19.0936.04000

# FISCAL NOTE

**Requested by Legislative Council**
**04/05/2019**

Amendment to: SB 2261

1 A. **State fiscal effect:** *Identify the state fiscal effect and the fiscal effect on agency appropriations compared to funding levels and appropriations anticipated under current law.*

| | 2017-2019 Biennium | | 2019-2021 Biennium | | 2021-2023 Biennium | |
|---|---|---|---|---|---|---|
| | General Fund | Other Funds | General Fund | Other Funds | General Fund | Other Funds |
| **Revenues** | $0 | $0 | $0 | $0 | $0 | $0 |
| **Expenditures** | $0 | $0 | $0 | $0 | $0 | $0 |
| **Appropriations** | $0 | $0 | $0 | $0 | $0 | $0 |

1 B. **County, city, school district and township fiscal effect:** *Identify the fiscal effect on the appropriate political subdivision.*

| | 2017-2019 Biennium | 2019-2021 Biennium | 2021-2023 Biennium |
|---|---|---|---|
| **Counties** | $0 | $0 | $0 |
| **Cities** | $0 | $0 | $0 |
| **School Districts** | $0 | $0 | $0 |
| **Townships** | $0 | $0 | $0 |

2 A. **Bill and fiscal impact summary:** *Provide a brief summary of the measure, including description of the provisions having fiscal impact (limited to 300 characters).*

Engrossed SB 2261 amends 49-22-08 to prohibit the commission from conditioning a permit or certificate on the applicant making a mitigation payment assessed or requested by another agency to offset a negative impact on wildlife habitat.

B. **Fiscal impact sections:** *Identify and provide a brief description of the sections of the measure which have fiscal impact. Include any assumptions and comments relevant to the analysis.*

SB 2261 should not have a fiscal impact on the PSC or any other state agency.

3. **State fiscal effect detail:** *For information shown under state fiscal effect in 1A, please:*

A. **Revenues:** *Explain the revenue amounts. Provide detail, when appropriate, for each revenue type and fund affected and any amounts included in the executive budget.*

There are no anticipated impacts on revenues.

B. **Expenditures:** *Explain the expenditure amounts. Provide detail, when appropriate, for each agency, line item, and fund affected and the number of FTE positions affected.*

See response to 2B.

C. **Appropriations:** *Explain the appropriation amounts. Provide detail, when appropriate, for each agency and fund affected. Explain the relationship between the amounts shown for expenditures and appropriations. Indicate whether the appropriation or a part of the appropriation is included in the executive budget or relates to a continuing appropriation.*

There are no anticipated impacts on appropriations.

**Name:** Illona Jeffcoat-Sacco
**Agency:** Public Service Commission
**Telephone:** 7013282407
**Date Prepared:** 04/05/2019

19.0936.03000

# FISCAL NOTE

**Requested by Legislative Council**
**02/14/2019**

Amendment to: SB 2261

1 A. **State fiscal effect:** *Identify the state fiscal effect and the fiscal effect on agency appropriations compared to funding levels and appropriations anticipated under current law.*

| | 2017-2019 Biennium | | 2019-2021 Biennium | | 2021-2023 Biennium | |
|---|---|---|---|---|---|---|
| | General Fund | Other Funds | General Fund | Other Funds | General Fund | Other Funds |
| **Revenues** | $0 | $0 | $0 | $0 | $0 | $0 |
| **Expenditures** | $0 | $0 | $0 | $0 | $0 | $0 |
| **Appropriations** | $0 | $0 | $0 | $0 | $0 | $0 |

1 B. **County, city, school district and township fiscal effect:** *Identify the fiscal effect on the appropriate political subdivision.*

| | 2017-2019 Biennium | 2019-2021 Biennium | 2021-2023 Biennium |
|---|---|---|---|
| **Counties** | $0 | $0 | $0 |
| **Cities** | $0 | $0 | $0 |
| **School Districts** | $0 | $0 | $0 |
| **Townships** | $0 | $0 | $0 |

2 A. **Bill and fiscal impact summary:** *Provide a brief summary of the measure, including description of the provisions having fiscal impact (limited to 300 characters).*

SB 2261 creates and enacts a new section to 49-22 and 49-22.1 relating to payments for mitigating adverse direct and indirect environmental or wildlife impacts of a proposed site, corridor, route, or facility.

B. **Fiscal impact sections:** *Identify and provide a brief description of the sections of the measure which have fiscal impact. Include any assumptions and comments relevant to the analysis.*

SB 2261 should not have a fiscal impact on the PSC.

3. **State fiscal effect detail:** *For information shown under state fiscal effect in 1A, please:*

A. **Revenues:** *Explain the revenue amounts. Provide detail, when appropriate, for each revenue type and fund affected and any amounts included in the executive budget.*

There are no anticipated impacts on revenues.

B. **Expenditures:** *Explain the expenditure amounts. Provide detail, when appropriate, for each agency, line item, and fund affected and the number of FTE positions affected.*

See response to 2B.

C. **Appropriations:** *Explain the appropriation amounts. Provide detail, when appropriate, for each agency and fund affected. Explain the relationship between the amounts shown for expenditures and appropriations. Indicate whether the appropriation or a part of the appropriation is included in the executive budget or relates to a continuing appropriation.*

There are no anticipated impacts on appropriations.

**Name:** John Schuh
**Agency:** Public Service Commission
**Telephone:** 7013282421
**Date Prepared:** 01/15/2019

19.0936.02000

# FISCAL NOTE

**Requested by Legislative Council**
**01/14/2019**

Bill/Resolution No.: SB 2261

1 A. **State fiscal effect:** *Identify the state fiscal effect and the fiscal effect on agency appropriations compared to funding levels and appropriations anticipated under current law.*

| | 2017-2019 Biennium | | 2019-2021 Biennium | | 2021-2023 Biennium | |
|---|---|---|---|---|---|---|
| | General Fund | Other Funds | General Fund | Other Funds | General Fund | Other Funds |
| **Revenues** | $0 | $0 | $0 | $0 | $0 | $0 |
| **Expenditures** | $0 | $0 | $0 | $0 | $0 | $0 |
| **Appropriations** | $0 | $0 | $0 | $0 | $0 | $0 |

1 B. **County, city, school district and township fiscal effect:** *Identify the fiscal effect on the appropriate political subdivision.*

| | 2017-2019 Biennium | 2019-2021 Biennium | 2021-2023 Biennium |
|---|---|---|---|
| **Counties** | $0 | $0 | $0 |
| **Cities** | $0 | $0 | $0 |
| **School Districts** | $0 | $0 | $0 |
| **Townships** | $0 | $0 | $0 |

2 A. **Bill and fiscal impact summary:** *Provide a brief summary of the measure, including description of the provisions having fiscal impact (limited to 300 characters).*

SB 2261 creates and enacts a new section to 49-22 and 49-22.1 relating to payments for mitigating adverse direct and indirect environmental impacts.

B. **Fiscal impact sections:** *Identify and provide a brief description of the sections of the measure which have fiscal impact. Include any assumptions and comments relevant to the analysis.*

SB 2261 should not have a fiscal impact on the PSC.

There may be an impact on the North Dakota Outdoor Heritage Fund, governed by the Industrial Commission, to the extent that a payment is made by an applicant for any assessed adverse direct environmental or wildlife impact deposited in the Outdoor Heritage Fund.

3. **State fiscal effect detail:** *For information shown under state fiscal effect in 1A, please:*

A. **Revenues:** *Explain the revenue amounts. Provide detail, when appropriate, for each revenue type and fund affected and any amounts included in the executive budget.*

There are no anticipated impacts on revenues.

B. **Expenditures:** *Explain the expenditure amounts. Provide detail, when appropriate, for each agency, line item, and fund affected and the number of FTE positions affected.*

See response to 2B.

C. **Appropriations:** *Explain the appropriation amounts. Provide detail, when appropriate, for each agency and fund affected. Explain the relationship between the amounts shown for expenditures and appropriations. Indicate whether the appropriation or a part of the appropriation is included in the executive budget or relates to a continuing appropriation.*

There are no anticipated impacts on appropriations.

**Name:** John Schuh

**Agency:** Public Service Commission

**Telephone:** 7013282421

**Date Prepared:** 01/15/2019

**2019 SENATE ENERGY AND NATURAL RESOURCES**

**SB 2261**

# 2019 SENATE STANDING COMMITTEE MINUTES

**Energy and Natural Resources Committee**
Fort Lincoln Room, State Capitol

SB 2261
1/24/2019
Job Number 31365

☐ Subcommittee
☐ Conference Committee

Committee Clerk: Marne Johnson

**Explanation or reason for introduction of bill/resolution:**

A bill relating to mitigating adverse direct and indirect environmental impacts.

**Minutes:** 6 Attachments

Attendance was taken, a quorum was present, the hearing was opened.

**Chair Unruh, District 33: Introduced the bill. Please see attachment #1. (1:15-7:05)** The conversation in the interim revolved around whether we should be requiring these payments in order for the Public Service Commission (PSC) to approve a project. The intent behind my bill was to make sure we were not requiring companies to pay indirect environmental impact mitigation payments. It is not something that has a scientific process behind it. The legislation attempts to disallow indirect payments for environmental impacts and directs the funds to the Outdoor Heritage Fund (OHF), whether or not that is the correct place to put those funds once they are required is something up for debate. This problem arose because I feel like the authority assumed by some of our agencies was overstepped. I do not think the solution to government intrusion is more government.

**Senator Schaible:** These payments are vast amounts of money. Is that right?

**Chair Unruh:** Yes, that third page list a payment of half a million dollars.

**Senator Schaible:** I would agree that indirect mitigation is very tough to do and shouldn't be allowed, but does your bill do that? Is indirect impact allowed in your bill?

**Chair Unruh:** What I was hoping to do, and I think I have done is allow for PSC to still consider direct and indirect environmental impacts. The language in section 1 says that the Commission may not require payment to assess adverse indirect environmental or wildlife impacts. Just trying to disallow those indirect payments, but still allow a pathway for the direct payments.

**Senator Piepkorn:** Please define or describe indirect environment impacts?

**Chair Unruh:** That is what I was talking about in my testimony, they are a very difficult thing to quantify. We have some other folks that will be talking about those. Direct is easy, if you take out a tree, you put a tree back. But indirect outside that corridor can get you into things that are mostly regulated by the US Fish and Wildlife Service, whether it's the endangered Species Act, and the impacts of an activity here affecting some specific species over here. That's one example.

**Zac Smith, North Dakota Association of Rural Electric Cooperatives (10:30) Testified in favor.** We agree with Chair Unruh about the concerns expressed over the mitigation payments. Ultimately these types of mitigation payments affect the ratepayer and the bottom line for developmental projects. I think that it is hard to quantify those indirect impacts, I think this would be a good place to start. The PSC is in position to look at that and decide whether to site a project or not, at those indirect impacts, but requiring a mitigation payment for those indirect impacts which are hard to quantify, is a challenge.

**Senator Piepkorn:** What's your primary concern, other than it's hard to define?

**Zac Smith:** The primary concern would be these payments that drive up the cost. We have concern for the environment, it's important, especially as cooperatives representing farmers and ranchers, our member owners those kind of things are important to us. We think the PSC still has the authority to address the environmental impacts, both direct and indirect with this bill it's just the mitigation payments.

