of a permit as required by this chapter as set forth in the table below. Such permit shall be in addition to any other permit required pursuant to the Mill Valley Municipal Code.

Description Wireless Facility	***Private Property***		***Public Right-of Way[3]***
	RS, RSP, DR, MFR Zoning Districts	***All Other Zoning Districts***	***Non-Residential Zoning Districts***
Roof-mounted facility, building-mounted facility, or facility mounted on an existing pole	Not Permitted	Conditional Use Permit/ Design Review	Conditional Use Permit/ Design Review
Facility mounted on a replacement pole or new telecommunications tower	Not Permitted	Conditional Use Permit/ Design Review	Conditional Use Permit/ Design Review
New wireless telecommunications collocation facility	Not Permitted	Conditional Use Permit/ Design Review	Conditional Use Permit/ Design Review
Eligible facilities request [1] or application pursuant to California Government Code Section 65850.6 [2]	Permitted	Permitted	Permitted

[1] See requirements of section 20.73.140.
[2] See requirements of section 20.73.150.
[3] For any public right of way not within a zoning district, the location of a wireless telecommunication facility shall be determined based upon the closest district adjacent to the facility's location.

* *you can clearly see that the City of Mill Valley is NOT permitting antennas in residential zones in the Public Right-of Way.*

20.73.060 Location and Configuration Preferences (pg. 13-14)

A. Purpose. The purpose of this section is to provide guidelines to applicants and the reviewing authority regarding the preferred locations and configurations for wireless telecommunication facilities in the City, provided that nothing in this section shall be construed to permit a wireless telecommunication facility in any location or configuration that it is otherwise prohibited by this chapter.

B. Review of Location and Configuration. The reviewing authority shall consider the extent to which a proposed wireless telecommunication facility complies with these preferences and whether there are feasible alternative locations or configurations to the proposed facility that are more preferred under this section. If the location or configuration of a proposed facility qualifies for two or more categories of preferred locations or configurations, it shall be deemed to belong to the least preferred category.

C. Order of Preference - Configurations. The order of preference for the configuration for wireless telecommunication facilities from most preferred to least preferred is:

1. Collocation with existing facilities,
2. Roof-mounted,
3. Building-mounted,
4. Mounted on an existing pole or utility pole
5. Mounted on a new pole or utility pole that will replace an existing pole or utility pole,
6. Mounted on a new telecommunication tower.

D. Order of Preference - Location. The order of preference for the location of wireless telecommunications facilities from most preferred to least preferred is:

1. In the C-G zoning district,
2. In the C-N zoning district,
3. In the C-L zoning district,
4. In the C-D zoning district,
5. In the public right-of-way with the closest adjacent district being the C-G district,
6. In the public right-of-way with the closest adjacent district being the C-N district,
7. In the public right-of-way with the closest adjacent district being the C-L district,

8. In the public right-of-way with the closest adjacent district being the C-D district,

9. Any public right-of-way location that abuts the property line of a structure recognized as a local, state or national historic landmark, historic district or on the register of historic places,

Stated purpose of actions:

(3) **Installation of small cell and other wireless telecommunications facilities within the public right-of-way can pose a threat to the public health, safety and welfare,** including disturbance to the right-of-way through the installation and maintenance of wireless facilities; traffic and pedestrian safety hazards due to the unsafe location of wireless facilities; impacts to trees where proximity conflicts may require unnecessary trimming of branches or require removal of roots due to related undergrounding of equipment or connection lines; land use conflicts and incompatibilities including excessive height or poles and towers; creation of visual and aesthetic blights and potential safety concerns arising from excessive size, heights, noise or lack of camouflaging of wireless facilities including the associated pedestals, meters, equipment and power generators; and the creation of unnecessary visual and aesthetic blight by failing to utilize alternative technologies or capitalizing on collocation opportunities which may negatively impact the unique quality and character of the City. (pg. 1)

City of Calabasas, CA. Ordinance No. 2012-295
https://library.municode.com/ca/city_of_calabasas/codes/code_of_ordinances?nodeId=TIT17LAUSDE_ARTIIZODIALLAUS_CH17.12STSPLAUS_17.12.050ANPEWITEFA

The ordinance passed by the City of Calabasas is another ordinance that creates a minimum setback (1,000 feet) between cell antennas and homes, as well as parks and schools. The ordinance also sets an ordered list of preferred locations and configurations, similar to Mill Valley.

17.12.050 – Antennas/Personal Wireless Telecommunication Facilities.

(C) 3. Preferred Zones and Locations. When doing so would not conflict with one of the standards set forth in this subsection (C) or with federal law, personal wireless telecommunication facilities shall be located in the most appropriate location as described in this subsection (3), which range from the most appropriate to the least appropriate. Nothing in this section shall detract from the requirements of section 17.12.050(C)(4)(a) below.

i. collocation on an existing facility in a commercial zone;

ii. collocation on an existing structure or utility pole in a commercial zone;

iii. location on a new structure in a commercial zone;

iv. collocation on an existing facility in a public facility or recreation zone;

v. location on an existing structure or utility pole in a public facility or recreation zone;

vi. location on a new structure in a public facility or recreation zone;

No new facility may be placed in a less appropriate area unless the applicant demonstrates to the satisfaction of the commission that no more appropriate location can feasibly serve the area the facility is intended to serve provided, however, that the commission may authorize a facility to be established in a less appropriate location if doing so is necessary to prevent substantial aesthetic impacts.

(C) 4. Design and Development Standards. Personal wireless telecommunication facilities shall be designed and maintained as follows:

a. **All new personal wireless telecommunication facilities shall be set back at least 1,000 feet from schools, dwelling units and parks,** as measured from the closest point of the personal wireless telecommunication facility (including accessory equipment) to the applicable property line, unless an applicant establishes that a lesser setback is necessary to close a significant gap in the applicant's personal communication service, and the proposed personal wireless telecommunication facility is the least intrusive means to do so. An applicant who seeks to increase the height of an existing personal wireless telecommunication facility, or of its antennas, located less than 1,000 feet Ordinance No. 2012-295 4 from a school, dwelling unit or park must establish that such increase is necessary to close a significant gap in the applicant's personal communication service, and the proposed increase is the least intrusive means to do so.

Stated purpose of actions:

A. Purpose and Intent. The purpose of this section is to regulate the installation, operation and maintenance of personal wireless telecommunication facilities in the city. **The city recognizes that the unrestricted installation of redundant personal wireless telecommunication facilities is contrary to the city's efforts to stabilize economic and social aspects of neighborhood environments, and to promote safety and aesthetic considerations, family environments and a basic residential character within the city.**

In enacting this section, the city intends to:

1. Promote and protect the health, safety, comfort, convenience and general welfare of residents and business in accord with section 17.01.020 of this title;

2. Protect the benefits derived by the city, its residents and the general public from access to personal wireless services while minimizing, to the greatest extent feasible, the redundancy of personal wireless telecommunication facilities in the city;

3. Balance these goals, by permitting the installation and operation of personal wireless telecommunication facilities where they are needed, while reducing, to the greatest extent feasible, adverse economic, safety and / or aesthetic impacts on nearby properties and the community as a whole; and

4. Comply with applicable law, including the 1996 Telecommunications Act.

5. In enacting this ordinance, it is the intent of the City Council that no additional rights or entitlements be conferred to construct or maintain personal wireless telecommunication facilities, other than those rights or entitlements existing under applicable state or Federal law.

City of Sonoma, CA. Ordinance 07-2018
https://sonomacity.civicweb.net/filepro/documents/12036?preview=23609

Sonoma is another city that restricted placement of cell antennas in residential districts and required a minimum setback of 1500 feet between antennas. Additionally, the rather lengthy ordinance places a large number of requirements for applicants.

5.30.040 Wireless Telecommunications Facility Permit Required

A. Use Permit required. A use permit shall be required to locate or modify any wireless telecommunications facility in any zone within the City, including the public right-of-way, subject to the following exceptions: 1) **no wireless telecommunications facility shall be permitted within a residential district**, or the Plaza Retail Overlay Zone (SMC Section 19.10.030(C)(4)); (pg. 13)

5.30.080 Additional Design and Development Standards for Facilities in the Public Right- of-Way

(F) 3. Each pole mounted wireless telecommunications facility must be separated by at least 1,500 feet. (pg. 24)

5.30.055 Notice of hearing

Notwithstanding the notice of hearing provisions in Section 19.88.020, notice of a public hearing before the Planning Commission or an appeal of a Planning Commission determination before the City Council of a use permit shall be published at least once in a newspaper of general circulation in the City and mailed or delivered in accordance with Section 19.88.020 no less than ten (10) days prior to the date of the hearing. (pg. 18)

5.30.220 Removal and Restoration, Permit Expiration, Revocation or Abandonment

C. Summary removal. In the event the planning director determines that the condition or placement of a wireless telecommunications facility located in the public right-of-way

constitutes a dangerous condition, obstruction of the public right-of-way, or an imminent threat to public safety, or determines other exigent circumstances require immediate corrective action (collectively, "exigent circumstances"), the planning director may cause the facility to be removed summarily and immediately without advance notice or a hearing. (pg.43)

Stated purpose of actions:

WHEREAS, This Ordinance is adopted as an urgency ordinance pursuant to Government Code Section 36937(b). The facts constituting the urgency are as follows:

(1) The purpose of this Ordinance is to amend the City's Municipal Code to provide uniform and comprehensive standards, regulations and permit requirements for the installation of wireless telecommunications facilities in the City's public right-of-way, in light of the Declaratory Ruling and Third Report and Order in "In the Matter of Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment" adopted September 26, 2018 by the Federal Communications Commission ("Order") setting new limitations on local standards for, and accelerating the processing of, the siting of small cell wireless telecommunications facilities1 by local jurisdictions over such applications.

(8) **Small cell wireless facilities are primarily installed within public rights-of-way and as such create significant and far-reaching local concerns in traffic and pedestrian safety, aesthetics, protection and preservation of public property, and the health, safety and welfare of the general public.**

(9) Installation of small cell and other wireless telecommunications facilities within the public right-of-way can pose a threat to the public health, safety and welfare, including disturbance to the right-of-way through the installation and maintenance of wireless facilities; traffic and pedestrian safety hazards due to the unsafe location of wireless facilities; impacts to trees where proximity conflicts may require unnecessary trimming of branches or require removal of roots due to related undergrounding of equipment or connection lines; land use conflicts and incompatibilities including excessive height or poles and towers; creation of visual and aesthetic blights and potential safety concerns arising from excessive size, heights, noise or lack of camouflaging of wireless facilities including the associated pedestals, meters, equipment and power generators; and the creation of unnecessary visual and aesthetic blight by failing to utilize alternative technologies or capitalizing on collocation opportunities which may negatively impact the unique quality and character of the City. (pg. 1-2)

Elk Grove, CA. Ordinance No. 19-2019
http://www.elkgrovecity.org/UserFiles/Servers/Server_109585/File/City%20Government/City%20Council/Ordinances/2019/09-11-19_8.5_19-2019.pdf

The Elk Grove ordinance is fairly unique in its approach to restrict placement of cell antennas near homes. The City opted to disallow placement of cell antennas immediately adjacent to, or across the street from residential front yards. This is good news for most Elk Grove residents, as the antennas will only be installed at the ends of streets, or behind homes that are at the end of a lot.

Cell antennas are allowed adjacent to a side yard of a "residential dwelling" (staff report, page 80) and presumably a back yard.

http://www.elkgrovecity.org/UserFiles/Servers/Server_109585/File/cityclerk/citycouncil/2019/attachments/08-28-19_9.3.pdf

However, it is very unfair to anyone living in those small percentage of homes where cell antenna construction will be allowed.

A cell antenna may also be permitted immediately adjacent to a side yard or back yard of an apartment building, which could be half of the apartments in the building or more depending on its orientation toward the street. Also the ordinance does not prohibit locating a cell antenna close to offices, restaurants, any type of retail store or in an industrial zone. There can be a cell antenna any distance from such places, which would expose people working or shopping there to constant electromagnetic radiation (EMR).

Another problem with this ordinance is that there is a potential loophole in 23.94.050A.6., which qualifies sections A.6.a. and A.6.b. To avoid this loophole it is our group's opinion that the last nine words "as to a particular small cell wireless communication facility" should have been left off. That phrase is unnecessary, unclear, it fails to align the ordinance with FCC Order 18-133 (the apparent purpose), and it appears to apply to every proposed cell antenna location.

