A G E N D A
JAMES CITY COUNTY BOARD OF SUPERVISORS
READING FILE
County Government Center Board Room
101 Mounts Bay Road, Williamsburg, VA 23185
July 11, 2017
5:00 PM

A. FOR YOUR INFORMATION

1. Citizen Protest Letters to Dominion Virginia Power

ITEM SUMMARY

DATE: 7/11/2017

TO: The Board of Supervisors

FROM: Bryan J. Hill, County Administrator

SUBJECT: Citizen Protest Letters to Dominion Virginia Power

ATTACHMENTS:

	Description	Type
🗋	Part 1	Exhibit
🗋	Part 2	Exhibit
🗋	Part 3	Exhibit
🗋	Part 4	Exhibit

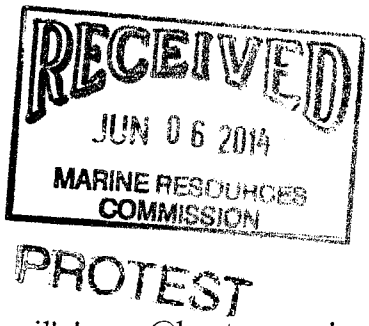
REVIEWERS:

Department	Reviewer	Action	Date
Board Secretary	Fellows, Teresa	Approved	7/5/2017 - 11:29 AM

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 06, 2014 6:30 AM
To: Howell, Beth (MRC)
Subject: FW: VMRC #13-0408; Dominion Surry-Skiffes Creek-Whealton Project
Attachments: 3376_001.pdf

Protest!!!



Sent with Good (www.good.com)

-----Original Message-----
From: Wendy Yohman [wyohman@cblaw.com]
Sent: Thursday, June 05, 2014 05:27 PM Eastern Standard Time
To: Stagg, Ben (MRC); 'bstagg@mrc.state.va.us'; 'randy.l.steffey@usace.army.mil'; 'rgary@hunton.com'; 'leo.rogers@jamescitycountyva.gov'
Cc: Mike Quinan
Subject: VMRC #13-0408; Dominion Surry-Skiffes Creek-Whealton Project

Gentlemen,

At Mike Quinan's request, please see the attached correspondence. Please let me know if you have any difficulty viewing the attachment.

Wendy

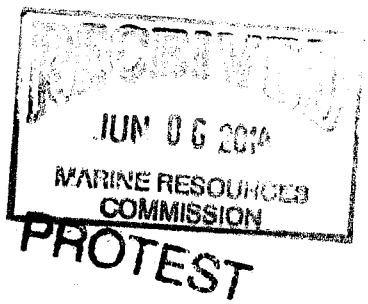
Wendy Paige Corker Yohman
Legal Secretary
CHRISTIAN & BARTON LLP
ATTORNEYS AT LAW
909 East Main Street, Suite 1200
Richmond, Virginia 23219
804.697.6308 tel
804.697.4112 fax
wyohman@cblaw.com
www.cblaw.com

CHRISTIAN & BARTON, LLP
ATTORNEYS AT LAW

MICHAEL J. QUINAN
Direct Dial: 804.697.4149
Direct Fax: 804.697.6149
E-mail: mquinan@cblaw.com

June 5, 2014

BY OVERNIGHT COURIER AND E-MAIL



Mr. Robert B. Stagg
Environmental Engineer
Virginia Marine Resources Commission
Third Floor
2600 Washington Avenue
Newport News, VA 23607

RE: VMRC #13-0408; Dominion Surry-Skiffes Creek-Whealton Project

Dear Mr. Stagg:

On behalf of our client, BASF Corporation ("BASF"), we are submitting by and with this letter comments and supporting documentation related to the referenced joint permit application ("JPA") submitted by Virginia Electric and Power Company t/a Dominion Virginia Power ("Dominion") for the above-referenced proposed electric power transmission line project ("Proposed Project") now under review by Virginia Marine Resources Commission ("VMRC") and the U.S. Army Corps of Engineers ("Corps"). These comments are submitted to VMRC pursuant to your letter of May 21, 2014 to BASF requesting such comments.

Under Chapter 12 of Title 28.2 of the Code of Virginia, cited in your letter as authority to issue the permit for encroachment onto state-owned bottomlands, we note that Code § 28.2-1205.A requires the VMRC to consider a project's effects on adjacent or nearby properties and tidal wetlands, among other things. As alluded to in your letter, under the plans submitted by Dominion's agent Stantec for the Proposed Project's JPA, BASF owns the property on the eastern shore of the James River in James City County on which the Proposed Project's transmission line river crossing would come ashore and then continue inland ("Property").

The Property is a former manufacturing facility that is now undergoing extensive and complex environmental remediation approved and overseen by both the United State Environmental Protection Agency ("EPA") and the Virginia Department of Environmental Quality ("DEQ"). In addition, the Property, either in part presently or in its entirety upon further progress in the remediation efforts, is well-suited for mixed-use redevelopment. Indeed, given its prime location on the north shore of the James River and with its varied and long waterfront exposure and current wildlife refuge area, the property is particularly unique in an area that has otherwise become developed over the years.

Unfortunately, the Proposed Project's proposed route under consideration as part of the JPA would involve the landing of the river crossing of the transmission line onto and the complete bisection of the Property ("Proposed Route"). Even worse, and discussed more fully below, the Proposed Route across the Property would pose substantial and extremely costly environmental concerns, upset planned redevelopment of the BASF property, and dramatically and adversely affect the scenically significant and historic waterfront of the Property and surrounding area, though the environmental impacts on the Property alone should be more than enough to render the Proposed Route unacceptable.

1. Environmental Remediation Impacts. The Proposed Route would significantly interfere with, disturb and prevent critical elements of a complex Resource Conservation and Recovery Act Corrective Action remediation of soil, groundwater and surface water contamination associated with past industrial activities on the Property. In particular, the Proposed Route would entail siting of transmission line towers on, immediately adjacent to, or otherwise in close proximity to closed industrial landfill and/or wastewater lagoon areas or installed remediation systems, which could generate new or aggravate existing groundwater contamination in ways not currently being addressed by the designed groundwater remediation systems. Siting the transmission line along the Proposed Route would also entail the eradication of a substantial portion of planted trees specifically designed for forested phytoremediation of site contamination. Potential replacement with grass or small brush would not achieve the remediation goals of the currently designed forested system. Other aspects of the remediation efforts include constructed wetlands near the Proposed Route. Such negative consequences at worst will lead to the need to replace and/or reengineer substantial components of the complex set of remediation systems already approved by DEQ and subject to EPA oversight, resulting in millions of dollars of wasted on-site improvements and infrastructure and years of planning and design effort. At best, such impacts may create uncertainty about the effectiveness of the remediation systems that will require changes to and increased monitoring efforts, again resulting in greater costs, to ensure there are no unintended releases or aggravation of contamination on the property. It would be an odd and incongruous result indeed for VMRC to issue a permit designed to minimize impacts to state owned bottom lands and wetlands for a power line crossing that would at the same time jeopardize the feasibility of and prior investment into sensitive groundwater and soil remediation projects located on tidal waterfront property.

2. Aesthetic Impacts. The Proposed Project, and especially the Proposed Route across the Property, would by its very nature entail substantial negative impacts on the viewshed from and on the BASF property and upset the wildlife sanctuary now on site. These features of the Property, currently tremendous given the long waterline and multidirectional perspectives of the James River from the Property, are likely to be so substantially impacted as to cause serious negative consequences on the redevelopment potential for the Property.

3. Property Redevelopment Impacts. As mentioned above, the Property lends itself greatly to many redevelopment opportunities given its unique location on the James

River shoreline, extensive and varied waterfront, and proximity to the Williamsburg and James City County markets and the many cultural and recreational amenities in that region. The attractiveness of such as a large site for a well-planned mixed use redevelopment is clear, and plans for such redevelopment are already underway. Should the Proposed Project be approved, the Proposed Route will greatly diminish the opportunity for and return on such redevelopment due to the presence of the transmission lines across the center of the Property and the negative impacts on the aesthetic value of the Property as noted above.

4. Property Valuation Impacts. Adding insult to injury, any and certainly all of the effects of the Proposed Route as discussed above can be reasonably expected to lead to a substantial decrease in the valuation of the Property. In particular, should the environmental remediation effort be compromised, the ability to make productive use of the Property in its highest and best use could be greatly impaired.

In addition to the specific concerns raised here, VMRC should also understand that BASF has previously asked the Corps to initiate an Environmental Impact Statement review pursuant to the National Environmental Policy Act due to the number, nature and complexity of the negative impacts posed by the Proposed Project, including those to the Property itself. Enclosed is our letter to the Corps of last September, which we include as part of the comments submitted herein. In any event, BASF requests that VMRC conduct a public hearing for this JPA before any permit decision is made given the substantial concerns and issues presented.

In light of the serious negative consequences posed by the Proposed Project in many respects, but especially given those posed by the Proposed Route onto and across the Property as described above, BASF requests that the permit for the Proposed Project be denied.

Thank you for your consideration of these comments and requested actions.

Sincerely,

Michael J. Quinan

Enclosure

cc: Mr. Randy Steffey
Richard D. Gary, Esquire
Leo P. Rogers, Jr., Esquire

CHRISTIAN & BARTON, L.L.P.
ATTORNEYS AT LAW

MICHAEL J. QUINAN
Direct Dial: 804.697.4149
Direct Fax: 804.697.6149
E-mail: mquinan@cblaw.com

September 26, 2013

[via UPS for delivery on Sept. 27, 2013]

Norfolk District, Corps of Engineers
(ATTN: CENAO-WR-R)
803 Front Street
Norfolk, Virginia 23510-1096

Re: NAO-2012-00080; 13-V0408
Dominion Surry-Skiffes Creek-Whealton Project

Dear Sir or Madam:

On behalf of our client, BASF Corporation ("BASF"), we are submitting by and with this letter comments on the referenced joint permit application submitted by Dominion Virginia Power ("Dominion") for a proposed transmission line project ("Proposed Project"). These comments are submitted to the Corps of Engineers ("Corps") pursuant to the public notice of such joint application posted August 8, 2013.

BASF owns the property on the eastern shore of the James River in James City County on which the Proposed Project's transmission line would come ashore. In Dominion's application to the Virginia State Corporation Commission for this same Project (SCC Case No. PUE-2012-00029), river crossings with two different landing points and with two different routes across the BASF property were offered and considered. Dominion favors the river crossing and route across the BASF property designated as Variation 1, which appears to be the same route proposed in Dominion's joint permit application under review by the Corps. That route would pose substantial and extremely costly environmental concerns, upset planned redevelopment of the BASF property, and dramatically and adversely affect the scenically significant and historic waterfront of the property and surrounding area, though the environmental impacts on the BASF property alone should be more than enough to render Variation 1 unacceptable. In short, Variation 1would significantly interfere with, disturb and prevent critical elements of a complex Resource Conservation and Recovery Act Corrective Action remediation of soil, groundwater and surface water contamination associated with past industrial activities on the BASF property, as discussed in the attached documents. BASF greatly prefers the river crossing and route designated as Variation 3 in the SCC application, or an alternative presented by Dominion at the SCC's evidentiary hearing and designated as Variation 4. (Variation 4 has a different river crossing but the same landing point and route across the BASF property as Variation 3.) Variations 3 or 4 would have a greatly reduced impact on the environmental remediation project and on the BASF property generally.

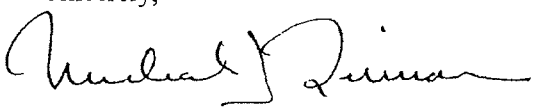
In the SCC Hearing Examiner's Report of August 2, 2013, the Hearing Examiner recommended that the Commission select the Variation 4 river crossing and route, and that Variation 1 should only be used if Variations 3 and 4 become impossible due to the failure of the James City County Economic Development Authority to provide a necessary easement. (The EDA has already agreed to provide that easement, so this caveat appears moot.) Comments on the Hearing Examiner's Report submitted on behalf of BASF, which are attached hereto and incorporated herein by reference as BASF's comments on Dominion's joint application under review by the Corps, address the reasons why a transmission line on the Variation 1 route would have serious adverse impacts on the BASF property and why it is critical that either the Variation 3 or 4 route be used in lieu of Variation 1, the proposed route in the joint application. BASF's comments on the Hearing Examiner's Report refer to the relevant testimony and evidence of record in the SCC proceeding, which are likewise incorporated and submitted for your consideration (available online at http://docket.scc.state.va.us:8080/vaprod/main.asp - search for PUE-2012-00029).

BASF urges the Corps to deny any permits for the Proposed Project based on the Variation 1 route. If the Proposed Project is to be approved, it should only be approved for construction along the Variation 3 or 4 route.

Further, should the Variation 1 river crossing and route be considered as a basis for the Proposed Project, BASF requests that a public hearing be scheduled given the substantial concerns and issues presented by the Proposed Project. In that event, BASF further believes an Environmental Impact Study would be required under the National Environmental Policy Act and should first be performed to inform the permit process. Finally, if the Corps determines that the Proposed Project would impact historically significant properties or interests, BASF would be an "organization with a demonstrated interest in the [Proposed Project] . . . due to the nature of [its] legal or economic relation to the undertaking or affected properties, or [its] concern with the undertaking's effects on historic properties," and therefore requests that it be treated as a Section 106 consulting party in the joint application process.

Thank you for your consideration of these comments and requested actions.

Sincerely,



Michael J. Quinan

MJQ

cc: Randy Steffey [via e-mail to randy.l.steffey@usace.army.mil
Richard D. Gary, counsel for Dominion Virginia Power
Leo P. Rogers, Jr., County Attorney for James City County

Atkins, Lou (MRC)

PROTEST

From: Howell, Beth (MRC)
Sent: Friday, August 22, 2014 5:55 AM
To: Atkins, Lou (MRC)
Subject: FW: Dominion Transmission Lines
Attachments: 8.21.14 Stagg.pdf

From: Stagg, Ben (MRC)
Sent: Thursday, August 21, 2014 3:43 PM
To: Howell, Beth (MRC)
Subject: FW: Dominion Transmission Lines

RECEIVED
AUG 21 2014
MARINE RESOURCES COMMISSION

Protest 2013-0408

Ben Stagg L.S.
Chief Engineer, Western Area
Engineering/Surveying Department
Environmental Engineer
Habitat Management Division
VMRC
757-247-2225 (Engineering/Surveying)
757-247-2009 (Habitat Management)

From: Alexis Feria [mailto:aferia@preservationvirginia.org]
Sent: Thursday, August 21, 2014 2:11 PM
To: Stagg, Ben (MRC)
Cc: 'Elizabeth Kostelny'
Subject: Dominion Transmission Lines

Please see the attached letter on behalf of Preservation Virginia.

Thank you!

Alexis Feria
Executive Assistant

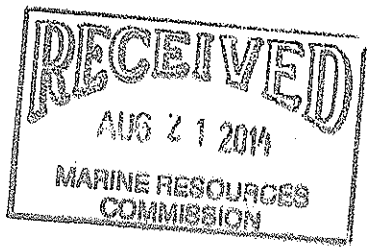
PRESERVATION VIRGINIA
204 West Franklin Street
Richmond, VA 23220
Phone: 804-648-1889 x. 300 | **Fax:** 804-775-0802
E-Mail: aferia@preservationvirginia.org | **Web:** preservationvirginia.org

Connecting people and resources to ensure the continued vitality of Virginia's historic places for 125 years

PRESERVATION VIRGINIA

PROTEST

21 August 2014



Mr. Ben Stagg
Chief Engineer
Virginia Marine Resources Commission
ben.stagg@mrc.virginia.gov

Dear Mr. Stagg:

On behalf of Preservation Virginia's Board of Trustees, staff, and statewide members, I am writing to you in reference to the Dominion proposal to seek a permit to construct 17 towers across a 4.1 mile stretch of the James River.

Preservation Virginia is the nation's oldest statewide preservation organization. For 125 years, we have served as stewards of historic places including Historic Jamestowne, Bacon's Castle, the John Marshall House, Patrick Henry's Scotchtown and Cape Henry Lighthouse—all National Historic Landmarks. With this experience, we serve as an advocate for the Commonwealth's irreplaceable historic and cultural assets.

At Historic Jamestowne, Preservation Virginia undertook an archaeological research project to find and study the archaeological remains of the 1607 James Fort. The research, uncovered artifacts, and interpretation of early American history resulting from this ongoing study continues to attract worldwide attention. This site and others, as part of America's Historic Triangle, generate national and international heritage tourism dollars for the region and state. While our excavations are confined to our property, the history we convey encompasses the James River and its essential role in defining the character of the region and the nation.

We are very concerned about the impact that this proposed project will have on the historic, cultural, scenic, and natural assets of the James River and its national and international significance. In 2007, Congress took two significant actions: naming the James "America's Founding River" and establishing the Captain John Smith Chesapeake National Historic Park. The first of its kind, this NPS unit focuses attention on the waterways used by the Native Americans and early settlers. The section of the James River potentially altered is deemed one of the most historic and one of the best preserved.

Not that long ago, Virginians thought the James River had been irreparably damaged by chemicals leaked into the water and other abuses. Through thoughtful policy and persistent vigilance, the James River has made a comeback. The endangered sturgeon population is being regained. Oyster reefs have been reestablished. Recreational use and fishing is now a major recreational activity. This proposed project could jeopardize these gains.

PROTEST

Tourism is a major economic driver in the region and helps support programs that maintain the integrity of the James River. More than 6 million people come to the region each year for an authentic experience. Individual landowners believe so strongly in the need to maintain the quality of this experience that they have donated easements on both sides of the James River to ensure the unspoiled viewsheds in perpetuity.

The decision to compromise this stretch of the James River will be a legacy that Virginians will have to live with and justify for the next 100 years and beyond. Preservation Virginia urges you to consider this permit carefully. We are an active consulting party in the Section 106 process being conducted by the Army Corps of Engineers. We believe strongly that if alternatives are considered, then innovative solutions that meet the need for power while respecting and protecting these invaluable resources will resolve this matter.

Thank you for your work to maintain the integrity and quality of Virginia's waterways.

Sincerely,

Elizabeth S. Kostelny
Executive Director

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Thursday, August 28, 2014 7:26 AM
To: Howell, Beth (MRC)
Subject: FW: Virginia Dominion Power Transmission Line

Protest to 2013-0408

PROTEST

Ben Stagg L.S.
Chief Engineer, Western Area
Engineering/Surveying Department
Environmental Engineer
Habitat Management Division
VMRC
757-247-2225 (Engineering/Surveying)
757-247-2009 (Habitat Management)

From: Chappell, Edward [mailto:echappell@CWF.org]
Sent: Wednesday, August 27, 2014 11:47 AM
To: Stagg, Ben (MRC)
Subject: Virginia Dominion Power Transmission Line

The Colonial Williamsburg Foundation

"THAT THE FUTURE MAY LEARN FROM THE PAST"

August 25, 2014

Mr. Ben Staff
Chief Engineer
Virginia Marine Resources Commission
Ben.stagg@mrc.virginia.gov

Dear Mr. Stagg:

I encourage you to consider the detrimental environmental impacts that the proposed Virginia Dominion Power transmission line from Surry to Skiffes Creek would have on the James River and the historic properties around it, and to deny Dominion's application for a permit.

This section of the James River is a precious natural and historic resource, of international importance, recognized as a central element in the Captain John Smith Water Trail. Heritage tourism is essential to Virginia's economy, and that tourism is drawn largely by the scenic character of the Historic Triangle, focused on the James River. A non-industrialized James is essential to the identity of the region.

The James River from Jamestown to Carter's Grove and Skiffes Creek remains remarkably unspoiled, scenic, and valuable to the Commonwealth, both itself as a natural resource and as the revered setting for one of the nation's greatest concentrations of historic sites. These sites have long been valued. Efforts to preserve and designate them as a means toward further protection include acquisition of parts of Jamestown by the Association for the Preservation of Virginia Antiquities (now Preservation Virginia) in 1893, acquisition of the rest of the island by the National Park Service and its creation of the Colonial Parkway and the Colonial National Historical Park beginning in the 1920s. Jamestown Island and Carter's Grove are National Historic Landmarks, and the Parkway is on the National Register of Historic Places. The U.S. Congress designated the Smith Trail as the nation's first national water trail in 2006. The proposed transmission line would devastate a broad section of the James and the scenic view from Carter's Grove.

Dominion has argued that their Surry power-plant domes already bring industrial character to the river, making acceptable the far larger-scale and more intrusive towers, transmission cables, and associated lights. This argument overlooks the vast difference in scale and the fact that the lines would profoundly affect the James River itself. It also illustrates the degree to which creation of such industrial development encourages further, future encroachment on the natural and scenic resources. Building the transmission line would be a destructive shift away from the sustained efforts to protect this part of the great James River and its surrounding land.

This is a project that must receive a full Environmental Impact Statement. I encourage the Virginia Marine Resource Commission to call for an EIS and to deny the application.

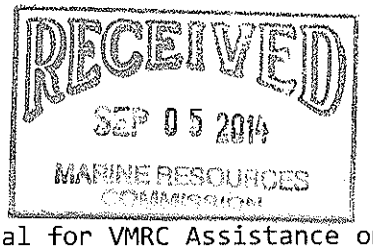
Sincerely yours,

Edward A. Chappell
Roberts Director of Architectural
and Archaeological Research
Colonial Williamsburg Foundation

PROTEST

Atkins, Lou (MRC)

From: Howell, Beth (MRC)
Sent: Friday, September 05, 2014 8:03 AM
To: Atkins, Lou (MRC)
Subject: FW: Save the James Alliance Concern and Appeal for VMRC Assistance on Surry-Skiffes Creek Permit Review
Attachments: STJA Ltr to VMRC 090414.pdf



-----Original Message-----
From: Stagg, Ben (MRC)
Sent: Friday, September 05, 2014 7:18 AM
To: Howell, Beth (MRC)
Subject: FW: Save the James Alliance Concern and Appeal for VMRC Assistance on Surry-Skiffes Creek Permit Review

Protest 2013-0408

Ben Stagg L.S.
Chief Engineer, Western Area
Engineering/Surveying Department
Environmental Engineer
Habitat Management Division
VMRC
757-247-2225 (Engineering/Surveying)
757-247-2009 (Habitat Management)

-----Original Message-----
From: Margaret Nelson Fowler [mailto:onthepond1@gmail.com]
Sent: Thursday, September 04, 2014 5:23 PM
To: Stagg, Ben (MRC)
Cc: James Zinn; Wayne Williamson
Subject: Save the James Alliance Concern and Appeal for VMRC Assistance on Surry-Skiffes Creek Permit Review

Mr. Stagg,

Please see the attached letter that expresses our concerns on this issue in detail. We are grateful for your time in reviewing this matter. If we can provide any additional information to the VMRC as you review this project, please let us know immediately.

Best,
Margaret Nelson Fowler, Trustee

Save the James Alliance
757.565.3213

PROTEST

Save the James Alliance
406 River's Edge Williamsburg, VA 23185
www.SaveTheJames.com

September 4, 2014

Mr. Ben Stagg
Chief Engineer
Virginia Marine Resources Commission

TRANSMITTED VIA EMAIL

Dominion Surry-Skiffes Creek – Whealton Project

Dear Mr. Stagg:

We write to you as representatives of Save the James Alliance, a group whose singular focus is to stop the impending damage to the historic, Lower James River that will be caused by the construction of Dominion Virginia Power's Surry-Skiffes Creek 500 kV Extra High Voltage transmission project. We understand the need for a reliable power system throughout the Commonwealth of Virginia, in general, and on the Hampton Roads Peninsula, specifically, given the impact of the announced closings of the region's coal-fired power plants. However, for the reasons noted below, we believe that serious thought must be given to the impact of this project on our internationally recognized irreplaceable historic treasures, and that an intellectually honest consideration of plausible alternatives must be deliberated. We believe these actions are consistent with the role of the Virginia Marine Resources Commission (VMRC) in their joint review of this application with the U.S. Army Corps of Engineers (ACOE). As your mandate recognizes, Virginia's marine resources extend far beyond merely fishing and boating.

Impact on the Historic James River

> *"The drama that has played itself out along the shores of the James is as powerful a tale as has ever been told, a sweeping saga of astonishing moments narrated by a vivid cast of characters as appear anywhere in the annals of history: pirates and tobacco barons, slave traders and thieves; evangelicals and turncoats, patriots and spies; redcoats and rebels, smugglers and knaves; soldiers of fortune, leaders of insurrection and peddlers of doom; Powhatan and Pocahontas, Patrick Henry, John Smith, Jefferson, Washington, Lincoln, and Lee. Their voices testify to the rawest ingredients of nation-building: accomplishment and ruin, charity and greed, selfishness and sacrifice, revolution, independence, and civil*

1. *From "The River Where America Began/ A Journey Along the James" by Bob Deans, Rowan & Littlefield Publishers, Inc. 2007.*

PROTEST

war, all within earshot of this river's watery spine. And, for all its celebrated triumph and glory, the river has witnessed hatred, betrayal, heartache, and loss on a scale along a timeline unsurpassed anywhere else in the country." [1]

It's hard to imagine that the betrayal referred to in Bob Dean's book was intended to suggest betrayal such as that devised by Virginia Dominion Power as it looks to build 17 massive electric transmission towers in this very same historic section of the James River. If this project goes forth as planned, future visitors to Jamestown Island, the Colonial National Parkway and Carter's Grove will long wonder why anyone allowed 17 immense towers to be built in the midst of America's founding waters. Today, throngs of visitors can experience this portion of the river much as it existed in 1607, but, yet, in a single, imperious move, Dominion Virginia Power will destroy this irreplaceable river view as if it were nothing more than pesky, mosquito-infested water hole menace. It is interesting to recall that not long ago this same Dominion Virginia Power fought hard to stop construction of a bridge across the James, just up river, near where the Jamestown-Scotland ferry runs. Ironically, their concern at that time was to prevent impaired views of this beautiful river vista from ***their*** newly constructed, residential real estate development project, Governor's Land. Curious the difference time and ownership make, isn't it.

Today's Lower James River is internationally recognized as America's Founding river and, thus, it attracts millions of visitors, annually. The Historic Triangle gives rise to over $1 billion in visitor spending and generates $80 million in state and local taxes, annually. The river's shores touch the lower third of the historic triangle of Jamestown, Williamsburg and Yorktown, all connected by the National Park Service's, Colonial National Parkway, a National Historic Landmark, from where these towers will be painfully visible. It is an imperative that the potentially damaging environmental impacts of this project to the Colonial National Parkway, which meanders just as naturally and iconically as the river itself, be thoroughly evaluated through a comprehensive Environmental Impact Statement, rather than merely settling for a boiler plate environmental assessment, so as to be sure that there is a full understanding of what will happen to the very soul of this place if the project is allowed to move forward as currently configured.

Dominion Power's Failure to Consider Plausible Alternatives

Since the announcement of this project in 2012, Dominion Power has failed, repeatedly, to serve its customers, and its responsibility to the Commonwealth, by disregarding all plausible alternatives, intractable in their own idea of building 17 lattice-style transmission towers across the James that will range in height from approximately 200 to 300 feet tall. To date, Dominion Power has presented only one alternative, that which involved a path through over 40 miles of woods, significantly impacting the Chickahominy River. It was in their initial presentation to James City County Board of Supervisors that Dominion offered the ruse of a Chickahominy route, showing how it crossed in or near wetlands, rivers, schools, churches, hospitals and other residential developments. The prospect of serious environmental destruction in using this route was immedi-

PROTEST

ately evident; Dominion knew that, but put it forth, knowing that the proposed route would be rejected. Dominion also knows that 500 kV lines are overkill. The 500 kV line will be immediately split to 230 kV once they reach the northern shoreline of the river in James City County. So, why not split the lines before crossing the river? By continuing the facade that 500 kV lines are essential, they condemn the project based on costs. A more feasible use of submerged, multi-phase, 230 kV lines would cost modestly more than the overhead alternative, but be much more in line with cost estimates for the proposed 500 kV overhead project, and protect the priceless, evocative 17th century viewshed.

It should be noted that a 7.4 mile span of three, 230 kV, submerged lines were recently approved by the SCC across the York River at a cost of $74 million. These lines, too, were originally proposed for overheading, but were later submerged to meet the order of the United States Navy. While the James has limited military purpose, its unique prominence in America's history, as described above, demands a hard, honest look at alternatives. We believe there is sufficient expert witness testimony that demonstrates that there are multiple alternatives that could accommodate the power needs of the peninsula at costs similar to what's been proposed for overhead construction.