**Senator Piepkorn:** At this point you haven't been affected, but you are looking to the future?

**Zac Smith:** It became an issue over this interim, looking forward this could become an issue.

**Carlee Mcleod, Utility Shareholders of North Dakota (13:55) Testified in favor.** This became a concern this summer, and our biggest concerns is cost for our customers. In particular, one of the things we like is that it does allow the entity to decide where the payment should go, if not to the Outdoor Heritage Fund. For my member companies, it's important that if they're causing a direct impact that they are able to fix that direct impact. It's our reputation on the line, we are affecting the environment of the people we serve and we want to make sure we are the ones to take care of that and we believe this bill allows us to do that.

**Senator Schaible:** If we have a direct payment of some kind, is this like a fine? You use the money to correct the direct impact, is there money left over or is it just a payment for the direct cause and it should be the amount to fix that?

**Carlee McCloud:** It's the amount to fix the direct impact. There shouldn't be money left over.

**Senator Schaible:** It seems to me that this is a fund raising avenue, in reality we should be paying the cost of the direct impact.

**Carlee McCloud:** It could be seen as that if you were adjusting indirect costs where you can't pinpoint they actual impact, but you are taking the money. But as far as this being a slush fund or way for government to take more and build up their reserves, that is not the case. There are direct impacts that are paid for frequently, there hasn't been a surplus.

**Senator Schaible:** But that's the question of indirect and direct, direct is easy to define, it's getting in this realm of indirect that would cause us a lot of problems. Would you agree?

**Carlee McCloud:** Absolutely.

**Mike Krumwiede, Wind Industry of North Dakota (17:15-18:02) Testified in favor, please see attachment #2.**

**Kayla Pulvermacher, North Dakota Farmer's Union (18:40-19:40) Testified in favor.** On behalf of the Ag community, the one person that gets lost in this conversation is the landowner. One thing they are looking for is some certainty in terms of what the process is and that it's being done in their best interest. We are supportive of this bill, I know there are some issues that agriculture sees in terms of the OHF, we could definitely do some work so we all get out of there what we like, also supportive the House Bill that addresses this, between the two we can come up with something that will be beneficial for everyone.

**Julie Fedorchak, North Dakota Public Service Commission (19:55-28:00) Provided neutral testimony, please see attachment #3.**

**Carmen Miller, Director, Ducks Unlimited (28:40-34:40) Testified in opposition, please see attachments #4 for testimony. See attachments #5-6 for scientific studies.** To answer the question of the difference between direct and indirect impacts, a direct impact is a collision between a duck and a wind turbine, or placing a wind tower in the middle of a wetland. Indirect impacts involved the avoidance of otherwise typical and useful habitats. Not nesting in a place because the landscape has changed.
The indirect impacts of wind energy marked by habitat avoidance are actually more significant than the direct impacts.

**Senator Piepkorn:** There is scientific evidence defining what indirect and direct impacts are?

**Carmen Miller:** Our researchers have studied this, yes; it has been studied, researched, peer reviewed, and published. Indirect impacts in the form of habitat avoidance, in this landscape, our study was limited to breeding females in windfarms, in a certain area of North Dakota. We found a 20% reduction in use of that habitat. So yes.

**Senator Piepkorn:** Do the impacted females, move or permanently affect the number within our state?

**Carmen Miller:** It's important to know, birds don't generally completely avoid it, some stick around, some don't. I can look at that and let you know.

**Chair Unruh:** In your testimony, you talked about indirect impacts, but not a lot about quantifying those in a dollar amount, which is what the bill is trying to avoid. Indirect impacts are real, but quantifying those into a dollar amount is the difficult task here, if we are going to do, we need to direct that better than the silence that's in century code right now. Your organization has received the one payment we have had for direct payments. If we don't change things now, how do you propose we handle this as we move forward.

**Carmen Miller:** That requires a lot more study and analysis and conversation among a wide variety of stakeholders. Quantifying this is not an easy task; it's something we all as a community need to continue to work on. You as elected officials, as regulators, the industry, the wildlife community would be involved in those conversations. Quantifying is not an easy thing, I can speak to the issue of the payment to Ducks Unlimited, which has been maybe overblown or mischaracterized. That was a one-time circumstance, outside-the-box of our normal operating business. It went from us to North Dakota farmers and ranchers. All we were doing is acting as a pass-through entity to facilitate that mechanism. How we look at these things going forward, it requires a lot of work. It's not easy to quantify this, even the direct ones aren't easy. This is still a relatively new and evolving industry that's only going to grow, as we look at challenges in this landscape, I think we have to look at those issues.

**Dan Wogsland, Executive Director, North Dakota Grain Growers Association (39:30-42:50) Testified in opposition.** This is new ground to have both Ducks Unlimited and North Dakota Grain Growers Association on the same side of an issue. Saying that, we have different concerns. We applaud you for your efforts in dealing with the indirect impact issues. It's a big issue we're ready to work with you, we want to be a part of the solution. We have three concerns with the bill as it stands. First, where the mitigation money goes. I was a member of the OHF, through actions by the committee and the legislature, the focus of that fund has become so narrow, it can't serve mitigation in North Dakota. We would look at another method of having those moneys distributed. One of the administrative things that have been talked about is the federal environmental law impact review committee that is in the North Dakota Department of Agriculture, it is already set up; it has energy, landowner, and legislative interests, it's already in law, already formed, and may be an area you could look at for administration of these funds. The second thing, the bill allows, by the use of 'may' through the legislation, the NDPSC the ability to assess indirect mitigation impacts. The way that these have been assessed is unacceptable. We think that by limiting or eliminating the ability for the NDPSC to direct indirect impacts is the right method to go. Third, the big thing that we are concerned about is the fact that landowners aren't included in this mitigation equation. If you're going to have public policy, and it's going to impact landowners, they should be consulted. That's a process that must be addressed as we move forward. We oppose this bill, but want to work with you to find solutions to this issue.

**Senator Piepkorn:** Describe what you call the narrowness of the OHF?

**Dan Wogsland:** Through administrative action within the advisory council, coupled with some of the things that have happened in the 2017 session, what has happened with the OHF that was wide in scope, had no rules, has now become narrowly focused on certain aspects of North Dakota conservation. I think we ought not narrow that, and put it within these parameters. I'm more comfortable with it in another place.

**Senator Piepkorn:** What is it narrowed to?

**Dan Wogsland:** There have been a host of projects that have come to the OHF. Some of which I agreed with, some not, because you can only look I don't think that is broad enough in scope to take care of the mitigation interests, especially the direct impacts that are envisioned.

**Senator Piepkorn:** We heard testimony from Ducks Unlimited, they basically acted as a conduit, between the wind company and landowners; how do you see that handled differently?

**Dan Wogsland:** At a half million dollars, I want to be one of their friends too. On the front end, we should have been discussing the PSC, along with energy, landowners, should be addressing up front how this is assessed, where it is assessed, how those impacts are impacting landowners, who are ultimately the ones that are going to be impacted. Including them, instead of having them in this process, but not adequately informed is something that should be done.

**Vice-Chair Kreun:** Closed the public hearing.

# 2019 SENATE STANDING COMMITTEE MINUTES

**Energy and Natural Resources Committee**
Fort Lincoln Room, State Capitol

SB 2261
1/24/2019
Job Number 31384

☐ Subcommittee
☐ Conference Committee

Committee Clerk: Marne Johnson

**Explanation or reason for introduction of bill/resolution:**

A bill relating to mitigating adverse direct and indirect environmental impacts.

**Minutes:** 1 Attachment

**Chair Unruh:** Opened additional testimony.

**Chair Unruh:** As I was drafting this, I was just trying to find a place for those dollars, a good fit. We've got someone who can give us additional information on what happens with those Outdoor Heritage Fund (OHF) dollars once they get into the pot.

**Andrea Fenwick, Deputy Executive Director, North Dakota Industrial Commission (0:50-3:20) Provided additional agency testimony, please see attachment #1.** I work with the OHF, it was brought up several times during testimony this morning, and I wanted to make myself available for any questions you might have. I've provided a handout; it gives some statistics about what has happened since program inception in 2013. The first page shows demand for the program, it's the number of applications that were submitted versus the number of applications that were funded. The next chart shows the amount of dollars requested versus the amount of awards made. On the second page, you have a financial summary through June 30th of 2018, I have updated numbers available, the second chart on page 2 shows the funds awarded by activity. This is something that we put together internally, we looked at all the applications that have been funded to date, approximately 140 projects. We divided them up by categories; you have tree planting, BMP stands for best management practices for agriculture, water projects, recreation, habitat, and access for sportsmen. There's a breakout for recreation as a whole, $6.3M. Then we're broken that into further categories. We have funds awarded by directives, this is the mean directive that the applicant selects themselves. On the final page, there is a chart that shows the amount of funds that we've received each biennium versus the amount of funds that were awarded.

**Chair Unruh:** On your third page, outdoor funds awarded by directive. You've got directive B, which is improving, maintaining, and restoring water quality, soil conditions, plant diversity, animal systems and by supporting other practices of stewardship to enhance farming and ranching. Do you have more information on what those specific projects look like, or who's been awarded funds out of that category? Or could you get that to us?

**Andrea Fenwick:** I do have that; I'll get it to you.

**Chair Unruh:** I'd like to take a look at that.

**Senator Schaible:** We've heard about narrow scope of what qualifies for a project, what is the criteria for what is an acceptable project?

**Andrea Fenwick:** I'm not sure what Mr. Wogsland was referring to in terms of narrow scope. In 2017, there were some parameters that were placed on the program, that were written into century code, some of them revolved around playgrounds, there was a limitation that we could only fund up to $10,000 on playground, and we could only fund 25% of the total cost for that. There was also a requirement about engineering and staffing costs, where it limited the amount we could provide for that. I believe that's what he was referring to in terms of legislation. In terms of the board and the scope; it's a diverse board, and I believe it was purposely set up that way. In general, the board has avoided projects that involve easements. I'm not sure if that was what he was referring to.

**Chair Unruh:** Is there any other information we want?

**Senator Schaible:** I have to agree with Dan Wogsland, I'm not a fan of OHF, into that agriculture fund would be something I'd rather look at. If there's information on that fund.

**Chair Unruh:** We'll find that, a fund in the Ag department that Dan Wogsland testified on today.

**Senator Cook:** I don't know if there a fund, rather a commission, I suppose there has to be a fund.

**Chair Unruh:** We'll see what is currently available.

# 2019 SENATE STANDING COMMITTEE MINUTES

**Energy and Natural Resources Committee**
Fort Lincoln Room, State Capitol

SB 2261
1/25/2019
Job Number 31507

☐ Subcommittee
☐ Conference Committee

Committee Clerk: Marne Johnson

**Explanation or reason for introduction of bill/resolution:**

A bill relating to mitigating adverse direct and indirect environmental impacts.

**Minutes:** 1 attachment

**Chair Unruh:** Opened additional testimony.

**Chair Unruh:** Some of the conversation yesterday revolved around the actual policy, the other conversation was about money looking for a home, we've got some mitigation dollars and we're trying to figure out the best place to put those dollars. The handout is the information requested on the OHF, with one specific directive to help farmers and ranchers **(Please see attachment #1)**. Which was the concern brought forward by the North Dakota Grain Growers Association, who wanted to make sure that these mitigation dollars go back to improve the lands that were needing to be mitigated in the first place.
In response to the concerns from the Grain Growers, I thought we should take a little bit of a deeper dive into the OHF, in this hand out are all of the programs that have been funded through the OHF and awarded by the board.
Another suggestion for a home for these dollars was a fund with the Ag department, that I vaguely recall passing in the 2015 session.