23.94.050 Development standards

> 6. In a residential zoning district, the following development standards shall apply, unless the applicant can demonstrate with substantial evidence satisfactory to the approving authority that such siting limitation will materially inhibit personal wireless service as to a particular small cell wireless communication facility.
>
> > a. No small cell wireless communication facility shall be placed within five hundred (500' O") feet of another small cell wireless communications facility.
> >
> > **b. No small cell wireless communication facility shall be located immediately adjacent to, nor immediately across the street from, a front yard of any residential dwelling.** (pg. 13)

Stated purpose of actions:

23.94.010 Purpose and intent.

The purpose of this chapter is to regulate the installation of antennas and other wireless communications facilities consistent with Federal law. The City acknowledges the community benefit associated with the provision of wireless communication service and potential public benefit from leasing of publicly owned properties. It is also recognized that unrestricted installations are contrary to the City's efforts to promote safety and aesthetic considerations. It is not the intent of this section to unreasonably limit the reception or transmission of signals or to add excessive permit costs. Rather, it is the intent of this chapter to permit antennas and wireless communications facilities where they can be installed without creating adverse safety and aesthetic impacts on abutting and nearby properties and the overall community. [Ord. 8-2011 §39(A), eff. 6-24-2011] (pg. 9)

City Council Meeting
11/5/19
Supplemental I - 14.A.
From: Sandra Booth

From: Sandra Booth
Sent: Tuesday, November 5, 2019 2:18 PM
To: Jill Techel <jtechel@cityofnapa.org>; Mary Luros <mluros@cityofnapa.org>; Liz Alessio <lalessio@cityofnapa.org>; Doris Gentry <dgentry@cityofnapa.org>; Scott Sedgely <ssedgely@cityofnapa.org>; Steve Potter <spotter@cityofnapa.org>
Subject: Small Cell Antennas

[EXTERNAL]

Please include this email as part of the Public Record with regards to the placement of Small Cell Antennas in the City of Napa and for consideration by our Decision Makers:

Dear Mayor, Council Members and City Manager,

Remember when you were told it was perfectly safe to use glyphosate? Well, you are now faced with another decision to weigh that could have potentially harmful affects on the residents and visitors to the City of Napa. In researching, I found ionizing waves from Small Cell Antennas have the potential of altering DNA and causing such health affects as cancer. The FCC says the strict health & safety guidelines make it safe, although there have not been enough studies done and there is controversy about how close these boxes should be place next to our settled populations, which also include our children, our older population and individuals who may already have health issues.

Cell reception is pretty good throughout Napa. There is no great urgency to get embroiled in spreading Small Cell Antenna technology in the City of Napa, but all the good reason to wait, see how other cities are doing who have installed this equipment and wait for more studies to prove or disprove these antennas are not a health hazard. I remember reading a year ago or so an article that said the current technology will be greatly improved in the next few years, making the boxes you are thinking of installing today obsolete in a very short time.

Respectfully,

Sandra Booth
Napa Resident

From: Lin Marie deVincent
Sent: Tuesday, November 5, 2019 2:25 PM
To: Julie Lucido <jlucido@cityofnapa.org>; Steve Potter <spotter@cityofnapa.org>
Subject: IMPORTANT NOTES FOR revised AGREEMENT

[EXTERNAL]

Hi Steve & Julie,
Below is a message from someone working on these "Agreements" in other cities as well. I sent her Napa's and she responded w/ these two specific suggestions. Perhaps you can review and either submit to the city attorney or however it will work tonight for other modifications. They sound good to me!
Lin Marie

From: catherine dodd
Sent: Tuesday, November 5, 2019 12:14 PM

Lin Marie deVincent
I want to point out two places that should be strengthened.[In the revised Accommodation Agreement]

- **Under 6 RF reports** it would be prudent to require compliance bond of $500,000 per facility to be paid to Napa City if RF emissions exceed FCC limits and ADD that if the limits are exceeded more than 3 times in one year, the license will be revoked and the facility must be removed.
  This is legal and Verizon should not contest it if in fact they believe their RF emissions meet the FCC requirements.

- **Under 12b Entire Agreement** this section MUST include that if a Federal Court rules that the FCC "order" are beyond the scope of their authority, the agreement is null and void and all "facilities" approved under it must be resubmitted for consideration of approval.

- In addition the agreement is not **forever** - it should be reviewed and reconsidered at least every 2-5 years lest you end up giving away the public right of way despite other legal changes (such as adding the environment and health to the Telecom Act of 1996).

- Lastly, in the Memo from Julie Lucido, on page 4 it refers to "Guidelines" - have you seen them, **was their public input into their approval? [No]** This is where Verizon literally wrote the guidelines in San Francisco - allowing 4 "facilities" and their ancillary equipment per pole and allowing "facilities" to be 6 feet from residential windows. It is essential that the Guidelines be reviewed by the public and approved by council members.

- This memo also discusses "financial impact" - $100 per pole is a give away. The FCC allows the municipality to charge what ever the City has spent in the process of approving the installation, and *random* independent monitoring of each "facility'.

I hope this is helpful.

Catherine Dodd RN, PhD, FAAN
Board Chair, National Committee to Protect Social Security and Medicare
Senior Advisor FACTS Families Advocating for Chemical and Toxic Safety
Board member, Commonweal
Principal, Healing the Health System
www.linkedin.com/in/catherinedoddphd

City Council Meeting
11/5/19
Supplemental I - 14.A.
From: Ernest Schlobohm

CITY OF NAPA
CITY CLERK

2019 NOV -5 PM 4:46

Napa County Landmarks
1754 2nd Street, Suite E
Napa, CA 94559

November 5, 2019

City of Napa, City Council
1600 First St
Napa, CA 94559

RE: 5G Network

Napa County Landmarks (NCL) is a non profit organization that advocates for the appreciation and preservation of historic buildings, sites and districts through educational programs, public policy, research and technical assistance.

NCL takes no position on any perceived or potential health 5G effects which is a continuing debate by multiple experts and is a concern which NCL acknowledges; but is a topic which we refrain from as it beyond the purvey of our expertise.

However, we offer our comment on the design and placement of the "small cell" sites. This issue reaches far beyond the effect on a local historic district and applies to the preservation of visual quality of all neighborhoods in Napa.

We are aware that the FTC is not allowing a stoppage for implementing a 5G network; and they are allowing municipalities a stringent path for passing regulations for their cities.

The actions of other California cities which dealt with this dilemma such as Sacramento, Huntington Beach, Seaside, San Diego, and more; should be studied.

We recommend the City Council support wireless antenna regulations which would include special protections, including the aesthetics factor, and consider the visual blight that the network providers will cause without strict design guidelines.

Ernest Schlobohm
President of Napa County Landmarks, Inc

From: Paul McGavin
Sent: Tuesday, November 5, 2019 4:42 PM
To: Caitlin Saldanha <CSaldanha@cityofnapa.org>; City Clerk <"clerk@"@cityofnapa.org>
Cc: Lin Marie Devincent ; Harry Lehmann; Shellie Rice; Val Wolf; Amy Martenson
Subject: 2019-1103-Proposed-Verizon-CPMRAs-in Napa.pdf -> Proof of No Significant Gap in Verizon Wireless Voice Transmissions (First of Two identical emails)

November 5, 2019

To: Caitlin Saldanha <csaldanha@cityofnapa.org>
City Clerk <clerk@@cityofnapa.org>

Re: 2019-1103-Proposed-Verizon-CPMRAs-in Napa.pdf -> Proof of No Significant Gap in Verizon Wireless Voice Transmissions

Will you please print this email and the slides attached for the 6:30 Napa City Council meeting this evening, 11/5/19, and put these materials in the Public Record for the 11/5/19 Napa/Verizon Accommodation Agreement?

Thank you for doing so.

I am sending two identical emails to you.

This one without the attachment so it goes through the email system quickly. The second one will have the attachment.

You can then download the file: a 7MB Powerpoint file called: **2019-1103-Proposed-Verizon-CPMRAs-in Napa.pdf** from the folder named **Napa** in my public OneDrive folder**:**

https://1drv.ms/u/s!AiN9Z5GnSKJRgvs1ZlX-gPh9EH-tgA?e=rgRBHJ

From http://mystreetmychoice.com/napa.html

- The 11/5/19 Accommodation Agreement between Verizon Wireless and the City of Napa (linked to from the agenda, above), the Napa City Staff addressed some,

BUT CERAINLY NOT ENOUGH of the many downsides the 10/15/19 Accommodation Agreement.

- In the matter of 11/5/19 Napa/Verizon Accommodation Agreement, the people of Napa, including the **over 550 people** who signed this petition have evidence that our voices are not being heard. We are watching our elected representatives get bullied by some **very bad actors** — evidence of which is already in the Public Record — into making an **unwise decision**. Bullied by those who stand to profit handsomely from a decision that **many in Napa strongly oppose**. On Nov 5, 2019, we implore our elected representative to consider the following evidence — **substantial written evidence in the City of Napa's written public record** — evidence that is relevant to the Napa City Council's 11/5/19 deliberations:

    1. **The Oath** that each City Council member took to uphold the California Constitution before they started serving in their respective positions: "All people are by nature free and independent and have **inalienable rights**. Among these are enjoying and defending life and liberty, acquiring, possessing, and protecting property, and pursuing and obtaining **safety**, happiness, and **privacy**." Installing CPMRAs in front of residences will **not preserve** Napans' quiet enjoyment of their streets, their safety or their privacy.

    2. **On Aug 9, 2019**, the DC Circuit Court of Appeals ruled in Case 18-1129: the ruling means that The FCC/Wireless Industy **must** now complete a NEPA Environmental Assessment (EA) and/or Environmental Impact Statement (EIS) **BEFORE** any CPMRA application can be considered complete. **All CPMRA shotclocks must now be tolled and all CPMRA installations must IMMEDIATELY STOP**.

    3. **On Oct 1, 2019**, the DC Circuit Court of Appeals ruled in Case 18-1051: the ruling means the FCC willingly pulled their own teeth and no longer regulates the Internet (web pages, video/music streaming, online gaming and other information services). Therefore, Big Wireless has **NO PREMPTION** to install or operate personal wireless facilities that emit wireless "information services" transmissions in any municipality in the USA,

including Napa. This also means that the Wireless Industry **only has preemption to** place, construct and modify personal wireless facilities for wirelessly transmitting "telecommunications services" (i.e. voice transmissions). Verizon's proven **lack of a significant gap in voice transmission coverage** in Napa is a very important factor in the Council's 11/5/19 decision: **whether or not** to sign an **unnecessary** Accommodation Agreement for these **unnecessary** CPMRA installations — because Napans **can currently make calls on Verizon Wireless everywhere** that Verizon is proposing to install a CPMRA. The videos on this page are proof; screen grabs from the video have been placed in the City of Napa written public record.

4. **On Nov 3, 2019**, Napa residents created a Powerpoint deck with screen grabs from and links back to this video, which is embedded below, that **proves there is NO SIGNIFICANT GAP IN VERIZON COVERAGE FOR WIRELESS VOICE TRANSMISSIONS** at every one of the 54 locations proposed by Verizon Wireless. Please do not believe any "spin" from Verizon — or your city attorney, for that matter — that the FCC has any jurisdiction to sweep aside a 2005 Ninth Circuit ruling (T-Mobile v. San Francisco) by fiat with the stroke of their captured and conflicted pen. It is very likely that the September 2018 FCC Order 18-133 will be vacated by the Ninth Circuit. We have placed this evidence in the Napa Public Record; the City of Napa should not ignore any of the substantial written evidence in the Public Record that we are citing.

Thank you.

--
Regards,

Paul McGavin
My Street, My Choice

Substantial Evidence:

No Significant Gap in Verizon Wireless Telecommunications coverage re: proposed **CPMRAs**

FOR **NOV 5, 2019** NAPA CITY COUNCIL MEETING

CPMRA = CLOSE PROXIMITY MW RADIATION ANTENNAS

No Significant Gap proven
at 54 Locations in Napa, CA.

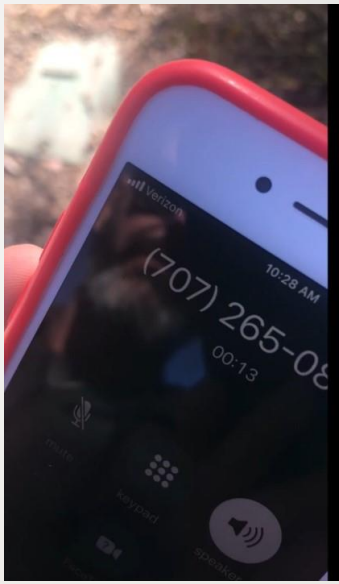
Analysis completed on 11/3/2019
by Napa residents.