Practical alternatives were about to be explored by Virginia's State Corporation Commission (SCC) in its 2013 public hearings when the originally assigned Hearing Examiner, Michael D. Thomas, was mysteriously, and summarily, removed from this case. His removal followed his sympathetic public remarks signaling his sensitivity, at least, to the historic assets of the area. He further put the burden of proof on Dominion Power to explain why they would harm such a significant nationally treasured area or to engineer a workable alternative. Closing ranks, the SCC refused to discuss the circumstances surrounding the lead examiner's reassignment, only to say it was "due to scheduling." The next hearing examiner ran a workmanlike process that clearly played "down the middle" of Dominion Power's fairway. We get it. It's not hard to understand Dominion Power's motivation in this project; they do not want the added complication and expense of going underwater every time they cross a river. We understand this concern, but ***the*** singular point that neither Dominion or the Virginia SCC understand, and they must, is that ***the James is not just any river***.

Unfortunately, Dominion Power holds a vast edge to any opposition when it comes to money, influence and engineering expertise, thus adroitly assuring themselves that they will not face challenges in the SCC process through the nuanced application of these monopoly-derived assets. And, they are correct. While outside experts presented a number of possible alternatives, nothing was seriously considered because Dominion single-mindedly pounded, both technically and politically, its solution as the ***only*** option that meets the power needs on the Hampton Roads peninsula; historic and cultural assets be damned.

While Save the James believes a more robust discussion of the 230 kV underwater solutions should be explored, we also believe there are yet other plausible alternatives. In particular, we understand that a conversion of the Yorktown coal-fired station to natural gas was not considered due to supply constraints on the Hampton Roads peninsula, however, we also understand that ample supply of natural gas exists on the south side of the James River, supplies which could be piped under the river to fuel a modified Yorktown plant. This path would obviously not be a quick solution, but the long-term benefits of lower cost natural gas have not been adequately studied. Moreover, the use of liquid natural gas (LNG) would enable the customers on the Hampton Roads peninsula to take advantage of a much greener source of electric power and, also help in meeting new federal greenhouse gas emission standards.

Other Matters

Save the James looks forward to assisting the Virginia Marine Resources Commission in its in-depth review of Dominion Power's application for this project. We ask, respectfully, that the VMRC process be a deliberate and exhaustive one that undertakes a comprehensive review of this critical matter. We welcome VMRC's leadership in exploring the full range of options for this project, which by definition demands that an Environmental Impact Statement be prepared and reviewed prior to permits being granted.

Please stop to think -- once built, these towers will stand for generations, opening a nearly pristine segment of the river to the broken window of real future industrialization. The Lower James in Williamsburg has managed to avoid that fate for over 400 years; ask yourself, why should it be allowed to start now?

Sincerely yours,

Margaret Nelson Fowler

Margaret Nelson Fowler, Trustee

C. Wayne Williamson

C. Wayne Williamson, Board Member

James M. Zinn

James M. Zinn, Trustee

COMMONWEALTH of VIRGINIA

Marine Resources Commission
2600 Washington Avenue
Third Floor
Newport News, Virginia 23607

Molly Joseph Ward
Secretary of Natural Resources

John M.R. Bull
Commissioner

February 14, 2017

Robert G. Beck
1323 Jamestown Road, Suite 101
Williamsburg, VA 23185

Re: VMRC #2013-0408

Dear Mr. Beck:

This will acknowledge receipt of your letter, dated February 2, 2017, in which you state objections to the request by Virginia Electric and Power Company to construct an electric power transmission line project across the James River from Surry County to James City County.

You provided photographs of power lines at a mini storage facility you constructed in Chesapeake in the 1980's. You further note your opposition to the placement of power lines in the James River.

Your objections are being made part of the file for this application and copies of this letter and your letter are being forwarded to Virginia Electric and Power Company and their permit agent, Stantec, for their consideration.

If you have any additional questions, please feel free to contact me at 757-247-2225.

Sincerely,

Ben Stagg
Environmental Engineer

BS/lra
HM
cc: Department of Environmental Quality #6
U. S. Army Corps of Engineers #6
James City County Wetlands Board
Surry County Wetlands Board
Applicant
Agent

PROTEST

Atkins, Lou (MRC)

From: Howell, Beth (MRC)
Sent: Monday, June 19, 2017 2:28 PM
To: Atkins, Lou (MRC)
Subject: FW: Deny Dominion Transmission Lines, Preserve America's Birthplace

#13-0408

From: Watkinson, Tony (MRC)
Sent: Monday, June 19, 2017 1:33 PM
To: Stagg, Ben (MRC) <Ben.Stagg@mrc.virginia.gov>; Howell, Beth (MRC) <Beth.Howell@mrc.virginia.gov>
Subject: FW: Deny Dominion Transmission Lines, Preserve America's Birthplace

From: MRC - Web Info
Sent: Monday, June 19, 2017 12:27 PM
To: Watkinson, Tony (MRC) <Tony.Watkinson@mrc.virginia.gov>
Subject: FW: Deny Dominion Transmission Lines, Preserve America's Birthplace

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From: Tom [mailto:tomrcor@aol.com]
Sent: Friday, June 16, 2017 1:15 PM
To: MRC - Web Info
Cc: info@preservationvirginia.org
Subject: RE: Deny Dominion Transmission Lines, Preserve America's Birthplace

Dear Commissioner Bull,

The integrity of America's birthplace is at risk. The Constitution of Virginia Article XI states, "it shall be the Commonwealth's to protect its atmosphere, lands, and waters from pollution, impairment, or destruction, for the benefit, enjoyment, and general welfare of the people of the Commonwealth."

The transmission lines proposed by Dominion Power will permanently and irreparably harm the James River and its nearly pristine historic, scenic and environmental assets.

The viewshed of 2017 is the same as that of 1607. Preserve this historic scenic beauty. Please deny the permit and save this history for future generations.

Thomas R. Corbin
4624 34th ST S
Arlington, VA 22206

Atkins, Lou (MRC)

From: Howell, Beth (MRC)
Sent: Monday, June 19, 2017 4:06 PM
To: Atkins, Lou (MRC)
Subject: Protest #13-0408

PROTEST

From: Stagg, Ben (MRC)
Sent: Monday, June 19, 2017 4:03 PM
To: Howell, Beth (MRC) <Beth.Howell@mrc.virginia.gov>
Subject: FW: No Power Lines Across The James River For Dominion Virginia Power

2013-0408

Ben Stagg, LS
Director, Shellfish Aquaculture Leasing & Mapping
VMRC Engineering/Surveying Dept.
757-247-2225

From: Bull, John (MRC)
Sent: Monday, June 19, 2017 3:39 PM
To: Stagg, Ben (MRC) <Ben.Stagg@mrc.virginia.gov>
Subject: FW: No Power Lines Across The James River For Dominion Virginia Power

This may be a duplicate protest letter.

From: Steve Nelson [mailto:sbnelson@gmail.com]
Sent: Monday, June 19, 2017 3:36 PM
To: Bull, John (MRC)
Subject: No Power Lines Across The James River For Dominion Virginia Power

Commissioner Bull,

I know you are receiving this boiler-plate message multiple times, but it is a concise statement of opposition to the power line on the James River. Please remember that every copy of this same message does represent a separate citizen.

The James River is no place for power lines!

The VMRC asks citizens to "join us as protectors of our critical natural resources so that they remain for our children and grandchildren to enjoy them as we do." Dominion Virginia Power's request for a permit from the VMRC to build transmission lines across the historic James River would permanently damage some of the nation's most cherished resources. Please deny Dominion's permit request.

Dominion's plan would dramatically alter the cherished landscape of the James River, disrupt its wildlife, and degrade its many recreational uses. This project also puts at risk decades of investment by the public and private sectors to protect and preserve this important part of our country's past for future generations.

PROTEST

Alternatives exist to this short-sighted proposal. Dominion can route its transmission line in a way that preserves the unique historic, scenic, and environmental assets of the James River. Please deny this permit and demand that Dominion pursue an alternative approach to meeting the region's power needs.

Sincerely,

Steve Nelson

2801 Mosby St.

Alexandria Va 22305

sbnelson@gmail.com

accordingly we urge you to seek alternatives to the overhead transmission lines. And request that Dominion Power provide more information on alternative plans. There are alternatives available to ensure the scenic beauty of the river and economic impact to tourism are not compromised.

Sincerely,

Gillian Cady

PROTEST

6th June, 2017

Dear Commissioner Bull,

I am writing in reference to Permit No. 20130408.

I belief you have the authority to act against the issuance of a the Permit to Dominion Power to build towers across the James River.

My husband, Fred Cady and I feel this would not be in the best interest of our State, & urge you to vote against it.

May 31, 2017

Mr. John M.R. Bull
Commissioner
Virginia Marine Resources Commission
2600 Washington Avenue, Third Floor
Newport News, Virginia 23607

Dear Commissioner Bull,

As a member of the Garden Club of Virginia, I would like to endorse the letter sent to you dated May 3, 2017 related to the proposed Surry-Skiffes transmission line across the lower James River from Nina Mustard, President of the Garden Club of Virginia. Our home is on the Rappahannock River, and we enjoy the very beautiful scenic view of the Rappahannock River Bridge as do tourists, photographers, local real estate agents and restaurants or any other business that benefits from this view. Scenic view sheds matter to our economy. Dominion Power provides a service that we all "must have," but we also need a healthy economy. My current understanding of the power line proposal from Lancaster County to Middlesex County, which Dominion Power wants to place on new very tall poles, will be more expensive than the initial quote they made to place the line under the river bed.

As a very concerned member of the Garden Club of Virginia, I ask you to work with Dominion Power but to please make sure they are held accountable for the long term impact of their proposals on our economy and seafood resources. VMRC has the authority to act in the public interest to protect our rivers as a part of the agency's public trust responsibilities under the Virginia state law. I ask you to deny Permit No. 201304048.

Sincerely,

Marilyn South

Marilyn South

987 Mill Woods Rd
Ware
Va 23176

PROTEST

#13-0408

Atkins, Lou (MRC)

From: Howell, Beth (MRC)
Sent: Monday, June 19, 2017 3:40 PM
To: Atkins, Lou (MRC)
Subject: FW: Skiffes
Attachments: 2017.06.15_Avoidance Plan.pdf

ADDITIONAL INFO
REVISION

From: Stagg, Ben (MRC)
Sent: Monday, June 19, 2017 3:15 PM
To: Howell, Beth (MRC) <Beth.Howell@mrc.virginia.gov>
Subject: FW: Skiffes

Additional information 2013-0408.

Ben Stagg, LS
Director, Shellfish Aquaculture Leasing & Mapping
VMRC Engineering/Surveying Dept.
757-247-2225

From: Courtney R Clements (Services - 6) [mailto:courtney.r.clements@dom.com]
Sent: Monday, June 19, 2017 3:11 PM
To: Stagg, Ben (MRC) <Ben.Stagg@mrc.virginia.gov>
Subject: RE: Skiffes

Attached, please find the avoidance plan, a PDF dated 2017.06.15.
Visuals for the record forthcoming.

Courtney
Environmental Consultant Electric Transmission~ (804) 380-9335

From: Stagg, Ben (MRC) [mailto:Ben.Stagg@mrc.virginia.gov]
Sent: Monday, June 19, 2017 1:20 PM
To: Courtney R Clements (Services - 6)
Subject: [External] RE: Skiffes

I have the first two items but not the last two. I knew Dominion had done some visual simulations in the past. I assume they may be provided at the hearing but wasn't sure. I was unaware of any underwater avoidance document so that might be good to have.

Ben Stagg, LS
Director, Shellfish Aquaculture Leasing & Mapping
VMRC Engineering/Surveying Dept.
757-247-2225

From: Courtney R Clements (Services - 6) [mailto:courtney.r.clements@dom.com]
Sent: Monday, June 19, 2017 12:58 PM

To: Stagg, Ben (MRC) <Ben.Stagg@mrc.virginia.gov>
Subject: Skiffes

ADDITIONAL INFO
REVISION

Ben-I was thinking of a few items that I'm not 100% sure you have, that may be helpful for you to consider, or for the record.

1. The provisional permit issued by the Corps
2. The executed MOA
3. The underwater avoidance archeological plan
4. Visual simulations booklet.

The provisional permit is too large a document to e-mail. Unless you let me know you already have it, I will set up an Eroom, where you can grab it. Even in the Eroom, it will be in 4 parts.
Attached in this e-mail is item #2.
I'll place all the other items in the Eroom, a separate e-mail will be forthcoming with a link to retrieve.
Thanks & I'll talk with you tomorrow.

Courtney

Courtney R. (Fisher) Clements//Environmental Consultant//Dominion Energy
701 E. Cary St.//Richmond, VA 23219//☎ Mobile (804) 380-9335//✉ courtney.r.fisher@dominionenergy.com

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ADDITIONAL INFO
REVISION

Archaeological Resources Avoidance Plan for the Surry-Skiffes Creek Whealton Project

VDHR File: 2011-2071
NAO-2012-0080 / 13-V0408

Stantec

Prepared for:
Virginia Electric and Power Company
d/b/a Dominion Energy Virginia
701 East Cary Street – 12th Floor
Richmond VA 23219
(804) 771-3970

Prepared by:
Stantec Consulting Services Inc.
1049 Technology Park Drive
Glen Allen VA 23059
(804) 355-7200

June 15, 2017

ADDITIONAL INFO
REVISION

Surry-Skiffes Creek and Skiffes Creek-Whealton
Archaeological Resources Avoidance Plan
June 15, 2017

1.0 Introduction

The following Archaeological Resource Avoidance Plan (Avoidance Plan) is provided pursuant to Stipulations I of that certain Memorandum of Agreement by and among Dominion Energy Virginia, the U.S. Army Corps of Engineers (USACE) the Virginia Department of Historic Resources (VDHR), and the Advisory Council on Historic Preservation (ACHP) (April 24, 2017) ("MOA") regarding Dominion Energy Virginia's construction of the Surry – Skiffes Creek – Whealton Transmission Line project (Project). The Project consists of 7.4 miles of new 500 kV overhead transmission line from the Surry Power Station to a proposed Skiffes Creek 500 kV-230 kV-115 kV switching station in James City County, followed by 20.2 miles of new 230 kV overhead transmission line within existing easement that connects with the existing Whealton substation in Hampton, Virginia. The 500 kV transmission line requires an approximate 4-mile crossing of the James River, including the construction of 17 lattice transmission structures and two protective fender systems within the river. The 230 kV line involves the replacement of existing structures, as well as new structures, within the existing easement. Vicinity and location maps of the proposed Project are provided as Figures 1 and 2 as part of Attachment 1.

During the course of identification surveys and subsequent review of the proposed Project, the USACE and VDHR identified a total of nineteen archaeological resources within the Project Area of Potential Effect (APE) as having the potential to be affected by the proposed undertaking. One additional resource, the grouping of 76 submerged anomalies[1], was also considered during the assessment of effects. Attachment 2 provides the locations of these historic properties within the Project APE.[2]

Through the consultation process, USACE determined, and VDHR concurred, that there would be an adverse effect from the Project to one archaeological property (Site 44JC0662), and the MOA provides for treatment of the adverse effect on Site 44JC0662. Under separate cover, Dominion Energy Virginia has prepared and will implement a Treatment Plan. Any adverse effects to all other archaeological properties will be avoided. This Avoidance Plan documents measures to be undertaken during construction of the Project to ensure that archaeological properties, including the aforementioned underwater anomalies, planned to be avoided, remain as such as Dominion Energy Virginia builds the Project. During the daily pre-construction/safety briefing cultural resource effects minimization and avoidance will be discussed.

[1] As described in Section 2.0, Dominion Energy Virginia conducted further investigation on one grouping of submerged anomalies and found that the anomalies did not represent underwater historic sites.

2.0 Underwater Anomalies

As part of historic property identification within the Project area, Dominion Energy Virginia retained the services of an underwater archaeologist to conduct a Phase I remote-sensing archaeological survey in 2013. The survey revealed 76 anomalies with signature characteristics indicative of a potential association with submerged cultural resources. Therefore, these anomalies were isolated within 22 buffers[3] and recommended for avoidance. A location map of the buffers and the anomalies located therein is set forth in Figure 3 contained in Attachment 3. The entirety of the survey is contained within the Tidewater Atlantic Research (TAR) report titled Variation Four Alignment Survey and Analysis in 2014 Remote-Sensing Survey of Fender Sites in 2016 Phase II Assessment of Buffer NS WN1 and Cluster EC EF Anomalies in 2016 dated April 11, 2016. As detailed within the TAR report, in order to conservatively protect the anomalies, the underwater archaeologist used professional experience and judgement, along with knowledge of extensive historical context of this area of the James River based upon previous survey projects in the James, to establish circular buffers based upon the spatial characteristics of the signatures and distances required to ensure protection from proposed construction activities.

During Project design, transmission structures were sited to avoid the buffers for the underwater anomalies. Several consulting parties to the Section 106 process expressed concern that the underwater anomalies could be adversely affected by structure construction activities even with the establishment of the buffers. Therefore, more recently, Dominion Energy Virginia decided it would conduct additional underwater investigations on all anomalies or groups of anomalies within 200 feet of a proposed structure, consistent with the investigations performed. Dominion Energy Virginia selected this distance because the pile driving barges require less than 200 feet of work space to install piles for the structure foundations. One grouping of three underwater anomalies southwest of structure 582/20 met this criterion. While the piles of structure 582/21 are within 200 feet of the buffer, the piles are still greater than 200 feet from the anomalies (see Figures 3 and 4, in Attachments 3 and 4). Additionally, in early 2016, Dominion Energy Virginia conducted remote sensing surveys at the locations of the fender system to identify potential historic resources that were outside of the original surveys for the alignments. This subsequent remote sensing survey identified three additional signatures that had characteristics indicative of a possible association with submerged cultural resources. Since these anomalies were located within 200 feet of a proposed fender at structure 582/26, Dominion Energy Virginia conducted underwater investigations at this location as well.

In March 2016, underwater investigations were performed on the three anomalies protected by buffer NS WN1 southwest of structure 582/20 and the three anomalies located near the fender at structure 582/26. These underwater investigations revealed that the anomalies southwest of structure 582/20 are associated with the construction of an oyster reef, while those near the fender are associated with modern wire cable buried in the river bottom. In accordance with VDHR's June 24, 2016 letter concurring with the TAR April 11, 2016 report, these two (2) anomaly clusters are not eligible for listing

[2]There was a typographical error in the text of the initial Phase I underwater archaeology report that stated that there were 23 buffers; however, tables and mapping in the report represented the 22 buffers. Permitting documentation made reference to the 23 buffers; however, all 76 anomalies were contained within 22 buffers.

in the National Register of Historic Places. With the VDHR determination, these anomalies are not shown in Figure 4. The TAR April 11, 2016 report provides greater detail of the underwater investigation.

The remainder of the anomalies will be managed as potentially eligible for listing in the National Register of Historic Places (NRHP). In order to ensure these anomalies are avoided during the construction of the Project, no work will occur within the buffers (except for a single instance noted below). All pilings for proposed structures and fenders are located outside of the proposed buffers. The approximate distances of buffers within 500 feet of proposed structure foundations or fender systems are provided in Table 1. These distances represent the location of the buffer from the closest foundation of the structure, while the underwater anomalies they protect are at greater distances. The remaining ten river structures are greater than 500 feet from any mapped buffer. Figure 3 shows the locations of the buffers and proposed structure and fender work.

Table 1. Buffers within 500 feet of structure foundations or fenders.

	Buffer ID	Nearest Structure	Approximate Distance (ft) to Protective Buffer
1	NW WN2	582/19	425
2	NC1	582/19	289
3	CC1	582/20	207
4	CC2	582/21; fender	411; 398
5	CC3	582/21; fender	145; 241
6	SE1	528/28	363
7	SE2	582/28	394

At approximately 145 feet from buffer CC3, structure 582/21 is the only work that will occur within 200 feet of a protective buffer (Attachment 4). All pilings including structure 582/21 will be sufficiently outside the protective buffer. Battered pilings will be driven at an angle, with the closest piling intersecting the river bottom 235 feet from the nearest anomaly. Because the pilings will be driven at an angle, the maximum horizontal extent of the pilings will be 202 feet from the anomaly. At this point, the bottom of the pilings would be approximately 80 feet below the bottom of the river. The underwater archaeologist has determined that this distance is more than sufficient to protect any potential historic resource from damage from pile driving activities

Pile driving barges must spud down the bow and stern to eliminate movement during pile driving activities. Pile driving barges can require up to 200 feet from bow to stern to spud down. Barges will not spud down within any of the protective buffers. Barges have sufficient room to spud down in any direction for all structures and fenders except for structure 582/21. For structure 582/21, barges must spud down using an orientation that avoids buffer CC3 (Figures 3 and 4, Attachments 3 and 4). Pile driving crews will be provided with GPS coordinates of the buffers to avoid encroachment.

When barges are not conducting active work, they will be temporarily anchored within the James River. Four potential anchorage locations are shown on the Anomaly Avoidance Plan mapping contained in

Attachment 4. Anchorage areas were chosen within corridors previously surveyed for potential underwater historic resources. All anchorage areas are located greater than 200 feet from buffers of potentially historic submerged anomalies, and the swing radius of the barges will be set for no more than 200 feet.

Given the proposed measures to be implemented, all underwater anomalies are expected to be avoided by a wide margin during construction. Dominion Energy Virginia also shall follow this Avoidance Plan for all maintenance activities.

3.0 Terrestrial Resources

As discussed above, there are eighteen archeological resources within the Project APE for which USACE has determined there would be no adverse effect because they would be avoided. These archaeological sites are shown on in Attachment 2.

The locations of these sites are included in the erosion and sediment control (E&S) plans so that they can be avoided during construction (Attachment 5). The E&S plans, Attachment 5, that are part of the avoidance plan are only the sheets that contain archeological resources. The entirety of the E&S plans are *not* included in Attachment 5.

Descriptions of the measures Dominion Energy Virginia will use to continue to avoid impacts to these terrestrial archaeological sites are provided in Table 2. In order to ensure these resources will not be compromised during construction, Dominion Energy Virginia also has agreed to have an independent archeologist approved by the VDHR on site during construction in these areas to ensure these resources are avoided. As described in Stipulation I.b.1.E, Dominion Energy Virginia will invite the Pamunkey Indian Tribe and Chickahominy Indian Tribe to have a member or representative present to observe and monitor ground disturbances associated with construction to ensure the protection of Native American Artifacts. Archaeological sites with a Native American component are identified in Table 2. Dominion Energy Virginia will coordinate with the Pamunkey Indian Tribe and Chickahominy Indian Tribe regarding scheduling and all safety training requirements for tribal monitors.

Before beginning construction within areas where archeological resources are present, Dominion Energy Virginia will hold a pre-construction meeting for all construction contractors and subcontractors to discuss the avoidance of these resources and Dominion Energy Virginia's commitments for discovery (Section 4.0). The independent archaeological monitor will attend this pre-construction meeting, and topics will include the types avoidance measures to be used to protect the resources, a description of how the resources are marked in the field, the contact for the independent archaeological monitor, and the location of where this Avoidance Plan is kept in the project Stormwater Pollution Prevention Plan (SWPPP). The avoidance of archeological resources will continue to be discussed at weekly construction meetings as the project progresses.

Table 2. Avoidance Measures for Terrestrial Archaeological Resources

DHR #	Site Description	Closest Structure(s)	Avoidance Measures
44JC0048	Martins Hundred Graveyard	2138/11, 2138/12	The cemetery is enclosed by a modern chain link fence and located between proposed structures 2138/11 and 2138/12. The resource is approximately 130 feet from the closest structure (2138/12). No access will occur within the limits of the fence or resource.
44JC0649	Indeterminate Historic Site	582/35, 582/36	Resource is in between the two proposed structures; however, ROW clearing will be required within this area. The resource appears to be mismapped in VDHR's database and may actually be located approximately 100 feet west of (outside) the ROW based on the findings of the Phase I survey. Regardless, trees will be cut above the ground surface and timber mats will be used within the mapped site boundaries to minimize the potential for ground disturbance.
44JC0650	Indeterminate 18th Century Site	582/35, 582/36	Resource is in between the two proposed structures; however, ROW clearing will be required within this area. During the Phase I survey, the portion of the resource within the ROW was found to lack integrity. Regardless, trees will be cut above the ground surface and timber mats will be used within the mapped site boundaries to minimize the potential for ground disturbance.
44JC0751	Prehistoric Camp, 18th – 19th Century Dwelling	2138/16	Resource is primarily outside of the Project APE; however, the site boundary touches the ROW. Structure 2138/16 is approximately 50 feet due east of the edge of the site boundary. Construction, including access, will avoid this area.
44JC0826	19th Century Farmstead	Access road to 2138/16	Site has likely been destroyed by activities associated with the Walmart distribution center. Site is within an existing road, which will be used by Dominion Energy Virginia with no ground disturbing activities within the site.
44NN0060	Indeterminate Woodland Site	2138/21	Site mapped within ROW in VDHR database. Existing lattice structure to be replaced, 285/436, is located within the mapped area. No evidence of this resource was identified during the Phase I survey for the Project; therefore the site may be mapped incorrectly in the VDHR database. Timber matting will be used in the site vicinity during construction to minimize ground disturbance to the mapped area of the site.
44YO0092	Civil War Earthworks	2138/91	Existing lattice structure to be replaced, 292/590, is located at the northern edge of the mapped site. The new structure will be constructed within the footprint

			of 292/590. The replacement monopole structure will be located outside of 44YO0092. Timber mats will be used within the mapped boundaries of the resource to minimize the potential for ground disturbance during construction. Earthworks will be avoided in the field during construction.
44YO0180	Prehistoric Camp Site	2138/90	Resource is approximately 70 feet southwest of the proposed structure replacement. No ground disturbing activities will occur within the vicinity of the site.
44YO0181	Indeterminate Late Archaic Site	2138/90	Resource is approximately 70 feet east of the proposed structure replacement. No ground disturbing activities will occur within the vicinity of the site.
44YO0183	18th Century Domestic Site	2138/72, 2138/73	Resource is approximately 270 feet from the closest structure (2138/73). Access across the south edge of the site will be required and will utilize timber mats to minimize the potential for ground disturbance.
44YO0184	Indeterminate 19th – 20th Century	access to 2138/91, 2138/92	Resource is mapped along the edge of existing dirt road to be used for construction access. Timber mats will be used to minimize the potential for ground disturbance.
44YO0233	Civil War Military Site	2138/90	Existing lattice structure 292/589 is located within the boundary of the resource and will be replaced. The new monopole structure, 2138/90 will be constructed southeast and away from the earthworks associated with the resource. Timber mats will be used within the mapped boundaries of the resource to minimize the potential for ground disturbance.
44YO0237	Archaic & Woodland Camp Site	2138/74	Resource is partially submerged by the Harwoods Mill Reservoir and located approximately 80 feet west of proposed structure 2138/74. No work will occur in the site area adjacent to the reservoir or within the reservoir.
44YO0240	Historic Bridge & Road	2138/90, 2138/91	Resource is submerged by the Harwoods Mill Reservoir. No work will occur within the reservoir. .
44YO0592	Mid 18th – 19th Century Military Camp	2138/86, 2138/87, 292/585, 292/586	Some ROW to be cleared within resource. Timber mats will be used for access and trees will be cut above the ground surface. Structures 292/585 and 292/586 will be rebuilt in place. Structures 292/586 and 2138/87 will be constructed within the bounds of an artifact concentration; however, this concentration consisted of a series of metal detector hits, all of which were recovered in the topsoil during the Phase I survey. Timber mats will be used within the resource during all construction.
44YO1059	Prehistoric Camp,	2138/82,	Existing structure 292/581 is on the edge of the

	Early to Mid-18th Century Dwelling	292/581	mapped resource boundary. This structure will be rebuilt further from the resource boundary. Structure 2138/82 was specifically sited outside of the site boundary to avoid impacts. Timber mats will be used within the mapped boundaries of the resource to minimize the potential for ground disturbance.
44YO1129	Historic Dwelling	2138/75, 58/305	Existing structure 292/574 is located within the mapped boundary of the resource. This existing lattice structure will be rebuilt as monopole structure 2138/75. Structure 58/305 will also be rebuilt within the resource. The portion of the site within the ROW lacks integrity, none-the-less, timber mats will be used in the site vicinity during construction to minimize ground disturbance.
44YO1131	19th Century Dwelling	2138/71, 2138/72	Resource is located between structures 2138/71 and 2138/72. No construction access is proposed through this resource; therefore the site will be avoided. If construction access is required, timber mats will be used within the site to minimize the potential for ground disturbance.

4.0 Unanticipated Discoveries

Stipulation IX of the MOA outlines the specific steps that Dominion Energy Virginia must take in the event of unanticipated discoveries. Should the Corps, with consideration to VDHR recommendations, determine that a discovery is potentially eligible for listing in the NRHP, any stipulations requiring avoidance or minimization measures of the historic property would be incorporated into this Avoidance Plan.

Stipulation X of the MOA outlines the specific steps that Dominion Energy Virginia must take in the event of the unanticipated discovery of human remains. Dominion Energy Virginia will make reasonable efforts to avoid disturbing gravesites including those associated with Native American human remains and associated funerary items. In the event that human remains are discovered, Dominion Energy Virginia shall treat all human remains in a manner consistent with applicable federal and state law [and to the extent such laws do not apply, the ACHP's *Policy Statement Regarding Treatment of Burial Sites, Human Remains and Funerary Objects* (February 23, 2007; http://www.achp.gov/docs/hrpolicy0207.pdf)] and in accordance with the guidelines set forth in Stipulation X of the MOA.