**Doug Goering, Agriculture Commissioner of North Dakota (2:20-)** I've been requested to be here to provide information on the Federal Environmental Law Impact Review Committee (FELIRC).

**Chair Unruh:** That's correct, it was suggested by the Grain Growers Association that that might be a home for these mitigation funds. These mitigation payments previously went through game and fish, while still an option, we are looking for a more permanent home within the state.

**Doug Goering:** To provide a little overview of the committee and some of the work that they do. It's actually broader in scope than what the title infers. I would suggest that you as the Legislative Body may actually want to modify some of that. It was initially set up to address a tax from the federal government on state rights, industries with respect to over-burdensome and very comprehensive laws, and rules and regulations that were being put in place. One

of the first places that this money was used was to direct and support the Attorney General challenge of the Waters of the US (WOTUS), with that, I believe we helped the Attorney General successfully do that. Because the way the committee was structured, they actually have a broader scope for some of the things they could do. The following year issues started to come up concerning endangered species. Back in 2009, there was a challenge from activist groups on endangered species in the United States. They identified 283. Every state had a list, some actually had some that crossed state lines. We became aware when the Fish and Wildlife Service had indicated there would be some bee, butterfly, fish, and bat species petitioned for the threatened or endangered species list in North Dakota. With that, we had a lot of conversation between the energy industry, agriculture industry, Game and Fish, and NDDOT. It was decided that it would be in our best interest do some of the work surrounding habitat species, based on what had happened with the Dakota Skipper; that butterfly ended up on the endangered species list in North Dakota, it was found months after it was listed that we could have prevented the listing, based on the fact that they started to find the habitat and species, and in fact pieces of information had been left out of the study such as the fact that there's only a short period of time in which they could appear. We had not had that information. We did a three-year study, the FELIRC took this under advisement, they raised some funds to leverage with some of the resources the legislature provided to fund studies and at the end of next year the studies will be completed. Game and Fish Wildlife service will receive some of that information, they were very much supportive of the work and were some of the folks doing the work concerning habitat.
The makeup of committee is the Commissioner of Agriculture, who serves as chairman, the Governor or Governor's designee, Majority Leader of the House or Representatives or their designee, The Majority Leader of the Senate or their designee, one member of the legislative assembly from the Minority Party, one individual appointed by the Lignite Energy Council, one from the North Dakota Corn Growers, one from North Dakota Grain Grower Association, one from the Petroleum Council, one for the Soybean Growers Association, and one from the Stockman's Association. That is the makeup of the committee. It's a pretty good cross representation reflecting the industries and the potential impacts. I believe that's probably why the Grain Growers talked about the work we had done, and maybe why it would fit into this. Primarily the issue with mitigation, direct or indirect, is there's one principle entity that is largely left out of the equation, the landowner. That would be with respect to agricultural land, pasture or farmland, also any assessments, evaluation, and work that's being done by wildlife biologists, soil scientists and scientists in general, may not always include or respect what the unintended consequences or the direct impacts are back the landowner who has the land; which includes wildlife which is another component to this. This has been discussed extensively, there is another bill out there about having that as part of the equation. When you have direct or indirect mitigation, you also can look at creating wildlife habitat, when you are mitigating some of these area, but it is best to have that farmer, rancher or landowner involved; they know lay of the land. They understand how we could add more value and minimize impact to their farm or land they own.

**Senator Cook:** What is the budget for FELIRC?

**Doug Goering:** The first appropriation was $1.5 M. the second, last legislative session was $1M. We have in a balance $924,000 left; we have some litigation to pay for in WOTUS. We have not made final payment on the endangered species studies until those are all completed. At that time, we'll be down to a couple hundred thousand and change.

**Chair Unruh:** If the committee were to receive these funds, do you have an idea how they would be utilized, given where they come from?

**Doug Goering:** There has been some discussion about some things that could be done, with the legislature granting the authority; for example, we would have the ability to make resources available to farmers, ranchers, and landowners that could help them in the assessment of a particular property. It could be considered mitigating various things, not just because of energy. There is wetland mitigation that could potentially take place. Maybe the conversation has been developed from a point, that there seems to be only those that are perceived as having bias, from a landowner's point of view, as being very targeted to doing one thing, without taking a holistic approach in understanding the soils, vegetation, and uses. So, part of that conversation has taken us to a point where we can maybe use those resources to contract with an environmental scientist, a wildlife scientist, wildlife biologist, soil scientist, range scientist, range scientist, engineer, or economist to help do some assessment and evaluation of what is being mitigated and where that potential mitigation that you would need to ops that could take place, in doing so it gave you another voice at the table, and given that most of these are scientists, and I would envision most of them to be NDSU, that's were some of these actually have a pretty good idea, they could work with NRCS, NDGF, Fish and Wildlife, and Core of Engineers, whatever that was to come to an agreement as to what the best way to mitigate something would be, as I believe they're only respecting PhDs in the room, quite frankly if you brought a farmer directly into that conversation they would be perceived as having a bias also. Maybe this would be the best way to utilize those funds, to have those resources available so that we have a better use and better outcome of the actual mitigated acres. For a project, or because of energy development, or a wetland issue that needs to be addressed, it has everybody's involvement.

**Chair Unruh:** I appreciate your input on this, it hasn't been an easy conversation. I appreciate the information and the willingness to participate.

# 2019 SENATE STANDING COMMITTEE MINUTES

**Energy and Natural Resources Committee**
Fort Lincoln Room, State Capitol

SB 2261
2/14/2019
Job Number 32747

☐ Subcommittee
☐ Conference Committee

Committee Clerk: Marne Johnson

**Explanation or reason for introduction of bill/resolution:**

A bill relating to mitigating adverse direct and indirect environmental impacts.

**Minutes:** 1 attachment

**Chair Unruh:** We've got the Christmas tree version (**Please see attachment #1**), if you remember this hearing, we had a couple of groups opposed to concept, regarding where the potential mitigation payments will go OHF. We received some information on when happens to money when it goes into the OHF, we had Commissioner Goehring speak to us about a group of agriculture folks that have a committee established, that would have been a possible place for these funds to go. What the amendments do is remove any of those funds and that was my original thought when I was drafting the bill. Just eliminate the possibility of any funds going anywhere. This gets closer to what I wanted anyway. The amendments take out both sub 2 and sub 3, because they are no longer necessary. They clarify the original intent, that the PSC can't require a payment for direct or indirect environmental mitigation just to approve a project. This can't be a fee that they have to pay before a site can be approved. It's not an explicit authority that the PSC has now, we are not taking anything away from the PSC, they can still consider direct and indirect impacts and require on the ground mitigation for those as they consider the siting of a project, as they currently do. Some of the information that we have received from myself in my testimony was letter from legislative council, that incorrectly stated that the PCS had required had required a payment like this previously. The PSC had not required it, it was something the company had elected to do through Game and Fish, which is why you see this language, 'the commission or any state agency with jurisdiction' making sure that we clarify that no agency can require these payments before a project will be approved they can require mitigation, on the ground, real mitigation, not a payment. Hopefully this simplifies things, alleviates confusing and concerns from our ag groups that were opposed to the funding going into the OHF. I've been working with industry on them to make sure that industry is comfortable with them, I think we've reached consensus, that this does what we wanted it to do, I think we're there.

**Senator Schaible:** I move to adopt the amendment ending in .02001
**Senator Piepkorn:** I second.

A voice vote was taken.
Motion carries.

**Senator Schaible:** I move moved a Do Pass as Amended.
**Vice-Chair Kreun:** I second.

A roll call vote was taken.
Motion passes 5-1-0.

**Chair Unruh will carry.**
**Chair Unruh:** Closed the meeting.

SK
1851

19.0936.02001
Title.03000

Prepared by the Legislative Council staff for
Senator Unruh
February 13, 2019

PROPOSED AMENDMENTS TO SENATE BILL NO. 2261

Page 1, line 2, remove "direct and"

Page 1, line 3, remove "indirect"

Page 1, line 7, remove " **direct and indirect**"

Page 1, line 8, remove "1."

Page 1, line 8, after "commission" insert "or any state agency with jurisdiction over any aspect of a proposed site, corridor, route, or facility,"

Page 1, line 9, after "adverse" insert "direct or"

Page 1, remove lines 11 through 16

Page 1, line 19, remove "**direct and indirect**"

Page 1, line 20, remove "1."

Page 1, line 20, after "commission" insert "or any state agency with jurisdiction over any aspect of a proposed site, corridor, route, or facility,"

Page 1, line 21, after "adverse" insert "direct or"

Page 2, remove lines 1 through 6

Renumber accordingly

Date: 2/14
Roll Call Vote #: 1

**2019 SENATE STANDING COMMITTEE**
**ROLL CALL VOTES**
**BILL/RESOLUTION NO.** 2261

Senate Energy and Natural Resources Committee

☐ Subcommittee

Amendment LC# or Description: 19.0936.02001

Recommendation: ☒ Adopt Amendment
☐ Do Pass ☐ Do Not Pass ☐ Without Committee Recommendation
☐ As Amended ☐ Rerefer to Appropriations
☐ Place on Consent Calendar

Other Actions: ☐ Reconsider ☐ _____

Motion Made By Sen. Schaible Seconded By Sen. Piepkorn

| Senators | Yes | No | Senators | Yes | No |
|---|---|---|---|---|---|
| Senator Jessica Unruh | | | Senator Jim Roers | | |
| Senator Curt Kreun | | | Senator Merrill Piepkorn | | |
| Senator Donald Schaible | | | | | |
| Senator Dwight Cook | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Total (Yes) _____ No _____

Absent _____

Floor Assignment _____

If the vote is on an amendment, briefly indicate intent:

Voice vote
Motion carries

Date: 2/14
Roll Call Vote #: 2

**2019 SENATE STANDING COMMITTEE**
**ROLL CALL VOTES**
**BILL/RESOLUTION NO.** 2261

Senate Energy and Natural Resources Committee

☐ Subcommittee

Amendment LC# or Description: 19.0936.02001

Recommendation: ☐ Adopt Amendment
☒ Do Pass ☐ Do Not Pass ☐ Without Committee Recommendation
☒ As Amended ☐ Rerefer to Appropriations
☐ Place on Consent Calendar

Other Actions: ☐ Reconsider ☐ _____

Motion Made By Sen. Schaible Seconded By Sen. Kreun

| Senators | Yes | No | Senators | Yes | No |
|---|---|---|---|---|---|
| Senator Jessica Unruh | X | | Senator Jim Roers | X | |
| Senator Curt Kreun | X | | Senator Merrill Piepkorn | X | |
| Senator Donald Schaible | X | | | | |
| Senator Dwight Cook | | Y | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Total (Yes) 5 No 1

Absent 0

Floor Assignment Sen. Unruh

If the vote is on an amendment, briefly indicate intent:

## REPORT OF STANDING COMMITTEE

**SB 2261: Energy and Natural Resources Committee (Sen. Unruh, Chairman)** recommends **AMENDMENTS AS FOLLOWS** and when so amended, recommends **DO PASS** (5 YEAS, 1 NAYS, 0 ABSENT AND NOT VOTING). SB 2261 was placed on the Sixth order on the calendar.