FOR **NOV 5, 2019** NAPA CITY COUNCIL MEETING

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 001 - Pending: 3421 Linda Vista Ave., City Steel Light Pole in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=796

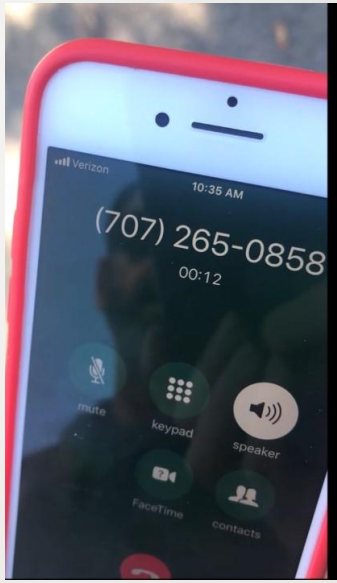


Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 002 - Pending: 3898 Oxford St., City Steel Light Pole in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=857

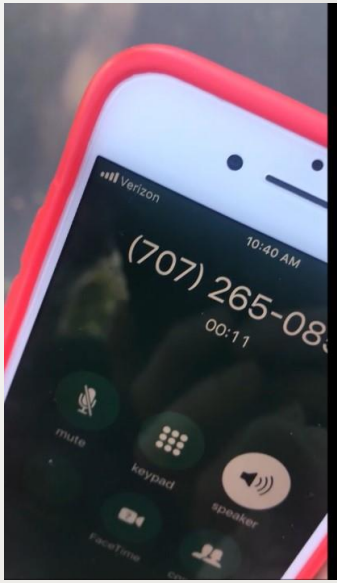


Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 003 - Delayed: 3563 Oxford St., PG&E Pole Top in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=911

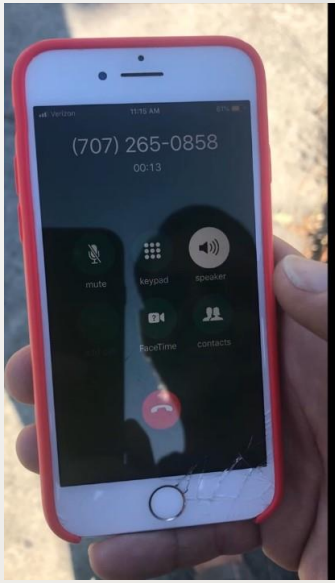


Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 004 - Delayed: 3690 Harkness St., Slimline Pole in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=1089

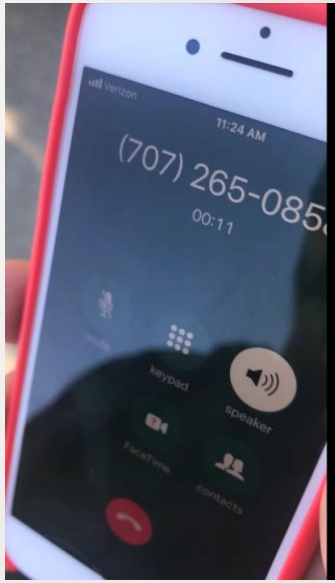


Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 005 - Additional:
3908 Jefferson St.
City Steel
Light Pole
in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=1145

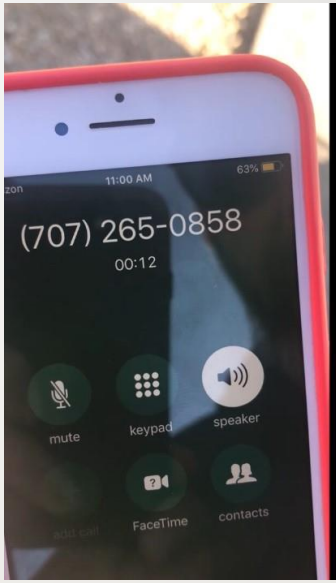


Proof of
No Significant
Gap in Verizon
Wireless
Coverage for
Voice
Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 006 - Additional: 2006 Redwood Rd., Traffic Light in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=1034



Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

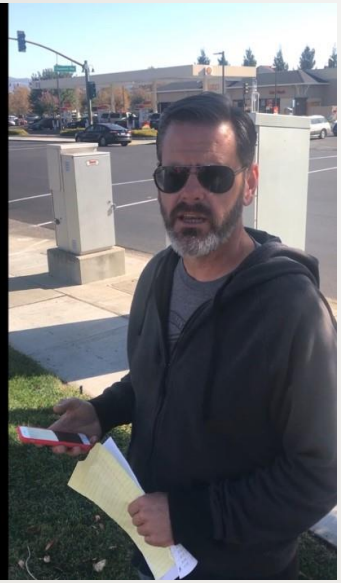
Site 007 - Additional: 4020 Bel Aire Plaza, Slimline Pole in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=1206

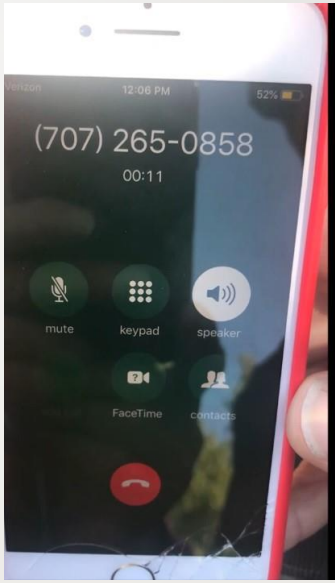
Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 008 -
Pilot:
1558 Trancas St.,
Traffic Light
in Napa, CA



- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=1266

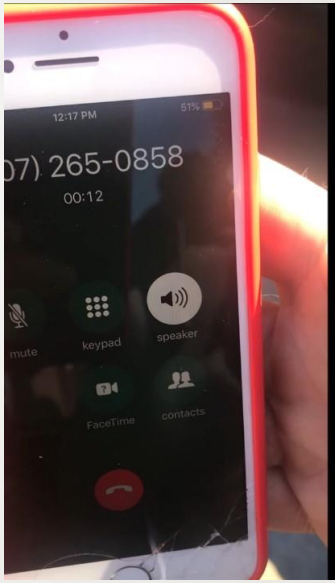


Proof of
No Significant
Gap in Verizon
Wireless
Coverage for
Voice
Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 009 - Additional: 702 Trancas St., Slimline Pole in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=1326

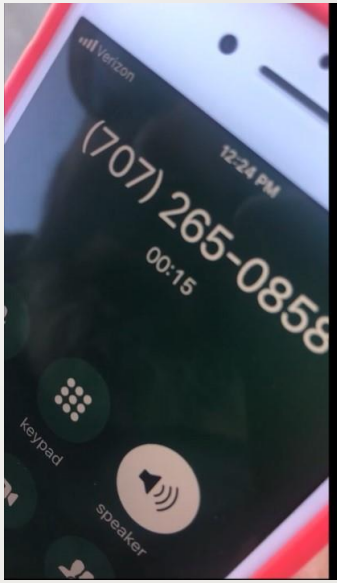


Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 010 - Delayed: 3033 Beard Rd., PG&E Pole Top in Napa, CA

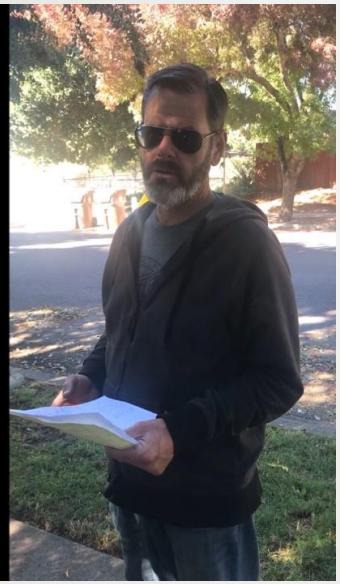
- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=1376



Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 011 - Delayed:
2875 La Homa Dr.,
City Steel
Light Pole
in Napa, CA



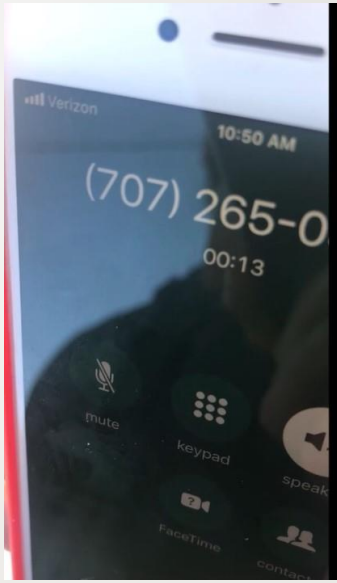
- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=1518

Proof of
No Significant
Gap in Verizon
Wireless
Coverage for
Voice
Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 013 - Delayed: 2999 Linda Vista Ave., PG&E Pole Top in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=972

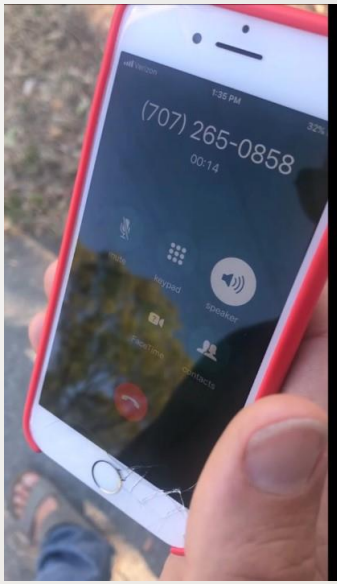


Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 014 - Delayed: 2855 Marin St., PG&E Pole Top in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=1718



Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

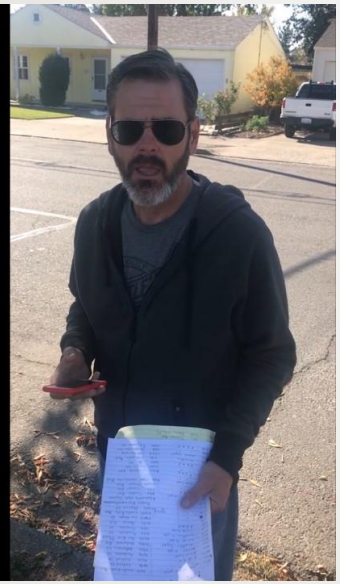
Site 015 - Pilot: 1429 Pueblo Ave. & Wine Train RR, PG&E Pole Top in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=1468

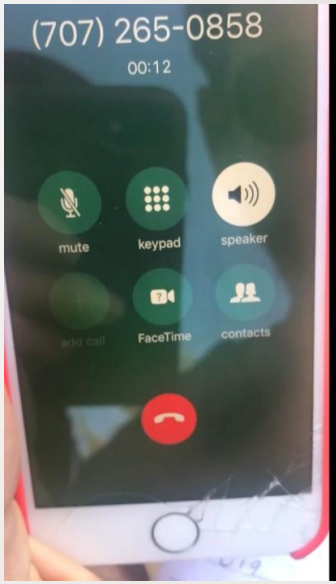
Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 016 - Delayed: 2623 Yajome St., PG&E Pole Top in Napa, CA



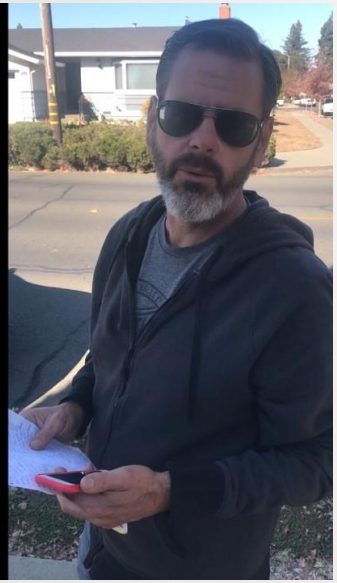
- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=1568



Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 017 - Pending:
802 Pueblo Ave., PG&E Pole Top in Napa, CA



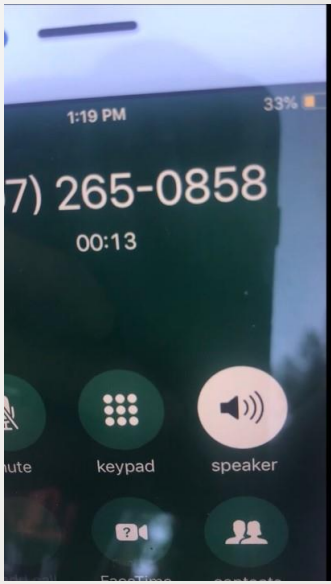
- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=1426

Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 018 - Deemed-Approved: 2449 Soscol Ave., PG&E Pole Top in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=1673

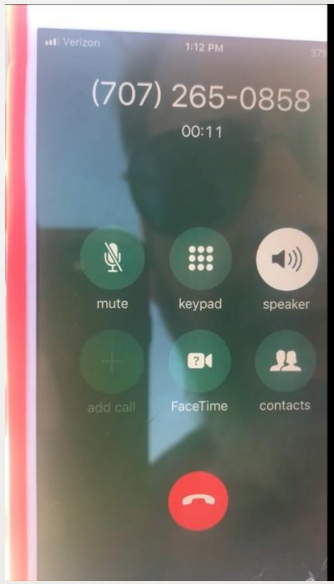


Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 019 - Additional: 2269 Soscal Ave., PG&E Pole Top in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=1622