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Wednesday, June 21, 2017 2:48 PM
To: Howell, Beth (MRC)
Subject: Fwd: Dominion Transmission Lines - Preserve America's Birthplace

Sent from my iPhone

Begin forwarded message:

From: MRC - Web Info <Web.Info@mrc.virginia.gov>
Date: June 21, 2017 at 12:33:02 PM EDT
To: "Stagg, Ben (MRC)" <Ben.Stagg@mrc.virginia.gov>
Subject: FW: Dominion Transmission Lines - Preserve America's Birthplace

From: Alexander Rawles [mailto:orgainsville@gmail.com]
Sent: Tuesday, June 20, 2017 1:58 PM
To: MRC - Web Info
Cc: info@preservationvirginia.org
Subject: Dominion Transmission Lines - Preserve America's Birthplace

Dear Commissioner Bull,

Please do not approve any permits associated with Dominion's bid to install major power lines across the James River. By approving these permits, you would cause irreversible harm to the James while lining the pockets of Dominion.

Dominion MUST be stopped!!

Please do not hesitate to contact me, should you have any questions.

Best,
Alexander B. Rawles
3382 Trottinridge Road
P.O. Box 353
Clarksville, Va. 23927
(434)374-1632

PROTEST

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Wednesday, June 21, 2017 2:48 PM
To: Howell, Beth (MRC)
Subject: Fwd: Please Deny Dominion Transmission Lines

Sent from my iPhone

Begin forwarded message:

From: MRC - Web Info <Web.Info@mrc.virginia.gov>
Date: June 21, 2017 at 12:33:12 PM EDT
To: "Stagg, Ben (MRC)" <Ben.Stagg@mrc.virginia.gov>
Subject: FW: Please Deny Dominion Transmission Lines

From: Anna Maas [mailto:annahopemaas@gmail.com]
Sent: Tuesday, June 20, 2017 1:27 PM
To: MRC - Web Info
Cc: info@preservationvirginia.org
Subject: Please Deny Dominion Transmission Lines

Dear Commissioner Bull,

When I was little, my parents trucked us kids all over Virginia, primarily to go canoeing, camping, and/or fishing wherever we had family or friends - Back Bay, the Staunton River, the York, the Rappahannock, and the James. We attended Camp Chanco on the south bank of the river near Scotland Ferry, in clear view of the proposed project. Our children and their cousins attend now. We went on excursions to Jamestown, Williamsburg, and Yorktown, where my grandmother lived. We soaked up these rivers and still spend many a getaway on them. The area is a powerful place and has immense integrity.

Alternatives exist that would power the Peninsula and preserve this historic place. Generations of Virginians have invested in the preservation of this section of the James River because it's where our nation began; don't let those investments be sacrificed for a transmission line. Article XI of the Constitution of Virginia states, "it shall be the Commonwealth's policy to protect its atmosphere, lands, and waters from pollution, impairment, or destruction, for the benefit, enjoyment and general welfare of the people of the Commonwealth." Please deny the permit and save this history for my children, theirs, and many generations beyond.

Thank you,
Anna Maas
Warrenton, Virginia

PROTEST

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Thursday, June 22, 2017 8:57 AM
To: Howell, Beth (MRC)
Subject: Fwd: Deny Dominion Transmission Lines, Preserve America's Birthplace

Sent from my iPhone

Begin forwarded message:

From: MRC - Web Info <Web.Info@mrc.virginia.gov>
Date: June 22, 2017 at 8:30:04 AM EDT
To: "Stagg, Ben (MRC)" <Ben.Stagg@mrc.virginia.gov>
Subject: FW: Deny Dominion Transmission Lines, Preserve America's Birthplace

From: c.j.yerkes@verizon.net [mailto:c.j.yerkes@verizon.net]
Sent: Wednesday, June 21, 2017 5:01 PM
To: MRC - Web Info
Cc: info@preservationvirginia.org
Subject: RE: Deny Dominion Transmission Lines, Preserve America's Birthplace

Dear Commissioner Bull, (Virginia Marine Resources Commission)

The 500 kilovolt transmission line on 17 towers across the James River by Dominion Power will put the integrity of America's birthplace at risk. Our pristine historic, scenic and environmental assets would be irreparable harmed denying future generations the history of America's birthplace.

There are less intrusive and cost effective means to accomplish Dominion's present plan. Please explore the alternatives successfully – producing power via transmission line in such place as Historic Charleston, SC (use of Texas slant well drillers to tunnel under the river), a 65 mile underwater line from New Jersey to Long Island, and a proposed underwater line from Montreal to New York City and Ontario to Lake Erie. Other alternatives using solar facilities, conversion of Yorktown plant to gas-fired, and wind turbine farms should be explored to augment Dominion's imported power sources.

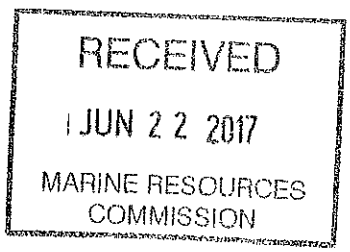
Now is the time to make an unbiased decision to protect our historically sacred area not only for the pleasure and education of tourists but to preserve this history for future generations.

Most sincerely,

Jane Yerkes
116 Berkeley Lane
Williamsburg, VA 23185

PROTEST

Sent from Mail for Windows 10



Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Thursday, June 22, 2017 8:57 AM
To: Howell, Beth (MRC)
Subject: Fwd: Deny Dominion Transmission Lines, Preserve America's Birthplace

Sent from my iPhone

Begin forwarded message:

From: MRC - Web Info <Web.Info@mrc.virginia.gov>
Date: June 22, 2017 at 8:30:15 AM EDT
To: "Stagg, Ben (MRC)" <Ben.Stagg@mrc.virginia.gov>
Subject: FW: Deny Dominion Transmission Lines, Preserve America's Birthplace

-----Original Message-----
From: Nancy Dowling [mailto:ndowling1@verizon.net]
Sent: Wednesday, June 21, 2017 4:40 PM
To: MRC - Web Info; info@preservationvirginia.org
Subject: RE: Deny Dominion Transmission Lines, Preserve America's Birthplace

Dear Commissioner Bull,

The integrity of America's birthplace is at risk. The Constitution of Virginia Article XI states, "it shall be the Commonwealth's to protect its atmosphere, lands, and waters from pollution, impairment, or destruction, for the benefit, enjoyment, and general welfare of the people of the Commonwealth." The transmission lines proposed by Dominion Power will permanently and irreparably harm the James River and its nearly pristine historic, scenic and environmental assets. Please deny the permit and save this history for future generations.

Sent from my iPhone

PROTEST

RECEIVED
JUN 22 2017
MARINE RESOURCES COMMISSION

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Thursday, June 22, 2017 8:57 AM
To: Howell, Beth (MRC)
Subject: Fwd: Deny Dominion Transmission Lines, Preserve America's Birthplace

Sent from my iPhone

Begin forwarded message:

From: MRC - Web Info <Web.Info@mrc.virginia.gov>
Date: June 22, 2017 at 8:29:53 AM EDT
To: "Stagg, Ben (MRC)" <Ben.Stagg@mrc.virginia.gov>
Subject: FW: Deny Dominion Transmission Lines, Preserve America's Birthplace

-----Original Message-----
From: Janine's Phone [mailto:jjphillips4@cox.net]
Sent: Wednesday, June 21, 2017 5:05 PM
To: MRC - Web Info; info@preservationvirginia.org
Subject: RE: Deny Dominion Transmission Lines, Preserve America's Birthplace

Dear Commissioner Bull,

The integrity of America's birthplace is at risk. The Constitution of Virginia Article XI states, "it shall be the Commonwealth's to protect its atmosphere, lands, and waters from pollution, impairment, or destruction, for the benefit, enjoyment, and general welfare of the people of the Commonwealth." The transmission lines proposed by Dominion Power will permanently and irreparably harm the James River and its nearly pristine historic, scenic and environmental assets. Please deny the permit and save this history for future generations.
Please protect and preserve our land...my grandmother told me to take care of the earth, without it, you have nothing.
Sincerely, Janine Phillips
Williamsburg, Virginia

Sent from my iPad

PROTEST

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:32 PM
To: Howell, Beth (MRC)
Subject: Fwd: James River Transmission Lines

Sent from my iPhone

Begin forwarded message:

From: Kate McAloon <Kate.McAloon.634030@muster.com>
Date: June 23, 2017 at 7:39:50 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: James River Transmission Lines
Reply-To: <k8mcaloo@hotmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Kate McAloon
2059 Huntington Ave Apt 708
Alexandria, VA 22303
7038441111

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Sunday, June 25, 2017 9:20 PM
To: Howell, Beth (MRC)
Subject: Fwd: Opposition to the Surry-Skiffes transmission line project

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Jonathan Cruise <Jonathan.Cruise.665627@muster.com>
Date: June 25, 2017 at 1:54:46 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Opposition to the Surry-Skiffes transmission line project
Reply-To: <jonathan@heycruises.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserved for the benefit of all citizens.

Sincerely,

Jonathan Cruise
4202 Bromley Ln
Richmond, VA 23221
8042390059

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Sunday, June 25, 2017 9:20 PM
To: Howell, Beth (MRC)
Subject: Fwd: Preservation of James River

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Sylvia Campbell <Sylvia.Campbell.294806@muster.com>
Date: June 25, 2017 at 1:07:25 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Preservation of James River
Reply-To: <medicinew0man@msn.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserved for the benefit of all citizens.

Sincerely,

Sylvia Campbell
100 Lakeview Park Rd
Colonial Heights, VA 23834
407-223-9161

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Sunday, June 25, 2017 9:20 PM
To: Howell, Beth (MRC)
Subject: Fwd: James River Power LIne

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Oliver Aurand <Oliver.Aurand.981381@muster.com>
Date: June 25, 2017 at 11:56:25 AM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: James River Power LIne
Reply-To: <ollieman77@gmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Oliver Aurand
1400 N Boulevard
Richmond, VA 23230
7579713416

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Saturday, June 24, 2017 8:30 AM
To: Howell, Beth (MRC)
Subject: Fwd: Surry-Skiffes

PROTEST

Sent from my iPhone

Begin forwarded message:

From: James Callaham <James.Callaham.935306@muster.com>
Date: June 24, 2017 at 7:33:15 AM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Surry-Skiffes
Reply-To: <mackcallaham@yahoo.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserved for the benefit of all citizens.

Sincerely,

James Callaham
121 Lake Ridge Dr
Madison Heights, VA 24572
4346600630

Howell, Beth (MRC)

PROTEST

From: Stagg, Ben (MRC)
Sent: Saturday, June 24, 2017 8:30 AM
To: Howell, Beth (MRC)
Subject: Fwd: No transmission lin s across the James River, please.

Sent from my iPhone

Begin forwarded message:

From: Eric Brakman <Eric.Brakman.660413@muster.com>
Date: June 23, 2017 at 11:13:50 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: No transmission lin s across the James River, please.
Reply-To: <ebrakman@mac.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Eric Brakman
3143 Grove Ave
Richmond, VA 23221
8046518897

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Saturday, June 24, 2017 8:29 AM
To: Howell, Beth (MRC)
Subject: Fwd: Objection to the Surry-Skiffes Transmission Line

PROTEST

Sent from my iPhone

Begin forwarded message:

From: David McKittrick <David.McKittrick.433881@muster.com>
Date: June 23, 2017 at 9:58:14 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Objection to the Surry-Skiffes Transmission Line
Reply-To: <mckitdav@gmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserved for the benefit of all citizens. The foregoing message is the canned message from the James River Association, but it totally represents my views. If this line is truly necessary, then a submerged cable should be the solution.

Sincerely,

David McKittrick
5111 Cary Street Road
Richmond, VA 23226
804-370-8398

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:39 PM
To: Howell, Beth (MRC)
Subject: Fwd: Protect the James River's scenic and historic beauty

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Christina Bonini <Christina.Bonini.294934@muster.com>
Date: June 23, 2017 at 2:55:09 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Protect the James River's scenic and historic beauty
Reply-To: <cbonini@jrava.org>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserved for the benefit of all citizens.

Sincerely,

Christina Bonini
8601 Burgundy Rd
Richmond, VA 23235
8049288111

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:39 PM
To: Howell, Beth (MRC)
Subject: Fwd: Please deny Surry-Skiffes permit!

PROTEST

Sent from my iPhone

Begin forwarded message:

From: cleo dan <cleo.dan.882908@muster.com>
Date: June 23, 2017 at 2:55:51 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Please deny Surry-Skiffes permit!
Reply-To: <cleo@muster.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserved for the benefit of all citizens.

Sincerely,

cleo dan
2513 founders bridge road
Midlothian, VA 23113
8042696966

PROTEST

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:38 PM
To: Howell, Beth (MRC)
Subject: Fwd: Unspeakable....

Sent from my iPhone

Begin forwarded message:

From: Frida Clark <Frida.Clark.885017@muster.com>
Date: June 23, 2017 at 2:56:11 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Unspeakable....
Reply-To: <fclark2013@gmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Frida Clark
2408 Nortonia Rd
Henrico, VA 23229
8045250205

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:38 PM
To: Howell, Beth (MRC)
Subject: Fwd: DO NOT destroy the james river for the sake of shareholders!!!!!!!! Go away!

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Joseph Mensh <Joseph.Mensh.660318@muster.com>
Date: June 23, 2017 at 2:58:15 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: DO NOT destroy the james river for the sake of shareholders!!!!!!!! Go away!
Reply-To: <joe.mensh@gmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Joseph Mensh
7458 academy dr
Mechanicsville, VA 23116
3012216027

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:38 PM
To: Howell, Beth (MRC)
Subject: Fwd: No to Surry-Skiffles transmission line project

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Janet Paisley <Janet.Paisley.517092@muster.com>
Date: June 23, 2017 at 3:00:16 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: No to Surry-Skiffles transmission line project
Reply-To: <janetpaisley@comcast.net>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserved for the benefit of all citizens.

Sincerely,

Janet Paisley
1435 Gentry Lane
Charlottesville, VA 22903
4349893857

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:38 PM
To: Howell, Beth (MRC)
Subject: Fwd: PROTECT THE JAMES

Sent from my iPhone

Begin forwarded message:

From: Mason Gerena <Mason.Gerena.885113@muster.com>
Date: June 23, 2017 at 3:01:14 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: PROTECT THE JAMES
Reply-To: <mason.gerena25@gmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Mason Gerena
1626 Porters Mill Lane
Midlothian, VA 23114
5408349896

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:38 PM
To: Howell, Beth (MRC)
Subject: Fwd: Dominion Energy Power Line Crossing

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Terry Moody <Terry.Moody.459545@muster.com>
Date: June 23, 2017 at 3:01:58 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Dominion Energy Power Line Crossing
Reply-To: <terryjmoody@gmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

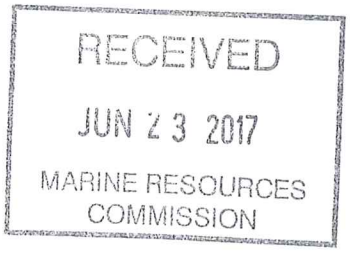
Sincerely,

Terry Moody
1812 Colonial Trail East
Surry, VA 23883
8047614780

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:37 PM
To: Howell, Beth (MRC)
Subject: Fwd: My Opposition to the Surry-Skiffes transmission line project

PROTEST



Sent from my iPhone

Begin forwarded message:

From: Michael McDermott <Michael.McDermott.735486@muster.com>
Date: June 23, 2017 at 3:02:02 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: My Opposition to the Surry-Skiffes transmission line project
Reply-To: <mcdermotthr@gmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape by placing an industrial backdrop t a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

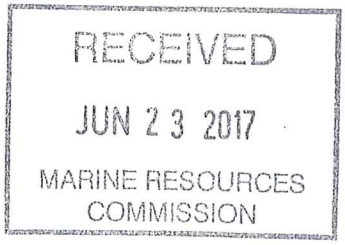
Sincerely,

Michael McDermott
11708 Kimbolton Pl.
Glen Allen, VA 23059
8042481837

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:37 PM
To: Howell, Beth (MRC)
Subject: Fwd: NO TO the Surry-Skiffes transmission line project

PROTEST



Sent from my iPhone

Begin forwarded message:

From: Earl Pollard <Earl.Pollard.660455@muster.com>
Date: June 23, 2017 at 3:01:58 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: NO TO the Surry-Skiffes transmission line project
Reply-To: <greshampollard@gmail.com>

Dear Commissioner Bull,

Please don't let the money talk!

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserved for the benefit of all citizens.

Sincerely,

Earl Pollard
7529 tanglewood road
Richmond, VA 23225
804 366 7527

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:37 PM
To: Howell, Beth (MRC)
Subject: Fwd: Please protect the James River

PROTEST

Sent from my iPhone

Begin forwarded message:

From: John Gillum <John.Gillum.986890@muster.com>
Date: June 23, 2017 at 3:02:43 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Please protect the James River
Reply-To: <gillum_j@jamesriverdayschool.org>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

John Gillum
204 Denver Ave
Lynchburg, VA 24503
8438131682

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:37 PM
To: Howell, Beth (MRC)
Subject: Fwd: Transmission lines across the James River

PROTEST

Sent from my iPhone

Begin forwarded message:

From: David Ross <David.Ross.294922@muster.com>
Date: June 23, 2017 at 3:03:12 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Transmission lines across the James River
Reply-To: <dross1aplcros@ymail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

David Ross
316 Calley street
Ashland, VA 23005
8045512712

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:37 PM
To: Howell, Beth (MRC)
Subject: Fwd: proposed transmission lines

Sent from my iPhone

Begin forwarded message:

From: "Bull, John (MRC)" <John.Bull@mrc.virginia.gov>
Date: June 23, 2017 at 3:06:23 PM EDT
To: "Stagg, Ben (MRC)" <Ben.Stagg@mrc.virginia.gov>, "Neikirk, Chip (MRC)" <Chip.Neikirk@mrc.virginia.gov>
Subject: Fwd: proposed transmission lines

Here is another protest letter. Thanks.
Sent from my iPhone

Begin forwarded message:

From: Turk Sties <turk.sties@gmail.com>
Date: June 23, 2017 at 3:04:01 PM EDT
To: <john.bull@mrc.virginia.gov>
Cc: Turk Sties <jamessties@msn.com>
Subject: proposed transmission lines

Dear Commissioner Bull,

The following is a form letter that I was encouraged to send. You may see a lot of them. But even though it says what needs to be said and there is an economy realized in using the text, i am compelled to add my own message.
Please note this is a matter of importance to the residents of Virginia. Short term gain and lazy planning are not good reasons to despoil this natural area. Thank you for considering this matter, please use your influence and authority to protect this area from special interests.

Dear Commissioner Bull,

The integrity of America's birthplace is at risk, and VMRC has the power to do something about it.

Article XI of the Virginia State Constitution states, "...it shall be the Commonwealth's policy to protect its atmosphere, lands, and waters from pollution, impairment, or destruction, for the benefit, enjoyment, and general welfare of the people of the Commonwealth.

Virginia's assets are at risk. Dominion Energy's transmission line project will permanently and irreparably harm this currently pristine section of the James River and its significant natural, historic, scenic, and environmental assets. Please deny the permit and save this history for future generations.

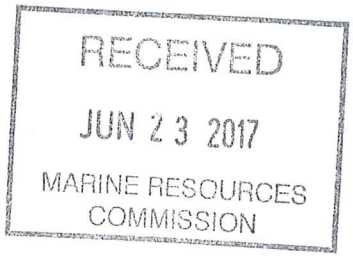
Sincerely,
James "Turk" Sties

--
Turk Sties
432-9999

Howell, Beth (MRC)

PROTEST

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:36 PM
To: Howell, Beth (MRC)
Subject: Fwd: Surry-Skiffes transmission line project



Sent from my iPhone

Begin forwarded message:

From: Alexis Willard <Alexis.Willard.964154@muster.com>
Date: June 23, 2017 at 3:06:00 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Surry-Skiffes transmission line project
Reply-To: <alexis.i.willard@gmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Alexis Willard
4719 Augusta Ave.
Richmond, VA 23230
8049381013

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:36 PM
To: Howell, Beth (MRC)
Subject: Fwd: Surry Skiffs transmission line

Sent from my iPhone

Begin forwarded message:

PROTEST

From: "J. Wilson Enochs" <J.Wilson.Enochs.459562@muster.com>
Date: June 23, 2017 at 3:07:44 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Surry Skiffs transmission line
Reply-To: <wilson@jwenochs.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

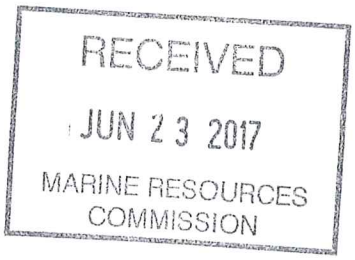
Sincerely,

J. Wilson Enochs
10913 Live Oak Court
Midlothian, VA 23113
8043666409

, Beth (MRC)

n: Stagg, Ben (MRC)
ent: Friday, June 23, 2017 9:36 PM
To: Howell, Beth (MRC)
Subject: Fwd: James River

PROTEST



Sent from my iPhone

Begin forwarded message:

From: Blane Chocklett <Blane.Chocklett.645093@muster.com>
Date: June 23, 2017 at 3:08:29 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: James River
Reply-To: <bchocklett@comcast.net>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

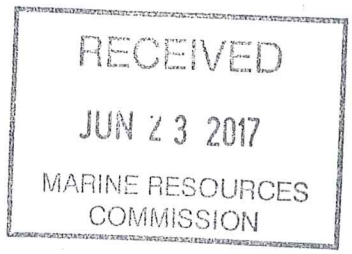
Sincerely,

Blane Chocklett
790 Dawnridge Lane
Troutville, VA 24175
5403541774

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:36 PM
To: Howell, Beth (MRC)
Subject: Fwd: Surry-Skiffes transmission line project

PROTEST



Sent from my iPhone

Begin forwarded message:

From: Max Schick <Max.Schick.294043@muster.com>
Date: June 23, 2017 at 3:10:54 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Surry-Skiffes transmission line project
Reply-To: <max@muster.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

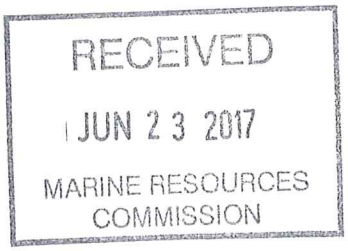
Sincerely,

Max Schick
6303 Bliley Rd.
Richmond, VA 23225
8043082988

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:36 PM
To: Howell, Beth (MRC)
Subject: Fwd: Protect the James

PROTEST



Sent from my iPhone

Begin forwarded message:

From: Phil Cunningham <Phil.Cunningham.672528@muster.com>
Date: June 23, 2017 at 3:09:49 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Protect the James
Reply-To: <philc1992@gmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Phil Cunningham
3319 North Ave Apt A
Richmond, VA 23222
5712441285

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:36 PM
To: Howell, Beth (MRC)
Subject: Fwd: Protect the James

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Robert Allen <Robert.Allen.660368@muster.com>
Date: June 23, 2017 at 3:12:00 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Protect the James
Reply-To: <lostgypsy36@yahoo.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Robert Allen
110 Kings Grant Dr
Goode, VA 24556
4344262800

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:36 PM
To: Howell, Beth (MRC)
Subject: Fwd: The Mighty James needs protecting

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Mary Mismas <Mary.Mismas.515896@muster.com>
Date: June 23, 2017 at 3:13:40 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: The Mighty James needs protecting
Reply-To: <mary.mismas@alumni.vcu.edu>

Dear Commissioner Bull,

I am strongly opposed to the Surry-Skiffes transmission line project. Dominion Power has not shown the respect and preservation to recent projects and I would like to see them fulfill their responsibilitie first.

The proposed transmission lines should be placed farther up the river with under water cables.

The landscape and the experiences of river visitors will be marred by placing an industrial backdrop to a scenic and historic stretch of river.

I don't need to tell you that the health of the Chesapeake Bay is dependent on the James River. I grew up in Hopewell when Kepone was poisoning the citizens, fisheries and wildlife. DEQ allows for self-monitoring and you can imagine how wrong that is.

This James River is a valuable asset to tourism, sportsmen, recreational uses and the general publi

I am urging the Commission to deny Dominion's permit application.

We are responsible to ensure that the James River is preserved for the benefit of if our children's children.

Sincerely,

Mary Mismas
1021 Grapevine Road
Sandston, VA 23150
804-338-3090

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:35 PM
To: Howell, Beth (MRC)
Subject: Fwd: Surry-Skiffes transmission line project

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Cameron Jackson <Cameron.Jackson.294625@muster.com>
Date: June 23, 2017 at 3:14:25 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Surry-Skiffes transmission line project
Reply-To: <camstj@hotmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Cameron Jackson
3348 Warner Rd
camstj@hotmail.com
Richmond, VA 23225
8049867896

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:35 PM
To: Howell, Beth (MRC)
Subject: Fwd: PROTECT OUR RIVER!

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Grace Beavers <Grace.Beavers.884904@muster.com>
Date: June 23, 2017 at 3:15:00 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: PROTECT OUR RIVER!
Reply-To: <gas7b@virginia.edu>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserved for the benefit of all citizens.

Sincerely,

Grace Beavers
2314 Chapel Spring Lane
Free Union, VA 22940
4344090252

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:35 PM
To: Howell, Beth (MRC)
Subject: Fwd: Opposition to the Surry-Skiffes Transmission Lines

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Jessica Sims <Jessica.Sims.642021@muster.com>
Date: June 23, 2017 at 3:17:31 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Opposition to the Surry-Skiffes Transmission Lines
Reply-To: <jessicaleesims@gmail.com>

Dear Commissioner Bull,

I write to ask you to preserve Virginia's history and vistas.
The proposed Surry-Skiffes transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of rive We are a state of such rich history and this unnecessary option will violate that history.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Jessica Sims
412 Walton Park Road
Midlothian, VA 23114
8043561228

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:35 PM
To: Howell, Beth (MRC)
Subject: Fwd: dominion power proposed transmission limes

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Frances Kerr <Frances.Kerr.632691@muster.com>
Date: June 23, 2017 at 3:18:23 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: dominion power proposed transmission limes
Reply-To: <foxiuk1268@gmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.
This proposal does not benefit any of the people or wildlife being affected by the transmission line.

Sincerely,

Frances Kerr
1268 Bremo rd
Bremo Bluff, VA 23022
4349812345

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:35 PM
To: Howell, Beth (MRC)
Subject: Fwd: Jamestown, our heritage

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Tom Layman <Tom.Layman.294961@muster.com>
Date: June 23, 2017 at 3:30:28 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Jamestown, our heritage
Reply-To: <tlayman@mac.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Tom Layman
2822 East Franklin Street
Richmond, VA 23223
8046444363

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:35 PM
To: Howell, Beth (MRC)
Subject: Fwd: Surry-Skiffs transmission line

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Anita Angelone <Anita.Angelone.660219@muster.com>
Date: June 23, 2017 at 3:35:58 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Surry-Skiffs transmission line
Reply-To: <anitaangelone@mac.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Anita Angelone
119 Seton Hill Road
Williamsburg, VA 23188
7576452943

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:34 PM
To: Howell, Beth (MRC)
Subject: Fwd: James River Needs Your Help

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Bri Conrad <Bri.Conrad.294061@muster.com>
Date: June 23, 2017 at 3:46:31 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: James River Needs Your Help
Reply-To: <beconrad@randolphcollege.edu>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

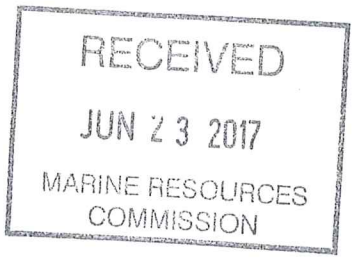
Sincerely,

Bri Conrad
67 Croatan Road
Newport News, VA 23606
7576721478

Howell, Beth (MRC)

PROTEST

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:34 PM
To: Howell, Beth (MRC)
Subject: Fwd: save our rivers!