Page 1, line 2, remove "direct and"

Page 1, line 3, remove "indirect"

Page 1, line 7, remove " **direct and indirect**"

Page 1, line 8, remove "1."

Page 1, line 8, after "commission" insert "or any state agency with jurisdiction over any aspect of a proposed site, corridor, route, or facility,"

Page 1, line 9, after "adverse" insert "direct or"

Page 1, remove lines 11 through 16

Page 1, line 19, remove "**direct and indirect**"

Page 1, line 20, remove "1."

Page 1, line 20, after "commission" insert "or any state agency with jurisdiction over any aspect of a proposed site, corridor, route, or facility,"

Page 1, line 21, after "adverse" insert "direct or"

Page 2, remove lines 1 through 6

Renumber accordingly

**2019 HOUSE AGRICULTURE**

**SB 2261**

# 2019 HOUSE STANDING COMMITTEE MINUTES

**Agriculture Committee**
Peace Garden Room, State Capitol

SB 2261
3/8/2019
Job #33460

☐ Subcommittee
☐ Conference Committee

Committee Clerk: ReMae Kuehn

**Explanation or reason for introduction of bill/resolution:**

Relating to mitigating adverse environmental impacts

**Minutes:** Attachments #1-7

**Senator Jessica Unruh, Sponsor:** (Attachment #1)

There is an error on page 2 of the letter from Legislative Council. The second paragraph says "The PSC reports it only has required." The PSC didn't require payments. They documented them in the final decision that was made on a project but they didn't require this payment for the project to be approved.

(3:00)
The payment is why we are here today. The company worked with North Dakota Game and Fish Department to determine the significance of any impact and developed a plan and signed an agreement which is attached. The company made a one-time payment of $557,000 to Ducks Unlimited for the purpose of implementing long term native prairie conservation actions. That situation is why we are here today. There are some issues with the word "payment." I don't want to eliminate the efforts of the PSC, the companies asking for siting, and the land owners. There are real environmental effects and I want those to be able to be mitigated on the ground. Not these large arbitrary payments to buy somebody off to allow for a siting of their project.

(7:15)
**Doug Goehring, North Dakota Agriculture Commissioner:** (Attachment #2)

(8:47)
**Chairman Dennis Johnson:** We have another mitigation bill. Are we mirroring what we are doing?

**Doug Goehring:** That bill is a bit more extensive about utilizing resources to help land owners, farmers, and ranchers. This is very straight forward. It no longer allows indirect mitigation to take place.

**Carlee McLeod, President of the Utility Shareholders of North Dakota:**
We like to do our own mitigation. We don't like the state to mandate payments and take control of it. We are the stewards of the land and want to be held responsible.

**Chairman Dennis Johnson:** Do you see the House Bill 1383 and this bill mirroring each other?

**Carlee McLeod:** We support both bills. This bill says an agency may not mandate payments for direct and indirect. The other bill only says that they may not mandate mitigation payments for indirect. We feel this is the safest combination.

**Zac Smith, North Dakota Association of Rural Electric Cooperatives:** We support this bill because it works in tandem with the other House Bill.

**Mike Krumwiede, Wind Industry of North Dakota**: (Attachment #3)

We also support the other bill and can work in tandem together.

(14:50)
**Representative Skroch:** What was the process for determining who would be the beneficiary of mitigation dollars?

**Mike Krumwiede:** There are some things that went on. The PSC assigns the mitigation. Then you hire the contractor or work with the landowner. We would like that to not be assigned to those areas and get ahead of it with this legislation.

**Representative McWilliams:** To summarize, NextEra came in to install wind towers and found an environmental impact. Game and Fish requested that they put a package together. Then the Public Service Commission decided where the money went?

**Mike Krumwiede:** That agreement was made with Game and Fish.

**Representative McWilliams:** "We are not requiring you to pay this, but we strongly recommend you do this."

**Mike Krumwiede:** That is correct.

**Representative McWilliams:** When money changes hands, is it paid to Game and Fish?

**Mike Krumwiede:** Sometime it goes to private contractors to do the mitigation.

**Representative McWilliams:** Where does the PSC fit?

**Mike Krumwiede:** The PSC is allowed to consider and assign mitigation to companies. What this is trying to clarify is that the PSC cannot require those payments. It gives the companies the ability to decide the best way to assign those mitigation payments.

**Representative Skroch:** Isn't the PSC involved in the final say whether their permit is approved? Every permit goes over their desk?

**Mike Krumwiede:** That is their job to establish that siting. They take into account direct and indirect impacts. They come up with the assessment to take care of those mitigations. Now those are coming to Game and Fish or other private contracts.

**Pete Hanebutt, North Dakota Farm Bureau**: We support this bill.

**Opposition:**

**Randy Christmann, North Dakota Public Service Commissioner:** (Attachment #4)

(29:00)
When we are siting a project, if it is going to interfere with a farmer's ability to use his runway by removing a landing runway, that is an indirect impact.

What I've been hearing about goes to one windfarm case. There is a perception that the commission made the company enter into an agreement for mitigation of impacts to wildlife. I don't believe we have that authority. We make a decision on a project that the company brings to us. The decisions we make are appealable to court. We acknowledge voluntary settlements.

(35:48)
**Representative McWilliams:** What is the objection to the word "payment"?

**Randy Christmann:** There is the initial reclamation of the land. We have a third party contractor do that. We don't have money in our budget to do that. It is part of a siting fee that companies pay when they seek a siting certificate. I would worry that as written we may not require them to authorize this money to hire a third party contractor to tell us if they seeded grass or not. That would need to be clarified.

**Representative McWilliams:** Of all the projects approved over the last six years, how many complaints has the PSC received with the way we are looking at mitigation and environmental impacts?

**Randy Christmann:** It startes with one wind farm. The details of that voluntary settlement weren't very popular. We didn't participate in it. We acknowledged it. Since then there have been projects built that are on cropland instead of native species. There have been complaints about that. There is less landowner fatigue. Much of that has to do with a thorough siting process.

**Representative McWilliams:** Has there been an evaluation of economic impact from putting a project in one location vs. another location?

**Randy Christmann:** Not by us. That is the applicants' decision to decide where they want to build something. If Game and Fish says there are problems, the company can dispute

that. Then we have to make a decision as to who brings the best evidence. Just because it is said to be an issue doesn't mean the company has to mitigate it.

**Representative McWilliams:** Even the perception of a problem can have an economic impact. If the industry chooses a different route, couldn't an industry reduce its project to avoid going through the process and thereby reducing the economic impact to the state?

**Randy Christmann:** That is accurate. There is a project that is avoiding the Dakota Skipper. Even though one has not been found but the land might be a potential territory for Dakota Skippers. Sometimes mitigating in advance prevents things from becoming endangered.

**Representative Skroch:** Do you see potential for abuse of powers of agencies to deny resolution of mitigation in order to obtain enhanced financial benefit?

**Randy Christmann:** Not on our watch. Any agency can try to persuade. We have the final say.

**Representative Skroch**: Those things were mitigated on the side and you didn't come into the picture until they were resolved?

**Randy Christmann:** Many issues are resolved in advance. We hold a public hearing. That is where things come to our attention. Then the concern is on the record.

**Representative Skroch:** What is settled before it comes to your table, you have no control over.

**Randy Christmann:** What prevents extortion is the fact that at the end of the day. the other agencies do not have the ability to veto our decision.

**Scott Peterson, Deputy Director, North Dakota Game and Fish Department:** (Attachment #5)

(52:55)
**Representative Satrom:** Did you provide similar testimony during the Senate hearings?

**Scott Peterson**: No.

**Representative Skroch:** Line 8 says "the commission or any state agency with jurisdiction over any aspect." But, it doesn't include any federal agency? Would the federal agencies be able to assign direct and indirect impacts even if a state agency is prohibited from doing that?

**Scott Peterson:** I am not sure.

**Representative Satrom:** Is there a reason why you did not testify in the Senate?

**Scott Peterson:** The department got involved with the NextEra project. We are just one of many agencies that they consult. They asked us if there were wildlife impacts. NextEra asked us to develop consistent and transparent guidelines. Energy companies don't like exclusion areas. We entered into a voluntary discussion/negotiation. When the department assesses impacts, we don't do that based on dollar figures. We do it based on acreage. The meadowlark is dependent on native prairie. If anyone is siting a wind tower on native prairie, there are concerns. The department doesn't have siting authority. The department was a broker. If the mitigation requirements are met, then it is up to the PSC to approve it.

**Representative Skroch**: Within this bill, line 9, the commission or agencies is directed to not require any applicant to provide payment to any person. Who is "person"? Is that a concern that a person may gain a benefit?

**Scott Peterson:** I think it would be any organization. The department did not take payment of the NextEra money. We were a broker. It went to a nonprofit conservation organization in Bismarck which went to payments to landowners to do mitigation on their lands to replace the impacts. I don't know why it says "person." There is also confusion about the word payment. Does that include payment in kind?

**Chairman Dennis Johnson:** Our legal intern says "person" is broad based. It doesn't mean an individual.

**Representative Headland:** Can you address how the dollars in this Foxtail case ended up with a private organization?

**Scott Peterson:** The money ($557,000) went to Ducks Unlimited. Those dollars then went to landowner payments for mitigation. Ducks Unlimited was not our first choice. It was not an open bid. We first went to North Dakota Natural Resources Trust. But they were asking a higher administrative cost.

**Representative Headland:** Are there rules against Game and Fish handling this themselves?

**Scott Peterson:** I don't think there are rules. There are accusations that the Game and Fish Department did this as a money grab. If we took the money, we are accountable for it. Then the argument could be made that we are negotiating these costs higher because we are getting the money for it. Our revenue stream is from the sale of hunting and fishing licenses and federal aid. The legislative body gives us spending authority.

The biggest reason is it removes any implication that we were being inappropriate when negotiating the cost.

**Representative Headland**: Why $557,000? How did you come up with the cost?

**Scott Peterson:** The process was based on acreage on how many acres will be impacted. The dollar amount was higher and was negotiated down by NextEra. We did not pass that money through our agency.

**Representative Tveit:** Regardless whether Game and Fish took money, the end result is that it helps wildlife.

**Scott Peterson:** We have a statutory responsibility to manage the states resources. Our goal is to keep them off the endangered species list. We are trying to keep the resources whole. This voluntary agreement was the first of its kind.

**Representative McWilliams**: This is a private agreement between Duck Unlimited and one company for mitigation that your department recommended. The department wasn't completely innocent.

**Scott Peterson:** A more typical route would be for us to identify the impacts and let the wind company determine how they want to mitigate those.

**Representative McWilliams:** In your testimony you say this law conflicts with the federal statute. What federal statute?

**Scott Peterson:** Our testimony speaks to our own lands. There are over 200,000 acres. We manage those with federal aid dollars. They require us to mitigate any impacts on those lands. Based on our current budget of $82 million, our federal aid revenue stream amounts to $32 million. That is approaching 40% of our revenue stream.

**Representative McWilliams:** Would it be more accurate to say in your testimony that it doesn't conflict with the federal statute but it has a financial impact from the feds.

**Scott Peterson:** Yes.

**Representative Schreiber-Beck:** Is the formula state or federal that is used to determine an amount?

**Scott Peterson:** It is one that we developed with input from NextEra and some conservation partners. It was based on research.