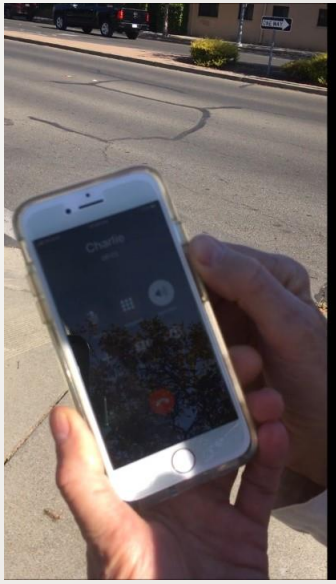


Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 021 - Additional: 2355 California Blvd., Slimline Pole in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=40



Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 022 - Additional: 1141 Lincoln Ave., Slimline Pole in Napa, CA

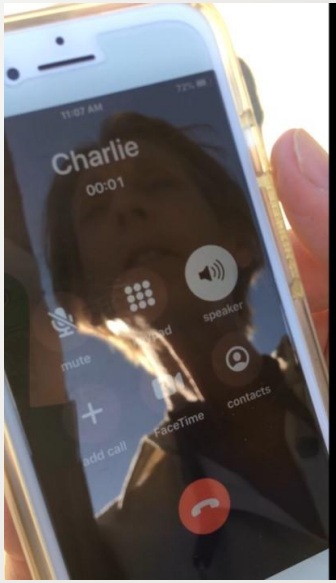
- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=615

Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 023 - Deemed-Approved: 806 Lincoln Ave., PG&E Pole Top in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=86



Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 024 - Deemed-Approved: 2632 1st St., PG&E Pole Top in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=575

Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 026 - Additional: 691 Lincoln Ave., Slimline Pole

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=176

Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 028 - Pending: 1616 Jefferson St., City Steel Light Pole in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=224

Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

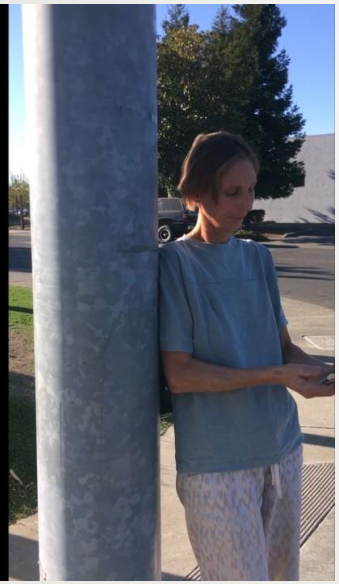
Site 029 - Delayed: 1746 Yajome St., JPA Pole Top in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=269

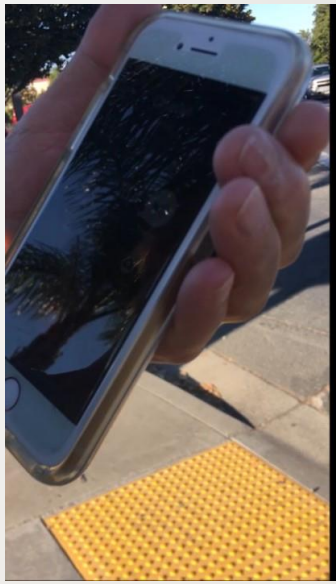
Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 030 - Additional: 1551 Soscol Ave., Slimline Pole in Napa, CA



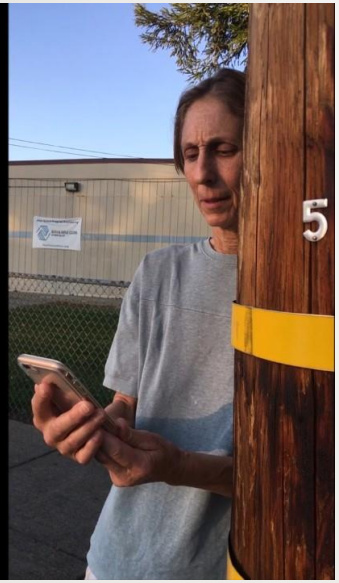
- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=311



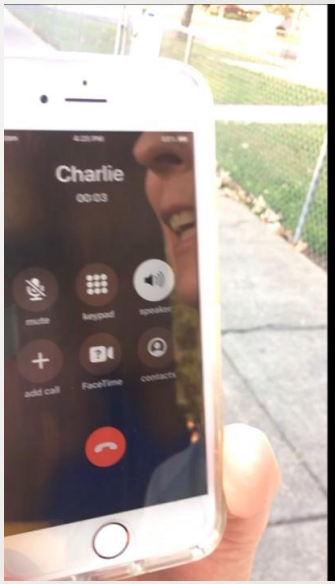
Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 031 - Deemed-Approved: 2790 Kilburn Ave., PG&E Pole Top in Napa, CA



- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=728

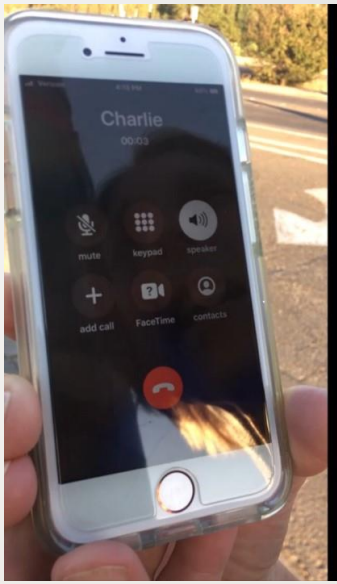


Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 032 - Additional: 629 Freeway Dr., Slimline Pole in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=674

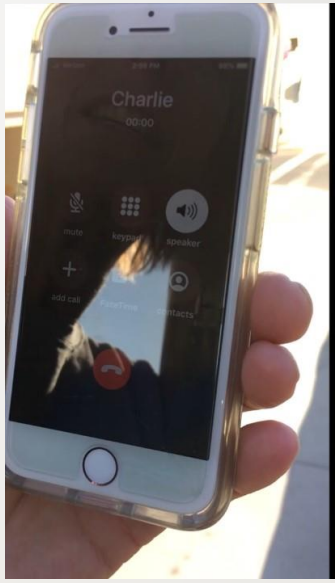


Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 034 - Pending: 2210 2nd St., City Steel Light Pole in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=355

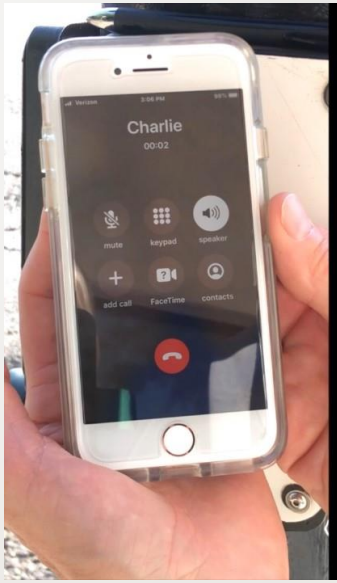


Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 037 - Additional: 1201 Main St., Slimline Pole in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=400

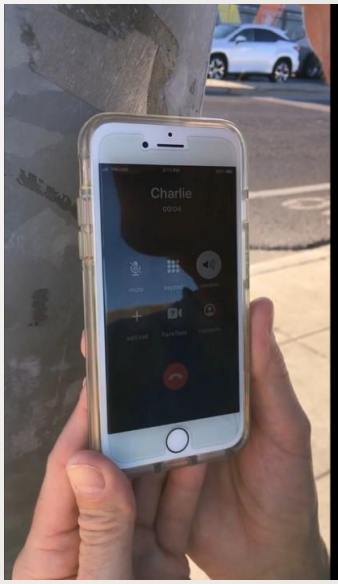


Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 040 - Additional: 1100 2nd St., Slimline Pole in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=446

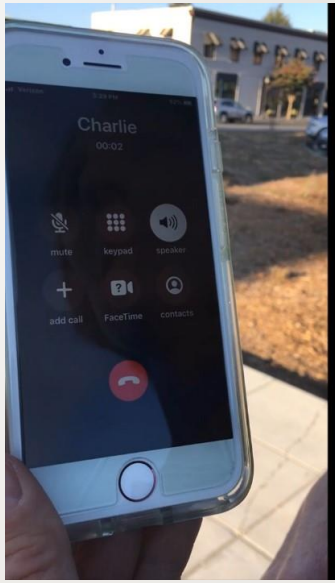


Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 041 - Pending:
730 Randolph St., City Steel Light Pole in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=529

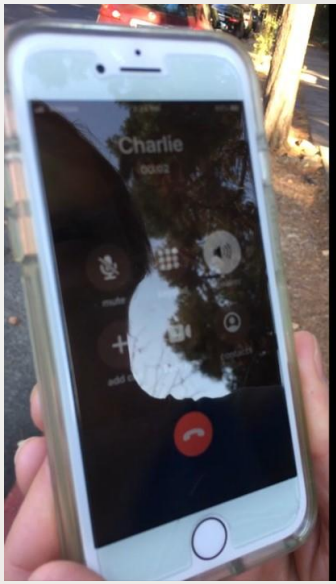


Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 042 - Additional: 580 Coombs St., City Steel Light Pole in Napa, CA

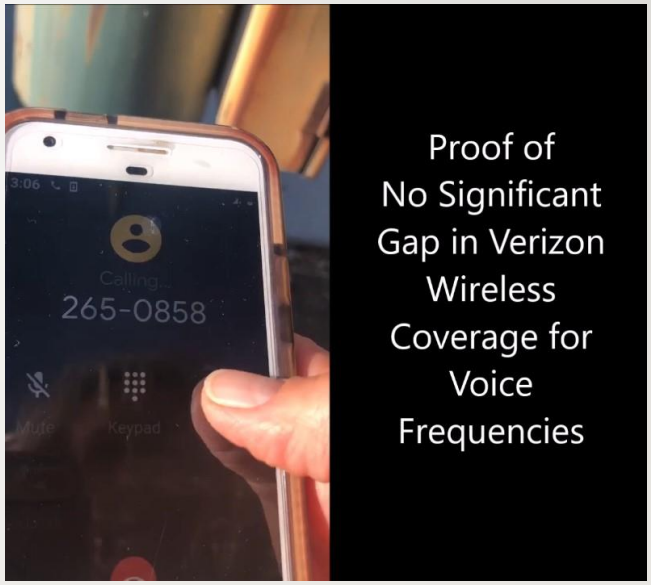
- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=486



Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

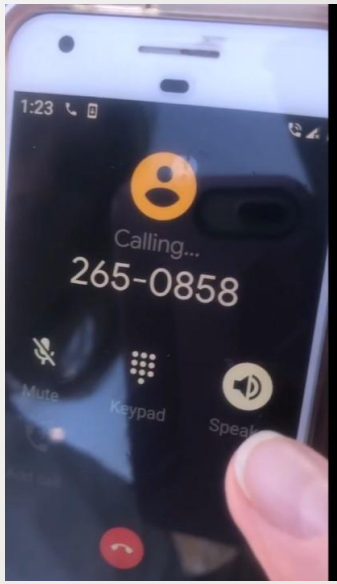
- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=2486



Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 047 - Additional: 593 Soscol Ave., Slimline Pole in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=2220

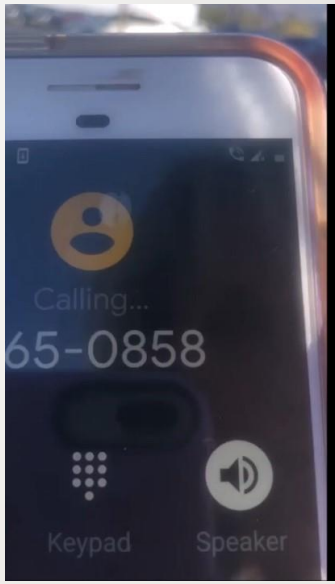


Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 048 - Additional:
529 Soscol Ave., City Steel Light Pole in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=2174

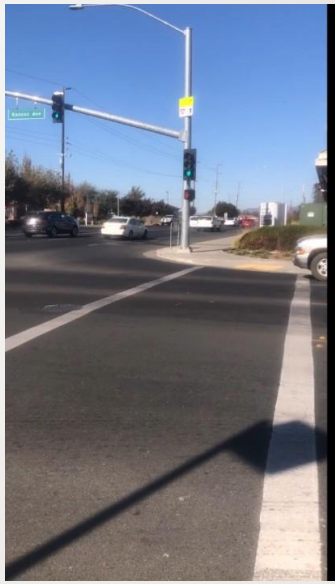


Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 050 - Additional:
225 Kansas Ave., City Steel Light Pole in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=1779