Sent from my iPhone

Begin forwarded message:

From: Melanie Waleski <Melanie.Waleski.808447@muster.com>
Date: June 23, 2017 at 3:47:27 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: save our rivers!
Reply-To: <waleski69@yahoo.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Melanie Waleski
116 lankford ave
Charlottesville, VA 22902
2152054751

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Sunday, June 25, 2017 9:19 PM
To: Howell, Beth (MRC)
Subject: Fwd: Surry-Skiffes project will ruin a beautiful asset

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Sarah Sanford <Sarah.Sanford.517112@muster.com>
Date: June 25, 2017 at 10:50:46 AM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Surry-Skiffes project will ruin a beautiful asset
Reply-To: <sdsanford@email.wm.edu>

Dear Commissioner Bull,

As a former resident of Williasmburg and alum of the College of William and Mary, I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Sarah Sanford
805 Clarendon Street
Durham, NC 27705
5404559811

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Sunday, June 25, 2017 9:19 PM
To: Howell, Beth (MRC)
Subject: Fwd: Unacceptable idea

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Lynn Wilson <Lynn.Wilson.294679@muster.com>
Date: June 25, 2017 at 8:53:49 AM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Unacceptable idea
Reply-To: <lynnpeacewilson@gmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. I frequen the Jamestown area for its priceless historic and natural resources. The proposed transmission line will permanently alter the landscape and the experiences of visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Lynn Wilson
680 Crib Lane
Sandston, VA 23150
8047377533

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Saturday, June 24, 2017 9:39 PM
To: Howell, Beth (MRC)
Subject: Fwd: Please protect the James

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Bradford Seagraves <Bradford.Seagraves.646723@muster.com>
Date: June 24, 2017 at 7:59:23 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Please protect the James
Reply-To: <bradford.seagraves@gmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Bradford Seagraves
2401 Stuart Ave
Richmond, VA 23220
8045395992

Howell, Beth (MRC)

PROTEST

From: Stagg, Ben (MRC)
Sent: Saturday, June 24, 2017 9:39 PM
To: Howell, Beth (MRC)
Subject: Fwd: Tell Dominion to find an alternative to the Surry-Skiffes transmission line project

Sent from my iPhone

Begin forwarded message:

From: Jerry Coalgate <Jerry.Coalgate.515919@muster.com>
Date: June 24, 2017 at 7:48:18 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Tell Dominion to find an alternative to the Surry-Skiffes transmission line project
Reply-To: <bcoalgate@cox.net>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

Dominion is now using scare tactics to get public approval. I recently had a phone call from a Dominion representative that tried to change my disapproval of this project by saying that the only alternative would be rolling blackouts to the Hampton Roads area. This is unacceptable - both as a scare tactic and as an answer to our electric transmission needs here. Send Dominion back to the drawing board. They are choosing the least expensive option for their company, not the best option for Hampton Roads residents.

This transmission line is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Jerry Coalgate
2624 Sir Thomas Way
Williamsburg, VA 23185
757-229-2528

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Saturday, June 24, 2017 9:39 PM
To: Howell, Beth (MRC)
Subject: Fwd: protect our river please

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Andrew Mondak <Andrew.Mondak.672939@muster.com>
Date: June 24, 2017 at 4:34:16 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: protect our river please
Reply-To: <afmondak@gmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserved for the benefit of all citizens.

Sincerely,

Andrew Mondak
3930 Cogbill rd
North Chesterfield, VA 23234
8049216873

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Saturday, June 24, 2017 9:39 PM
To: Howell, Beth (MRC)
Subject: Fwd: opposition to transmission lines over the James River

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Jeff Elgin <Jeff.Elgin.459633@muster.com>
Date: June 24, 2017 at 11:12:13 AM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: opposition to transmission lines over the James River
Reply-To: <mailbox@jeffelgin.com>

Dear Commissioner Bull,

I am a lifelong Virginia resident. I live within a stones throw of the James River, and I have frequentl spent time enjoying the views, both on (from the ferry and while boating), and from both sides of the river including while hunting ducks from the Hog Island WMA.

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Jeff Elgin
7009 Riverside Dr
Richmond, VA 23225
8043107163

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Saturday, June 24, 2017 9:38 PM
To: Howell, Beth (MRC)
Subject: Fwd: Protect our river

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Emaleigh Franzak <Emaleigh.Franzak.1129853@muster.com>
Date: June 24, 2017 at 9:30:30 AM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Protect our river
Reply-To: <elfranzak@gmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

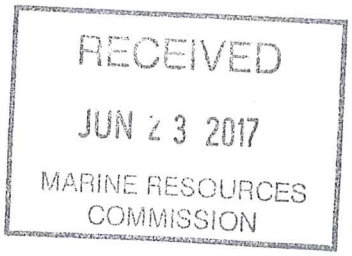
Sincerely,

Emaleigh Franzak
3301 Rosewood Ave
Richmond, VA 23221
8049124115

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Saturday, June 24, 2017 9:38 PM
To: Howell, Beth (MRC)
Subject: Fwd: opposition to transmission lines- from a fourth grade teacher

PROTEST



Sent from my iPhone

Begin forwarded message:

From: Katherine Rivara <Katherine.Rivara.660345@muster.com>
Date: June 24, 2017 at 9:20:13 AM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: opposition to transmission lines- from a fourth grade teacher
Reply-To: <kate4change@gmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

As a fourth grade teacher, I take an annual trip to the Jamestown with my students. We explore botl the settlement and the historic site. My students sit in the skeleton of the church at Historic Jamestown, the building where American democracy began. They imagine what it was like for the settlers, watching for Spanish ships to sail up the James when they should have been more concerned with their neighbors on land. The largely scenic view from Jamestown helps them picture life in the 1600s. Giant transmission lines would rob them of that tranquil outlook.

As a citizen concerned about the health of our rivers, I deem this project too risky to undertake, and too damaging to the delicate river bottom where so many fish are born.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Katherine Rivara
1707 Winder St

Richmond, VA 23220
8044453281

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Saturday, June 24, 2017 9:38 PM
To: Howell, Beth (MRC)
Subject: Fwd: Surry-Skiffes transmission line

Sent from my iPhone

Begin forwarded message:

From: christie bondurant <christie.bondurant.508340@muster.com>
Date: June 24, 2017 at 9:00:14 AM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Surry-Skiffes transmission line
Reply-To: <christie.bondurant@gmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

christie bondurant
101 raven rock road
Henrico, VA 23229
8045143001

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:34 PM
To: Howell, Beth (MRC)
Subject: Fwd: River

PROTEST

Sent from my iPhone

Begin forwarded message:

From: diane hill <diane.hill.645238@muster.com>
Date: June 23, 2017 at 3:49:43 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: River
Reply-To: <dianeomite11@gmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

diane hill
404 w 27st
Apt b
Richmond, VA 23225
8045030245

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:34 PM
To: Howell, Beth (MRC)
Subject: Fwd: Surry-Skiffes

Sent from my iPhone

Begin forwarded message:

From: Phillip Harris <Phillip.Harris.935669@muster.com>
Date: June 23, 2017 at 3:51:50 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Surry-Skiffes
Reply-To: <p.harris@comcast.net>

PROTEST

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

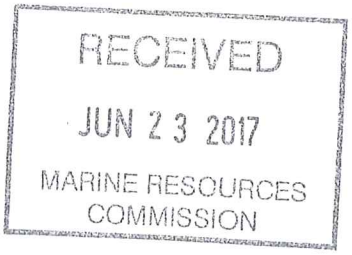
Sincerely,

Phillip Harris
2604 The Terrace
Richmond, VA 23222
8049297276

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:34 PM
To: Howell, Beth (MRC)
Subject: Fwd: Please consider safety, common sense, and conservation over special interests. The true special interest groups are future generation who are entitled, yes entitled to a pristine James River.

PROTEST



Sent from my iPhone

Begin forwarded message:

From: Elizabeth Joseph <Elizabeth.Joseph.656959@muster.com>
Date: June 23, 2017 at 3:59:07 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Please consider safety, common sense, and conservation over special interests. The true special interest groups are future generation who are entitled, yes entitled to a pristine James River.
Reply-To: <liddylewis@yahoo.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Elizabeth Joseph
40 Skipwith Green Circle
Henrico, VA 23294
8042291948

Howell, Beth (MRC)

PROTEST

RECEIVED
JUN 23 2017
MARINE RESOURCES
COMMISSION

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:34 PM
To: Howell, Beth (MRC)
Subject: Fwd: Power lines over Jamestown?

Sent from my iPhone

Begin forwarded message:

From: Christopher Fuller <Christopher.Fuller.504352@muster.com>
Date: June 23, 2017 at 3:59:28 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Power lines over Jamestown?
Reply-To: <cmfuller@umich.edu>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Christopher Fuller
92 Oak Forest Circle
Charlottesville, VA 22901
2485356088

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:33 PM
To: Howell, Beth (MRC)
Subject: Fwd: Dominion is a bully. Stand up to the bully.

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Daniel Shaye <Daniel.Shaye.459572@muster.com>
Date: June 23, 2017 at 4:09:11 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Dominion is a bully. Stand up to the bully.
Reply-To: <danieldoc@tni.net>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. It is simp staggering that Dominion Virginia Power is so POWERFUL that you'd even pause to consider this heinous act against the environment, our citizens, and history itself.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River views, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Daniel Shaye
3000 East Tiverton
Williamsburg, VA 23185
7572294161

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:33 PM
To: Howell, Beth (MRC)
Subject: Fwd: Surry-Skiffes Transmission Line Project

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Natalie DeBoer <Natalie.DeBoer.966065@muster.com>
Date: June 23, 2017 at 4:22:55 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Surry-Skiffes Transmission Line Project
Reply-To: <nbd53@yahoo.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Natalie DeBoer
8823 Michaux Lane
Henrico, VA 23229
8045036512

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:33 PM
To: Howell, Beth (MRC)
Subject: Fwd: Opposition to transmission line

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Victoria Purdy <Victoria.Purdy.885086@muster.com>
Date: June 23, 2017 at 4:56:37 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Opposition to transmission line
Reply-To: <serenemomof3@comcast.net>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Victoria Purdy
4304 Gaines Rd.
Richmond, VA 23222
8049373650

PROTEST

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:33 PM
To: Howell, Beth (MRC)
Subject: Fwd: Say no to Surry Skiffes Transmission lines

Sent from my iPhone

Begin forwarded message:

From: Patricia VonOhlen <Patricia.VonOhlen.517737@muster.com>
Date: June 23, 2017 at 4:46:03 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Say no to Surry Skiffes Transmission lines
Reply-To: <wvonohlen@gmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Patricia VonOhlen
9801 River Rd
Newport News, VA 23601
7575958269

C)

Stagg, Ben (MRC)
Friday, June 23, 2017 9:32 PM
Howell, Beth (MRC)
Fwd: Oppose Survey-Skiffes transmission line project

PROTEST

Sent from my iPhone

Begin forwarded message:

From: Amy Smith <Amy.Smith.645354@muster.com>
Date: June 23, 2017 at 5:44:31 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Oppose Survey-Skiffes transmission line project
Reply-To: <amysmith099@comcast.net>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Amy Smith
55-E Barclay Place Ct
Charlottesville, VA 22901
4348069737

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:32 PM
To: Howell, Beth (MRC)
Subject: Fwd: Surry transmission towers

PROTEST

RECEIVED
JUN 23 2017
MARINE RESOURCES COMMISSION

Sent from my iPhone

Begin forwarded message:

From: Joe Seiffert <Joe.Seiffert.459661@muster.com>
Date: June 23, 2017 at 6:35:28 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Surry transmission towers
Reply-To: <joe4council@aol.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Joe Seiffert
1263 Fleming Way
Lynchburg, VA 24503
4343843583

Howell, Beth (MRC)

PROTEST

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:32 PM
To: Howell, Beth (MRC)
Subject: Fwd: James River

Sent from my iPhone

Begin forwarded message:

From: Sara Shoop <Sara.Shoop.459576@muster.com>
Date: June 23, 2017 at 6:59:47 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: James River
Reply-To: <sarashoop@hotmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Sara Shoop
22431 Cypress Point Rd
Williamsburg, VA 23185
7572566043

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:32 PM
To: Howell, Beth (MRC)
Subject: Fwd: James River Transmission Line Project

Sent from my iPhone

Begin forwarded message:

PROTEST

From: Anne Dunn <Anne.Dunn.885049@muster.com>
Date: June 23, 2017 at 7:04:43 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: James River Transmission Line Project
Reply-To: <andunn1@comcast.net>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Anne Dunn
15124 Hall Street
Culpeper, VA 22701
5409052811

Howell, Beth (MRC)

From: MRC - Web Info
Sent: Friday, June 23, 2017 11:05 AM
To: Howell, Beth (MRC); Stagg, Ben (MRC)
Subject: FW: Dominion Power's Proposed Towers across James River
Attachments: GCA Letter re Dominion Towers Jamestown June 22 Signed.pdf

---

From: Lee Guerry [mailto:leeguerry@comcast.net]
Sent: Friday, June 23, 2017 10:47 AM
To: MRC - Web Info
Subject: Dominion Power's Proposed Towers across James River

Hi, Michelle!

It was nice to speak with you just now. Thank you for including this letter on behalf of the Garden Club of Alexandria in the documents you are preparing for the Commissioner and others for the meeting on Tuesday morning about the Dominion Power transmission towers proposed for the lower James River. Our club joins with others to oppose these towers. We hope the VMRC will deny Permit No. 20130408.

I have also sent the original of this letter by overnight mail to arrive by 3pm today.

Thank you, Michelle.

Best wishes.

Lee

Lee Guerry
TTR Sotheby's International Realty
Licensed in Virginia and DC
400 S. Washington Street / Alexandria, VA 22314
703-739-4995 Direct / 703-969-3566 Cell
leeguerry@comcast.net / leeguerry.ttrsir.com

PROTEST

June 22, 2017

Mr. John R. Bull
Commissioner
Virginia Marine Resources Commission
2600 Washington Avenue, Third Floor
Newport News, Virginia 23607

PROTEST

Dear Commissioner Bull:

On behalf of the 50 members of the Garden Club of Alexandria, I write in reference to Permit No. 20130408. We continue to oppose Dominion Power's proposed Surry-Skiffes Creek transmission line across the lower James River. However, the Army Corps of Engineers has granted tentative approval of the project. The approval is contingent upon the Virginia Marine Resources Commission (VMRC) approving Permit No. 20130408.

The VMRC has the authority and must act in the public interest to protect the James River, and we hope you will consider our concerns in your deliberations on this permit.
The Garden Club of Alexandria is a proud member of the Garden Club of Virginia and the Garden Club of America. All three clubs are on record opposing the proposed towers. We have a long history of working to protect the view shed of the lower James, so that it remains as our forefathers found it centuries ago.

We share the concerns about the negative impact that the installation of seventeen towers – some 295 feet tall- will have on tourism and recreation in the region. How would you like to be camping and look up to see a red lights blinking to warn airplanes? We also worry about the environmental and ecological impacts on the endangered sturgeon population along with the potential harm to other aquatic life posed by long term changes to the river bottom due to construction. Oysters are a thriving industry in the area. Silt and residual pollutants disturbed by construction could jeopardize productive beds and threaten the incomes of local watermen.

Providing adequate power to the region is in everyone's interest. However, there are alternatives available to building towers in this pristine historic location which should have been considered but still can be.

We urge you and your associate commissioners to reject permit 20130408. You will be fulfilling your responsibility under state law and ensuring that this special place will be available in its natural state for future generations to visit, enjoy and cherish. Thank you for your consideration to deny Permit No. 20130408.

Sincerely,

Lee Bradford Guerry, J.D.
Conservation Chair
Garden Club of Alexandria

Howell, Beth (MRC)

From: MRC - Web Info
Sent: Friday, June 23, 2017 12:27 PM
To: Howell, Beth (MRC); Stagg, Ben (MRC)
Subject: FW: Objection to Dominion Energy's request for a permit to cross state-owned river bottomlands
Attachments: Magnetic orientation and magnetoreception in birds and other animals.pdf; Extremely low-frequency electromagnetic fields disrupt magnetic alignment of ruminants.pdf

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From: James Bennett [mailto:aging.mitochondria@gmail.com]
Sent: Friday, June 23, 2017 12:08 PM
To: MRC - Web Info
Subject: Objection to Dominion Energy's request for a permit to cross state-owned river bottomlands

Dear VMRC Commissioner John Bull,

As a Virginia resident and Neuroscience investigator, I write to request that you and the other VMRC Commissioners reject Dominion Energy's permit request to erect 27.75 miles of unsightly overhead transmission lines across the James River in James City County.

While others will likely express similar views based on physical/visual violation of a natural space and the need for a more modern electrical grid infrastructure, I wanted to make you and other VMRC Commissioners aware of recent scientific data which indicates that these transmission lines produce a significant disturbance of the earth's geomagnetic field that can disorient wildlife and potentially interfere with migration of fish and other James River life forms, and other wildlife in the area of the power lines.

I specifically call your attention to two publications (attached). They review the general nature of geomagnetism and magnetoreception used by animals ("Magnetic orientation and magnetoreception in birds and other animals", W. Wiltschko and R. Wiltschko, 2005) and the specific disorienting effects of high-voltage power line electromagnetic fields on orientation of ruminants (cattle and deer) ("Extremely low-frequency electromagnetic fields disrupt magnetic alignment of ruminants", H. Burda, et al, 2009).

I am very concerned that the proposed high-voltage power lines proposed by Dominion energy will disorient wildlife in the area of the lines. It would be particularly tragic if spawning behavior of Atlantic sturgeon and shad in the James River were disrupted by these power lines crossing the James River. In addition, changes in migration of deer and other mammals in the area of these electrical lines are likely to occur and will be disruptive to these populations.

For these reasons I request that you reject the Dominion Energy permit request. There are other, less biologically damaging solutions to our Commonwealth's electrical energy needs.

Sincerely,

PROTEST

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J Comp Physiol A (2005) 191: 675–693
DOI 10.1007/s00359-005-0627-7

REVIEW

Wolfgang Wiltschko · Roswitha Wiltschko

Magnetic orientation and magnetoreception in birds and other animals

Received: 27 October 2004 / Revised: 4 March 2005 / Accepted: 5 March 2005 / Published online: 11 May 2005

Abstract Animals use the geomagnetic field in many ways: the magnetic vector provides a compass; magnetic intensity and/or inclination play a role as a component of the navigational 'map', and magnetic conditions of certain regions act as 'sign posts' or triggers, eliciting specific responses. A magnetic compass is widespread among animals, magnetic navigation is indicated e.g. in birds, marine turtles and spiny lobsters and the use of magnetic 'sign posts' has been described for birds and marine turtles. For magnetoreception, two hypotheses are currently discussed, one proposing a chemical compass based on a radical pair mechanism, the other postulating processes involving magnetite particles. The available evidence suggests that birds use both mechanisms, with the radical pair mechanism in the right eye providing directional information and a magnetite-based mechanism in the upper beak providing information on position as component of the 'map'. Behavioral data from other animals indicate a light-dependent compass probably based on a radical pair mechanism in amphibians and a possibly magnetite-based mechanism in mammals. Histological and electrophysiological data suggest a magnetite-based mechanism in the nasal cavities of salmonid fish. Little is known about the parts of the brain where the respective information is processed.

The geomagnetic field

Many animals are able to perceive the magnetic field of the earth; among them are mollusks, arthropods and members of all major groups of vertebrates. This seems alien to us, as man cannot consciously sense the geomagnetic field (but see Baker 1989). To fully understand this phenomenon, we must first consider the type of information the geomagnetic field can provide and—even more important—the type of information animals do actually use.

The earth itself is a huge magnet, with its poles situated close to the rotational poles. The magnetic field lines leave the surface of the earth at the southern magnetic pole, run around the globe and re-enter at the northern magnetic pole. As a consequence, the magnetic field lines point upward on the southern hemisphere, run parallel to the earth's surface at the magnetic equator and point downward in the northern hemisphere. Magnetic inclination or dip, the angle between the local magnetic vector and the horizontal, changes continuously, showing a fairly regular gradient, from $-90°$ at the southern magnetic pole to $+90°$ at the northern magnetic pole, being $0°$ at the magnetic equator (Fig. 1). The intensity of the geomagnetic field, indicated by the length of the arrows in Fig. 1, is highest at the two poles and lowest near the magnetic equator. It thus forms gradients running from the poles to the equator on each hemisphere (see Skiles 1985 for details). This regular field can be locally distorted by material in the upper crust resulting in magnetic anomalies with slight increases or decreases in intensity. It is temporally altered by electromagnetic radiation originating in the sun causing daily variations, which, in the temperate latitudes, lead to slight decrease in magnetic intensity around noon; occasional magnetic storms may cause more pronounced changes in all magnetic parameters. These changes, however, are mostly small compared to the regular field.

The geomagnetic field thus represents a reliable, omnipresent source of navigational information. This information can be of two kinds: the magnetic vector provides directional information that animals could use as a compass, whereas total intensity and/or inclination may provide information that might be used as a component of the navigational 'map' indicating position.

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Magnetic orientation

Animals have been shown to use both types of information for various tasks. However, our knowledge on magnetic orientation differs greatly between the various animals. Birds are by far the best studied group, followed by marine turtles, while little is known about other vertebrates and arthropods. Here, we summarize the findings that are most important in demonstrating how widespread the use of magnetic information is and what types of information the animals utilize.

Magnetic compass orientation

A magnetic compass means that directions can be determined with the help of the magnetic field. In orientation experiments, the observation that an animal responds to shift in magnetic North with a corresponding change in its heading is diagnostic of magnetic compass use.

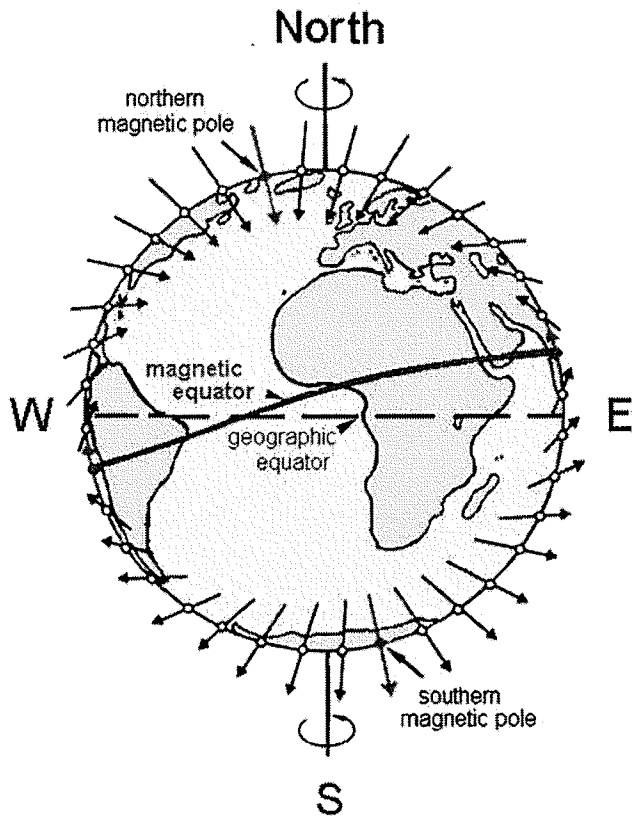

Fig. 1 Magnetic field of the earth. The *arrows* indicate the local magnetic vectors with their lengths proportional to the intensity of the local field. The magnetic poles and the magnetic equator are marked in red (after Wiltschko and Wiltschko 1995)

Demonstrating magnetic compass orientation

A magnetic compass appears to be rather widespread among animals. It was first demonstrated in migratory birds, taking advantage of a spontaneous behavior: during migration season, the urge of migrants to move into migratory direction is so strong that even captive birds head into the respective direction in their cages. When tested in the local geomagnetic field, European robins, *Erithacus rubecula*, but also other species of migrants, showed a strong preference of their seasonally appropriate migratory direction. Tested in an experimental field of equal intensity, but with magnetic North turned by a certain angle with the help of Helmholtz coils, the same birds altered their headings accordingly and preferred the direction that now corresponded to the same magnetic course (Fig. 2, left, center). This clearly shows that robins used the geomagnetic field to orient their movements (see Wiltschko and Wiltschko 1995 for details).

Meanwhile, magnetic compass orientation has been described for a number of other birds, such as several passerine migrants, homing pigeons (Walcott and Green 1974) and a shorebird species (Gudmundsson and Sandberg 2000). A magnetic compass has also been demonstrated in numerous other animals, including members of the other major groups of vertebrates, crustaceans, insects and a mollusk species (see Table 1). The behaviors involved range from spontaneous behavior, like e.g. the headings of sockeye salmon fry, *Oncorhynchus nerka* (Quinn 1980) or building a nest in Zambian mole rats, *Cryptomy* s sp. (Marhold et al. 1997a), over directions set by other environmental factors, like in hatchling marine loggerhead turtles *Caretta caretta* heading away from the shore (e.g. Lohmann 1991), *y*-axis orientation of various arthropods (e.g. Pardi et al. 1988) and the salamander *Notophthalmus viridescens* (e.g. Phillips 1986) at the border land/water, building activities in honeybees, *Apis mellifera* (e.g. DeJong 1982) and compass termites, *Amitermes meridionalis* (Duelli and Duelli-Klein 1978; Jacklyn and Munro 2002) to directional training and other acquired directions (for summary, see R. Wiltschko and Wiltschko 1995).

Functional mode of magnetic compass mechanisms

The functional mode of the magnetic compass was first analyzed in birds, again with the help of migratory orientation. Two unexpected properties became evident.

In contrast to our technical compass, the avian magnetic compass was found to be an '*inclination compass*', based on the inclination of the field lines instead of their polarity. Apparently, birds can only perceive the axial course of the field lines; to derive non-ambiguous directional information, they must interpret the inclination of the field lines with respect to up and down. This was demonstrated in a magnetic field where the vertical component was inverted: birds heading north in

Table 1 Animals demonstrated to use a magnetic compass (numbers in parentheses give the number of species where the respective type of compass is indicated; ??? means that the type of compass has not yet been analyzed)

Systematics	No. of orders	No. of families	No. of species	Type of compass?
Mollusks				
Snails	1	1	1	???
Arthropods				
Crustacean	3	3	5	Polarity compass (1)
Insects	6	7	9	Polarity compass? (1)
Vertebrates				
Cartilageous fish	1	1	1	???
Bony fish	2	2	4	Polarity compass? (1)
Amphibians	1	2	2	Inclination compass (1)
Reptilians	1	2	2	Inclination compass (2)
Birds	3	11	20	Inclination compass (8)
Mammals	2	2	3	Polarity compass (1)

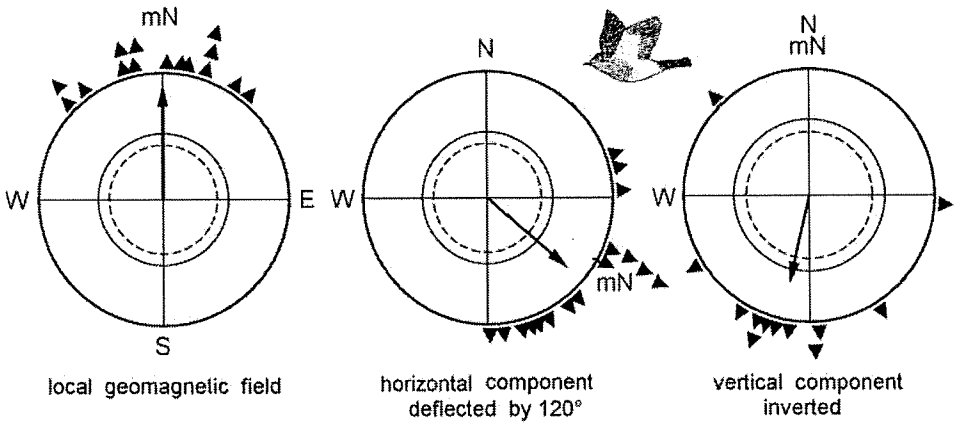

Fig. 2 Orientation behavior of migrating European Robins in spring, tested in the local geomagnetic field and in two experimental fields. *mN*, magnetic North. The *triangles* at the periphery of the circle mark mean headings of individual birds, the *arrows* represent the grand mean vectors with their lengths proportional to the radius of the circle. The two *inner circles* are the 5% (*dashed*) and the 1 % significance border of the Rayleigh test (data from Wiltschko and Wiltschko 1999; Wiltschko et al. 2001)

the geomagnetic field reversed their heading, now preferring magnetic South (Fig. 2, right diagram). Reversing the horizontal component and inverting the vertical component alter the axial course of the field lines in the same way (Fig. 3); an animal not perceiving the polarity of the magnetic field will not realize any difference. Hence birds reverse their headings in both situations alike (Wiltschko and Wiltschko 1972). This means that the avian magnetic compass does not distinguish between magnetic 'north' and 'south' as indicated by polarity, but between 'poleward' where the field lines point to the ground, and 'equatorward', where they point upward (Fig. 3).