**Representative Schreiber-Beck:** Who verifies that the actual mitigation takes place?

**Scott Peterson:** That is written into the agreements that Ducks Unlimited negotiated with the landowners.

**Representative Schreiber-Beck:** I would hope there would be follow through with the state.

**Scott Peterson:** I don't have records with me today.

**Representative Schreiber-Beck:** I would like to see them.

**Representative McWilliams:** The department would have no idea if it was mitigated.

**Scott Peterson:** That is a fair concern.

**Representative Skroch:** The contract with Ducks Unlimited would have an enforcement mechanism. They are a private group that is given enforcement authority.

**Scott Peterson:** I would assume the agreements would have compliance checks.

**Representative Skroch:** Is that in statute?

**Scott Peterson**: Not in statute.

**Karl Rockeman, Director of the Division of Water Quality, North Dakota Department of Environmental Quality:** (Attachment #6)

(1:19:20)
**Representative McWilliams:** Would mitigation and environmental impacts be defined anywhere else in Century Code?

**Karl Rockeman:** I am not aware that it is defined anywhere else. That is one of our concerns.

**Chairman Dennis Johnson:** Are there similar concerns in the other bill?

**Karl Rockeman:** The bill does specifically refer to the commission. That is more limited than this one. We don't have the same concerns. We didn't testify for this bill on the Senate side because the language of "any state agency" was added as an amendment.

**Neutral:**

**John Olson, NextEra Energy:** It was a voluntary negotiation. There was no requirement imposed by the PSC. The payment was voluntary.

**Representative Skroch:** Are you aware of other situations like this?

**John Olson:** No.

**Dale Niezwaag, Basin Electric Power Cooperative:** Mr. Peterson referenced that Basin Electric made a voluntary payment on a project. We did make a payment to Resources Trust when we built the windfarm outside of Minot. The reason that was made was because we were part of a federal program. The power from that wind project went into the transmission line. That required us to fall under the United States wildlife rules. The federal rules required over $1 million for a Whooping Crane flyway that the transmission line infringed upon.

Our concern now is that this will create another layer of state requirements on top of the federal requirements.

**Provided written testimony in support but not present:**
**Dan Wogsland, Executive Director of the North Dakota Grain Growers Association:** (Attachment #7)

# 2019 HOUSE STANDING COMMITTEE MINUTES

**Agriculture Committee**
Peace Garden Room, State Capitol

SB 2261—Committee Work
4/4/2019
Job #34545

☐ Subcommittee
☐ Conference Committee

Committee Clerk: ReMae Kuehn

**Explanation or reason for introduction of bill/resolution:**

Relating to mitigating adverse environmental impacts

**Minutes:** Attachment #1

**Senator Unruh:** (Attachment #1) This hog house amendment was drafted by the Public Service Commission staff. It does two things:

1. Takes out anything in the bill that referred to Chapter 49-22.1. That is the citing act for the oil and gas industry.
2. The underline language is inserted.

I still had concerns how the word "payment" was used. This addresses that.
This gets to the heart of the issue. This language makes sure that can't happen.

**Carlee Mcleod, President of the Utility Shareholders of North Dakota:** We are fine with this amendment.

**Vice Chair Wayne Trottier:** Moved to adopt amendment #.03001.

**Representative Skroch:** Seconded the motion.

Voice Vote.

**Amendment is adopted**.

**Representative Schreiber-Beck:** Moved Do Pass as amended.

**Representative Skroch**: Seconded the motion

**A Roll Call vote was taken: Yes 11, No 2, Absent 1.**

Do Pass as amended carries.

**Representative Schreiber Beck** will carry the bill.

DB 4/4/19

19.0936.03001
Title.04000

Prepared by the Legislative Council staff for
Senator Unruh
March 21, 2019

PROPOSED AMENDMENTS TO ENGROSSED SENATE BILL NO. 2261

Page 1, line 1, after "A BILL" replace the remainder of the bill with "for an Act to amend and reenact subsection 5 of section 49-22-08 of the North Dakota Century Code, relating to conditions imposed on the designation of sites, corridors, and routes.

**BE IT ENACTED BY THE LEGISLATIVE ASSEMBLY OF NORTH DAKOTA:**

**SECTION 1. AMENDMENT.** Subsection 5 of section 49-22-08 of the North Dakota Century Code is amended and reenacted as follows:

5. The commission may designate a site or corridor for a proposed facility following the study and hearings provided for in this chapter. Any designation shall be made in accordance with the evidence presented at the hearings, an evaluation of the information provided in the application, the criteria established pursuant to section 49-22-05.1, and the considerations set out in section 49-22-09 in a finding with reasons for the designation, and shall be made in a timely manner no later than six months after the filing of a completed application for a certificate of site compatibility or no later than three months after the filing of a completed application for a certificate of corridor compatibility. The time for designation of a site or corridor may be extended by the commission for just cause. The failure of the commission to act within the time limits provided in this section shall not operate to divest the commission of jurisdiction in any certification proceeding. The commission shall indicate the reasons for any refusal of designation. Upon designation of a site or corridor, the commission shall issue a certificate of site compatibility or a certificate of corridor compatibility with such terms, conditions, or modifications deemed necessary. The commission may not condition the issuance of a certificate or permit on the applicant providing a mitigation payment assessed or requested by another state agency or entity to offset a negative impact on wildlife habitat."

Renumber accordingly

Date: 4/4/2019

Roll Call Vote #: 1

# 2019 HOUSE STANDING COMMITTEE
# ROLL CALL VOTES
# BILL/RESOLUTION NO. SB 2261

House **Agriculture** Committee

☐ Subcommittee

Amendment LC# or Description: 19.0936.03001

**Recommendation:**
☒ Adopt Amendment
☐ Do Pass ☐ Do Not Pass ☐ Without Committee Recommendation
☐ As Amended ☐ Rerefer to Appropriations
☐ Place on Consent Calendar

**Other Actions:** ☐ Reconsider ☐ _____

Motion Made By Rep. Trottier Seconded By Rep. Skroch

| Representatives | Yes | No | Representatives | Yes | No |
|---|---|---|---|---|---|
| Chairman Dennis Johnson | | | Rep. Ruth Buffalo | | |
| Vice Chairman Wayne Trottier | | | Rep. Gretchen Dobervich | | |
| Rep. Jake Blum | | | | | |
| Rep. Jay Fisher | | | | | |
| Rep. Craig Headland | | | | | |
| Rep. Dwight Kiefert | | | | | |
| Rep. Aaron McWilliams | | | | | |
| Rep. David Richter | | | | | |
| Rep. Bernie Satrom | | | | | |
| Rep. Cynthia Schreiber Beck | | | | | |
| Rep. Kathy Skroch | | | | | |
| Rep. Bill Tveit | | | | | |

**Voice Vote**
**Motion Passed**

**Total Yes** _____ **No** _____

**Absent** _____

Floor Assignment _____

If the vote is on an amendment, briefly indicate intent:

Date: 4/4/2019

Roll Call Vote #: 2

# 2019 HOUSE STANDING COMMITTEE
# ROLL CALL VOTES
# BILL/RESOLUTION NO. SB 2261

House **Agriculture** Committee

☐ Subcommittee

Amendment LC# or Description: 19.0936.03001

**Recommendation**

☐ Adopt Amendment
☒ Do Pass ☐ Do Not Pass ☐ Without Committee Recommendation
☒ As Amended ☐ Rerefer to Appropriations
☐ Place on Consent Calendar

**Other Actions:** ☐ Reconsider ☐ _____

Motion Made By Rep. Schreiber Beck Seconded By Rep. Skroch

| Representatives | Yes | No | Representatives | Yes | No |
|---|---|---|---|---|---|
| Chairman Dennis Johnson | X | | Rep. Ruth Buffalo | | X |
| Vice Chairman Wayne Trottier | X | | Rep. Gretchen Dobervich | | X |
| Rep. Jake Blum | X | | | | |
| Rep. Jay Fisher | X | | | | |
| Rep. Craig Headland | X | | | | |
| Rep. Dwight Kiefert | X | | | | |
| Rep. Aaron McWilliams | X | | | | |
| Rep. David Richter | X | | | | |
| Rep. Bernie Satrom | X | | | | |
| Rep. Cynthia Schreiber Beck | X | | | | |
| Rep. Kathy Skroch | X | | | | |
| Rep. Bill Tveit | AB | | | | |

**Total Yes** 11 **No** 2

**Absent** 1

Floor Assignment Rep. Schreiber Beck

If the vote is on an amendment, briefly indicate intent:

**REPORT OF STANDING COMMITTEE**

**SB 2261, as engrossed: Agriculture Committee (Rep. D. Johnson, Chairman)** recommends **AMENDMENTS AS FOLLOWS** and when so amended, recommends **DO PASS** (11 YEAS, 2 NAYS, 1 ABSENT AND NOT VOTING). Engrossed SB 2261 was placed on the Sixth order on the calendar.

Page 1, line 1, after "A BILL" replace the remainder of the bill with "for an Act to amend and reenact subsection 5 of section 49-22-08 of the North Dakota Century Code, relating to conditions imposed on the designation of sites, corridors, and routes.

**BE IT ENACTED BY THE LEGISLATIVE ASSEMBLY OF NORTH DAKOTA:**

**SECTION 1. AMENDMENT.** Subsection 5 of section 49-22-08 of the North Dakota Century Code is amended and reenacted as follows:

5. The commission may designate a site or corridor for a proposed facility following the study and hearings provided for in this chapter. Any designation shall be made in accordance with the evidence presented at the hearings, an evaluation of the information provided in the application, the criteria established pursuant to section 49-22-05.1, and the considerations set out in section 49-22-09 in a finding with reasons for the designation, and shall be made in a timely manner no later than six months after the filing of a completed application for a certificate of site compatibility or no later than three months after the filing of a completed application for a certificate of corridor compatibility. The time for designation of a site or corridor may be extended by the commission for just cause. The failure of the commission to act within the time limits provided in this section shall not operate to divest the commission of jurisdiction in any certification proceeding. The commission shall indicate the reasons for any refusal of designation. Upon designation of a site or corridor, the commission shall issue a certificate of site compatibility or a certificate of corridor compatibility with such terms, conditions, or modifications deemed necessary. The commission may not condition the issuance of a certificate or permit on the applicant providing a mitigation payment assessed or requested by another state agency or entity to offset a negative impact on wildlife habitat."

Renumber accordingly

**2019 TESTIMONY**

**SB 2261**

SB 2261
1.24.19
#1
Pg.1

01/24/2019

North Dakota Senate

State Capitol
600 East Boulevard Avenue
Bismarck, ND 58505-0360

Senator Jessica Unruh
District 33
1224 First Avenue NE
Beulah, ND 58523-6301

jkunruh@nd.gov

Committees:
Energy and Natural Resources, Chairman
Finance and Taxation

Senate Bill 2261 addresses the authority of the North Dakota Public Service Commission and their ability to require mitigation payments for indirect environmental impacts during the siting process. This bill expressly states in both siting acts (addressing all types of energy development) that mitigation payments for indirect environmental impacts cannot be required for approval of a project. Direct environmental mitigation payments are still allowed, which includes the surface of the land that is actually disturbed by the project, and if direct environmental impact payments are required, this bill allows those funds to be placed in the Outdoor Heritage Fund or paid to another organization of the applicant's choosing.

I've attached some documents to explain the history on this topic. I'll refer to them now.

This bill does not change what the Commission can consider when siting a project. Direct and indirect environmental and economic impacts are still tools the Commission has when siting a project.