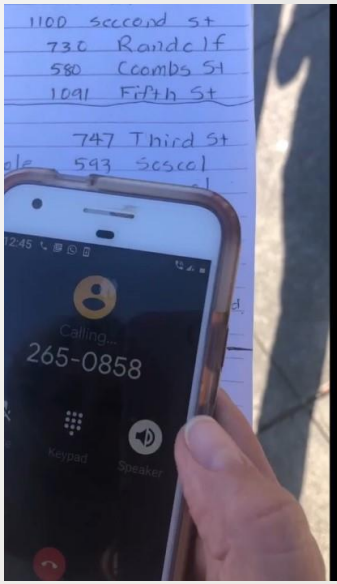


Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 051 - Additional: 100 Gasser Dr., City Steel Light Pole in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=1822



Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

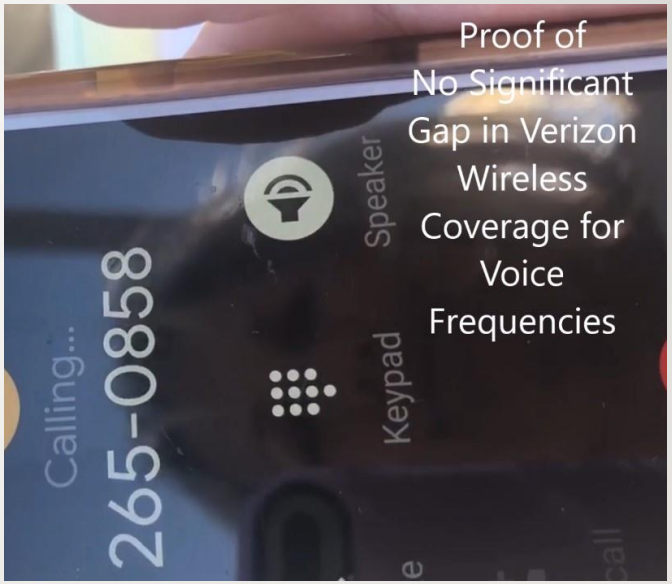
Site 052 - Deemed-Approved: 2601 Elm St., PG&E Pole Top in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=2123

Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

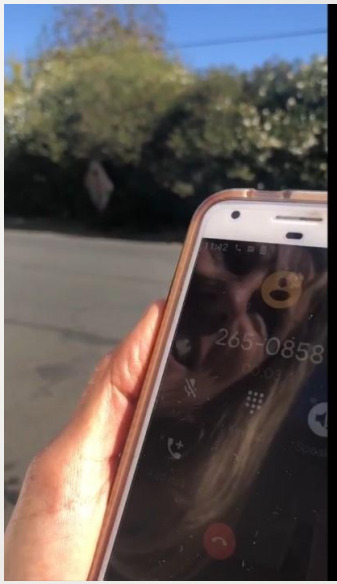
- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=2087



Proof of **No Significant Gap in Verizon Wireless Coverage**

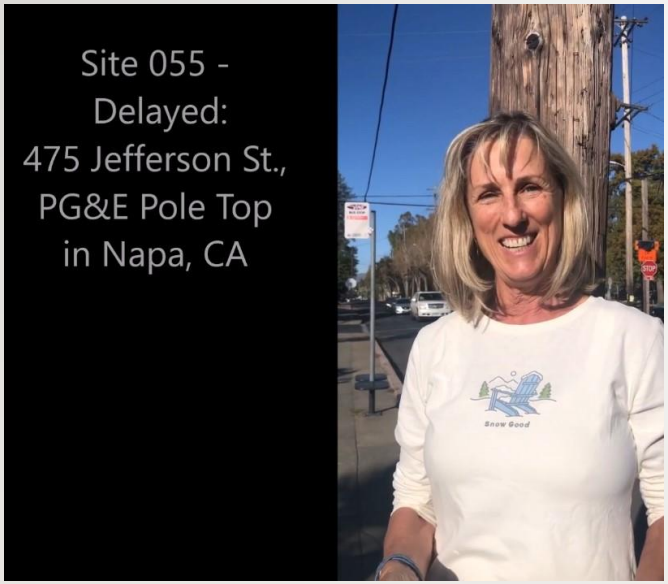
Site 054 - Pending: 253 Walnut St., City Steel Light Pole in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=1915

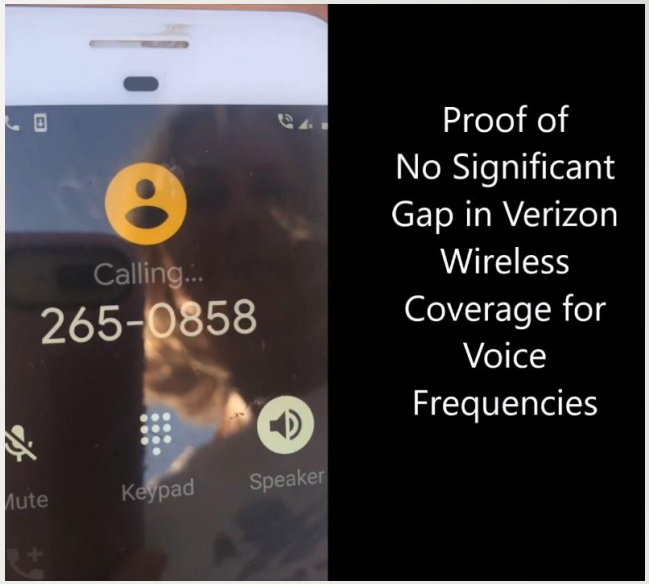


Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**



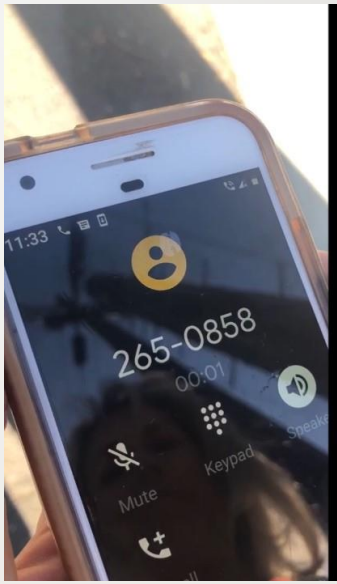
- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=2434



Proof of **No Significant Gap in Verizon Wireless Coverage**

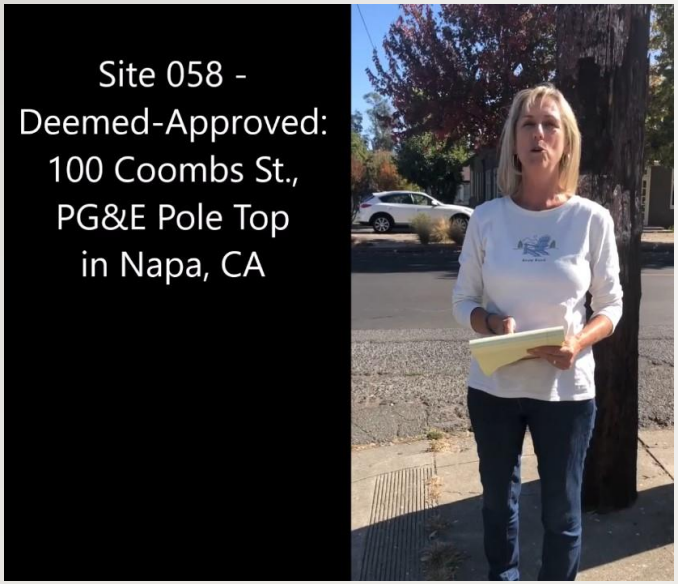
Site 057 - Delayed:
418 Franklin St., PG&E Pole Top in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=1866



Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

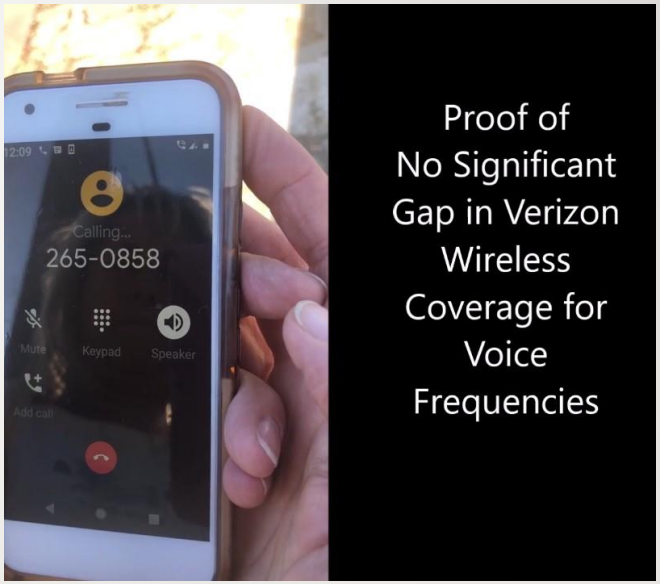
Proof of **No Significant Gap in Verizon Wireless Coverage**



- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=1963

Proof of **No Significant Gap in Verizon Wireless Coverage**

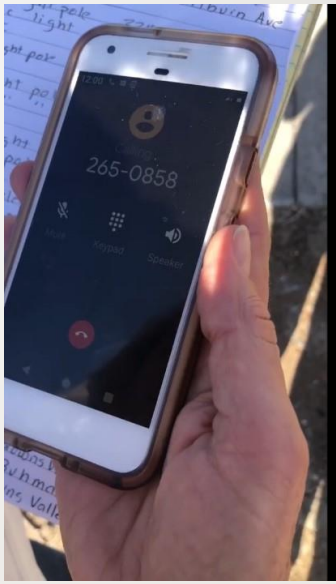
- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=2041



Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 061 - Deemed-Approved: 679 Cabot Way, PG&E Pole Top in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=1995



Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 062 - Pending: 4014 Browns Valley Rd., City Steel Light Pole in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=2327

Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 063 - Pending:
1001 Buhman Ave.
City Steel Light Pole
in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=2381

Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Proof of **No Significant Gap in Verizon Wireless Coverage**

Site 064 - Delayed: 3263 Browns Valley Rd., PG&E Pole Top in Napa, CA

- A phone call was successfully placed using Verizon Wireless voice transmissions on Nov 3, 2018
- Video evidence here: https://youtu.be/GuLx4hDQM8w?t=2275

Proof of No Significant Gap in Verizon Wireless Coverage for Voice Frequencies

Effective CPMRA Next Steps

- **VOTE NO** on Accommodation Agreement
- **Update** Napa-Municipal Wireless Code
- **Allow CPMRAs only** in commercial zones
- **Insist on least intrusive** means for coverage
- **Fiber Optics is most energy-efficient** for internet
- **Accommodate** those disabled with EMS

2019 Authorities for City of Napa

- **On Aug 9, 2019**, the DC Circuit Court of Appeals ruled in Case 18-1129: the ruling means that The FCC/Wireless Industry must now complete a NEPA Environmental Assessment (**EA**) and/or Environmental Impact Statement (**EIS**) **BEFORE** any CPMRA application can be considered complete. **All CPMRA shotclocks must now be tolled and all CPMRA installations must IMMEDIATELY STOP**
- **On Oct 1, 2019**, the DC Circuit Court of Appeals ruled in Case 18-1051: the ruling means the FCC willingly pulled their own teeth and **no longer regulates the Internet** (web pages, video/music streaming, online gaming and other information services). Therefore, Big Wireless has **NO PREMPTION** to install or operate personal wireless facilities that emit wireless "information services" transmissions in any municipality in the USA, **including the City of Napa**.

No Significant Gap proven
at 14 Locations in Napa, CA

Analysis completed on 6/16/2018
by Napa residents.

FOR **NOV 5, 2019** NAPA CITY COUNCIL MEETING

Proof of **No Significant Gap in Verizon Wireless Coverage**

- Near 418 Franklin St.. Napa
- **26,500 µW/m²** pulsed, data-modulated, peak Radiofrequency Microwave Radiation
- Call successfully placed on Verizon.

Applying the correction factor for the high-speed, pulsed, digital signals of 4G/LTE, the **peak levels of 4G/LTE RF/MW radiation are 26,500 µW/m²**, per the meter manufacturer's product manual and product video.