All bird species studied so far use an 'inclination compass'. Yet this is not the only type of magnetic compass found in animals. Sea turtles possess an inclination compass like birds (Light et al. 1993; Lohmann and Lohmann 1992), whereas salmon (Quinn and Brannon 1982) and rodents (Marhold et al. 1997a) have a '*polarity compass*' based on the polarity of the field lines (see Table 1, last column): they do not reverse their headings when the vertical component is inverted (Fig. 4). The latter seems to apply also for the few invertebrate species analyzed so far (e.g. Lohmann et al. 1995). Salamanders were first reported to use both types of mechanisms, an inclination compass for shoreward orientation and a polarity

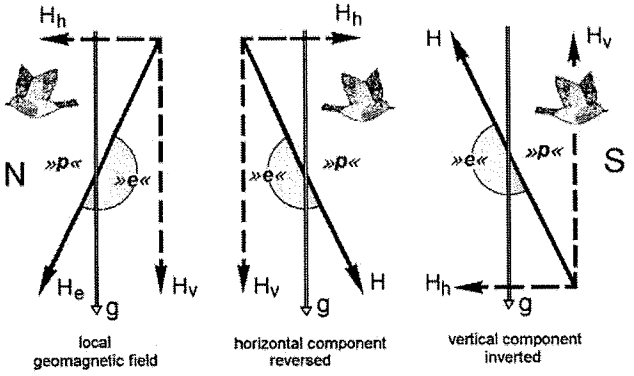

Fig. 3 Vertical section through the geomagnetic field to illustrate the functional mode of the inclination compass. *N*, *S*, magnetic North and South. *H*, magnetic vector, with H_e, the vector of the geomagnetic field; H_h, H_v, horizontal and vertical component, respectively; *g*, gravity vector. » *p* «, » *e* « , 'poleward' and 'equatorward', the readings of the inclination compass. The *bird* flies 'poleward'

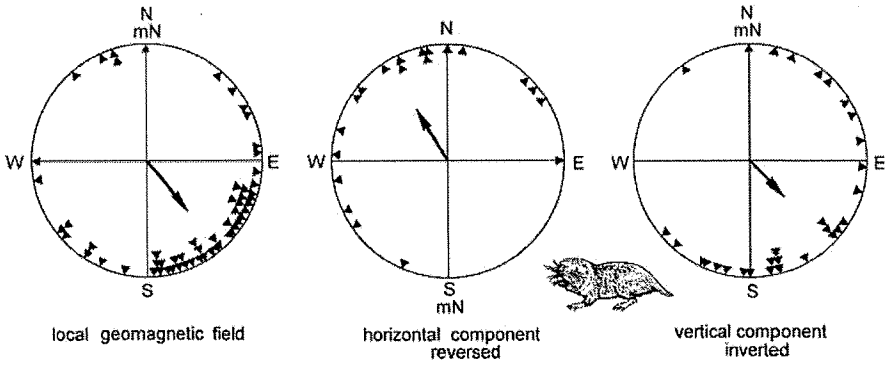

Fig. 4 Orientation of mole rats *Cryptomys* sp.(Rodentia) in the geomagnetic field and in two experimental fields. The *triangles* at the periphery of the circle mark the direction of the nest position from the center of the arena; the *arrow* represents the mean vector proportional to the radius of the circle (data from Marhold et al. 1997a)

compass for homing (Phillips 1986); however, as magnetic parameters are also involved in determining the home course, the data were interpreted to suggest a polarity compass for homing may also reflect an effect on the mechanisms determining this course (Phillips and Borland 1994), leaving the inclination compass as the only compass mechanism demonstrated in salamanders.

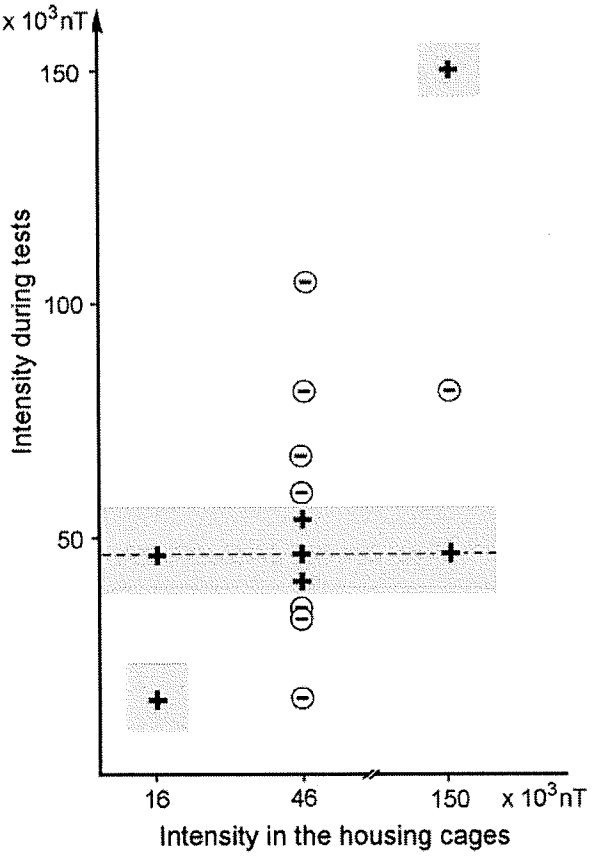

Fig. 5 Orientation responses of robins in magnetic fields of different total intensities indicating the functional window of the avian magnetic compass (*shaded in blue*). It is narrowly tuned to the intensity in which the bird is living; keeping birds at other intensities gives rise to a new functional window at the respective intensity. The intensity of the local geomagnetic field, 46,000 nT, is marked by a *dashed line* (data from Wiltschko 1978)

Another surprising finding in birds was that their magnetic compass is closely tuned to the total intensity of the ambient field. When the intensity of an experimental field was reduced or increased by 20–30%, birds were no longer oriented, suggesting a rather narrow functional window (Fig. 5). This window is not fixed, however, but adjusts to lower or to higher intensities when birds are exposed to these intensities for three days, but possibly also after a much shorter period of time. At the same time, these birds did not lose their ability to orient in the local geomagnetic field, yet they proved unable to orient in an intermediate field. (see Fig. 5; Wiltschko 1978). This indicates that the newly-gained ability to orient in higher or lower fields represents neither a shift nor an amplification of the functional range. Apparently, birds can orient only in field intensities they experienced before, with this experience possibly forming a new functional range. The magnetic compass of other animals has not yet been analyzed in view of a functional window of limited range.

Non-compass use of the magnetic field

Because of their nature as gradients running from north to south, magnetic intensity and inclination can give information on position. Evidence for this use of magnetic information is much rarer than that supporting compass use, and the number of species involved is much smaller.

Magnetic navigation

Magnetic intensity has been discussed as a component of the navigational 'map' of pigeons ever since the late nineteenth century (Viguier 1882). It could be used in the following way: in the northern hemisphere, birds know by experience that magnetic intensity increases towards north; when finding themselves at a location with intensity higher than at home, they would conclude that they are north of home and hence must head south to return. The intensity difference to be detected for magnetic navigation within the home range would be in the order of magnitude of 20 to 100 nT, the

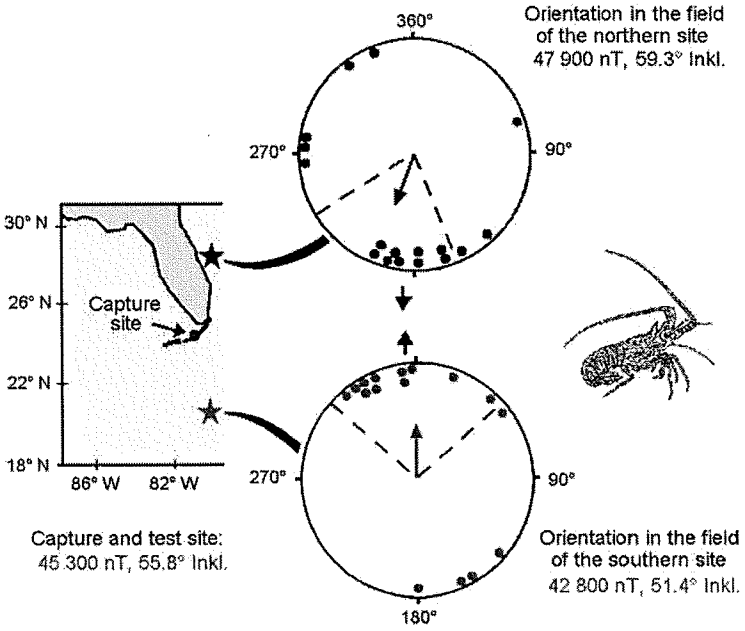

Fig. 6 True navigation by magnetic parameters indicated in spiny lobsters. The lobsters were tested near their capture site in magnetic fields replicating the ones of two distant geographic locations (marked with *asterisks*). In the circular diagrams, the *small arrows* outside the circle indicate the home directions from the simulated sites. *Dots* at the periphery of the circle mark the headings of single lobsters; the *arrow* represents the mean vector proportional to the radius of the circle, with the *dashed radii* indicating the 95% confidence interval of the mean direction (after Boles and Lohmann 2003)

differences in inclination in fractions of a degree, depending on the regional gradients and the distances involved.

First indications that animals use magnetic parameters in their navigational 'map' came from correlations of the vanishing bearings of homing pigeons, *Columba livia* f. *domestica*, with temporal changes of the magnetic field (e.g. Keeton et al. 1974). Pigeons released in a magnetic anomaly showed an increase in scatter up to disorientation that was strongly correlated with steepness of the local intensity gradient (Walcott 1978). The effects of various magnetic treatments on pigeons' initial

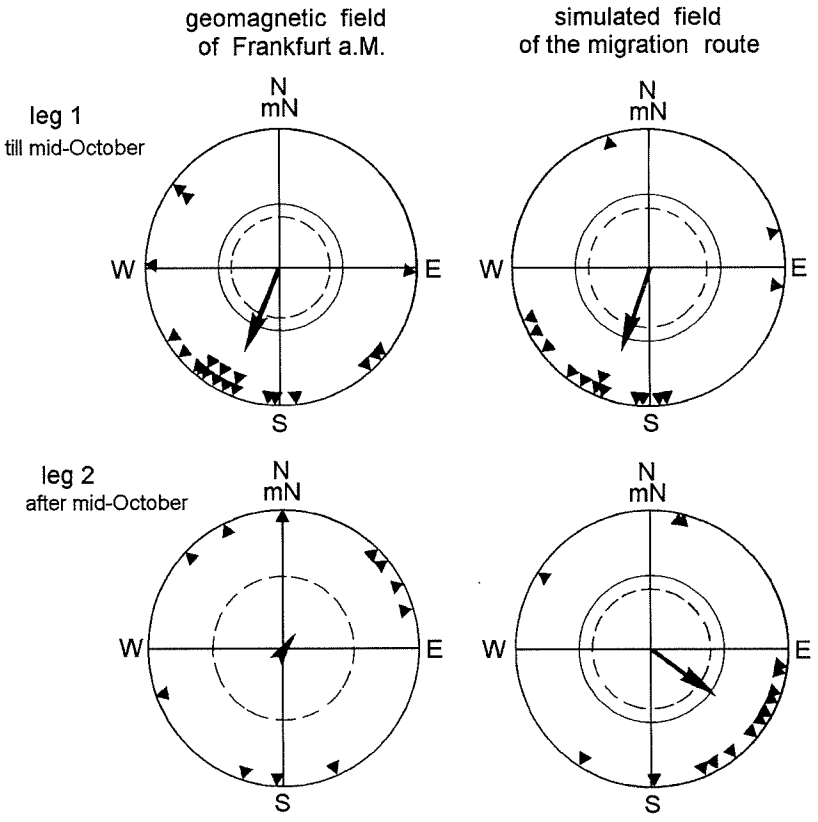

Fig. 7 Specific magnetic conditions acting as 'sign posts' in Pied Flycatchers: orientation of hand-raised birds tested in cages during their first autumn migration. *Left diagrams*: birds tested in the local magnetic field of Frankfurt a.M. (46,000 nT, 66° inclination) during the entire migration season; *right diagrams*: birds tested in magnetic fields simulating in four steps the decrease in intensity and inclination to 34,000 nT, 10° inclination Pied Flycatchers would normally experience during autumn migration. *Symbols* as in Fig. 2 (data from Beck and Wiltschko 1988)

orientation that cannot be attributed to interfering with the magnetic compass also suggested an involvement of magnetic factors in the navigational process (for summary, see Wiltschko and Wiltschko 1995). Migratory Australian Silvereyes, *Zosterops lateralis*, also responded to slight changes in magnetic intensity and inclination (Fisher et al. 2003).

Recently, however, more direct evidence for the use of magnetic factors as navigational parameters became available: When spiny lobsters *Panulirus argus* were captured and exposed at their capture site to magnetic conditions found at a distant site, they headed into the direction that would have brought them home from that distant site (Fig. 6; Boles and Lohmann 2003). Similar results also indicating true navigation by magnetic parameters have now also been reported for subadult green sea turtles, *Chelonia mydas* (Lohmann et al. 2004). In salamanders *Notophthalmus viridescens*, a response to changes in the angle of inclination alone has been described (Phillips et al. 2002a).

Magnetic conditions as 'sign posts' or triggers

Total intensity and/or inclination may also serve as 'sign-posts', marking specific regions where animals must act in a specific way. The respective responses are innate and are elicited when the animals encounter the crucial magnetic conditions. A first example involved passerine birds that change their migration course in order to avoid ecological barriers. The central European population of Pied Flycatchers, *Ficedula hypoleuca*, heads first southwest to Iberia, then changes to a southeasterly course, in this way travelling around the Alps, the Mediterranean Sea and the central Sahara. Hand-raised birds of this population started autumn migration with southwesterly preferences when tested in cages in the local geomagnetic field of central Europe; however, they showed the change in direction only when they experienced the magnetic field of northern Africa (Fig. 7; Beck and Wiltschko 1988). Apparently, these magnetic conditions serve as a 'sign post' and initiate the second leg of migration. Likewise, in Garden Warblers, *Sylvia borin*, transequatorial migrants, a horizontal field caused a reversal in headings – here, the field of the equator serves as trigger, eliciting the change in magnetic heading from 'equatorward' to 'poleward' that enables these birds to go on into the southern hemisphere (Wiltschko and Wiltschko 1992). The function of magnetic parameters as 'sign post' is not restricted to orientation responses, however; it also includes physiological responses. Thrush nightingales, *L. luscinia*, caught and held in Sweden, showed a slow weight gain during autumn migration; simulation of the specific magnetic condition of northern Egypt induced a much more rapid gain in weight; during real migration, this extra fat load enables these birds to cross the vast ecological barrier of the Sahara (Fransson et al. 2001).

Other well-documented cases of magnetic conditions of certain regions eliciting specific responses have been reported from young loggerhead turtles. Juvenile turtles from Florida spend the first years of their life in the Atlantic gyre; conditions found at the edge of the Atlantic gyre caused them to prefer headings that would lead them back into the gyre and thus prevent them from leaving the normal range of their population. Here, intensity, inclination and a combination of both proved effective (Fig. 8; Lohmann and Lohmann 1994, 1996; Lohmann et al. 2001).

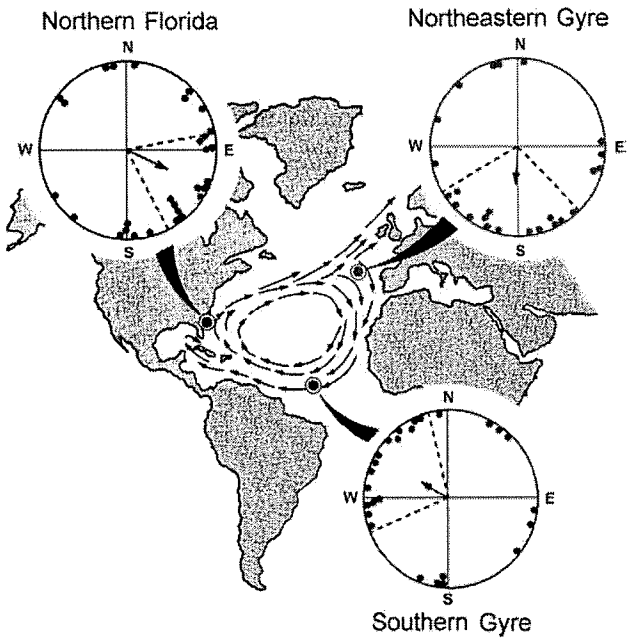

Fig. 8 Orientation of hatchling loggerhead turtles tested in magnetic field characteristic for three locations (marked by *dots*) at the edge of the Atlantic gyre (indicated by *small arrows*). *Symbols* in the circular diagrams as in Fig. 6 (from Lohmann et al. 2001)

Implications for magnetoreception

The behavioral evidence summarized above clearly shows that magnetoreception is not a uniform phenomenon: animals use different parameters of the geomagnetic field in different tasks. The nature of these parameters makes it rather unlikely that they are detected by the same mechanism. The magnetic compass does not respond to the small differences in intensity whose detection is crucial for using magnetic intensity as component of the navigational 'map'; these small changes are well within the functional window of the compass mechanism and are thus filtered off. Likewise, a mechanism designed to record tiny changes in intensity can, at the same time, hardly measure the direction of the magnetic field with great precision. Hence we must expect animals to have specialized receptors for mediating magnetic intensity and others for mediating information on magnetic direction, just as we use different technical devices – a compass and a magnetometer – to measure

the direction and the intensity of the magnetic field. Additionally, the two types of magnetic compass – inclination compass and polarity compass – imply that here, too, different mechanisms may be involved.

Magnetoreception

For a complete understanding of a 'magnetic sense', one needs to know (1) details on the primary processes mediating magnetic input, (2) the location of the sensory organ, its structure and its connections to the central nervous system and (3) what parts of the brain are involved in processing magnetic information. Unfortunately, our knowledge on the physiological and neurobiological processes associated with magnetoreception is still rather limited. The various animal groups are not equally represented: birds are by far the best studied group; fish are the only other group where some neuroanatomical and electrophysiological evidence is available.

A number of models for magnetoreception based on fundamentally different principles have been proposed, the three most prominent ones being (1) induction, (2) interactions of chemical processes with the ambient magnetic field and (3) processes involving permanently magnetic material.

Induction would be restricted to marine animals because it requires sea water as a surrounding medium with high conductivity. When skates and rays swim into different directions, they cross the field lines of the geomagnetic field at different angles, thus inducing different voltages at their electric organs (Murray 1962). The ampullary organs of skates and rays are known to be sensitive enough to detect the differences in voltage induced when the fish are heading in different directions (e.g. Kalmijn 1978), but evidence that this information is indeed used to derive compass orientation is still lacking.

The other two models – the 'radical pair'-model and the magnetite-hypothesis – are more general and would also serve terrestrial animals and those living in fresh water.

Magnetoreception based on 'radical pair'-mechanisms, and associated findings

The radical pair model, first proposed by Schulten and Windemuth (1986) and later detailed by Ritz et al. (2000), postulates a 'chemical compass' based on direction-specific interactions of radical pairs with the ambient magnetic field. It is supported by experimental evidence in birds and amphibians.

The model

In the initial step, the radical pair model assumes that specialized photopigments absorb a photon and are elevated to the singlet excited state. They form singlet radical pairs with antiparallel spin, which, by singlet–triplet interconversion, may turn into triplet pairs with parallel spin (Fig. 9). The magnetic field alters the dynamics of the transition between spin states; as a consequence, the triplet yield depends on the alignment of the macromolecule in the ambient magnetic field (for details, see Ritz et al. 2000) – it can thus convey information on magnetic directions. As receptor molecule, Ritz and colleagues (2000) suggested cryptochromes, a class of photopigments known from plants and related to photolyases (Sancar 2003); they possess chemical properties crucial for the model, including the ability to form radical pairs (Giovani et al. 2003).

To obtain magnetic compass information by a radical pair mechanism, animals must take advantage of the fact that triplet products are chemically different from singlet products and compare the triplet yields in different directions. This requires an orderly array of photopigments oriented in the various spatial directions. These conditions could be met by the more or less spherical arrangement of receptors in the eyes – radical pair processes would generate characteristic patterns of activation across the retina (Ritz et al. 2000). These patterns whose specific manifestations depend on magnetic intensity, would be centrally symmetric around the axis of the field lines, that is, axial rather than polar, and would enable animals to detect the direction of the ambient field. At the same time, the initial photon absorption would make magnetoreception a light-dependent process.

Evidence supporting the radical pair model

Because of the axial pattern of activation, a radical pair mechanism would provide an inclination compass.

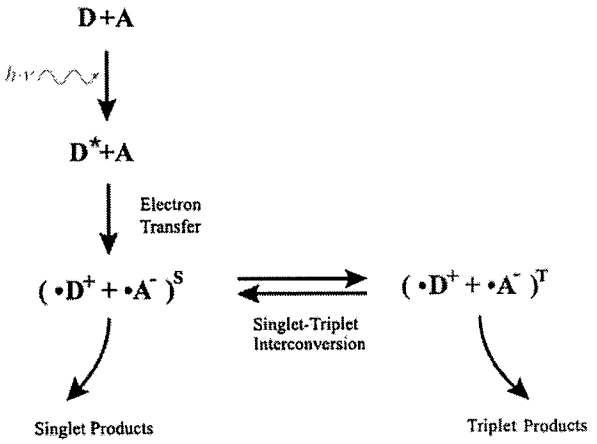

Fig. 9 Schema of a radical pair mechanism: a donor absorbs a photon and, by electron transfer, a singlet radical pair is formed. Singlet–triplet interconversion leads to triplet pairs, with the triplet yield depending on the alignment of the molecules in the ambient magnetic field. Triplet products are chemically different from the singlet products and thus may play a role in magnetoreception (modified from Ritz et al. 2000)

Hence the radical pair model can only apply to the magnetic compass of birds, amphibians and marine turtles (see Table 1). In birds, this model also provides an explanation for the narrow functional window of the magnetic compass that can be altered by exposing them to magnetic intensities outside the normal functional range (see Fig. 5): when tested under intensities that differ markedly from that of the local geomagnetic field, the birds would be faced with a novel activation pattern (Ritz et al. 2000). This may confuse them at first, yet the pattern retains its central symmetry around the axis of the field lines. Given sufficient time, the birds may become familiar with the novel pattern and learn to interpret it, thus regaining their ability to orient.

The radical pair model predicts that magnetoreception is light-dependent. Light is indeed required for magnetic compass orientation in birds and salamanders. First evidence came from behavioral experiments with young homing pigeons that use their magnetic compass to record the direction of displacement: displaced in total darkness, they were disoriented (Wiltschko and Wiltschko 1981), just as young pigeons displaced in a distorted magnetic field had been (Wiltschko and Wiltschko 1978). Disorientation in the absence of visible light was also observed in the salamander *Notophthalmus viridescens* (Phillips and Borland 1992a). Later tests revealed a wavelength-dependency of the magnetic compass in amphibians (Phillips and Borland 1992b), migratory birds and pigeons (see Wiltschko and Wiltschko 2002). Marine turtles, on the other hand, proved well oriented in total darkness (Lohmann 1991; Lohmann and Lohmann 1993). Although an inclination compass is involved here, magnetoreception as proposed by the radical pair model appears unlikely, unless there is a yet unknown way that radical pairs could be generated in total darkness.

Demonstrating a radical pair mechanism

A diagnostic test based on magnetic resonance aimed at obtaining direct evidence for a radical pair mechanism underlying the avian magnetic compass. If the triplet yield is crucial for magnetoreception, interfering with the singlet-triplet interconversion should alter the output of the receptors markedly and thus disrupt magnetoreception. The singlet–triplet interconversion rate can be significantly affected by oscillating fields of specific frequencies in the MegaHertz range (Ritz et al. 2000). The intensities required for these resonance effects are so low that they would not affect any of the magnetite-based mechanisms currently considered (as explained below), so that a disruption of magnetic orientation would be diagnostic for the involvement of a radical pair mechanism.

At present, it is not easy to predict exactly which specific frequencies will interfere with the radical pair mechanisms underlying magnetoreception, because the chemical composition and the geometric structures of molecules involved are not yet known; theoretical considerations and in vitro studies indicate that they are to be expected in the 0.1–10-MHz range. The effect of the oscillating fields should depend on their orientation with respect to the static background field (Cranfield et al. 1994). These resonances are generally very broad and might therefore lead to disturbing effects at virtually all frequencies within this range, provided the intensity of the oscillating field is sufficiently strong (Henbest et al. 2004). However, a special resonance occurs when the frequency of the oscillating field matches the energetic splitting induced by the static geomagnetic field; here, one expects a marked effect regardless of the structure of the molecules forming the radical pairs. For the 46,000 nT geomagnetic field of Frankfurt, this frequency is 1.315 MHz (see Thalau et al. 2005).

First tests with a weak broad band noise field of frequencies from 0.1 MHz to 10 MHz added to the geomagnetic field indeed showed that this disrupted the orientation of migratory birds (Ritz et al. 2004). Further tests used the single frequencies of 1.315 and 7.0 MHz with an intensity of about 480 nT. When these fields were presented parallel to the geomagnetic vector, the birds were oriented in their migratory direction, whereas they were disoriented when the same fields were presented at an angle of 24° or 48° to the geomagnetic field (Fig. 10; Ritz et al. 2004; Thalau et al. 2005). This is in agreement with the radical pair model and clearly shows that the observed effect of high-frequency field is a specific one. Together, these findings indicate that the primary process of magnetoreception in birds involves a radical pair mechanism.

Interactions of at least two receptors

If photopigments were involved, these pigments can hardly be expected to absorb light over the entire range of the visual spectrum – hence magnetoreception should

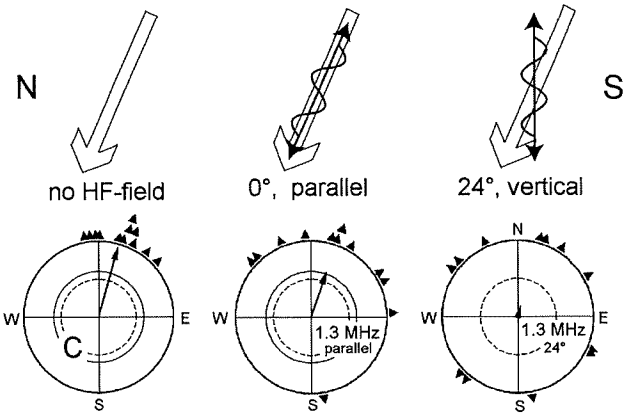

Fig. 10 Orientation of European Robins in the geomagnetic field (Control, *C*) and in high-frequency fields added to the geomagnetic field in two different orientation. The *upper part* of the diagram illustrated the orientation of the geomagnetic field and the high-frequency field in the three test conditions; symbols in the circular diagrams as in Fig. 2 (data from Thalau et al. 2005)

depend on the wavelength of light. A wavelength-dependency of magnetic compass orientation was reported for salamanders, passerine birds, and homing pigeons. In the respective experiments, salamanders and birds were tested under monochromatic lights of various wavelength and intensities. By reflecting the absorption ranges of the crucial pigments, these studies may indicate the number of receptors involved and how they interact.

Salamanders Salamanders show a wavelength dependency that is characterized by normal orientation only in a rather narrow wavelength band at the short-wavelength end of the spectrum and a variety of responses induced by long-wavelength light, with the specific manifestations of these responses attributed to different motivational stages. Salamanders manipulated to head shoreward showed normal orientation only up to 450 nm; at 475 nm, they were disoriented; and under wavelength of 500 nm and beyond, their headings were shifted by approximately 90° counterclockwise. When the animals were kept under long wavelength light with $\lambda > 500$ nm, they showed a mirror-image clockwise shift under 'white' light, but headed shoreward under long-wavelength light (Phillips and Borland 1992b). To explain these findings, the authors suggested two antagonistic spectral mechanisms indicating directions perpendicular to each other. Only the short wavelength receptor was to indicate the correct magnetic directions, while the long-wavelength receptor activated by most of the visual spectrum indicated shifted ones. To reconcile these findings with the normal orientation observed under 'white' light, where both receptors are stimulated, the authors postulate that the signal of the short-wavelength dominates over the contradicting input (Phillips and Borland 1992b; Phillips et al. 2001). Since a spectral mechanism providing animals with false information is difficult to accept, Phillips and Deutschlander (1997) speculated about the two spectral mechanisms being connected, possibly being essential components of the same biochemical process.

When the salamanders were manipulated to head homeward, however, they were normally oriented only under 400 nm light and disoriented under wavelength of 450 nm and beyond (Phillips and Borland 1994). The authors attributed this disorientation to the false compass readings under long-wavelength light, which no longer allow the 'map'-receptors to work properly and determine the home course. Held under long-wavelength light, the salamanders now preferred an axis that roughly corresponded with the magnetic north-south axis under both, 'white' and long-wavelength light (Phillips et al. 2002b). This response was discussed as being related to alignments and possibly controlled by tiny magnetite particles in the heads of the salamanders.

Birds Most tests with birds used migratory orientation as a criterion whether or not normal directional information from the magnetic field could be obtained in a given situation. Migratory birds have not only been tested under different wavelengths, but also under different intensities and under combinations of two monochromatic lights. Their responses under the various light regimes indicate highly complex interactions between at least two, possibly more, receptors.