As a professional in this area, I can say one thing for certain - it is almost impossible to use the scientific process to adequately and fairly quantify or even identify indirect environmental impacts. Allowing a payment to be attached to them is irresponsible of us at this time. We need this legislation to provide direction and clarity. And we need to avoid increasing the cost of energy to ratepayers, which is the real end result of required mitigation payments.

This bill is not (yet) perfect. The solution to this problem is complicated. We may need to completely disallow environmental mitigation payments or we may need to change where the funds go if direct environmental mitigation payments are required. My hope is to hear from all the parties affected today and that we can all head in the same direction together.

SB 2261 1/24/19 #1 Pg 2

19.9416.01000

# North Dakota Legislative Council

STATE CAPITOL, 600 EAST BOULEVARD, BISMARCK, ND 58505-0360



October 3, 2018

Honorable Jessica Unruh
State Senator
1224 First Avenue NE
Beulah, ND 58523-6301

Dear Senator Unruh:

This letter is in response to your inquiry regarding the Public Service Commission's (PSC) authority to require direct and indirect mitigation payments when companies request siting permits.

In 1975 the Legislative Assembly passed Senate Bill No. 2050, the North Dakota Energy Conversion and Transmission Facility Siting Act (Appendix A). Section 9 of the bill, codified as North Dakota Century Code Section 49-22-09, lists the factors the PSC must consider when evaluating an application and designation of sites and corridors. The factors include an evaluation of the adverse direct and indirect environmental effects that cannot be avoided if the proposed site, corridor, or route is accepted. The factors also include an analysis of the direct and indirect economic impact of a proposed energy conversion facility and transmission facility.

Senate Bill No. 2233 (1979) (Appendix B) amended Section 49-22-09 to remove "corridor" from consideration of the adverse direct and indirect environmental effects factor. The bill replaced the phrase "energy conversion facility and transmission facility" with "facility" in the analysis of the direct and indirect economic impact factor.

The 1979 legislation also amended Section 49-22-08, which governs the certificate application requirements, by requiring an application for a certificate also must include a description of mitigative measures that must be taken to minimize all foreseen adverse impacts resulting from the location, construction, and operation of the proposed facility. The bill also added the same requirement to Section 49-22-08.1, which governs an application for a route permit.

House Bill No. 1144 (2017) separated the siting requirements for electric energy facilities and the gas or liquid facilities into two chapters in Title 49. The bill created Chapter 49-22.1 to address gas or liquid transmission facilities and gas or liquid energy conversion facilities while amending Chapter 49-22 to pertain only to electric transmission and electric energy conversion facilities. The factors the PSC must consider when evaluating an application and designation of sites and corridors; however, remained unchanged in Section 49-22-09 for electric energy conversion and transmission facilities. Section 49-22-09 was duplicated and codified into the newly created gas or liquid transmission facilities and energy conversion facilities chapter as Section 49-22.1-09.

To summarize, Chapters 49-22 and 49-22.1 do not grant the PSC the authority to require direct or indirect mitigation payments from companies applying for siting permits. However, when evaluating an application for a permit or certificate, Chapters 49-22 and 49-22.1 require the PSC to consider the adverse direct and indirect environmental effects that cannot be avoided if the proposed site, corridor, or route is accepted. By

law, the PSC also is required to consider the mitigative measures that must be taken to minimize all foreseen adverse direct and indirect impacts resulting from the location, construction, and operation of the proposed facility.

Attached as Appendix C is the information you requested relating to the amount the PSC has required a company to pay toward direct or indirect mitigation payments for siting permit purposes and where the money from these mitigation payments has been allocated. The PSC reports it only has required direct and indirect mitigation on one wind energy project. The company worked with the North Dakota Game and Fish Department to determine the significance of any impact and developed a plan and signed an agreement with the Game and Fish Department to mitigate those impacts as identified in the attachment. As indicated in the agreement, the company involved made a one-time payment of $557,000 to the Ducks Unlimited Great Plains Regional Office for the purpose of implementing long-term, "on-the-ground" native prairie conservation actions. The implementation of the agreement is being monitored by the Game and Fish Department.

We hope this answers your inquiry. If you would like additional information or have any other questions, please contact us.

Sincerely,

Christopher S. Joseph
Counsel

CJ/JJB
Encs.

SB 2261
1.24.19
#1
Pg. 4

# NORTH DAKOTA GAME & FISH DEPARTMENT

"Variety in Hunting and Fishing"

GOVERNOR, Doug Burgum

DIRECTOR, Terry Steinwand
DEPUTY, Scott A. Peterson

100 North Bismarck Expressway
Bismarck, North Dakota 58501-5095
Phone: (701) 328-6300
FAX: (701) 328-6352



December 20, 2017

ND Public Service Commission
600 E. Boulevard, Dept. 408
Bismarck, ND 58505-0480

RE: Case PU-17-284 Foxtail Wind Energy Center – Dickey County, North Dakota

In a November 6, 2017 letter to the PSC, the North Dakota Game and Fish Department (Department) acknowledged NextEra's important role of assisting in the development of state specific wind energy guidelines for offsetting impacts to fish and wildlife resources, but expressed a number of concerns specific to the Foxtail project due to the loss of some of the highest value, unbroken prairie remaining in the state. The Department recommended NextEra develop an offset package for the permanent impact of roads and turbine pads that are to be constructed within unbroken prairie habitat ≥ 160 acres and any CRP-SAFE tracts (a program designed to maintain or increase populations of high-value or high priority wildlife species). The Department recommended that this offset package include direct effects of development features (i.e. turbines, roads, buildings), as well as indirect effects of the fragmentation of the unbroken prairie habitat of up to 100 meters from new or improved roads and 200 meters of turbine sites.

Since the Foxtail project hearing, NextEra and the Department have been working collaboratively in an attempt to address this offset package. Using peer reviewed literature and existing, vetted mitigation guidelines, the Department determined what we believe is an appropriate offset for the loss of high value, native grassland habitat associated with the Foxtail project. However, we also recognize and acknowledge the development of state voluntary guidelines were in a transitional period and not fully agreed upon when this project was filed and heard.

NextEra has committed to a financial contribution for long-term, "on-the-ground" offsets for the direct disturbance of 293.6 acres and indirect disturbance of 2004.5 acres resulting from the Foxtail project.

This equates to less than 60% of the economic value of the acreage (based on $500/ac.) recommended for offsets by the Department. However, because a comprehensive framework for determining offsets has not been completely developed and finalized, full compensation of impacts on this project would not be reasonable at this time. We anticipate this science-based framework to be completed and shared with wind interests in the very near future. The Department intends to use it to determine wildlife resource impacts and recommend avoidance, minimization, and full offsets for future wind development. We commend NextEra's commitment to the stewardship of our wildlife resources and their collaborative spirit as we move forward with these state guidelines. In good faith, the Department believes that the project should move forward.

Sincerely,

Terry Steinwand

Terry Steinwand
Director

CC: North Dakota Governor's Office
Kimberly Wells, NextEra Energy Resources, Inc.
Kevin Shelley, US Fish and Wildlife Service ESA
Representative Mike Brandenburg, District 28

**Cooperative Agreement and Memorandum of Understanding**

This Cooperative Agreement and Memorandum of Understanding ("**MOU**"), dated April 17, 2018, is between Foxtail Wind, LLC ("**Foxtail**") and North Dakota Game and Fish Department ("**NDGFD**") (Foxtail and NDGFD, jointly the "**Parties**"). The purpose of this MOU is to address the anticipated impacts to native prairie caused by the Project (as defined herein), as requested by the North Dakota Public Service Commission ("**PSC**").

The Foxtail Wind Project (the "**Project**") is a 150 MW wind energy project located in southeastern Dickey County, North Dakota that received certification from the PSC in January 2018. Foxtail anticipates that the Project will be owned, constructed and operated by Northern States Power Company ("**NSP**"), a subsidiary of Xcel Energy. This MOU is subject to Foxtail obtaining all certifications and permits required to construct the Project.

Since October of 2016, Foxtail, along with other participants in the wind industry, has been participating in a voluntary, industry-led collaborative effort referred to as the North Dakota Wind and Wildlife Collaborative ("**NDWWC**") with both the NDGFD and the U.S. Fish and Wildlife Service ("**USFWS**"). The purpose of this collaborative effort is to balance responsible wind development with protection for wildlife and native habitats, and to provide improved predictability in the permitting process through the PSC. In letters dated November 6 and 14, respectively, from the NDGFD and the USFWS to Foxtail submitted to the PSC Docket (PU-17-284), both agencies recognized the efforts of Foxtail as a key participant in the NDWWC.

NDWWC is developing, but has not yet completed, an approach to protect wildlife and native habitats, specifically one that addresses avoidance, minimization, and formal offsets where appropriate. Notwithstanding, NDGFD and USFWS acknowledge that Foxtail is a transitional, late-stage development project that should not establish a precedent, or otherwise be subject to the full application of any framework requiring consistency with any as-yet undeveloped formal offset principles.

In its letter dated November 6, 2017, NDGFD recommended that permanent impacts be defined to include unbroken prairie habitat greater than 160 acres or impacts on CRP SAFE tracks associated with roads and turbines. In addition, indirect fragmentation impacts on native prairie (defined as 100 meters from new or improved roads and 200 meters from turbines) were also recommended for inclusion in the offset package.

In light of the transitional stage of the NDWWC recommendations and Foxtail's continued collaboration with both agencies, Foxtail agrees to make a one-time offset payment in the amount of $557,000.00 to Ducks Unlimited Great Plains Regional Office for the purposes of implementing long-term, "on the ground" native prairie conservation actions (the "***Conservation Payment***").

Payment for this offset package is contingent on the Project receiving all final approvals to begin construction and will be paid within 60 days of Foxtail filing a Notice of Intent to Begin Construction with PSC.

Respectfully submitted,

**Foxtail Wind, LLC**

John Di Donato

Vice President

Acknowledged and agreed this 17th day of April, 2018

**North Dakota Department of Game and Fish**

Terry Steinwand

Director

SB 2261
1.24.19
#2
Pg. 1

WIND
Wind Industry of North Dakota

**Senate Energy and Natural Resources Committee**

**January 24, 2019**

**Support SB 2261**

Chairman Unruh and Members of the Committee,

For the record my name is Mike Krumwiede, and I'm here today representing Wind Industry of ND, or WIND. We are a coalition of industry members and supporters formed in 2018 that advocates for the continued support of wind as one of North Dakota's valuable energy resources. Our current coalition includes:

- American Wind Energy Association (AWEA)
- Apex Clean Energy
- Capital Power
- EDF Renewable Energy
- Enel Green Power North America Inc.
- Invenergy
- NextEra Energy Resources
- Tenaska
- Tradewind
- Wanzek Construction, Inc.

These members came together because we believe wind is an abundant asset in our state which should be harnessed for the continued benefit of our local communities and residents. North Dakota currently ranks 5th in share of electricity generated from wind. The 29 commercial wind farms in North Dakota generated 3000mw of power in 2016. The Wind industry currently accounts for two to three thousand permanent direct, indirect, and manufacturing jobs in ND with a total business activity of $174 million in 2016. In that same year the wind industry paid property taxes of $7.7 million and $14.4 million in lease payments to North Dakota Landowners. The result of all this activity is that Wind now comprises approximately 27% of the energy mix used by utilities in North Dakota.

WIND supports 2261 because the science of indirect environmental impacts is inconclusive and, accordingly, the PSC should not require mitigation of those impacts.