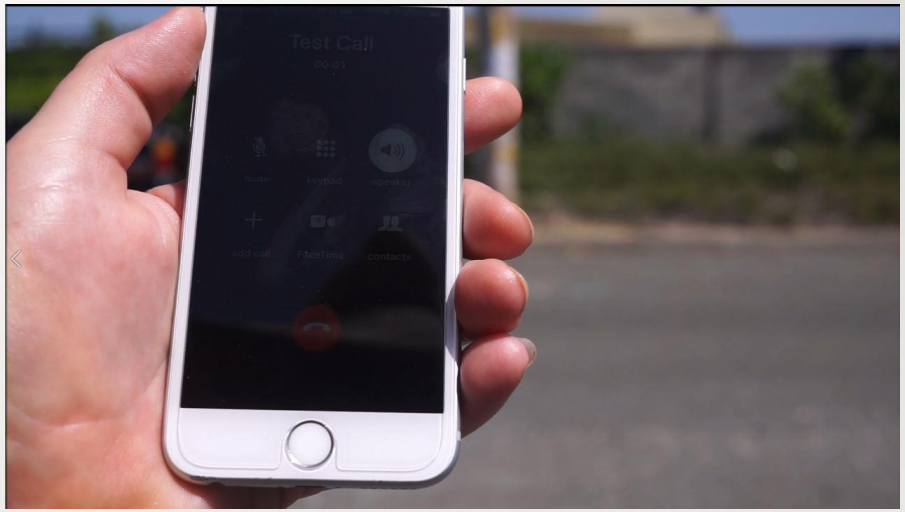
Proof of **No Significant Gap in Verizon Wireless Coverage**

- Near 100 Coombs St., Napa
- **94,800 µW/m²** pulsed, data-modulated, peak Radiofrequency Microwave Radiation
- Call successfully placed on Verizon.

Applying the correction factor for the high-speed, pulsed, digital signals of 4G/LTE, the **peak levels of 4G/LTE RF/MW radiation are 94,800 µW/m²**, per the meter manufacturer's product manual and product video.

Proof of **No Significant Gap in Verizon Wireless Coverage**

- Near 679 Cabot Way, Napa
- **30,900 µW/m²** pulsed, data-modulated, peak Radiofrequency Microwave Radiation
- Call successfully placed on Verizon.



Applying the correction factor for the high-speed, pulsed, digital signals of 4G/LTE, the **peak levels of 4G/LTE RF/MW radiation are 30,900 µW/m²**, per the meter manufacturer's product manual and product video.

Proof of **No Significant Gap in Verizon Wireless Coverage**

- Near 353 Greenbach St., Napa
- **5,900 µW/m²** pulsed, data-modulated, peak Radiofrequency Microwave Radiation
- Call successfully placed on Verizon.

Applying the correction factor for the high-speed, pulsed, digital signals of 4G/LTE, the **peak levels of 4G/LTE RF/MW radiation are 5,900 µW/m²**, per the meter manufacturer's product manual and product video.

Proof of **No Significant Gap in Verizon Wireless Coverage**

- Near 1850 Old Sonoma Rd., Napa
- **28,700 µW/m²** pulsed, data-modulated, peak Radiofrequency Microwave Radiation
- Call successfully placed on Verizon.

Applying the correction factor for the high-speed, pulsed, digital signals of 4G/LTE, the **peak levels of 4G/LTE RF/MW radiation are 28,700 µW/m²**, per the meter manufacturer's product manual and product video.

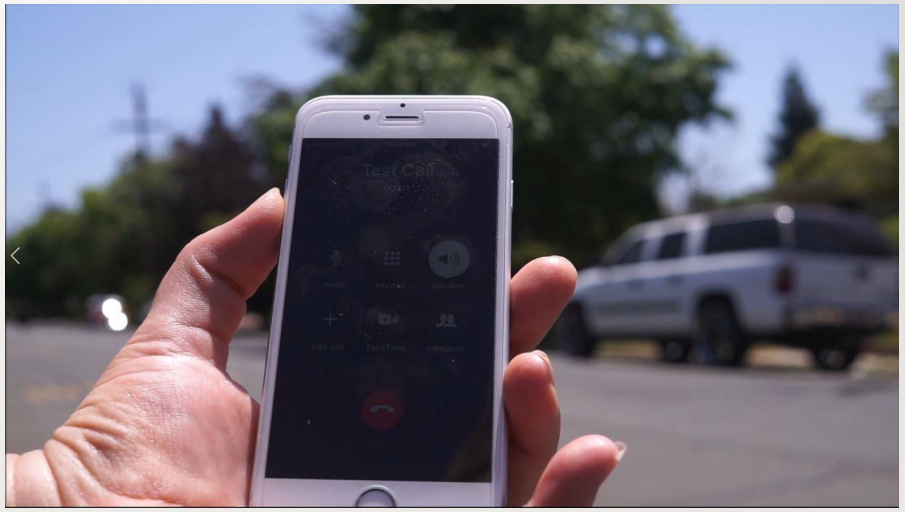
Proof of **No Significant Gap in Verizon Wireless Coverage**

- Near 2447 Old Sonoma Rd., Napa
- **64,600 µW/m²** pulsed, data-modulated, peak Radiofrequency Microwave Radiation
- Call successfully placed on Verizon.

Applying the correction factor for the high-speed, pulsed, digital signals of 4G/LTE, the **peak levels of 4G/LTE RF/MW radiation are 64,600 µW/m²**, per the meter manufacturer's product manual and product video.

Proof of **No Significant Gap in Verizon Coverage** at Address

- Near 1857 Sierra Ave., Napa
- **70,600 µW/m²** pulsed, data-modulated, peak Radiofrequency Microwave Radiation
- Call successfully placed on Verizon.



Applying the correction factor for the high-speed, pulsed, digital signals of 4G/LTE, the **peak levels of 4G/LTE RF/MW radiation are 70,600 µW/m²**, per the meter manufacturer's product manual and product video.

Proof of **No Significant Gap in Verizon Coverage** at Address

- Near 3563 Oxford St., Napa
- **12,600 µW/m²** pulsed, data-modulated, peak Radiofrequency Microwave Radiation
- Call successfully placed on Verizon.

Applying the correction factor for the high-speed, pulsed, digital signals of 4G/LTE, the **peak levels of 4G/LTE RF/MW radiation are 12,600 µW/m²**, per the meter manufacturer's product manual and product video.

Proof of **No Significant Gap in Verizon Coverage** at Address

- Near 3033 Beard Rd., Napa
- **12,600 µW/m²** pulsed, data-modulated, peak Radiofrequency Microwave Radiation
- Call successfully placed on Verizon.

Applying the correction factor for the high-speed, pulsed, digital signals of 4G/LTE, the **peak levels of 4G/LTE RF/MW radiation are 12,600 µW/m²**, per the meter manufacturer's product manual and product video.

Proof of **No Significant Gap in Verizon Coverage** at Address

- Near 2623 Yajome St., Napa
- **2,100 µW/m²** pulsed, data-modulated, peak Radiofrequency Microwave Radiation
- Call successfully placed on Verizon.

Applying the correction factor for the high-speed, pulsed, digital signals of 4G/LTE, the **peak levels of 4G/LTE RF/MW radiation are 2,100 µW/m²**, per the meter manufacturer's product manual and product video.

Proof of **No Significant Gap in Verizon Wireless Coverage**

- Near 1350 Pueblo Ave. & Wine Train Railroad, Napa
- **3,800 µW/m²** pulsed, data-modulated, peak Radiofrequency Microwave Radiation
- Call successfully placed on Verizon.

Applying the correction factor for the high-speed, pulsed, digital signals of 4G/LTE, the **peak levels of 4G/LTE RF/MW radiation are 3,800 µW/m²**, per the meter manufacturer's product manual and product video.

Proof of **No Significant Gap in Verizon Wireless Coverage**

- Near 806 Lincoln Ave., Napa
- **306,600 µW/m²** pulsed, data-modulated, peak Radiofrequency Microwave Radiation
- Call successfully placed on Verizon.

Applying the correction factor for the high-speed, pulsed, digital signals of 4G/LTE, the **peak levels of 4G/LTE RF/MW radiation are 306,600 µW/m²**, per the meter manufacturer's product manual and product video.

Proof of **No Significant Gap in Verizon Wireless Coverage**

- Near 1746 Yajome St., Napa
- **38,800 µW/m²** pulsed, data-modulated, peak Radiofrequency Microwave Radiation
- Call successfully placed on Verizon.

Applying the correction factor for the high-speed, pulsed, digital signals of 4G/LTE, the **peak levels of 4G/LTE RF/MW radiation are 38,800 µW/m²**, per the meter manufacturer's product manual and product video.

Effective CPMRA Next Steps

- **VOTE NO** on Accommodation Agreement
- **Update** Napa-Municipal Wireless Code
- **Allow CPMRAs only** in commercial zones
- **Insist on least intrusive** means for coverage
- **Fiber Optics is most energy-efficient** for internet
- **Accommodate** those disabled with EMS

2019 Authorities for City of Napa

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- **On Oct 1, 2019**, the DC Circuit Court of Appeals ruled in Case 18-1051: the ruling means the FCC willingly pulled their own teeth and **no longer regulates the Internet** (web pages, video/music streaming, online gaming and other information services). Therefore, Big Wireless has **NO PREMPTION** to install or operate personal wireless facilities that emit wireless "information services" transmissions in any municipality in the USA, **including the City of Napa**.

Law Offices of Harry V. Lehmann

Harry Vere Lehmann,
Principal Attorney

4 Vineyard Court
Novato, California 94947

Area Code 415
Telephone: 897-2121
Facsimile: 898-6959

November 5, 2019

Respectfully, to Mayor Jill Techel
and each member of
Napa City Council

Re: Possible effects on agricultural pollinators and Other hazards mandate further study by City prior to enablement of any 5G distribution in Napa.

Dear Mayor and Council –

Almost everybody in this room has roots and friends in Napa. This Council and this community face dense saturation of Napa with microwave signal from profuse antennas, which in most instances are being called 5G small cell antennas when the permits are sought.

Introduction

The goal of this letter is to sufficiently acquaint you with mainstream science findings which indicate possible harm to all DNA organisms in the Napa Valley, from people to grapes, from the proposed dense installation of what are being labeled as 5G small cell antennas.

In order to acquaint you with these data quickly, this piece is broken down into several sub-categories. The main thrust here is to provide hard data demonstrating that further study by the City of Napa is mandated by the proven nature of cellular microwave impact on living things. Provided below are issues which it is respectfully suggested make it best for all of us if this Council will please table the approval of any telecom antenna permit applications until, as speedily as possible, technical, scientific, and legal analysis can be provided to the members of this Council on these issues:

1. Whether dense antenna installation presents peculiar risks of harm to the vineyards and wineries in the Napa Valley as a whole, due to pollinator impairment.

2. Whether, in the opinion of your City Attorney, recent developments in federal and California case law broaden the alternatives to cities facing dense microwave deployment.

3. Whether, mainstream scientific data indicates that saturating Napa residents with intense 24/7 microwave will cause health problems for those residents, including: 2) Whether the increase in density of microwave carcinogens resultant from the proposed 5G rollout is a phenomena which through its cumulative constancy of exposure constitutes a reportable hazard within the context of California law pertaining to endangerment of minors.

4. Whether the City of Napa faces greater liability and litigation expense from the issuance of these permits than it does from any telecom lawsuit threats.

5. Whether the possible use of 3G and 4G frequencies in what is being sold as a 5G rollout has DNA rupture differentials in effect based upon frequencies.

This is provided to you electronically so that the people of the City of Napa and residents of the Napa Valley generally can access the data stated here. Due to intermittence in the effectiveness of the pasted in links supplied with this letter, the reader is encouraged to cut each link and plug it into your chosen browser.

1. Science findings regarding pollinator navigation show needed further study

There is a risk to all pollinators in the Napa Valley from the now proposed high-density telecom antenna permit applications. This discussion will be on bees.

Bees navigate by magnetic orientation. Please see the thorough discussion on this titled ***Honey bees navigate using magnetic abdomens***:

https://physicsworld.com/a/honey-bees-navigate-using-magnetic-abdomens/

See also from ***Nature*** a 2016 article titled ***Magnetic Sensing through the Abdomen of the Honey bee*** which can be found at:

https://www.nature.com/articles/srep23657

Clear and convincing evidence including from the first two able studies prove that the abdomens of honey bees have magnetite and that this provides directional and return guidance.

It is not claimed here that Hive Collapse Disorder is a single cause process or that microwave exposure is the sole cause. The harm from mites is recognized. The existence

of solid studies showing bees perception of polarized light is a navigation source including in very low light conditions is also recognized.

Rather than making any overreaching pitch, it is suggested that the data are sufficient to indicate that study of the relationship between pollinator survival and microwave installation should be examined, not only by appropriately qualified persons with environmental scientific credentials, but also by the City Attorney in light of potential lawsuits against the City of Napa derivative from decreased yields experienced by affected vineyards.

Our windshields used to clog with insects, especially in low elevation roads, like out on 37, especially between 101 and Black Point, or on 121 before Arnold Drive or on highway 12 between Ford's Corner and the Napa line. We don't see that any more. A recent study showed more than 75 percent decline over 27 years in total flying insect biomass in the sample areas studied in Germany - see Hallmann CA, Sorg M, Jongejans E, Siepel H, Hofland N, et al. (2017).