Wavelength-dependency: European Robins were tested under monochromatic light produced by light-emitting diodes (LEDs) with a half band-width of 30–50 nm. Their behavior at various wavelengths revealed the following pattern: magnetic orientation was possible under 424 nm blue, 510 nm turquoise and 565 nm green light, whereas under 590 nm yellow and 635 nm red, the birds were disoriented (Fig. 11; Wiltschko and Wilt-

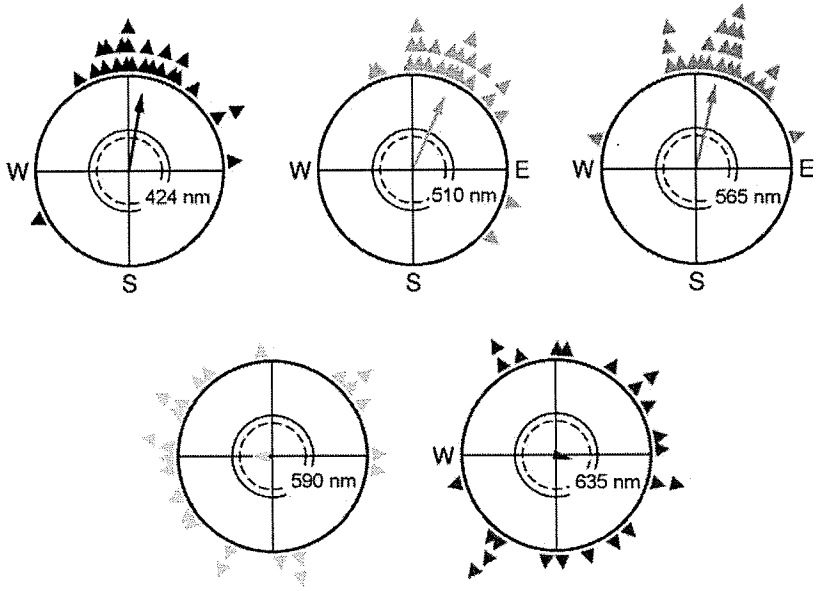

Fig. 11 Orientation behavior of European robins in spring under monochromatic lights of different wavelength (indicated in the circles); symbols as in Fig. 2. (after W. Wiltschko and Wiltschko 2002)

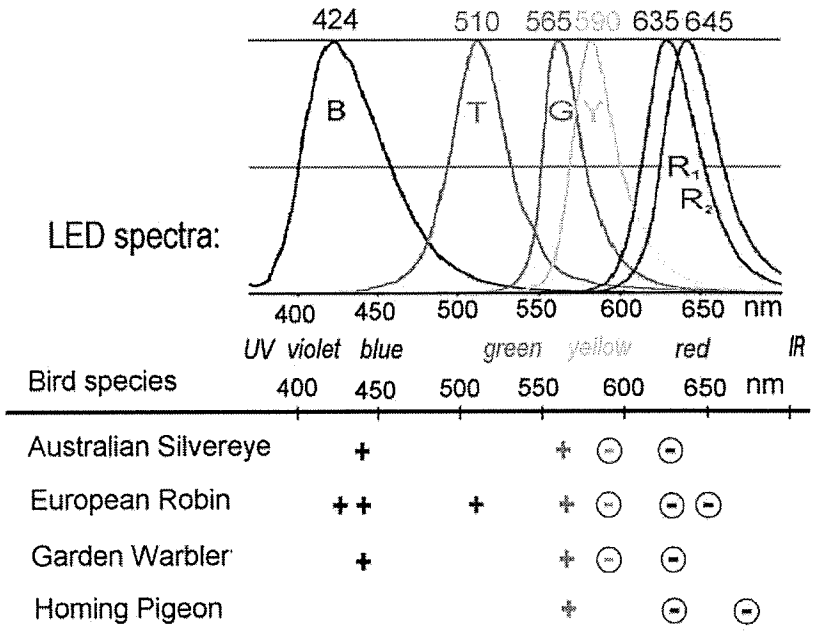

Fig. 12 Oriented behavior of four birds species tested under monochromatic light produced by light-emitting diodes (LEDs). *Upper part* of the diagram: spectra of the test lights; *lower part*: (+) oriented behavior or (−) disoriented behavior observed at the respective wavelengths (after W. Wiltschko and Wiltschko 2002)

schko 1999). Experiments using interference filters with a half-band width of only 10 nm could narrow down the onset of disorientation in robins even further to between 561 nm and 568 nm (Muheim et al. 2002). This pattern seems to be common to passerine species and homing pigeons (Fig. 12; see Wiltschko and Wiltschko 2002). That is, in contrast to salamanders, the spectral range where birds obtain normal magnetic compass information includes the larger part of the visual spectrum. At the same time, this wavelength dependency of magnetoreception shows no relationship to the peaks of the four color cones of the birds' visual system (see Maier 1992) and thus speaks against their involvement in mediating magnetic directions, suggesting the existence of another type of receptor. The birds' response looked like an 'all-or-none'-response that could be attributed to one receptor, yet the rather abrupt transition to disorientation, which persisted under increased intensity of the yellow or red light (Wiltschko and Wiltschko 2001; Wiltschko et al. 2004a), seems to suggest an antagonistic interaction with a second receptor.

A second receptor with peak absorption at long wavelengths is also indicated by another finding. Although normally disoriented under long wavelengths, birds could orient under 645 nm red light after they had been exposed to this wavelength for 1 h prior to the critical test (Möller et al. 2001; Wiltschko et al. 2004a). The orientation induced this way proved to be normal migratory orientation. This ability to orient after having been pre-exposed to the test condition shows an interesting parallel to the ability to adjust the functional window to magnetic intensities outside the normal functional range (Wiltschko 1978) and may be based on similar mechanisms, namely learning to interpret a novel pattern of activation. The disorientation normally observed under red light suggests that under 'white' light, the long-wavelength receptor forms the minor component of a complex response pattern. Presented by itself, it would seem novel, but it would also be centrally symmetric to the axis of the field lines. Birds suddenly faced with this pattern alone might need a certain time until they are able to recognize its general characteristic and interpret it to derive magnetic directions (for a more detailed discussion, see Wiltschko et al. 2004b).

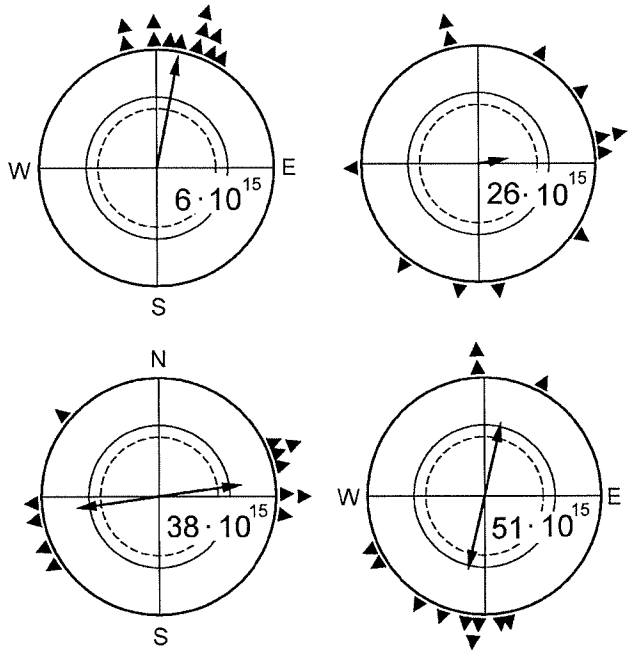

Fig. 13 Orientation behavior of European robins under the same 565 nm green light at different intensities; the respective quantal flux (in quanta m^{-2} s^{-1}) is indicated in the *circular diagrams*. Symbols as in Fig. 2

Effect of higher intensities: The findings mentioned so far were obtained under rather low light levels of 6–9×10^{-15} quanta s^{-1} m^{-2}, an intensity found in nature more than half an hour after sunset or before sunrise. This seemed to be appropriate, because the passerine species tested were either nocturnal migrants or migrating during the twilight hours. When the light intensity was increased six times, birds were still disoriented under yellow and red light (see above), but under light from the blue-to-green part of the spectrum, a marked change in behavior was observed: passerine migrants no longer preferred their natural migratory direction, but instead showed axial preferences or odd unimodal tendencies (Wiltschko et al. 2000, 2003b; Wiltschko and Wiltschko 2001). Tests at the same wavelength of light showed that changes in intensity led to different responses: e.g. under 565 nm green light, robins first showed normal migratory orientation, then disorientation, followed by preference of the east–west-axis and finally a preference of the north–south-axis, depending on intensity (Fig. 13; R. Wiltschko and R. Wiltschko, unpublished data). The unimodal preferences observed at higher intensities were 'fixed directions' in the sense that they did not show the normal seasonal change between spring and autumn (Wiltschko et al. 2000). They were found to be fundamentally different from migratory orientation, as they also did not depend on the inclination compass normally used by birds (Wiltschko et al. 2003b).

The nature of these odd responses is not yet clear. The axial preferences show some similarities to alignments, but unimodal tendencies in directions other than the migratory direction (e.g. Wiltschko et al. 2000, 2004b) are hard to explain. As motivational differences can largely be excluded, they imply that the magnetic receptors no longer provide information that can be used to locate the migratory course. Yet the light with identical spectral compositions, but lower intensity, allows excellent migratory orientation. The light levels of these brighter lights were still fairly low – on a sunny day, the natural light is brighter by powers of ten. Hence saturation of the receptors appears highly unlikely. Because 'white' light of high intensity allows normal orientation, the reason for the odd responses seem to lie in the near monochromatic nature of the light consisting of a narrow band of wavelengths only. Speculating on why this should matter leads to considerations about the interaction of the input of various receptors at higher centers. The number of receptors involved in magnetoreception is still unclear, but if they were more than one or two, monochromatic light would stimulate one receptor strongly, while others are not stimulated at all. This could result in an imbalance of input at higher units where the input of these receptors converge. The other receptors may also be specialized on magnetic input, or they may involve the cones of color vision which might provide background information of the general light level. Possibly, as long as the quantal flux is so low that the cones are not activated, monochromatic light from the blue-to-green part of the spectrum allows normal orientation; if the monochromatic lights are strong enough to activate the cones, however, the resulting imbalance might affect the processing of magnetic input in a way that the information content of magnetic input changes its general characteristics.

Bichromatic test lights: A combination of light from the blue-to-green part of the spectrum with 590 nm yellow light also leads to unimodal responses that no longer coincided with the natural migratory direction. These responses were likewise 'fixed directions', as they failed to show the normal seasonal change (Wiltschko et al. 2004b). The responses to bichromatic light combined from wavelengths where birds normally show excellent orientation, and yellow light, where they are disoriented when it is presented alone, clearly show that yellow light is not neutral, also pointing out interactions between at least two receptors that have not yet been fully understood. Interestingly, the specific response depended on the wavelength from the blue-to-green part of the spectrum: robins preferred northerly headings under green-and-yellow, southeasterly headings under turquoise-and-yellow and southerly headings under blue-and-yellow (Wiltschko et al. 2004b; Stapput et al. 2005). Apparently, the receptor(s) activated by light from the blue-to green part of the spectrum, although no longer providing magnetic compass information for locating the migratory direction, are active and determine the specific directions of the 'fixed' headings.

Similar patterns in birds and amphibians? The findings described above indicate that certain light regimes drive the reception mechanisms for compass information towards their limits, leading to odd responses that cannot yet be explained. In birds, specific combinations of wavelengths as well as monochromatic light above a certain quantal flux result in such responses. To what extend this is also true for salamanders is unclear, because salamanders have not yet been tested under the same wavelengths at different intensities. It is interesting to note that the odd shifts in directions of salamanders heading shoreward and the disoriented behavior of salamanders heading homeward observed from 500 nm onward (Phillips and Borland 1992b, 1994; Phillips et al. 2002b) were recorded at light intensities where birds no longer prefer their migratory direction; at 400 nm, where salamander always showed normal orientation, the light intensity was markedly lower. Unfortunately, it is still unknown how salamanders would respond to long wavelengths at this lower light intensity. The manifestations of the responses under higher intensity – unimodal preference of unexplained directions, axial preferences and disorientation – are very similar in salamanders and birds. Hence it appears possible that the odd responses in these two animal groups represent related phenomena, which in salamanders depend not only on wavelength, as described by Phillips et al. and colleagues (e.g. 2001), but also on the intensity of light, reflecting a magnetoreception system functioning under borderline conditions. Future studies will have to clarify this question.

The site of the light-dependent magnetoreceptors

Another question concerns the location of the magnetoreceptors. Theoretical considerations favored the eyes as site of magnetoreception because of their almost spherical shape (Ritz et al. 2000) – this prediction has also been confirmed in birds, with the surprising finding that magnetoreception seems to be restricted to the right eye. Passerine migrants tested with their left eye covered were just as well oriented as binocular birds, whereas the same birds failed to show oriented behavior when their right eye was covered (Wiltschko et al. 2002a, 2003a). In salamanders, however, the receptors were found to be located in the pineal, the ancient third eye of vertebrates, which in amphibians is directly sensitive to light. Critical tests in which the skull above the pineal was covered with a color filter, but the eyes were open to the natural light, clearly showed that the magnetic compass in salamanders depended solely on the spectral properties of the light reaching the pineal (Deutschlander et al. 1999; Phillips et al. 2001).

Cryptochromes, first known from plants, but recently also discovered in animals (see Sancar 2003 for review) have been suggested to form the radical pairs involved in magnetoreception (Ritz et al. 2000). These photopigments have been found in the retina of vertebrates, first in mammals (Miyamoto and Sancar 1998), but also in chicken (Haque et al. 2002) and recently in migrating passerine birds. In Garden Warblers, *Sylvia borin*, cryptochromes are located in the large displaced ganglion cells (Mouritsen et al. 2004). In European robins, two forms of cryptochrome 1, splice product of the same gene, were identified, with the novel C-terminal of the second form implying a novel function (Möller et al. 2004). These findings support the idea that cryptochromes may be involved in the radical pair processes underlying the avian magnetic compass, yet direct evidence for their crucial role is still lacking.

Neuronal pathways associated with the avian magnetic compass

Our knowledge on the neural pathways and the parts of the brain processing magnetic compass information is rather limited; the available evidence comes entirely from studies with birds. Electrophysiological recordings in pigeons suggest that magnetic input is processed in parts of the visual system. Recordings from the nucleus of the basal optic root (nBOR) and from the *tectum opticum* revealed units that responded to changes in magnetic direction (Semm et al. 1984; Semm and Demain 1986). These responses are in accordance with the predictions of the radical pair model, as they were observed only in the presence of light; they seem to originate in the retina, as they depended on an intact retina and optic nerve. When the eyes were illuminated with monochromatic light of various wavelengths, units with a peak of responsiveness around 503 nm and others with a peak beyond 580 nm were identified, thus suggesting the two types of receptors with different absorption maxima, a finding that is in agreement with the behavioral studies likewise indicating two types of receptors with absorption peaks in the blue-to-green and in the long-wavelength range (e.g. Möller et al. 2001; Wiltschko et al. 2004b).

Individual neurons in the nBOR as well as the *tectum opticum* showed distinct peaks of response at particular alignments of the magnetic field (Fig. 14). These varied between cells so that the input of a number of units

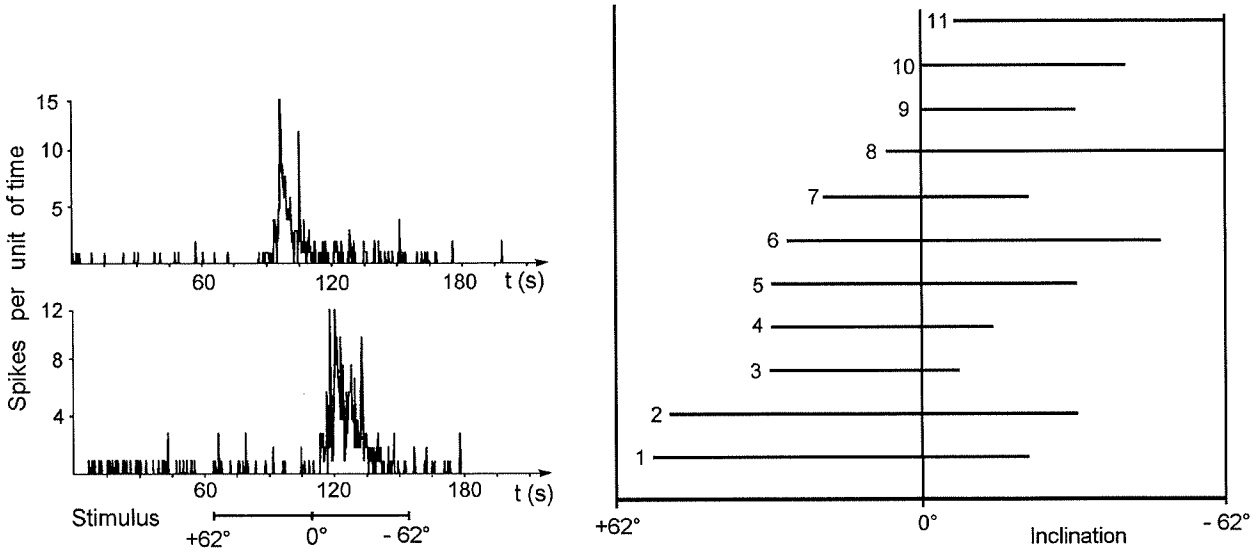

Fig. 14 Electrophysiological responses recorded from direction-selective cells in the nucleus of the basal optic root (nBOR) of pigeons; the stimulus was a gradual change of magnetic inclination from 62° downward to 62° upward (= vertical component inverted). *Left*: responses of to individual units; *right*: different neurons responding to different spatial directions of the magnetic vector, with the horizontal bars indicating the range of augmentation of electrical activity of representative neurons (data from Semm et al. 1984)

would represent the various directions in space model (Semm et al. 1984; Semm and Demaine 1986). Processed collectively and integrated, it would thus provide a suitable basis for a compass as predicted by the radical pair model.

The finding that magnetic input is mediated exclusively by the right eye (Wiltschko et al. 2002a) indicates a stong lateralization of the magnetic compass that appears to be rather widespread among birds (see Wiltschko et al. 2003a; Prior et al. 2004). Because of the very few connections between the two hemispheres, it means that magnetic information is processed almost exclusively by the left hemisphere of the brain. This is intriguing, as a number of morphological asymmetries have been described in the tectofugal system, a part of the visual system (Güntürkün 1997) which, aside from the *tectum opticum*, comprises the *nucleus rotundus*, where activation by magnetic stimuli was indicated by the glucose method (Mai and Semm 1990). Together, the few findings available suggest that magnetic input originating in the right eye shares neuronal pathways with the visual system, being processed in the tectofugal system of the left hemisphere of the brain. Other parts of the brain involved in processing magnetic compass information are yet to be determined.

Magnetoreception based on magnetite, and associated findings

Magnetite is a specific form of iron oxide Fe_3O_4 whose general properties depend on the size and shape of the particles (Fig. 15). Spin interactions cause the spins of adjacent atoms to align, thus forming *domains* with all spins parallel. Large particles include multiple domains with their magnetic moments largely canceling each other; particles in the range between about 1.2 μm and 0.05 μm consist of a *single domain* and have a stable magnetic moment, acting as tiny permanent magnets. Even smaller particles are *superparamagnetic*: at room temperature, their magnetic moment fluctuates as a results of thermal agitation, but it can easily be aligned by an external magnetic field (see Kirschvink et al. 1985 for details).

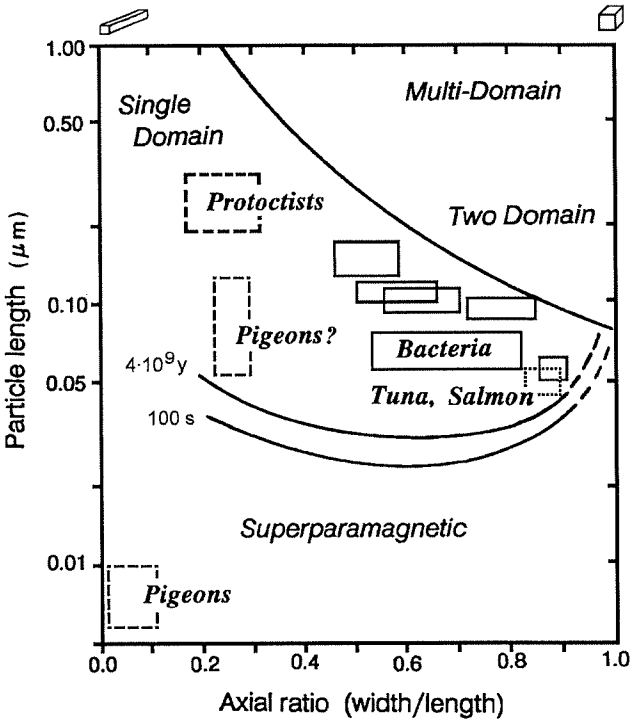

Fig. 15 Magnetic properties of magnetite particles: domain stability field diagram indicating how the magnetic moments of particles of a given shape differ with size; size of particles found in various living beings is indicated (after Kirschvink and Gould 1981, with the superparamagnetic particles identified by Fleißner et al. 2003 added)

The model

In the 1970s, certain bacteria were discovered to contain chains of single domain magnetite (Blakemore 1975) that act as magnets and align these bacteria along the field lines of the geomagnetic field. Magnetic information mediated by tiny magnets was an attractive idea, and the existence of magnetic material of biogenic origin caused authors to speculate about its potential role in the orientation of higher animals.

Based on theoretical considerations, the magnetite hypotheses propose a variety of models on how magnetite particles might mediate magnetic information, some of them involving single domains (e.g. Yorke 1979; Kirschvink and Gould 1981; Kirschvink and Walker 1985; Edmonds 1996), others superparamagnetic particles (e.g. Kirschvink and Gould 1981; Shcherbakov and Winklhofer 1999). A uniform concept on how magnetite-based magnetoreceptors might work does not yet exist. Interestingly, some of the models predict polar, others axial responses. Model calculations showed that magnetite-based receptors could convey directional information or information on magnetic intensity, depending on their specific structure and on the amount

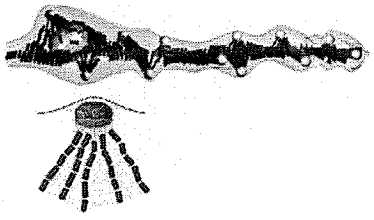

Fig. 16 Schematic reconstruction of structures found in the skin of upper beak of pigeons, based on ultrathin section series. *Above*: the terminal region of a nerve containing a scaffold of iron platelets and numerous spherules of superparamagnetic magnetite particles; *below*: a spherule of superparamagnetic particles and the structures surrounding it (from Fleissner et al. 2003)

of magnetite included; they could account for the sensitivities indicated by behavioral evidence.

Histological findings

Magnetite has been discovered in a large number of species belonging to all major phyla, mostly by measuring the natural and induced remanence with highly sensitive SQUID-magnetometers. In honey bees, *Apis mellifera*, magnetic material was described in the front part of the abdomen (Gould et al. 1978); in vertebrates, it appears to be located mostly in the ethmoid region in the front of the head (see Kirschvink et al. 1985).

In salmonid fish, chains of single domain magnetite have been isolated from ethmoid tissue (Mann et al. 1988). A histological study showed magnetite particles embedded in specific cells in the basal lamina within the olfactory lamellae of rainbow trout, *Oncorhynchus mykiss* (Walker et al. 1997). These particles were identified as single domains; applying a strong external magnetic field could change the direction of their magnetization (Diebel et al. 2000). In birds, histological and electron-optic studies revealed magnetite particles in the orbital and in the nasal cavity, where single domains were reported (Beason and Nichols 1984; Beason and Brennon 1986; William and Wild 2001), and at specific locations in the skin of the upper beak of pigeons, where clusters of very small crystals were described, with the particles identified by crystallographic means as superparamagnetic magnetite (Hanzlik et al. 2000). These clusters were located within nervous tissue and associated with a remarkable framework of platelets consisting of elementary iron (Fig. 16); the authors speculate about possible functions in a magnetoreceptor (Fleissner et al. 2003). Altogether, the magnetite-containing structures found in birds and fish do not seem to be identical, implying that the respective magnetite-based receptors might differ in their general characteristics.

Effects of a strong, short magnetic pulse

The first behavioral tests were designed to generally demonstrate an involvement of magnetite in magnetoreception. They aimed at interfering with the potential receptors by altering the magnetization of the magnetite crystals. This was expected to change the output of receptors in a dramatic way and thus cause a lasting after-effect on orientation behavior. A popular method was to apply a brief, strong magnetic pulse to the head of the test animal – the pulse had to be strong enough to remagnetize the magnetite particles but, at the same time, short enough to prevent these particles from rotating into the pulse direction and thus to escape remagnetization. In most studies, a 0.5 T pulse with 3–5 ms duration was used.

Behavioral tests Tests with migratory birds again use the preference of the migratory direction as a criterion whether pulse treatment affected behavior. A pulse prior to the critical tests caused a marked 90° change in direction: Australian Silvereyes, *Zosterops lateralis*, preferred easterly headings, and that when they had been heading northward in autumn as well as southward in spring (Fig. 17, left). This effect of the pulse lasted for about 3 days; after that, the birds became disoriented and, about 10 days after pulse treatment, resumed their original orientation in migratory direction (Wiltschko et al. 1994, 1998). Interestingly, this effect of pulsing was restricted to experienced migrants that had completed at least one migratory trip; young birds that had been captured immediately after fledging proved to be unaffected and continued in their normal migratory direction (Fig. 17, right; Munro et al. 1997). This suggests that the pulse affected a mechanism that is based on experience, and points to the position-finding system of the 'navigational map'. The same pulse also caused experienced pigeons to deviate from the mean of untreated control birds (Beason et al. 1997).

In further tests, the protocol of the pulse treatments was modified to identify specific properties of the receptor. An identical pulse applied in two different orientations – e.g. 'south anterior', the induced south pole towards the beak, and 'south left', the induced south pole towards the left side of the head - lead to deflections to different sides of the control birds (Fig. 18). This was true for passerine migrants like bobolinks, *Dolichonyx orycivorus*, as well as for homing pigeons (Beason et al. 1995, 1997). It implies that the pulse does not simply deactivate the receptors altogether, but instead causes them to provide altered information, which causes birds to head in different directions. In other tests, the same pulse was applied together with a strong, 100 μT biasing field. It had been argued the pulse alone would remagnetize only an unknown portion of the particles of the receptor; the biasing field was to align movable particles in one direction so that a pulse affected them all. A pulse applied parallel would not change their magnetization,

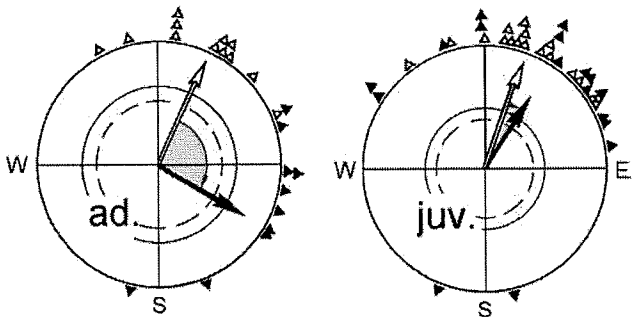

Fig. 17 Effect of a short, strong magnetic pulse on the orientation behavior of Australian Silvereyes in Australian autumn. *ad.*, old, experienced birds tested; *juv.*: young, inexperienced birds tested. *Open symbols* indicate control data recorded before, *solid symbols* data recorded after pulse treatment. Symbols as in Fig. 2 (data from W. Wiltschko et al. 1994, Munro et al. 1997).

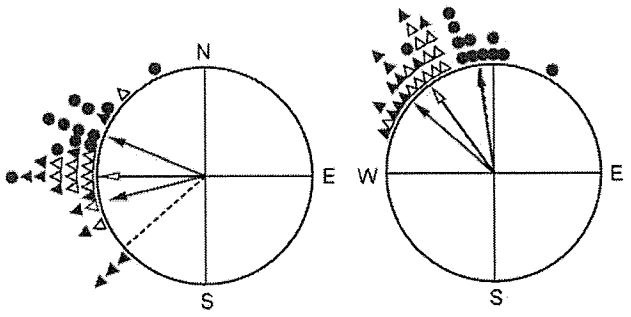

Fig. 18 The effect of a magnetic pulse on the orientation of homing pigeons released at sites 129 km and 108 km from the loft; the home directions 229° and 353° are indicated by a *dashed radius*. The *symbols* at the periphery of the circle mark the vanishing bearings of individual pigeons: *open symbols*, untreated control birds; *blue symbols*, birds treated with a pulse oriented 'south anterior'; *red symbols*: birds treated with a pulse oriented 'south left'; the *arrows* represent the respective mean vectors (data from Beason et al. 1997)

whereas the pulse applied in an antiparallel direction should have a maximum effect. In critical tests, however, both groups of birds showed the same deflections (Wiltschko et al. 2002b). These results largely exclude single-domain particles free to move as part of a polarity-sensitive receptor.