WIND understands that mitigation payments of direct impacts are something that will have to be dealt with in developing new wind projects. WIND is in favor of the language in this bill as it pertains to payments for mitigation assessed on adverse direct environmental impacts. WIND likes that this bill gives options to the developer to either make mitigation payments to the outdoor heritage fund or another option that the developer sees as a more appropriate method.

For these reasons, we respectfully request a Do Pass recommendation on SB 2261. Thank you for your time.

SB 2261
1.24.19
#3

**Senate Bill 2261**

**Presented by:** **Julie Fedorchak, Commissioner**
**Public Service Commission**

**Before:** **Senate Energy and Natural Resources Committee**
**The Honorable Jessica Unruh, Chairman**

**Date:** **January 24, 2019**

**TESTIMONY**

Madam Chair, members of the Committee, my name is Julie Fedorchak. I'm a member of the ND Public Service Commission and I'm here today speaking on behalf of the commission to provide information as it relates to SB 2261.

We do not have an official position, but felt it was important to be here today to provide some information about our siting process and be available to answer questions on issues that may have inspired this measure.

As you well know, the siting process is laid out in chapter 49-22 of the ND century code. It's a section of law that I' refer to as the Bible of siting. It provides a lot of clarity and direction to the commission regarding our process, what companies are to do to apply, how we are to go about considering applications, and what factors we shall consider in providing a permit.

This law has been in place since the mid 1970s and has helped successfully permit billions of dollars of energy infrastructure, including nearly $10 billion in the last six years. It is a success story for public policy. We receive a lot of compliments from citizens about the process, the accessibility, the transparency when they attend our hearings.

It is something you all should take pride in as you are the creators of it.

For example, by following closely this process, the Commission successfully permitted the Dakota Access pipeline, involving more than 30 hours of public testimony and an extensive give and take between the company, landowners, other government agencies and the commission that resulted in a permit that was never legally challenged during the entire international protest against that project.

I read from the statement of policy provided in the law at every hearing. It sets the stage for our work and helps participants better understand the goals and purpose of the hearing and the permitting process.

In a nutshell the statement says "it is the policy of this state to site energy conversion facilities and transmission facilities in an orderly manner comparable with environmental preservation and the efficient use of resources." It further states that "sites and routes should be chosen that minimize adverse human and environmental impact while ensuring continuing system reliability."

That language quite beautifully frames the balance that we work to achieve. The law provides considerable flexibility, while also outlining specific boundaries.

In 49-22-09, the law spells out 11 factors to consider and directs the commission to further identify exclusion areas, avoidance areas and policy considerations.

One of the factors we are to consider are direct and indirect environmental impacts. Companies provide testimony identifying these impacts. Agencies, organizations and individuals also provide information on these issues.

The law spells out how this information is to be used. 49-22-08.1 describes the process companies must follow to apply for a permit and point (d) in that subsection directs companies to describe "mitigative measures that will be taken to minimize all foreseen adverse impacts resulting from the location, construction and operation of a proposed facility."

A good portion of the application and hearing process is dedicated to this piece.

It's a process. The company outlines the impacts they anticipate and how they plan to mitigate them. Agencies and citizens outline the impacts they believe will occur and the mitigation they believe is necessary. And we listen, ask questions and highlight areas of concern.

Ultimately, we are directed to make a decision based on the record. So, often after hearings, the company will walk away with additional issues to respond to.

How they respond is not something we direct. We receive additional information from the company through late file exhibits and work through those responses in public meetings until we believe a decision is in order. And in every case since I've been on the commission, that process has resulted in us determining that the project will have minimal impact and the company receives the permit.

Throughout this process the company listens to the concerns we identify based on the information we are receiving and determines what if anything they intend to do to mitigate the impact.

In the case of this bill, Section 1.1: "The commission may not require an applicant to provide payment to any person for the mitigation of any assessed adverse indirect environmental or wildlife impact." The commission wants you to know that we have not and do not require applicants to make payments to mitigate impacts. If companies use that tool to mitigate an identified impact, it is their choice.

We don't object to the legislature prohibiting the commission from requiring these payments but want to clarify any misconception that this is something that we are doing.

In terms of number 2, this prohibits the company from voluntarily choosing offset payments as a mitigation tool. I can't speak for applicants but my experience suggests that this may be a tool companies want at their disposal and prohibiting it might restrict their options for mitigating impacts.

The one item in the proposed bill that we do have concerns with is the last part of line 16, the language "unless directed otherwise by the applicant." This seems to run counter to the main concerns we heard as it related to voluntary mitigation payments a company made in a wind permitting case last year. People were frustrated that the payments were being made to outside organizations with perceived agendas and wanted more neutrality for the organizations receiving such payments. Striking that language and directing the payments to the outdoor heritage fund would likely address that concern.

That concludes my prepared remarks. I would be happy to answer any questions.

Thank you.

SB 2261
1.24.19
#4

**Ducks Unlimited**

**TESTIMONY IN OPPOSITION TO SB 2261**
**Carmen Miller, Director of Public Policy, Ducks Unlimited**
**North Dakota House Finance and Taxation Committee**
**January 24, 2019**

Good morning, Chairwoman Unruh, and members of the committee. My name is Carmen Miller and I am the Director of Public Policy for Ducks Unlimited's Great Plains Region in Bismarck. I'm here today to testify in opposition to SB 2261. Ducks Unlimited was founded in 1937 and is now the world's largest private waterfowl and wetlands conservation organization, with over 80 years of experience restoring and protecting wetlands and other aquatic habitat. DU has been working in North Dakota for over 30 years, has over 4000 members in the State, has invested over $100 million in North Dakota, and employs a staff of over 40 in an office here in Bismarck which serves as a regional headquarters for 7 states.

Our primary concerns with SB 2261, and the issue that I'm going to focus on today, is the fact that it minimizes, or even completely disregards, indirect impacts to the environment and wildlife resulting from energy transmission, conversion, and siting. More specifically, I want to provide the committee with scientific information on the indirect impacts of wind development on breeding duck pairs within North Dakota.

Ducks Unlimited is generally supportive of the wind industry as a renewable source of energy that can be produced locally. DU has been monitoring the growth of the industry in North Dakota since 2003, and has been involved in numerous wind energy collaboratives, including the Northern Plains Wind Energy Forum and the North Dakota Wind and Wildlife Collaborative. North Dakota is in the heart of the Prairie Pothole Region, known as "the duck factory" of North America, which provides breeding habitat for more than 50% of the continent's population of breeding ducks. North Dakota has an export economy – we export beef, wheat, corn, electricity, oil and ducks. Attached to my testimony are two maps showing, first, the Prairie Pothole Region, and the density of breeding pairs in that landscape, and second, the overlay of the PPR with average annual wind speed. In addition to being the "duck factory" of North America, North Dakota has also been referred to as the "Saudi Arabia of wind," and these maps illustrate that.

DU began researching both direct and indirect impacts of wind development in 2008, with a focus on the impact on breeding females. Direct impacts typically involve collisions with wind turbines, or the actual placement of a wind turbine directly in a wetland. Indirect impacts involve the avoidance of otherwise typical habitat. Ducks Unlimited researchers spent two summers conducting the first-ever study on the impacts of collisions on just breeding female ducks. While collisions have a significant impact on migrating birds, there were limited collisions for breeding female mallards and blue-winged teals, suggesting that wind turbines had no direct effect on female survival. In other words, breeding females were not meaningfully impacted by collisions with wind turbines.