All life is built of DNA, not just our rapacious human species. It is scientifically established that exposure to cellular mast radiation will cause tree withering proportional to exposure. Please see a careful a 26 page study report on the effects of radiofrequency radiation on trees around mobile phone base stations can be found through your search for the unusual title 'Bernartzky (1986), revisited'. Quoting briefly from the Abstract, after a discussion of methods; "***The measurements of all trees revealed significant differences between the damaged side facing a phone mast and the opposite side, as well as differences between the exposed side of damaged trees and all other groups of trees on both sides***." (emphasis added) These findings are consistent with the determination by Dr. Henry Lai of the University of Washington School of Medicine that ***DNA strand fracture results from cellular signal exposure***. There is a particularly instructive article on Dr. Lai in Seattle magazine, as information exchange in a lawsuit turned up a memo from one telecom advocate to another about how to 'war game' against Dr. Lai.

Briefly, as thoroughly discussed in a ten page letter to Assembly Appropriations dated July 19, 2017 in opposition to CA SB 649 (available at www.greenswan.org) in 1983, a team at the University of Maryland found that establishing a 7.43 concentration of DNA to plain water resulted in a 24-fold increase in the Specific Absorption Rate of the resulting fluid, compared to the plain water used as a base, ***and that the mechanism was 'acoustic,' in physics language, not ionic.*** This is consistent with the way a microwave oven works, which is that heat is the *result* of molecular agitation, *not the cause*. The industry-lap-dog FCC continues to push that the mechanism of causation is thermal despite the fact that our own federal government, after $25 million dollars and the efforts of our best toxicology scientists proved that the cancer mechanism is non-thermal.

Since the swaths of more dense development in the Valley tend naturally to reside across the Valley on level land, all insects and birds which transit the more developed and antenna-dense areas will experience decrease in magnetite-based navigational accuracy.

In considering these issues it is helpful to comprehend the mass extent of industry practices in pruning publicly available information, in this regard see the article entitled How Big Wireless Made Us Think Cell Phones Are Safe, by Mark Hertsgaard and Mark Dowie in the March 29, 2018 edition of The Nation magazine:

https://www.thenation.com/article/how-big-wireless-made-us-think-that-cell-phones-are-safe-a-special-investigation/

People concerned with the preservation of the Napa wine culture and industry here should join together, on this Council and as friends, to insure that these issues be decently studied before permit approval. The heart of the Valley is at stake in more ways than one.

2. Recent developments in Federal and California case law broaden the alternatives to cities facing dense microwave deployment.

On Aug 9, 2019, the DC Circuit Court of Appeals ruled in Case 18-1129: the ruling means that The FCC/Wireless Industy must now complete a NEPA Environmental Assessment (EA) and/or Environmental Impact Statement (EIS) BEFORE any CPMRA application can be considered complete. This signals a broad and accomplished modification of applicable law, including as to presently pending permit applications. Under these circumstances it respectfully suggested that the City Attorney should be allowed to determine by research and opinion report whether any arguably applicable CPMRA shot clocks should now be considered tolled, perhaps with re-set proviso as an adjunct aspect.

On Oct 1, 2019, the DC Circuit Court of Appeals ruled in Case 18-1051: the ruling means the FCC willingly pulled their own teeth and no longer regulate the Internet (web pages, video/music streaming, online gaming and other information services).

Therefore, it is humbly and respectfully suggested that the City Attorney or other unbiased counsel determine whether it is true, as we believe, that whatever preemption was and remains, Big Wireless has NO PREMPTION to install or operate personal wireless facilities that emit wireless "information services" transmissions in any municipality in the USA, including Napa. Therefore as to those increased services, which

can be delivered without radiation through fiber optic means, the decision should and does reside with local governance.

This also means that the Wireless Industry only has preemption to place, construct and modify personal wireless facilities for wirelessly transmitting "telecommunications services" (i.e. voice transmissions).

In the above regard, the proven absence of a significant gap in Verizon's voice transmission coverage in Napa is a very important factor in the Council's 11/5/19 decision. It is respectfully suggested that it is not necessary for the City of Napa to 'rush to signature' a Accommodation Agreement for these unnecessary CPMRA installations — because Napa residents can currently make calls on Verizon Wireless everywhere that Verizon is proposing to install a CPMRA.

The that the recent restrictions on the FCC grab should be taken seriously, taking into account that this is the DC Circuit, ruling on the FCC's power grabs, which Circuit sets the lighthouse for many other Courts. Thanks to Paul McGavin for his contributions to this area of this document.

3. Whether, mainstream scientific data indicates that saturating Napa residents with intense 24/7 microwave will cause health problems for those residents, including: 2) Whether the increase in density of microwave carcinogens resultant from the proposed 5G rollout is a phenomena which through cumulative constancy of exposure constitutes a reportable hazard within the context of California law pertaining to endangerment of minors.

It has been long established for about two decades from the work of Dr. Henry Lai of the University of Washington School of Medicine that cellular telephone wavelengths cause DNA fracture. That a generally prevailing concern about EMF radiation now exists is buttressed by, for one, the publication by Scientific American in October of an article by Dr. Joel Moscowitz of the University California Berkeley tells us of potential health consequences from 5G dispersal as currently contemplated by giant telecom. The national toxicology program of the United States government's National Institutes of Health issued its final report on November 2, 2018 following 2 ½ years

On May 27, 2016 the National Toxicology Program (hereafter NTP) of the U. S. National Institutes of Health (hereafter NIH) issued its first report on results of the NTP's $25 million study of whether cellular non-ionizing radiation causes cancer. The NTP determined that cellular radiation causes an increased risk of cancer, including the thereby-forced creation of glioma cells, the root cells of glioblastoma, the deadly brain cancer. The study also showed that the radiation caused the formation of the cells which

cause acoustic neuroma in humans. On 2/27/16 when the NTP study results were made public, a thorough discussion of the findings appeared in a *Mother Jones* article titled; ***"Game-Changing" Study Links Cellphone Radiation to Cancer***, which you can easily find. Then followed nearly two years of further peer review until March 28th of 2018, when, at the end of a three day peer consortium on the issue in Research Triangle NC the NTP used the clarifying language that their $25 million study showed 'clear evidence' that cellular radiation causes cancer. ***But that wasn't the NTP's final word on whether cellular microwave causes cancer***.

The final report of the National Toxicology Program on the NTP's $25 million study was issued on November 2, 2018. This final report confirmed the finding that microwave radiation from cellular sources is carcinogenic, and that the mechanism of harm is non-thermal. The entire industry-influenced 'regulatory,' standards used by the FCC are based on the assumption that the only possible mechanism of tissue damage is thermal. The best website for your obtainment of scientific findings is www.ehtrust.org, for The Environmental Health Trust. At the EHT site, please see the letters to school districts from Dr. Martha Herbert, a Pediatric Neurologist at Massachusetts General Hospital and on the faculty of the Harvard Medical School, citing hundreds of studies.
Hundreds of pages could easily be taken simply to list sources on this subject yet there are sufficient sources stated above to show the 5G cancer hazard to all Napa residents.

To state it briefly: There is a sufficient national professional scientific and medical consensus that microwave radiation, especially in near-field, is harmful, such that prudent administrative and legislative practices should include the completion of a review of the health consequences from increased multi-axial microwave saturation.

4. Whether the City of Napa faces greater liability and litigation expense from the issuance of these permits than it does from any telecom lawsuit threats.

The great thing about getting a written opinion letter from a lawyer is that they lawyer is thereafter stuck with it, right or wrong. For example, after the National Toxicology Program of the U. S. National Institutes of Health determines that cellular radiation causes cancer cell formation, where such an antenna generating such carcinogenic waves is permissively placed, with revenue, on a publicly owned utility pole, isn't this therefore a Dangerous Condition of Public Property?

Because of what they were repeatedly told, and believed in good faith, few professional administrators have studied deeply in this field. Seldom to we find professional administrators who have spent more than a half hour giving serious consideration to the actual language of the Act. As advocates our experience with government advisory lawyers are very uneven. Some lawyers, whether or not agreeing on a core point, will evidence actual study. Others, appear to parrot simplistic interpretations of complex and science areas.

There are, for one example, legal issues concerning the extent to which application to situations of 'direct physical harm' is not consistent with language norms ubiquitous when that Bill was passed. The Act puts forth wattage limits, and preemption only applies to approved wattage levels, whereas it has been from time to time found, including by sophisticated meter reading in the field, that actual field antenna strength has been far greater than claimed

But, beyond that, would you, as responsible souls on this Council, want people who were damaged from radiation they had no way to avoid, to go without recompense on a technicality like that? There are sophisticated legal arguments on this, in my view Separation of Powers is at the crucible of it. But it is suggested that any experienced lawyer long engaged with governmental entities would agree with the following points, not involving rocket science:

1)The defendants in a lawsuit do not get to choose whether to be sued. That choice is made by plaintiffs' counsel.

2) Once the involved cellular antenna box is attached to the governmental utility pole with telecom as the tenant, the Doctrine of Fixtures from ordinary landlord tenant law applies and a melding takes place, and plaintiffs' counsel will allege, as is consistent with the law, that the melded unit as a whole is now Public Property.

3) The main CA Government Code section which is pled by experienced public entity lawyers is Dangerous Condition of Public Property, Government Code 835.

4) There is now overwhelming evidence of DNA and cellular damage from radio-frequency EMF as emitted by cellular phones and towers. Therefore, 5G's close proximity radiation source is 'dangerous' under Government Code 835.

5) Liability of the County of Napa and other regional and local governmental and regulated entities (here we go, PG&E again) will be alleged, and in legal logic and fact shown to exist on multiple other basis, including joint venture and with the damages resulting from the concurring actions of independent tortfeasors under the Summers v. Tice approach, see 33 C2d 80.

6) In California and elsewhere, 'joint and several liability' means that a 1% liability contributor has 100% of financial responsibility from a loss in the instance of the insolvency (or in this instance unavailability if the 1996 Act is sustained) , ***the result of the combination of the factors stated above is that <u>all financial burdens from cellular injury are shifted to the taxpayers.</u>***

Bottom line, if 5G is allowed in Napa in every case that arises from people claiming injury, whether that injury is in reality from cell phones or towers, industry will say that the 1996 Act protects them, but not the involved local entities. A far more detailed explanation

of this issue can be found in the above July 19, 2017 letter to Assembly Appropriations from our successful effort against CA SB 649. Importantly, 5G does not create a 'risk' of injury, like some essential medicines, because the participation of our bodies in microwave saturation is not a choice; 5G thus creates a constant hazard, not just a risk of injury. Allowing 5G in Napa is morally wrong for the above reasons.

4. Whether the possible use of 3G and 4G frequencies in what is being sold as a 5G rollout has DNA rupture differentials in effect based upon frequencies.

The wavelengths primarily used for telephonic communication at the 800 MHz range with spillover the 1900 MHz. As the numbers get bigger the waves get shorter and the tops of the waves closer together.

The frequencies with the lower numbers carry data more easily than the frequencies with the higher numbers.

As the numbers get higher it will take more power to pump any given cluster of data. This boils down to money, in terms of dollars spent per corresponding units of power.

We have sometimes encountered situations where persons in policy positions understood that they were approving 5G so-called 'small cell' antennas in greatly increased density (quarter mile intervals common), but where the language of the actual permit included a great variation in the frequencies which the applicant would be allowed to permit to issue from the antenna involved.

Maybe this is beneath the dignity I try for, but it occurred to me that if one were to think of this in golfing terms, the lower frequencies at the 800 MHz range especially (with spillover the 1900 MHz) are like a TaylorMade M6 Driver, it will hit the ball a long distance; the 5G is more like a putter.

As the frequency goes up the distance that ball can be driven diminishes the higher the frequency to lower the effective range because it's not a very good frequency it's not very efficient frequency.

It is my understanding that in Napa 800 MHz and 1900 MHz by spillover are the primary frequencies that your use for telephonic processes because those are very efficient and that means dollar efficient frequencies takes less energy and energy cost money; 800 MHz or the 1900 MHz venue have far greater penetration range then 5G which is the technical justification for this 5G dispersal. The effect of this is that if the 5G signal is sufficient to allow receipt in a room in your residence, then it is sufficient to bathe you in microwave 24/7.

It is beyond any letter to treat this fully. It is of independent value to have understand the basics of frequencies and penetration and range, and that's all which I've sought to get across here. In addition, if sometimes a telecom person might say or imply 'don't worry, it's just 4G,' the data show that isn't a good thing to couple unavoidable long reach signal with constantly penetrating high density.

Conclusion

This is a hastily assembled letter, taking assistance from many, and in several instances tailoring language from prior works involving Marin County or then-pending California legislation.

The core point defended here is that there exist a substantial number of issues which should be vetted carefully before the City of Napa proceeds with further so-called 5G applications for permit. The term 'so-called,' is not stated out of meanness, but simply to clarify that many such applications have been found to contain immense elasticity wattage and type, with such issues left to the later un-encumbered choice of the telecom provider, in a situation, which is the main point here, that this stuff needs to be studied, first.