Treating mammals with the same pulse also induced noticable deflections. Zambian molerats shifted the position of their nest by about 75° from the south-southeast to east. Retesting the same animals showed that this altered preference, in contrast to the one observed in birds, was stable for three months until the end of the experiments (Marhold et al. 1997b).

Single domains or superparamagnetic particles? Since none of the other reception mechanisms would show an after-effect following treatment with a magnetic pulse, the observation that the pulse had an effect is diagnostic for magnetite particles involved in the receptor controlling the observed behavior. The response to pulse treatment can also be interpreted in view of the type of magnetite particles involved – single domains or superparamagnetic particles.

In birds, where both types have been described, the short duration of the pulse effect seems to speak against single domains. Remagnetization of single domain particles should be just as stable and lasting as the original one. Yet in birds, a clear pulse effect was observed only on the day of pulsing and the following two days (Wiltschko et al. 1994, 1998; Beason et al. 1997). The behavior of birds after pulse treatment thus indicates magnetite-based receptors, but these receptors do not seem to be based on single domains. This leaves superparamagnetic particles. Single superparamagnetic particles are not affected by a magnetic pulse as used in the experiments described above, but clusters and chains of clusters are. A strong pulse might break up the clusters and disrupt the chains, but they rearrange themselves, with a time rate in the order of several days, depending on the specific structure of the clusters, the angle with which they are hit by the pulse etc. (Davila et al., in press).

In rodents, the situation is different insofar as anatomical and histological data are entirely lacking. The pulse effect indicates a receptor based on magnetite, and the long duration of the pulse effect would be in accordance with single domains.

Neuronal pathways associated with magnetite-based receptors

The region of the head where magnetite particles were found in birds and fish is innervated by the *ramus ophthalmicus*, a branch of the *nervus trigeminus*. Electrophysiological recordings from the ophthalmic nerve in passerine birds used stimuli produced by a coil system that in some experiments was set up in a way that the axis of the coils was aligned with the magnetic vector so

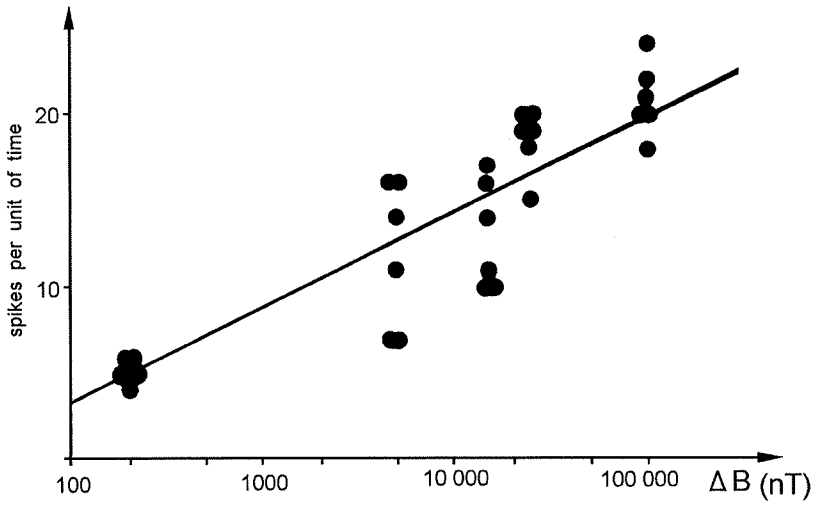

Fig. 19 Electrophysiological recordings from a trigeminal ganglion cell of a bobolink, responding to different changes in the intensity of the geomagnetic field (after Beason and Semm 1991)

that intensity alone could be modified. Units responding to magnetic stimuli modified their spontaneous activity by changes in magnetic intensity, showing a logarithmic characteristic. The minimum intensity difference tested was 200 nT (Fig. 19), where the birds still showed a clear response. Similar recordings are reported from the trigeminal ganglion (Semm and Beason 1990). Electrophysiological recordings from the corresponding nerve in rainbow trouts produced likewise responses to changes in intensity (Walker et al. 1997).

Two other findings provide more direct evidence that the input from magnetite-based receptors in birds is mediated by the ophthalmic nerve: behavioral experiments showed that deactivating the ophthalmic nerve with a local anesthetic suppressed the pulse effect (Beason and Semm 1996); the bobolinks treated this way continued in their migratory direction, which clearly shows that the pulse does not affect the compass mechanism. In conditioning experiments, pigeons trained to respond to changes in intensity failed to respond correctly after deactivation of the ophthalmic nerve (Mora et al. 2004). Together, these findings suggest that in birds and probably also in fish, magnetite-based receptors mediate information on intensity rather than compass information.

In rodents, a study using c-Fos identified the *superior colliculus* as a site of neural activity caused by magnetic stimulation (Němec et al. 2001). The origin of this activity is unclear; an involvement of the magnetite-based receptor indicated by the pulse effect seems possible.

Two types of receptors for different tasks

In recent years, the number of publications on the aspects of reception and processing magnetic information has greatly increased, but it is only in case of birds, that the various pieces of the puzzle begin to form a consistent picture, although many questions still remain unanswered. The available data indicate the existence of two magnetoreceptor systems in birds for different types of information (see Beason and Semm 1991): a radical-pair mechanism in the right eye provides directional information, and magnetite-based receptors in the upper beak records differences in magnetic intensity – one might say: birds have a compass in their eye and a magnetometer in their beak. The input of the former appears to be mediated and processed by parts of the visual system, involving the nBOR, the *tectum opticum* and the *nucleaus rotundus*; the input of the latter by the ophthalmic nerve and the trigeminal ganglion. It is still unknown as to where these two types of information finally converge to form crucial components of the 'map and compass' system used for navigation (for review, see Wiltschko and Wiltschko 2003).

In other vertebrates, our knowledge is limited to certain aspects of magnetoreception. In marine turtles, the various uses of magnetic information are well documented, yet magnetoreception has not yet been analyzed. The nature of the primary processes of magnetoreception are indicated by behavioral data in salamanders, where the light-dependency of an inclination compass suggests magnetoreception based on a radical pair mechanism, and in mammals, where the pulse effect points to magnetite-based receptors. The position of the receptors and anatomical details about their structure are known in fish, where they are found in the olfactory lamellae; in salamanders, behavioral studies identified the pineal as site of the receptors. Some of the neuronal pathways are known in fish, where electrophysiological recordings indicate that information on magnetic intensity is mediated by the trigeminal system; in mammals, an involvement of the *superior corniculus* is suggested, but neither the origin nor the type of the respective magnetic information is entirely clear.

At the same time, the mechanisms employed by fish, mammals and several arthropods in their polarity compass are entirely unknown. Magnetite-based receptors are an option, as they could theoretically provide information on direction as well as on intensity. Here, the lasting pulse effect on nest building in mole rats is interesting: since the direction of the nest would involve only a compass, we may speculate that this compass might be based on single domain magnetite, but direct evidence is still lacking.

In view of the many open questions, we can only hope that the 'magnetic sense' continues to meet with great interest and that further research in the coming years will lead to a better understanding of reception and processing of magnetic information.

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Extremely low-frequency electromagnetic fields disrupt magnetic alignment of ruminants

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Resting and grazing cattle and deer tend to align their body axes in the geomagnetic North-South direction. The mechanism(s) that underlie this behavior remain unknown. Here, we show that extremely low-frequency magnetic fields (ELFMFs) generated by high-voltage power lines disrupt alignment of the bodies of these animals with the geomagnetic field. Body orientation of cattle and roe deer was random on pastures under or near power lines. Moreover, cattle exposed to various magnetic fields directly beneath or in the vicinity of power lines trending in various magnetic directions exhibited distinct patterns of alignment. The disturbing effect of the ELFMFs on body alignment diminished with the distance from conductors. These findings constitute evidence for magnetic sensation in large mammals as well as evidence of an overt behavioral reaction to weak ELFMFs in vertebrates. The demonstrated reaction to weak ELFMFs implies effects at the cellular and molecular levels.

cattle | magnetoreception | roe deer | power lines

Diverse animals, including birds, mammals, reptiles, amphibians, fish, crustaceans and insects, use the Earth's magnetic field (EMF) for directional orientation and navigation (1–3). Despite being phylogenetically widespread, magnetic compass orientation has been convincingly demonstrated in only a few species of mammals representing only 2 taxonomic groups: rodents (4–8) and bats (9, 10). Not surprisingly, all these model species are small mammals amenable to experimental manipulation of the ambient magnetic field. Demonstration of magnetic orientation in animals requires well-designed laboratory and/or field experiments combining manipulations of magnetic fields with either spontaneous behavioral reactions (e.g., an innate preference for a certain direction, migration, or homing) or conditioning to magnetic field properties. However, it is technically demanding, if not impossible, to perform such experiments with sufficient numbers of larger mammals. Alternatively, naturally occurring geomagnetic anomalies can be exploited to study the behavior of animals dwelling at these localities. However, this approach has seldom been applied in the study of magnetic orientation of mammals thus far (11).

Recently, we reported that resting and grazing cattle as well as roe deer (*Capreolus capreolus*) and red deer (*Cervus elaphus*) tend to align their body axes in the geomagnetic North-South (N-S) direction (12). Because wind, sunshine, and slope could be excluded as common ubiquitous factors, alignment toward the vector of the magnetic field provides the most likely explanation for the observed behavior. The study thus provided strong but indirect evidence for magnetoreception in ruminants. However, because of the descriptive nature of the original study, alternative explanations (e.g., the sun compass; cf. ref. 13) could not be excluded. We analyzed body orientations of ruminants in localities where the geomagnetic field is disturbed by high-voltage power lines to determine how local variation in magnetic fields may affect the previously described orientation behavior.

Steel pylons deflect the natural geomagnetic field within a radius of up to 30 m (14). Overhead high-voltage power lines produce an alternating magnetic field (AMF) attributable to the electric current, with a frequency of 50/60 Hz, producing what are known as extremely low-frequency magnetic fields (ELFMFs). Such fields are the strongest (up to about 15 μT/380 kV, 8 μT/220 kV, and 5 μT/110 kV) directly under power lines in the middle of the span between 2 pylons, where the sag of the conductors brings the lines nearest to the ground. Magnetic flux density diminishes with the distance from power lines, such that density reaches the value of 1 μT at about 70 m (380 kV), 45 m (220 kV), and 20 m (110 kV) away from the midline (14–16). According to other measurements, the maximum magnetic field values to which humans and animals are exposed are even lower and increase by about 80% (from 3.4 to 6.2 μT for 380 kV) when changing the position from near the pylon to the flux region (17).

Here, we analyze satellite and aerial images of herds of cattle and field observations of body alignment in grazing roe deer. Assuming that the observed body orientation is attributable to magnetic alignment, we hypothesize that cattle and deer grazing and resting under power lines and near pylons will be disoriented with respect to those outside the influence of local perturbations.

Results

ELFMFs Disrupt Alignment. Cattle and roe deer resting and grazing in open pastures and meadows show very consistent N-S alignment (12). The control cattle recorded in Europe, grazing in localities without overhead high-voltage power lines within a radius of at least 500 m, aligned their bodies significantly along the N-S axis (mean axis = 1.2°/181.2°, $r = 0.422$, $P < 10^{-8}$, $n = 111$ localities/herds; Fig. 1*A*). By contrast, cattle grazing under or in the vicinity (<150 m) of high-voltage overhead power lines were randomly distributed (i.e., no preference for orienting their body axes in a certain direction could be revealed) (mean axis = 80.1°/260.1°, $r = 0.11$, $P = 0.169$, $n = 153$ localities/herds; Fig. 1*B*).

Similarly, roe deer in locations without overhead high-voltage power lines exhibited roughly N-S alignment (mean axis = 9.1°/189.1°, $r = 0.83$, $P < 10^{-4}$, $n = 201$ localities/herds; Fig. 1*A*), whereas those in the vicinity (<50 m) of power lines (mostly in the vicinity of steel pylons) exhibited random body orientation (mean axis = 75.0°/255.0°, $r = 0.14$, $P = 0.397$, $n = 47$ localities/herds; Fig. 1*B*).

No alignment with power line direction could be detected when all cattle grazing up to a distance of 150 m from the power lines were taken into account (Fig. 1*B*). The same was true for roe deer grazing up to 50 m from the power lines (Fig. 1*B*). The

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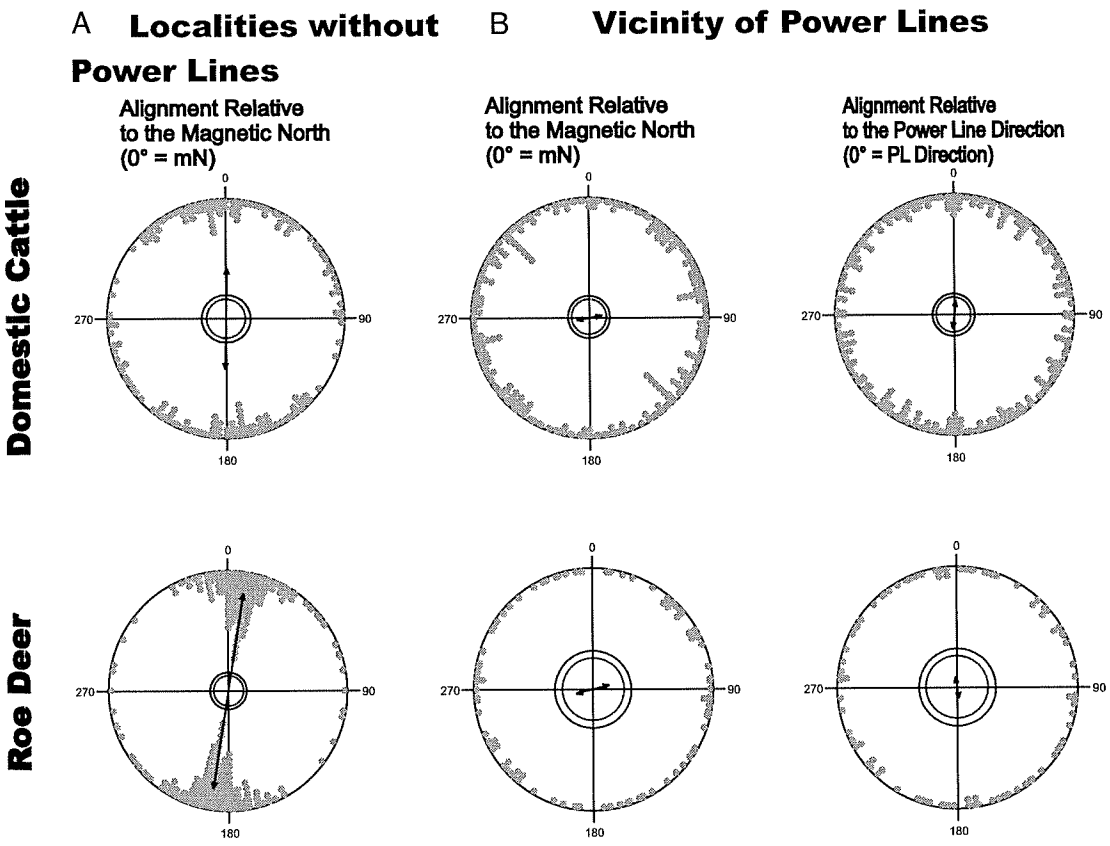

Fig. 1. Axial data revealing body orientation of domestic cattle (*Bos taurus*) (*Upper*) and roe deer (*Capreolus capreolus*) (*Lower*). (*A, Left*) Animals at localities without high-voltage power lines. (*B*) Animals grazing and resting under or in the vicinity of power lines. (*Center*) Bearings relative to the geomagnetic N-S axis. (*Right*) Bearings of body axes relative to power line direction. Each pair of data points (located on opposite sites within the unit circle) represents the direction of the mean axial vector of the herd. The double arrows indicate the length (*r*) and direction of the grand mean axial vectors. The inner circles mark the 5% (dotted) and 1% significance borders of the Rayleigh test. (Copyright 2008, National Academy of Sciences.)

animals' body orientation was random when plotted with respect to the power line direction (cattle: mean axis = 6.8°/186.8°, $r = 0.12$, $P = 0.112$, $n = 153$ herds; roe deer: mean axis = 171.9°/351.9°, $r = 0.09$, $P = 0.674$, $n = 47$ herds), indicating that the power lines did not serve as a visual orientation cue.

Magnetoreceptive Nature of Alignment. The disruptive effect of ELFMFs clearly rules out the effect of the sun's position and implies magnetic alignment cues. Therefore, we tested more specific predictions resulting from the interaction between the AMFs generated by high-voltage power lines and the EMF. First, we analyzed the body orientation of cattle grazing directly under power lines (<5 m from outer conductors) trending in various compass directions [Fig. 2, supporting information (SI) Tables S1 and S2].

Below the power lines, the AMF vector is horizontal and perpendicular to the conductors. Thus, the angle between the AMF and EMF vectors and resultant field characteristics depend on the direction of the power lines (Fig. 2, left 3 columns, and Table S1). In the case of East-West–oriented (E-W) power lines, the AMF vector is parallel to the horizontal component of the EMF lines. Thus, the AMF considerably affects the horizontal intensity but not the azimuth of the EMF. Intensity and inclination of the resultant field oscillate between 2 values as the polarity of the AMF changes (i.e., with a frequency of 50 Hz); the azimuth remains constant. The AMF vector of N-S-oriented power lines is, by contrast, perpendicular to the horizontal component of the EMF lines (i.e., the AMF affects mainly the azimuth and the horizontal intensity of the EMF much less). The azimuth of the resultant field oscillates symmetrically around magnetic North, although intensity and inclination remain nearly constant. For the Northwest-Southeast–oriented (NW-SE) and Northeast-Southwest–oriented (NE-SW) power lines, the AMF vector is 45° and 135° relative to the horizontal component of the EMF lines, respectively. The AMF affects both the horizontal intensity and the azimuth of the EMF. Intensity, inclination, and azimuth of the resultant field oscillate with a frequency of 50 Hz.

The distribution of body orientation differed significantly among cattle grazing under differently oriented power lines (Mardia-Watson-Wheeler-test: $W = 22.756$, $P < 0.001$; Fig. 2, fourth column, alignment relative to magnetic North). Under E-W power lines, cattle were highly significantly aligned along the power lines/magnetic E-W axis (mean axis = 85.4°/265.4°, $r = 0.524$, $P < 0.001$, $n = 25$ herds; Fig. 2*A*). Their mean alignment axis differed significantly from that of control cattle (Watson-Williams-test: $F = 62.972$, $P < 10^{-12}$) as well as from that of cattle grazing under N-S power lines ($F = 32.078$, $P < 10^{-6}$). Under N-S power lines, cattle tended to align along the N-S axis; the alignment was marginally significant (mean axis = 13.1°/193.1°, $r = 0.338$, $P = 0.056$, $n = 25$ herds; Fig. 2*B*), and the mean alignment axis was not different from that of controls ($F = 1.446$, $P = 0.231$). Interestingly, body axes were distributed almost symmetrically around the N-S axis. Under NW-SE and NE-SW power lines, cattle alignments were indistinguishable from random, with a trend toward bimodal distribution (Fig. 2 *C* and *D* and Table S2). Taken together, animals exposed to the fields characterized by maximal oscillations of the horizontal intensity

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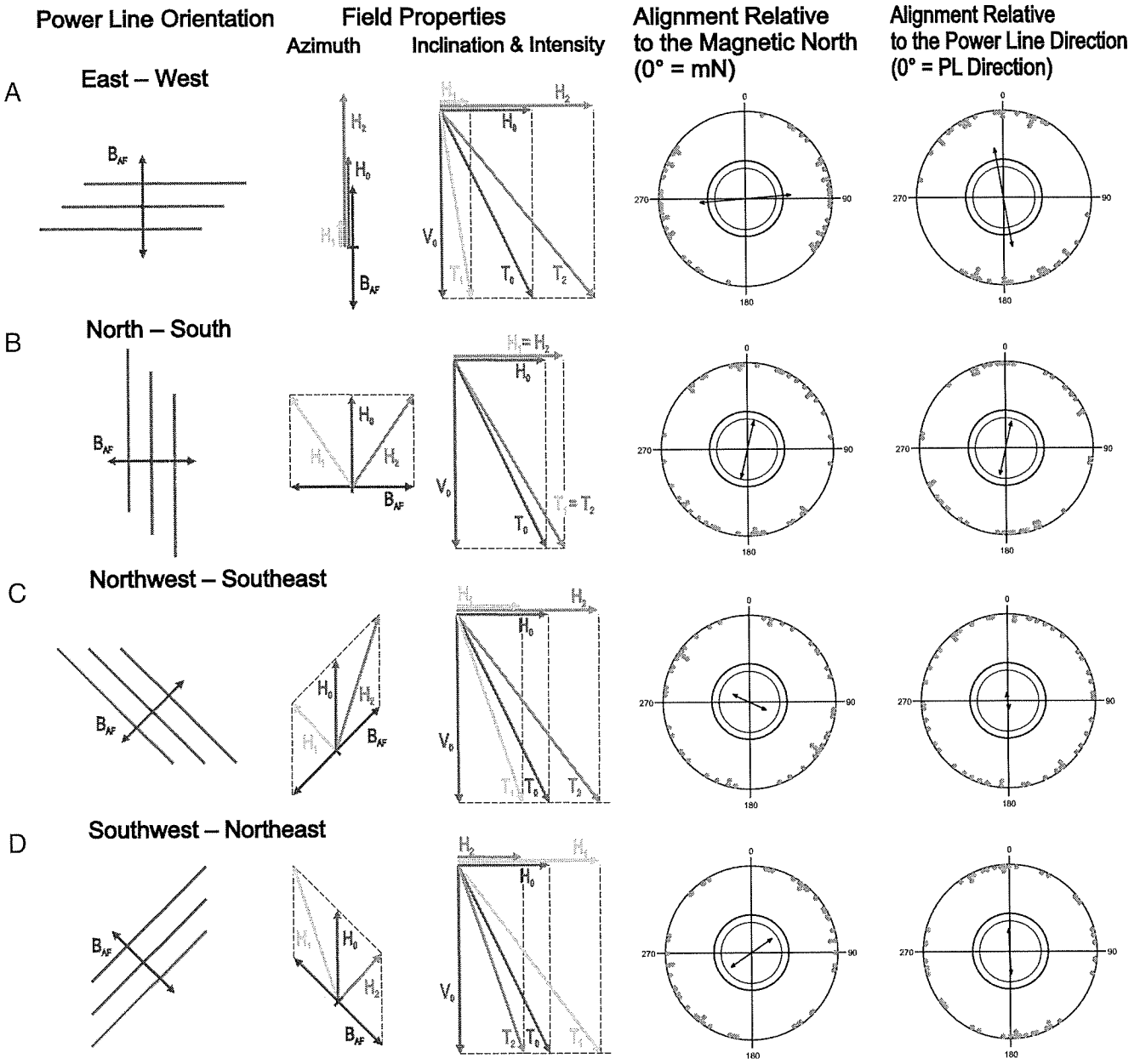

Fig. 2. Magnetic field properties and body orientation of cattle directly under power lines. Power lines trending in the ranges of 70°–110°, 340°–20°, 115°–155° and 25°–65° were classified as E-W (*A*), N-S (*B*), NW-SE (*C*), and NE-SW (*D*), respectively. The total intensity vector of the field (T) can be resolved into 2 vector components: the horizontal field intensity (H) and the vertical field intensity (V). The inclination is a vertical angle between the H (or the Earth's surface) and T. The azimuth is a horizontal angle measured clockwise between the horizontal intensity vector of the EMF (H_0) and the horizontal intensity vectors of the fields resulting from summation of the AMF and EMF (H_1 or H_2). B_{AF}, AMF vector; H_0, V_0, T_0, vectors of the EMF; H_1, H_2, V_1, V_2, T_1, T_2, vectors of the fields resulting from summation of the AMF and the EMF (the actual field oscillates between H_1 and H_2, V_1 and V_2, and T_1 and T_2, respectively, with a frequency of 50 Hz). Axial alignment data presented as in Fig. 1. See Tables S1 and S2 for numerical values.

and inclination shifted their body alignment by ≈90°, animals exposed to the azimuth oscillations increased scatter of their body orientation, and those exposed to the oscillations of all field parameters were disoriented.

To confirm that the observed orientation changes were caused by a direct effect of the oscillating fields on the magnetic alignment and not by nonspecific effects attributable to the utilization of nonmagnetic orientation cues, we analyzed body orientation of individual cows as a function of the distance from the power lines (Fig. 3 and Table S3). The effect of the ELFMF should attenuate with the distance from the conductors, and at a certain distance, animals should be aligned just as on pastures without power lines. Considering the alignment patterns observed directly below lines, predictions differ again when E-W and N-S trending power lines are compared. Cattle should shift their alignment progressively toward the N-S axis with increasing distance from E-W power lines (Fig. 3*B*), and the scatter in body orientation of cattle near N-S power lines should progressively decrease with increasing distance from power lines (Fig. 3*C*). Importantly, the prediction is opposite if cattle align themselves visually with the power lines: scatter should increase with increasing distance from N-S power lines.

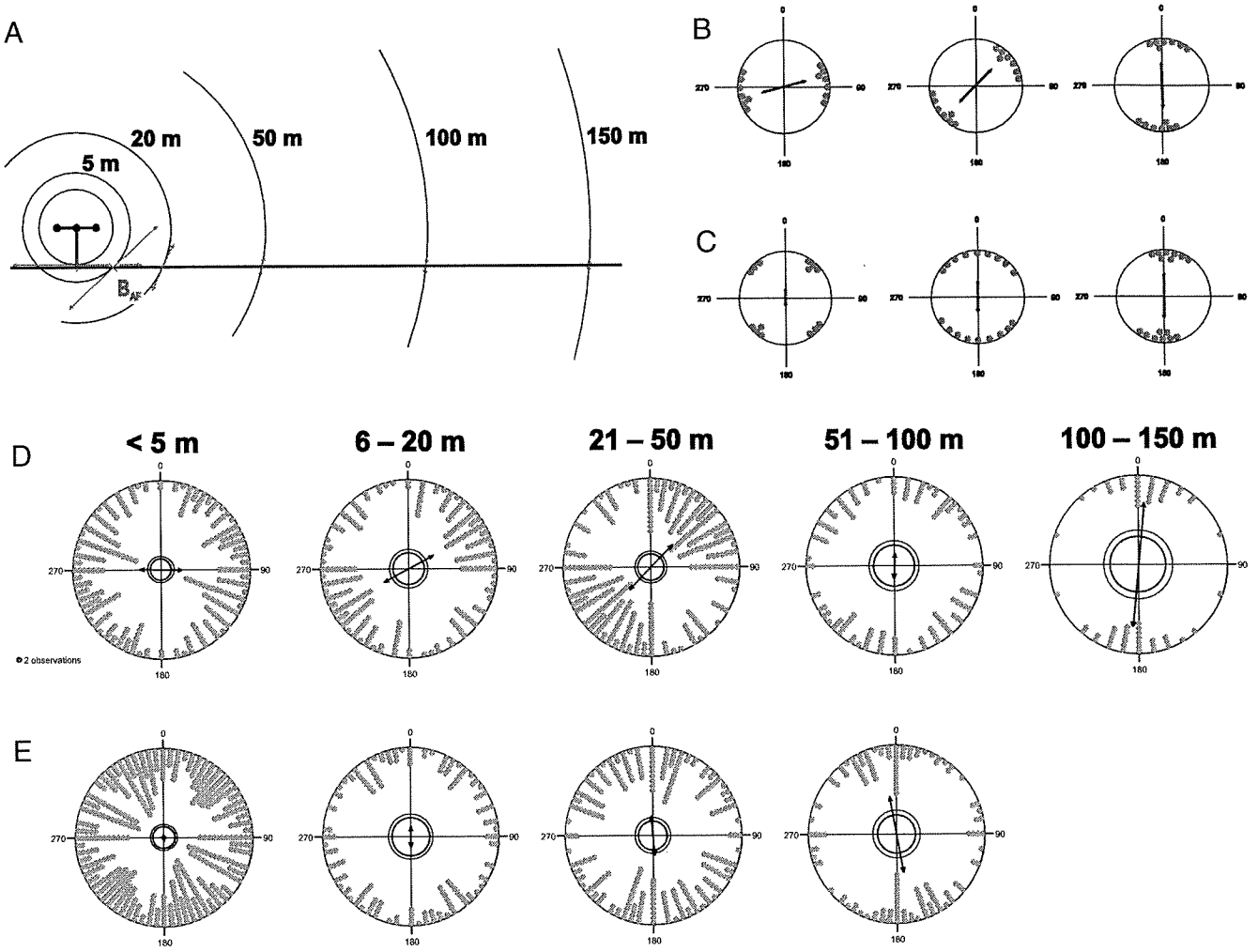

Fig. 3. Body alignment of individual cows as a function of the distance from E-W (*B* and *D*) and N-S power lines (*C* and *E*). (*A*) Decrease of the AMF intensity with the distance from conductors. Predicted (*B* and *C*) and observed (*D* and *E*) alignment patterns. See text and Table S3 for detailed information. Each pair of data points (located on opposite sites within the unit circle) represents the body axis of an individual cow. The double arrows indicate the length (*r*) and direction of the mean axial vector.