I am honored that activists for Napa and Sonoma as well kindly asked that I prepare remarks for you this evening, which are provided to keep a promise made to activist Lin Marie DeVincent, who contributed to this presentation. This document was hurriedly composed today with only early drafting yesterday, the inevitable resulting typos will be my responsibility, but I will answer any question.

In order to provide the broadest level of documented sources of scientific expertise a copy of a letter from Beatrice Golomb MD PhD, Professor of Medicine, University of California, San Diego, is attached to the electronic, but due to the pages taken (22) for the 360 scientific presentations, not the paper, variant of this letter. My assignment is to provide data sources, the data are clear that cellular microwave is carcinogenic as well as damaging to agriculture, and, here, to the historic Napa wine culture which has made this valley the destination it is today.

Very truly yours,

Harry V. Lehmann

UNIVERSITY OF CALIFORNIA, SAN DIEGO UCSD

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August 18, 2017

To whom it may concern,

I urge in the strongest terms that you vigorously oppose California SB 649.

If this bill passes, many people will suffer greatly, and needlessly, as a direct result.

This sounds like hyperbole. It is not.
My research group at UC San Diego alone has received hundreds of communications from people who have developed serious health problems from electromagnetic radiation, following introduction of new technologies. Others with whom I am in communication, have independently received hundreds of similar reports. Most likely these are a tip of an iceberg of tens or perhaps hundreds of thousands of affected person. As each new technology leading to further exposure to electromagnetic radiation is introduced – and particularly introduced in a fashion that prevents vulnerable individuals from avoiding it – a new group become sensitized to health effects. This is particularly true for pulsed signals in the radiowave and microwave portion of the spectrum, the type for which the proposed bill SB 640 will bypass local control.

Mechanisms by which health effects are exerted have been shown to include oxidative stress (the type of injury against which antioxidants protect ,see optional section below), damage to mitochondria (the energy producing parts of cells), damage to cell membranes[1, 21], and via these mechanisms, an impaired "blood brain barrier"[3-5] (the blood brain barrier defends the brain against introduction of foreign substances and toxins; additionally, disruption can lead to brain edema[6]), constriction of blood vessels and impaired blood flow to the brain[7], and triggering of autoimmune reactions[8, 9]. Following a large exposure, that depresses antioxidant defenses, magnifying vulnerability to future exposures, some persons no longer tolerate many other forms and intensities of electromagnetic radiation that previously caused them no problem, and that currently cause others no problem. But this group deserves – nay needs -- the right to be able to avoid these exposures.

Affected individuals not only experience "symptoms" that "merely" cause them distress and suffering, when they are exposed – symptoms like headaches[10, 11], ringing ears[10, 11] and chest pain[10] from impaired blood flow, heart rhythm abnormalities[10, 11], and inability to sleep[10, 11]. These symptoms arise from physiological injury. Moreover, **many experience significant health problems that can include seizures[11], heart failure, hearing loss[12-14] and severe cognitive impairment[11, 15].** The mechanisms involved are those also involved in development and progression of neurodegenerative conditions including Alzheimer's disease[16].

Fully half who were employed when their problems developed lost their job because of the problem, among participants of a survey we conducted. They reported that their condition had cost them up to 2 million dollars to date. Many had lost their homes. A number became homeless, and have swelled the ranks of so-called "EMF refugees"[17-19]. Among those affected, many were previously high functioning individuals – engineers, doctors, lawyers. The best and the brightest are among those whose lives – and ability to contribute to society –will be destroyed. High profile individuals with acknowledged electrohypersensitivity include, for instance, Gro Harlem Brundtland – the former 3-time Prime Minister of Norway and former Director General of the World Health Organization[20]; Matti Niemela, former Nokia Technology chief[21]; as well as the wife of Frank Clegg[22], who formerly headed Microsoft Canada and is current head of Canadians for Safe Technology[23].

Each new roll-out of electromagnetic technology for which exposure is obligatory, swells the ranks of those who develop problems with electromagnetic fields (EMF).- particularly following a significant exposure to pulsed radiowave-microwave radiation, and particularly when people have no ability to avoid it.

Many state that they didn't give credence to the problem (if they had heard of it at all) **until they themselves fell prey to it.**

This is not a psychologically driven condition. Multiple objective physiological changes reflecting mechanisms of injury have been shown in persons with this condition[24, 25].

The role for oxidative stress, that has been shown in innumerable studies (below)**, is affirmed by evidence of a link of this condition to genetic variants in antioxidant defenses**, that are less avid in defending against oxidative stress[307]. People cannot manipulate their genes, to produce such an outcome by suggestibility.

An analysis by a University of Washington researcher showed that most studies funded by industry reported failure to show physiological effects. However, most studies without such industry bias affirmed effects. This is redolent of findings shown in medicine[26], regarding which the former editor in chief of the BMJ (the British Medical Journal), Richard Smith, noted, based on findings of a study, "This {result} suggests that, far from conflict of interest being unimportant in the objective and pure world of science where method and the quality of data is everything, it is the main factor determining the result of studies."[27]. So where articles deny injury from nonionizing radiowave-microwave radiation, there is commonly a stake aligned with financial benefit from such denial.

Those who are affected are in desperate need of *protection* by our elected officials. They need creation of safe spaces and housing, and roadways to allow travel, not removal of any prospect of one; protection of local rights to make decisions - **not removal of any recourse or ability to avoid what injures them**. They are far more strongly in need of protections than a great many protected classes – their problems arose due to actions of others, against which they were given no control – *and can be reversed,* in most cases, if the assault on them is rolled back. Through no fault of their own, and in some cases against their will (e.g. before opt out was permitted with smart meters), they were subjected to an

exposure that has altered their lives as they knew them, and forced them – needlessly - to the margins of society.

Let our focus be on safer, wired and well shielded technology – not more wireless.

This legislation, if passed, and the resulting unrestricted roll-out of this technology, will predictably and directly injure and disable a new group, and add depth of suffering to those already affected.

In other spheres we abridge freedoms to protect the vulnerable few. We require that every schoolchild be vaccinated, supposedly to protect the vulnerable few who may not respond effectively to a vaccine. The need to protect the vulnerable group is deemed to be so great that it justifies the decision to abridge individual rights.

In contrast, this bill seeks to abridge individual freedoms, and local rights, in the service of *harming* a vulnerable group, and creating a new one.
(The common factor appears to be that in both cases, the direction is aligned with a powerful industry that influences political decisions.)
Luckily, no abridgment of individual rights and freedoms is required to protect,t here.

If any group can opt out (such as, I understand, firefighters*)[28]; **then *every* group deserves that equal right**. Others should not be second class citizens, subject to fewer protections.

It would go far to helping this cause if anyone complicit in promoting or passing the legislation (and then after that, *their* families) were required to be the first subjected, for a substantial test period, to the *greatest* amount of exposure that anyone *else* (and their families) may be subjected to, when new policies of this type are rolled out. It will still not do them equal damage; because they may not represent the vulnerabilities that others will have; but such a policy might help them to think twice. *That* is a bill I would strongly endorse.

Most who are now affected – were not, until they were. This may become you – or your child or grandchild. Moreover, if you have a child, or a grandchild, his sperm, or her eggs (all of which she will already have by the time she is a fetus in utero), will be affected by the oxidative stress damage created by the electromagnetic radiation, in a fashion that may affect your future generations irreparably.

It was noted above that, among survey completers, fully half of those who were employed at the time they developed electrosensitivity, lost employment *due to* this problem. (This may understate the scope of the tragedy, since this most-affected group may be least likely to be able to respond to an online survey.) **Many who previously had no problem navigating in the world are now restricted from access to basic services** like hospital care, post offices and libraries because of these problems. With each new introduction of technology that exposes many to yet a new nondiscretionary source of electromagnetic radiation, particularly (but not exclusively) that which emits pulsed radiation in the radiowave-microwave part of the spectrum, a new group of people are affected; and the suffering of those who are already affected increases greatly.

Please, defend the public and our future. Protect the rights of the individual and the locality, against a form of incursion that will lead to serious harm to some – and set a terrible precedent. **Vote no on California SB 649**, and urge that everyone else do the same.

Sincerely,

Beatrice Alexandra Golomb, MD, PhD
Professor of Medicine
UC San Diego School of Medicine

*Comment on the fire fighter exemption:"The legislature granted an exemption from SB 649 to the firefighters who requested it for health reasons. Throughout California firefighters have long complained of often disabling symptoms from cell towers on their stations. Cities frequently rent out space on fire stations to add to city revenue. …Symptoms experienced by the firefighters have included neurological impairment including severe headache, confusion, inability to focus, lethargy, inability to sleep, and inability to wake up for 911 emergency calls. Firefighters have reported getting lost on 911 calls in the same community they grew up in, and one veteran medic forgot where he was in the midst of basic CPR on a cardiac victim and couldn't recall how to start the procedure over again…Prior to the installation of the tower on his station, this medic had not made a single mistake in 20 years. A pilot study (2004) of California firefighters showed brain abnormalities, cognitive impairment, delayed reaction time, and lack of impulse control in all 6 firefighters tested (https://ecfsapi.fcc.gov/file/7022117660.pdf). This study led to the overwhelming passage of Resolution 15 by the International Association of Firefighters in Boston in August 2004. Res. 15 called for further study and was amended to impose a moratorium on the placement of cell towers on fire stations throughout the US and Canada."[15 28]
Clearly, others who experience similar problems also deserve protections.

Optional – More on the Science

There is a robust literature showing that electromagnetic radiation, including in nonionizing frequencies, and at *levels*[29, 30] *below* those that are cause thermal effects (heating) – causes physiological effects, injury, and cell death –not only in humans but many animals and plants[3, 7, 31-49]. Unsurprisingly, industry has sought – against the tide of evidence to the contrary - to maintain that radiation must be ionizing or heating to cause injury.

Scores or hundreds of studies show that radiation, including specifically radiowave-microwave spectrum radiation, and including low-level exposure, can impair antioxidant defenses, increase "oxidative stress" (free radical injury) and damage mitochondria, the energy producing parts of cells[1, 2, 34, 50-6930, 70-104105-13646, 137-171]. These effects occur with ionizing and nonionizing radiation, at thermal and subthermal levels. (Indeed, much or most of the damage by ionizing radiation, and radiation above the thermal limit, occurs by mechanisms also documented to occur without ionization, and below the thermal limit.) These

mechanisms cohere with the mechanisms documented to play a role in symptoms and health conditions that are reported in those who are electrosensitive – extending to seizures[172-176], heart failure[177-184] and cognitive decline[5, 32, 57, 108, 185-195].

These mechanisms have known involvement in induction of **brain cancer, metabolic diseases like obesity and diabetes, autism, autoimmune disease, and neurodegenerative conditions**, conditions that have exploded. In each case these have been linked, or presumptively linked, in some studies to electromagnetic radiation[8, 9, 16, 34, 196-219].

Such radiation also has effects on sperm[33, 100, 220-228]; and the DNA of sperm[229] (consistent with recent news reports of marked recent declines in sperm counts and function)..

Such radiation also has toxic effects in pregnancy[230], to the fetus and subsequent offspring[231-235] including at low levels[236], and is tied to developmental problems in later life, including attention deficit and hyperactivity[31, 235-241]. It is critical to defend pregnant women (and eggs of girls who may at a later time become pregnant) from exposures with such toxicity.

Electromagnetic radiation across much or most of the spectrum (not excluding visible light) has been shown to depress levels of melatonin[40, 72, 242-252], which is best known for its role in sleep (and indeed, impaired sleep is the most consistent symptom in affected individuals[10, 11]).

Melatonin is in fact a critical antioxidant that defends the body against harm from *many* toxic exposures[253-266] **including electromagnetic radiation itself** [61, 66, 67, 82, 101, 107, 118, 121, 138, 144, 151, 204, 249, 267-284] **- reducing the oxidative stress** that is implicated in cancer, metabolic diseases like obesity and diabetes, autism, autoimmune disease, bipolar disorder and neurodegenerative conditions, and that also plays a role in heart attack and stroke[9, 285-329330-343].

Radiation, and specifically radiation in the radiowave-microwave portion of the spectrum can also depress levels of other critical antioxidant systems that also defend the body against chemical, radiation, and other sources of injury. These other antioxidant systems include the glutathione system, superoxide dismutase and catalase[81, 102, 115, 116, 233, 344-358] - which are also involved in defending against health problems.

This suggests that depression of antioxidant defenses due to electromagnetic radiation may magnify risk of chemically induced health effects (and depression of antioxidant systems due to some chemicals may amplify risk of harm from electromagnetic radiation). Indeed just such effects have been reported[359, 360].

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