The alignment patterns observed at different distances were in very close agreement with the predictions for magnetic alignment (Fig. 3 *D* and *E*). Animals shifted their body orientation progressively from E-W to N-S with increasing distance from E-W trending power lines; with increasing distance from N-S trending power lines, scatter decreased. Cattle were roughly aligned to the magnetic N-S axis (comparable to controls) at a distance of 100–150 m and 50–100 m from E-W and N-S power lines, respectively.

Functional Properties of Alignment. Finally, we compared the body orientation of cattle grazing 6–100 m to the south and to the north of E-W trending power lines (Fig. 4). South and north to the E-W power line, the AMF vector is parallel and antiparallel to the EMF vector, respectively (Fig. 4*A*). Consequently, field characteristics are different on the opposite sides of the line (Table S4). At the same distance from the power line, the horizontal intensity and vertical intensity of the EMF are affected equally by the AMF. However, vector addition results in a strong oscillation of the inclination and weaker oscillation of the total intensity on the north side and a weak oscillation of the inclination and a stronger oscillation of the total intensity on the south side. The azimuth remains constant on both sides of the line. The difference in the intensity oscillation amplitude was accentuated in the analyzed sample, because the mean distance of individual cows being south or north from the power lines was slightly asymmetrical (27.9 ± 1.6 m SEM and 32.8 ± 1.5 m SEM, respectively).

This complex situation enabled us to identify the magnetic cue that is most decisive for cattle alignment. Because the azimuth of the resultant field remains constant on both sides, an animal using a polarity compass should align likewise north and south of the power line. By contrast, an animal relying on the inclination compass should orient better on the south side. If an unknown physiological mechanism depending on the intensity of the resultant field were to underlie the alignment behavior, animals should orient better on the north side.

The distribution of body orientation as well as the mean alignment axes differed significantly between cattle grazing on the south and north sides of the E-W power lines (distribution: $W = 6.088$, $P = 0.048$; alignment axis: $F = 7.068$, $P = 0.01$; Fig. 4 *B* and *C*). On the south side, animals exhibited a wider spread of body orientation and a larger deflection from the N-S axis (mean axis = 65.1°/245.1°, $r = 0.311$, $P = 0.04$, $n = 33$ herds) than animals on the north side (mean axis = 35.4°/215.4°, $r = 0.539$, $P < 0.0001$, $n = 25$ herds). Thus, cattle oriented better on the north side of the E-W power lines.

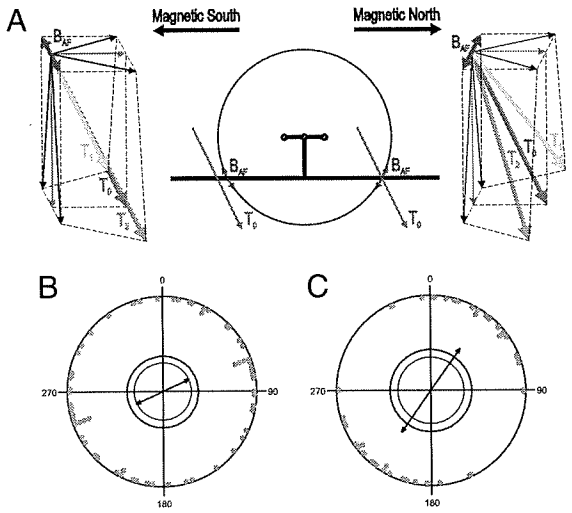

Fig. 4. (*A*) Magnetic field characteristics north and south of E-W power lines, respectively (see Table S4 for numerical values). Alignment of cattle grazing south (*B*) or north (*C*) of E-W power lines. Alignment data are given relative to magnetic North (i.e., 0° = mN) and presented as in Fig. 1. B_{AF}, AMF vector; H_0, V_0, T_0, vectors of the EMF; H_1, H_2, V_1, V_2, T_1, T_2, vectors of the fields resulting from summation of the AMF and the EMF (the actual field oscillates between H_1 and H_2, V_1 and V_2, and T_1 and T_2, respectively, with a frequency of 50 Hz).

Because the bird inclination compass works properly only within a narrow range of magnetic intensities (EMF ± approximately 25%; cf. ref. 18), we tested for a possible indirect effect of the total intensity oscillation on the inclination compass. We ran the same analysis but included only cattle being more than 20 m from power lines. At a distance of 20 m from the outer conductors, the intensity certainly remains within the normal functional window of the inclination compass (EMF ± approximately 12%; Table S4). Nonetheless, animals on the north side again oriented better (mean axis = 31.7°/211.7°, $r = 0.50$, $P = 0.002$, $n = 24$ herds) than animals on the south side (mean axis = 54.9°/234.9°, $r = 0.305$, $P = 0.096$, $n = 25$ herds). The mean distance of individual cows being south or north from the power lines was very similar (38.4 ± 1.95 m SEM and 39.0 ± 1.5 m SEM, respectively). This finding indicates that the intensity oscillation compromises cattle magnetosensory capacities even when the oscillation amplitude does not exceed the intensity window, in which magnetic compass orientation is functional. These results do not specifically support the polarity compass and are clearly not in line with the inclination compass, but they show that the observed alignment is based on an intensity-dependent mechanism.

Discussion

Possible Alignment Mechanisms. We can only speculate about the physiological mechanisms of the magnetic alignment of ruminants. Of the numerous mechanisms proposed for the direct interaction of electromagnetic fields with the human or animal body, 3 stand out as operating potentially (also) at lower field levels: magnetically sensitive radical pair reactions (19), electric field ion cyclotron resonance interactions (20), and mechanisms based on biogenic magnetite (21–24). Theoretically, each of these mechanisms (separately or in combination) could be responsible for magnetic alignment. For instance, the radical pair hypothesis proposes an intimate coupling of magnetic sensing with vision. According to this hypothesis, magnetic fields are perceived as visual patterns, which are dependent on both field direction and intensity (19). Thus, it is conceivable that the oscillations of the direction and intensity resulting from the EMF and AMF interaction may blur magnetically modulated visual patterns and, in turn, compromise or disrupt magnetic compass orientation. Likewise, ambient AMF could compromise or disrupt the resonant interactions of the EMF with alternating electric fields occurring in the nervous system. Finally, putative magnetite-based receptors also theoretically could be affected by both the static magnetic field and AMF. Kirschvink (25) and Kirschvink et al. (26) developed a simple biologically plausible biophysical model of the interaction of single-domain magnetosomes in a viscous fluid (cytoplasm) with a mechanically activated transmembrane ion channel. The model shows that motions of magnetosomes induced by an ELFMF on the order of 0.1 to 1 μT can be large enough to open mechanically sensitive transmembrane ion channels, which, in turn, have the potential to influence a wide range of cellular processes. Depending on where such a channel is located, and whether it is coupled to secondary messenger systems, this process could influence the cell membranes, DNA synthesis, RNA transcription, calcium release, and virtually any ionically mediated cellular processes. Although the applicability of this model has been questioned for ELFMFs <5 μT (27–29), it is apparent that, in any case, the model may be relevant for sites directly beneath and in close proximity to power lines.

Mechanisms of magnetoreception in mammals have been less studied than those of other vertebrates (1, 2, 30, 31). At least for subterranean mole-rats (5, 32–34) and bats (10, 35), there is evidence for the magnetite-based polarity compass. However, whether these properties can be generalized to other mammals remains unclear. The analyses performed in this study are inconclusive with regard to the functional properties of magnetic alignment in ruminants. Theoretically, this behavior might be based on an unknown intensity-dependent mechanism or intensity-dependent polarity compass. Thus, the only safe inference appears to be that the inclination compass does not account for cattle alignment.

Magnetic Alignment in Ruminants. Whatever the underlying mechanism, our results provide further evidence that the recently described spontaneous directional preference in grazing and resting cattle and deer represents a case of magnetic alignment. The fact that animals grazing under or near high-voltage power lines were not commonly aligned but exhibited distinct alignment patterns beneath or in the vicinity of power lines trending in various magnetic directions clearly rules out a role of the sun compass in alignment behavior of ruminants. If cattle and deer primarily used the sun compass (i.e., derive directional information from the azimuth of the sun and the internal clock; cf. ref. 13), there should be no effect of the power lines. Furthermore, highly significant alignment in localities without power lines (12) and the fact that the disturbing effect of the ELFMF attenuates with the distance from power lines clearly show that other factors possibly causing alignment, such as sunshine, wind direction, terrain conditions, herding instinct, or directional plant growth, play only a secondary role.

One can speculate that magnetic alignment may help to synchronize the direction of movement of individuals in herds (e.g., effective grazing, coordinated escape as an effective antipredatory behavior), and it also may be a manifestation of the magnetic compass orientation or even navigation (being a basic tool for mentally mapping their everyday surroundings and learning new landmarks, J. B. Phillips, personal communication). However, it should be stressed that cattle and deer show magnetic alignment also, particularly when resting (12), such that the role of alignment behavior may be manifold and may also include the regulation of vegetative functions. The disturbing effect of the ELFMF on body alignment deserves further theoretical and experimental scrutiny.

Methods

We used the same technique to analyze axial body orientation of domestic cattle as previously described (12). The Google Earth satellite and aerial images used here met the criteria of the former study, but in contrast to the previous study, we were searching for cattle that were located under or near high-voltage power lines and electricity pylons. Although the standards of epidemiological studies (36) consider residences located up to 300 m from 380-kV power lines to be exposed to magnetic fields (<0.1 μT), we included only cattle being no more than 150 m away from power lines as "experimental" animals in the analysis to increase the likelihood of a detectable effect. A total of 1,699 cattle in 153 localities in Belgium, Germany, Great Britain, and The Netherlands were analyzed. The number of pastures with different orientations of power lines was balanced [33 pastures with N-S power lines ($0 \pm 20°$), 41 with E-W power lines ($90 \pm 20°$), 39 with NW-SE power lines ($135 \pm 20°$), and 40 with NE-SW power lines ($45 \pm 20°$)]. For the analysis of cattle dwelling directly beneath power lines, we evaluated an equal number of randomly chosen pastures ($n = 25$) for each power line direction and analyzed only cattle that were located no more than 5 m lateral to the outer conductors.

Body orientation of roe deer ($n = 653$ in 47 herds) grazing or resting under high-voltage power lines or no more than 50 m to the side, with the center of the herd being no more than 20 m aside, was studied in the Czech Republic by direct observation during January through December 2008. Because there were almost no recordings of roe deer at the distance of 50–150 m from power lines, we decided to set the distance to 50 m. Typically, in the open countryside with power lines, roe deer prefer the vicinity of electricity pylons. This may be because the area around a pylon is generally not cultivated and higher grasses and bushes offer more shelter. More than half of the sampled roe deer were observed close to pylons.

Controls for both cattle and roe deer were obtained from our previously published data (cattle: $n = 1,488$ in 111 localities in Europe; roe deer: $n = 1,912$ animals at 201 localities in the Czech Republic; cf. ref. 12).

We calculated 1 mean vector per herd to obtain statistically independent data. Only for the analysis of cattle being located at different distances (0–5 m, 6–19 m, 20–49 m, 50–100 m, 101–150 m) from N-S and E-W power lines, respectively, did we use axial data of individuals and not of herds. The distance class of 101–150 m from N-S power lines contained too few data to run the analysis.

The Rayleigh test was used to assess significant deviations from random distribution of the mean vectors of the herds. The Watson-Williams F test was used to determine whether mean axes of 2 or more samples differed significantly, and the Mardia-Watson-Wheeler test was used for determining whether 2 or more distributions were identical. All circular statistics were calculated with Oriana 2.0 (Kovach Computing).

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Supporting Information

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Table S1. Magnetic field properties directly under power lines (<5 m from outer conductors) trending in various compass directions

Power line direction	Horizontal intensity (μT) <H_1; H_2>	Vertical intensity (μT) $V_0 = V_1 = V_2$	Total intensity (μT) <T_1; T_2>	Inclination (°) <I_1; I_2>	Azimuth (°) <Az_1; Az_2>
N-S (0°)	<26.63; 26.63>	45	<52.29; 52.29>	<59.4°; 59.4°>	<325.7°; 34.3°>
E-W (90°)	<7; 37>	45	<45.54; 58.25>	<81.2°; 50.6°>	0°
NW-SE (135°)	<15.57; 34.28>	45	<47.61; 56.57>	<70.9°; 52.7°>	<317.1°; 18.3°>
NE-SW (45°)	<34.28; 15.57>	45	<56.57; 47.61>	<52.7°; 70.9°>	<341.7°; 43°>

H_1, H_2, V_1, V_2, T_1, and T_2 are vectors of the fields resulting from summation of the AMF and the EMF; the actual field oscillates between H_1 and H_2, V_1 and V_2, and T_1 and T_2, respectively, with a frequency of 50 Hz. All calculations were made for the AMF vector (B_{AF}) =15 μT.

Table S2. Body alignment of cattle grazing directly under power lines (lateral distance from outer conductors 0–5 m)

Power line direction	Mean axis μ	Length of mean vector r	Rayleigh test Z	Rayleigh test P	n
	Alignment relative to magnetic North (mN = 0°)				
N-S (0 ± 20°)	13.1°/193.1°*	0.33	2.85	0.056	25 (146)
E-W (90 ± 20°)	85.4°/265.4°*	0.52	6.87	0.0007	25 (98)
NW-SE (135 ± 20°)	115.4°/295.4°*	0.21	1.14	0.322	25 (123)
NE-SW (45 ± 20°)	55.7°/235.7°*	0.29	2.11	0.121	25 (83)
	Alignment relative to the power line direction (PL direction = 0°)				
N-S (0 ± 20°)	12.9°/192.9°†	0.32	2.51	0.08	25 (146)
E-W (90 ± 20°)	170.0°/350.0°†	0.57	8.23	<0.001	25 (98)
NW-SE (135 ± 20°)	171.5°/351.5°†	0.10	0.25	0.785	25 (123)
NE-SW (45 ± 20°)	177.0°/357.0°†	0.27	1.77	0.171	25 (83)

n, number of pastures analyzed (numbers in parentheses give the numbers of cattle analyzed).
*0° = mN.
†0° = power line direction.

Table S3. Body alignment of individual cows as a function of the distance from power lines

Lateral distance to power line	Mean axis μ (0° = mN)	Length of mean vector r	Rayleigh test Z	Rayleigh test P	n
		Distances from E-W power lines			
0–5 m	90.4°/270.4°	0.24	14.15	$<10^{-6}$	240
6–20 m	61.8°/241.8°	0.32	10.52	$<10^{-4}$	100
21–50 m	44.1°/224.1°	0.35	18.68	$<10^{-8}$	152
51–100 m	1.7°/181.7°	0.15	1.32	0.267	62
101–150 m	5.4°/185.4°	0.70	15.77	$<10^{-7}$	32
		Distances from N-S power lines			
0–5 m	171.7°/351.7°	0.04	0.38	0.686	230
6–20 m	179.5°/359.5°	0.12	1.07	0.341	74
21–50 m	174.5°/354.5°	0.23	6.00	0.002	119
51–100 m	169.7°/349.7°	0.44	13.26	$<10^{-5}$	70

mN, magnetic North; *n*, number of cattle analyzed.

Table S4. Magnetic field properties north and south of E-W power lines

	Horizontal Intensity (μT) <H_1; H_2>	Vertical Intensity (μT) <V_1; V_2>	Total Intensity (μT) <T_1; T_2>	Inclination (°) <I_1; I_2>
North				
5 m	<16.05; 31.22>	<53.73; 37.77>	<56.08; 49>	<50.4°; 73.4° >
10 m	<18.33; 28.18>	<52.59; 38.02>	<55.69; 47.32>	<53.5°; 70.8° >
20 m	<20.50; 24.89>	<50.6; 39.5>	<54.59; 46.69>	<57.8°; 69.4° >
50 m	<21.72; 22.5>	<47.47; 42.37>	<52.2; 48>	<62°; 65.4° >
100 m	<21.91; 22.09>	<45.99; 44>	<50.94; 49.15>	<63.3°; 64.5° >
South				
5 m	<16.05; 31.22>	<37.77; 53.73>	<41.04; 62.14>	<67°; 59.8° >
10 m	<18.33; 28.18>	<38.02; 52.59>	<42.20; 59.66>	<64.3°; 61.8° >
20 m	<20.5; 24.89>	<39.5; 50.6>	<44.5; 56.39>	<63.8°; 62.6° >
50 m	<21.72; 22.55>	<42.37; 47.47>	<47.61; 52.55>	<64.6°; 62.9° >
100 m	<21.91; 22.09>	<44; 45.99>	<49.15; 51.02>	<64.3°; 63.5° >

H_1, H_2, V_1, V_2, T_1, and T_2 are vectors of the fields resulting from summation of the AMF and the EMF; the actual field oscillates between H_1 and H_2, V_1 and V_2, and T_1 and T_2, respectively, with a frequency of 50 Hz. All calculations were performed for the AMF vector (B_{AF}) = 15 μT.

Howell, Beth (MRC)

From: MRC - Web Info
Sent: Friday, June 23, 2017 9:38 AM
To: Howell, Beth (MRC); Stagg, Ben (MRC)
Subject: FW: Save the James Deny Dominion's Permit Request

From: Carolyn Gamble [mailto:carolynjgamble@hotmail.com]
Sent: Thursday, June 22, 2017 8:52 PM
To: MRC - Web Info
Subject: Save the James Deny Dominion's Permit Request

Dear Commissioner Bull,

Please protect sturgeon breeding grounds and the irreplaceable historic views of the James River. Tourism is vital to Virginia, particularly in this area, and the VMRC can help maintain the historic integrity of the James for future generations by denying Dominion's permit request.

Sincerely,
Carolyn Gamble

PROTEST

Howell, Beth (MRC)

From: MRC - Web Info
Sent: Friday, June 23, 2017 9:38 AM
To: Howell, Beth (MRC); Stagg, Ben (MRC)
Subject: FW: Dominion proposal

-----Original Message-----
From: howard cobb [mailto:nellandhowardcobb@hotmail.com]
Sent: Thursday, June 22, 2017 8:37 PM
To: MRC - Web Info
Subject: Dominion proposal

To Commissioner Bull:

I am requesting that you deny the proposal by Dominion Power over the historic Jamestown River. We must preserve and protect our historic State, our rivers for our present and future generations.

Please show foresight and leadership in this crucial matter.

Nell Cobb
Manakin-Sabot, Virginia

PROTEST

Howell, Beth (MRC)

From: MRC - Web Info
Sent: Friday, June 23, 2017 9:38 AM
To: Howell, Beth (MRC); Stagg, Ben (MRC)
Subject: FW: request

From: Philip Irwin [mailto:rphilipirwin@gmail.com]
Sent: Thursday, June 22, 2017 6:19 PM
To: MRC - Web Info
Subject: request

Please deny plan to desecrate Virginia's foundng river James with unnesecary transmission line towers

--
Phil Irwin
47 Dearing Rd.
Flint Hill VA 22627
(540) 675-3693
www.bnb1812.com

PROTEST

Howell, Beth (MRC)

From: MRC - Web Info
Sent: Friday, June 23, 2017 9:37 AM
To: Howell, Beth (MRC); Stagg, Ben (MRC)
Subject: FW: Dominion towers

-----Original Message-----
From: Betty Byrne Ware [mailto:bettybware1@gmail.com]
Sent: Thursday, June 22, 2017 5:50 PM
To: MRC - Web Info
Subject: Dominion towers

Dear Commisioner Bull,

It is of great concern to me that Dominion is planning to place very tall towers for power transmission across the Jamestown section of the James River. This is a site of national significance as the birthplace of our nation. I cannot imagine wanting to desecrate it for transmission towers. Surely the company can protect this historical site by placing the lines underground and underwater.

As significance to your commission, I understand that this area of the river is a breeding ground for the American sturgeon which has recently been making a comeback there.

Please, for the sake of the entire country, do not allow this project to proceed in this way.

Sincerely,
Betty Byrne Ware
2 Paxton Road
Richmond, VA 23226

PROTEST

Howell, Beth (MRC)

From: MRC - Web Info
Sent: Friday, June 23, 2017 9:37 AM
To: Howell, Beth (MRC); Stagg, Ben (MRC)
Subject: FW: Proposed Power Lines

From: m h [mailto:ricav8r@yahoo.com]
Sent: Thursday, June 22, 2017 5:32 PM
To: MRC - Web Info
Subject: Proposed Power Lines

Dear Sir,

Please ensure that your legacy is that you worked to protect the historic James River and the species that live there that are struggling to recover. This is still a free country and people are free to do what they want as long as long as it is legal and doesn't infringe upon the rights of others. The proposed power lines will infringe on the rights of most of the residents who prefer a view of this historic viewshed uncluttered by hideous high-power lines.

Respectfully,

Mike Horan
Richmond

PROTEST

Howell, Beth (MRC)

From: MRC - Web Info
Sent: Friday, June 23, 2017 9:37 AM
To: Howell, Beth (MRC); Stagg, Ben (MRC)
Subject: FW: Deny Dominion permit request

From: Eugenia Anderson-Ellis [mailto:eandersonellis@gmail.com]
Sent: Thursday, June 22, 2017 4:31 PM
To: MRC - Web Info
Subject: Deny Dominion permit request

Dear Commissioner Bull,

Please deny the permit requested by Dominion to install 27.75 miles of unsightly overhead transmission lines across the James River in James City County.

There are many strong arguments in opposition, including the irreparable damage to be done to marine life during its construction, but my points go to the reason for the request. It is based on an estimated future usage of energy that is not justified by the current trend of reduction in energy use, and the rapid advancement of alternative sources of energy.

Why should we jeopardize this pristine view that has stood for the entire existence of our nation, to satisfy an exaggerated plea for predicted increases in consumption that may never happen?

Please urge exploration of the increasingly popular alternatives.

Sincerely,
Eugenia Anderson-Ellis

--
Eugenia Anderson-Ellis
804-643-3915

PROTEST

Howell, Beth (MRC)

From: MRC - Web Info
Sent: Friday, June 23, 2017 9:37 AM
To: Howell, Beth (MRC); Stagg, Ben (MRC)
Subject: FW: Deny Dominion Transmission Lines, Preserve America's Birthplace

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From: Bert [mailto:hilpat@cox.net]
Sent: Thursday, June 22, 2017 2:59 PM
To: MRC - Web Info; info@preservationvirginia.org
Subject: RE: Deny Dominion Transmission Lines, Preserve America's Birthplace

Dear Commissioner Bull,

The integrity of Americaâ€™s birthplace is at risk. The Constitution of Virginia Article XI states, â€œit shall be the Commonwealth's to protect its atmosphere, lands, and waters from pollution, impairment, or destruction, for the benefit, enjoyment, and general welfare of the people of the Commonwealth.â€ The transmission lines proposed by Dominion Power will permanently and irreparably harm the James River and its nearly pristine historic, scenic and environmental assets. Please deny the permit and save this history for future generations.

PROTEST

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:32 PM
To: Howell, Beth (MRC)
Subject: Fwd: Protect the James River

Sent from my iPhone

Begin forwarded message:

From: Aaron Sutch <Aaron.Sutch.645081@muster.com>
Date: June 23, 2017 at 7:23:37 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Protect the James River
Reply-To: <sutch74@yahoo.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Aaron Sutch
3116 Stuart ave
#5
Richmond, VA 23221
505 7303943

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:31 PM
To: Howell, Beth (MRC)
Subject: Fwd: No way!

Sent from my iPhone

Begin forwarded message:

From: Alex Schettine <Alex.Schettine.294811@muster.com>
Date: June 23, 2017 at 7:58:58 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: No way!
Reply-To: <alexschettine@gmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Alex Schettine
1524 West Avenue
33
Richmond, VA 23220
5049130908

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:31 PM
To: Howell, Beth (MRC)
Subject: Fwd: Notification of Violation

Sent from my iPhone

Begin forwarded message:

From: Jenny Heilborn <Jenny.Heilborn.1129849@muster.com>
Date: June 23, 2017 at 8:06:21 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Notification of Violation
Reply-To: <jennyheilborn@hotmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserved for the benefit of all citizens.

Sincerely,

Jenny Heilborn
4412 Grove Ave Apt 3
Richmond, VA 23221
8045363526

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:31 PM
To: Howell, Beth (MRC)
Subject: Fwd: Surry Skittles project

Sent from my iPhone

Begin forwarded message:

From: John Bragg <John.Bragg.632664@muster.com>
Date: June 23, 2017 at 8:14:44 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Surry Skittles project
Reply-To: <johnbragg1@gmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

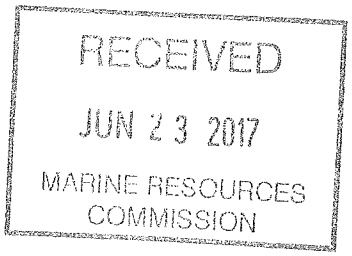
I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

John Bragg
5462 Ridgewood Drive
New Kent, VA 23124
8042916761

Howell, Beth (MRC)

From: Stagg, Ben (MRC)
Sent: Friday, June 23, 2017 9:30 PM
To: Howell, Beth (MRC)
Subject: Fwd: Proposed transmission lines



Sent from my iPhone

Begin forwarded message:

From: Polly McConnell <Polly.McConnell.433860@muster.com>
Date: June 23, 2017 at 9:12:42 PM EDT
To: <ben.stagg@mrc.virginia.gov>
Subject: Proposed transmission lines
Reply-To: <pmcpotts@gmail.com>

Dear Commissioner Bull,

I am writing to express my strong opposition to the Surry-Skiffes transmission line project. The proposed transmission lines will permanently alter the landscape and the experiences of river visitors, by placing an industrial backdrop to a scenic and historic stretch of river.

This is an unacceptable risk for the people who utilize Virginia's waterways. The James River is a valuable asset to the public, but the proposed project will undermine the uses that all Virginian's enjoy. There are alternative projects which can prevent this proposal from interfering with wildlife habitat, spoiling the James River viewshed, and harming recreational experiences.

I urge the Commission to deny this permit application, and ensure that the James River is preserve for the benefit of all citizens.

Sincerely,

Polly McConnell
6291 Midway Rd.
Charlottesville, VA 22903
4349601515

Howell, Beth (MRC)

From: MRC - Web Info
Sent: Thursday, June 22, 2017 1:08 PM
To: Stagg, Ben (MRC)
Cc: Howell, Beth (MRC)
Subject: FW: Deny Dominion Transmission Lines, Preserve Americaâ€™s Birthplace

From: DOUG HARSHBARGER [mailto:rdharsh@cox.net]
Sent: Thursday, June 22, 2017 12:26 PM
To: MRC - Web Info; info@preservationvirginia.org
Subject: RE: Deny Dominion Transmission Lines, Preserve Americaâ€™s Birthplace

Dear Commissioner Bull,

The integrity of America's birthplace is at risk. The Constitution of Virginia Article XI states, "it shall be the Commonwealth's (responsibility) to protect its atmosphere, lands, and waters from pollution, impairment, or destruction, for the benefit, enjoyment, and general welfare of the people of the Commonwealth." The transmission lines proposed by Dominion Power will permanently and irreparably harm the James River and its nearly pristine historic, scenic and environmental assets. Please deny the permit and save this history for future generations.

Thank you for your time and attention.

R. D. Harshbarger, Williamsburg VA

PROTEST

Howell, Beth (MRC)

From: MRC - Web Info
Sent: Thursday, June 22, 2017 11:07 AM
To: Stagg, Ben (MRC)
Cc: Howell, Beth (MRC)
Subject: FW: Derry Transmission Lines

From: Bill Pettus [mailto:bill.pettusv@gmail.com]
Sent: Thursday, June 22, 2017 9:05 AM
To: MRC - Web Info; info@preservationvirginia.org
Subject: Derry Transmission Lines

Dear Commissioner Bull,

The integrity of America's birthplace is at risk. The Constitution of Virginia Article XI states, "it shall be the Commonwealth's to protect its atmosphere, lands, and waters from pollution, impairment, or destruction, for the benefit, enjoyment, and general welfare of the people of the Commonwealth." The transmission lines proposed by Dominion Power will permanently and irreparably harm the James River and its nearly pristine historic, scenic and environmental assets. Please deny the permit and save this history for future generations.

I have visited the Jamestown area throughout my entire life. In the 1600s, my ancestor owned property on the property that is now the Kingsmill Resort. I now take my children to see that area and greatly admire the view. It would be a shame to see that changed. I'd like my grandchildren to enjoy that same unspoiled view.

Sincerely,

Bill Pettus
3818 Prices Fork Rd
Blacksburg, VA 24060

PROTEST