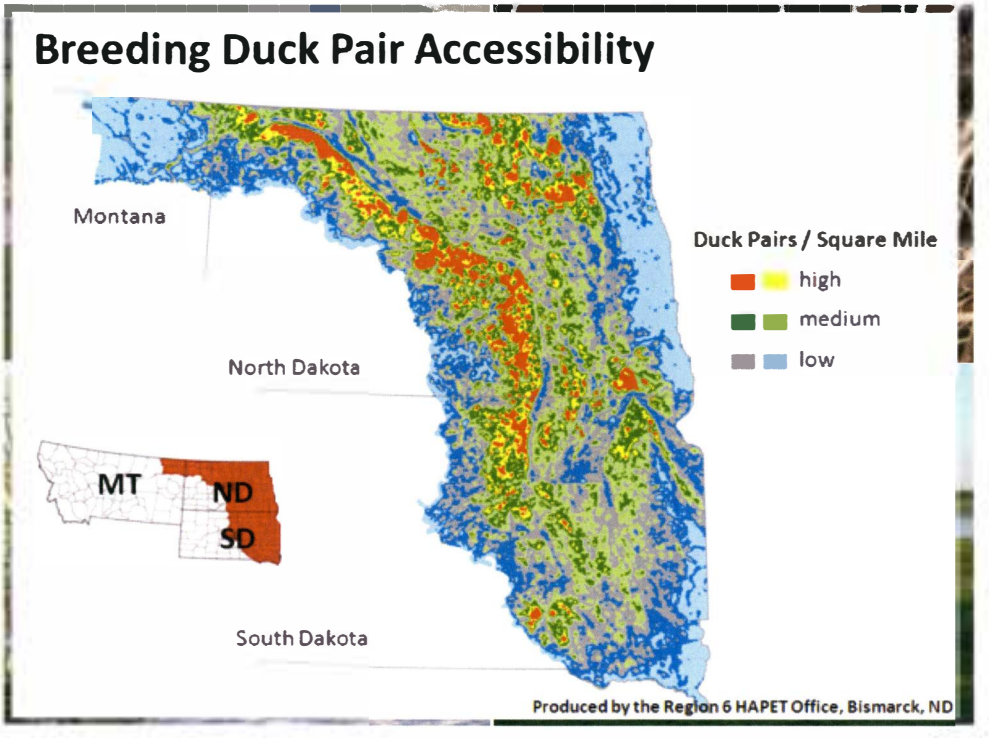
SB2261
1.24.19
#4

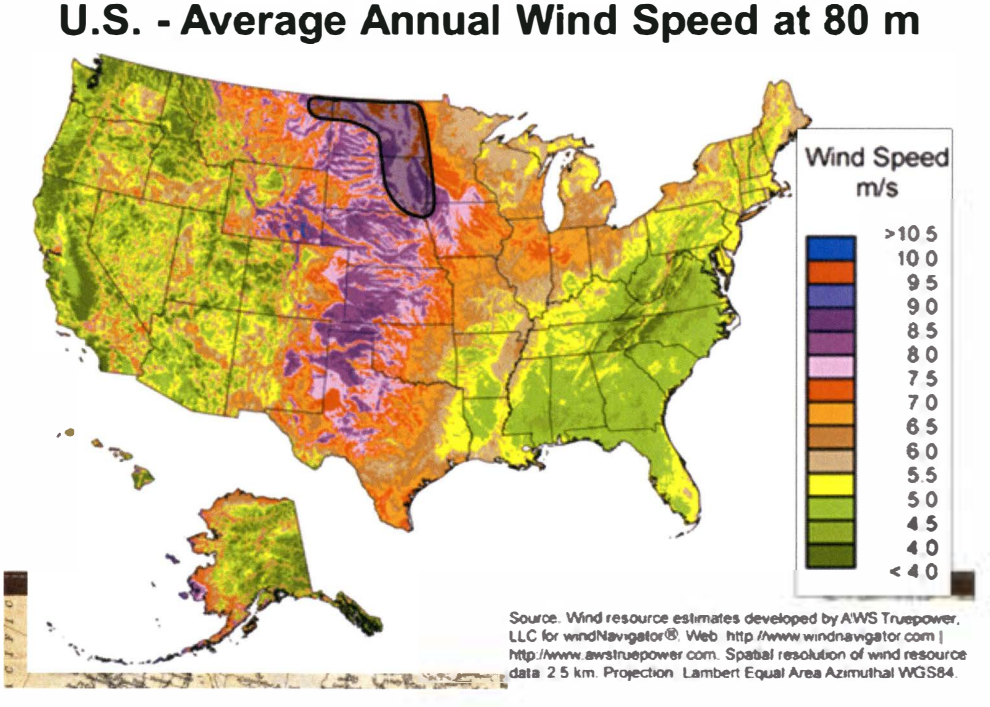
During the summers of 2008-2010, Ducks Unlimited partnered with the US Fish and Wildlife Service and NextEra Energy to study the impacts of wind energy development on the density of breeding duck pairs. For three summers, researchers conducted field surveys of breeding pairs in the Kulm-Edgeley and Tatanka wind farms, which involved over 10,000 wetland visits and observation of over 15,000 breeding duck pairs, and comparisons of conditions and pairs at those sites with comparable reference sites without wind energy development. The study demonstrated that five species of dabbling ducks exhibited an average decline of 20% within 800 meters of wind turbines on the Tatanka and Kulm/Edgeley wind farms. These species include the Mallard, Northern Pintail, Northern Shoveler, Blue-winged Teal, and Gadwall, all species important to the "duck factory of North America." In the breeding-intense landscape of the Prairie Pothole Region, the indirect impacts of wind energy development, marked by habitat avoidance, are actually more significant than the direct impacts, or collisions.

SB 2261 diminishes these important impacts, and also limits the ability of the PSC and the wind industry to address these issues. 15 years after the wind industry began in North Dakota, the state now has about 3,000 MW of installed wind capacity, with potential growth from 395,000-742,000 MW, according to the American Wind Energy Association. Indirect impacts in the form of habitat avoidance are very real, documented, and the subject of peer-reviewed and published scientific research. They will continue to exist, regardless of how these issues are addressed in the Century Code. A 20% reduction in one of our state's exports should not be taken lightly, and we urge the committee to allow the full consideration of these impacts by adopting a do not pass recommendation.

Thank you for your time and consideration of this important issue, and for your service.

SB 2261
1.24.19
#4



The Journal of Wildlife Management; DOI: 10.1002/jwmg.583



*Research Article*

# The Effects of a Large-Scale Wind Farm on Breeding Season Survival of Female Mallards and Blue-Winged Teal in the Prairie Pothole Region

**C. TANNER GUE,**[1,2] *Department of Biology, University of North Dakota, 10 Cornell Street, Grand Forks, ND 58201, USA*
**JOHANN A. WALKER,** *Great Plains Regional Office, Ducks Unlimited, 2525 River Road, Bismarck, ND 58503, USA*
**KATHERINE R. MEHL,**[3] *Department of Biology, University of North Dakota, 10 Cornell Street, Grand Forks, ND 58201, USA*
**JEFFREY S. GLEASON,**[4] *Kulm Wetland Management District, U.S. Fish and Wildlife Service, 1 First Street SW, Kulm, ND 58456, USA*
**SCOTT E. STEPHENS,**[5] *Great Plains Regional Office, Ducks Unlimited, 2525 River Road, Bismarck, ND 58503, USA*
**CHARLES R. LOESCH,** *Habitat and Population Evaluation Team, U.S. Fish and Wildlife Service, 3425 Miriam Avenue, Bismarck, ND 58501, USA*
**RONALD E. REYNOLDS,**[6] *Habitat and Population Evaluation Team, U.S. Fish and Wildlife Service, 3425 Miriam Avenue, Bismarck, ND 58501, USA*
**BRETT J. GOODWIN,** *Department of Biology, University of North Dakota, 10 Cornell Street, Grand Forks, ND 58201, USA*

**ABSTRACT** The wetlands and grasslands of the Prairie Pothole Region (PPR) make it the most productive breeding habitat for North American ducks. The growth rate of mallard (*Anas platyrhynchos*) populations is sensitive to changes in survival of adult females during the breeding season. Much of the PPR is suitable for large-scale wind-energy development and collisions of breeding females with wind turbines may be a novel source of mortality in this area. We assessed the effects of wind energy on breeding female mallard and blue-winged teal (*A. discors*) survival by monitoring 77 radio-marked mallards and 88 blue-winged teal during the 2009 and 2010 breeding seasons at the Tatanka Wind Farm (TWF) near Kulm, North Dakota. During the same period, we monitored 70 female mallards and 75 blue-winged teal at an adjacent reference site without wind turbines (REF). We used an information-theoretic approach to investigate relationships between female survival and site (TWF vs. REF), year (2009 vs. 2010), and date. Collision mortalities were rare. Only 1 radio-marked female mallard and no blue-winged teal collided with wind turbines. Most mortalities were caused by predators (78.3%; 36/46), irrespective of species and site. For mallards, the best-approximating model indicated that breeding season survival was 1) lowest when a high proportion of radio-marked females were incubating, and 2) dependent on year and site such that expected survival ($\hat{S}$) in 2009 was higher at TWF ($\hat{S}$ = 0.90, 85% CI = 0.79–0.98) than at REF ($\hat{S}$ = 0.83, 85% CI = 0.68–0.95), but expected survival in 2010 was lower at TWF ($\hat{S}$ = 0.62, 85% CI = 0.46–0.79) than at REF ($\hat{S}$ = 0.84, 85% CI = 0.72–0.94). For blue-winged teal, the constant model was the best-approximating model and indicated that expected female survival was 0.75 (85% CI = 0.69–0.82). The most competitive model for blue-winged teal that included the effect of wind turbines indicated that expected survival at TWF ($\hat{S}$ = 0.71, 85% CI = 0.62–0.79) was lower than survival at REF ($\hat{S}$ = 0.81, 85% CI = 0.73–0.89). The limited number of collisions observed for female mallards and blue-winged teal nesting at TWF suggests that wind turbines had no direct effect on female survival. Thus, conservation strategies that include protection of wetland and grassland habitat in wind-developed landscapes will most likely not cause a direct reduction in survival of breeding females due to collisions with wind turbines. © 2013 The Wildlife Society.

**KEY WORDS** adult survival, *Anas discors*, *Anas platyrhynchos*, blue-winged teal, breeding population, mallard, Prairie Pothole Region, radio-telemetry, wind energy, wind turbines.

Received: 31 October 2012; Accepted: 22 April 2013

[1]*E-mail: tgue@ducks.org*
[2]*Present address: Great Plains Regional Office, Ducks Unlimited, 2525 River Road, Bismarck, ND 58503, USA*
[3]*Present address: Newfoundland and Labrador Department of Environment and Conservation, P.O. Box 2007, 117 Riverside Drive, Corner Brook, CA NL A2H 7S1, USA*
[4]*Present address: Alabama Ecological Services Field Office, U.S. Fish and Wildlife Service, 1208 Main Street, Daphne, AL 36526, USA*
[5]*Present address: Oak Hammock Marsh Conservation Centre, Ducks Unlimited Canada, P.O. Box 1160, Stonewall, CA MB R0C 2Z0, USA*
[6]*Present address: Retired, 14622, 246th Avenue Northwest, Zimmerman, MN 55436, USA*

The demand for energy and growing concern about potential environmental impacts of traditional energy sources have caused increased interest in alternative energy sources (Arnett et al. 2007, Meseguer 2007). Wind energy is the fastest growing source of alternative energy, with an average annual growth rate in the United States of 39% (2005–2009; American Wind Energy Association 2010). Similar to more traditional energy development projects (coal, Anderson 1978; coal-bed natural gas, Walker et al. 2007; natural gas and oil, Gilbert and Chalfoun 2011), wind energy may also create conflicts for wildlife populations when it alters habitat in a way that reduces survival, productivity, or both (Fox et al. 2006, Johnson and St-Laurent 2011). For example, recent studies have confirmed additional mortality in populations of birds (primarily raptors and passerines) and bats due to direct collisions with wind turbines or associated infrastructure (Erickson et al. 2001, Arnett et al. 2008). However, collision risk may depend on a variety of site- and species-specific factors (Drewitt and Langston 2006). For example, collision risk may be higher at wind developments near preferred hunting habitat, as documented for common kestrels in Spain (*Falco tinnunculus*; Barrios and Rodrguez 2004), or for species that have high wing loading (Janss 2000, De Lucas et al. 2008). Given the rate at which wind energy is expanding and an incomplete understanding about the potential impacts of wind energy on wildlife, concern exists about the effect of large-scale wind-energy developments on wildlife populations (Kiesecker et al. 2011, Fargione et al. 2012).

The Prairie Pothole Region (PPR) provides critical breeding habitat for more than 50% of the continent's population of dabbling ducks (*Anas* spp.; Smith et al. 1964, Bellrose 1980, Kaminski and Weller 1992). As a result, the PPR has been identified as the highest priority for waterfowl conservation by the North American Waterfowl Management Plan (NAWMP; North American Waterfowl Management Plan Committee 2012). However, programs that conserve habitat for breeding waterfowl in the PPR were conceived in the absence of large-scale wind-energy development. Wind resources are particularly abundant in the PPR (Kiesecker et al. 2011:fig. 2, National Renewable Energy Lab 2011). This creates an apparent overlap between an area of high wind-energy potential and an area of primary conservation concern for migratory waterfowl. Although wind-energy development in the PPR is expanding, the effect of wind-energy development on waterfowl populations, particularly in North America, is poorly understood (Stewart et al. 2007, but see Loesch et al. 2013).

A primary concern regarding wind energy in the PPR is decreased survival of breeding females because of potential collisions with wind turbines. Breeding season survival of female mallards (*Anas platyrhynchos*), and presumably other upland nesting ducks, is one of the most limiting factors on population growth (Hoekman et al. 2002). Female dabbling ducks suffer greater mortality during the incubation period than any other period of their annual life cycle because of increased vulnerability to predation (Johnson and Sargeant 1977, Sargeant et al. 1984), but collision of ducks with turbine blades or other associated infrastructure may represent a novel source of breeding season mortality.

We predicted that if breeding females are susceptible to collision with wind turbines, the probability of survival for females nesting in landscapes near wind turbines would be lower than for females nesting in similar landscapes without wind turbines. Siegfried (1972) hypothesized that male dabbling ducks may be susceptible to collisions with anthropogenic structures during pursuit flights because of a potential decrease in their awareness of such features. We predicted that female ducks may also be particularly susceptible to collision with wind turbines during pre-nesting courtship flights shortly after arrival at the breeding grounds (Titman 1983), as opposed to other periods (e.g., incubation) when females may spend more than 20 hours of a 24-hour period at nests (Afton and Paulus 1992). Further, because of increased fragmentation of grassland habitat at wind farms in the PPR (Bureau of Land Management 2005), predators might be more efficient at locating duck nests and depredating nesting females in wind-developed landscapes (Cowardin et al. 1983, Sargeant et al. 1993). To test these predictions, we used an impact-reference study design (Morrison et al. 2008). We radio-marked and monitored breeding female ducks from April to August in 2009 and 2010 at a wind development and an adjacent reference site with similar landscape characteristics but without wind turbines.

To our knowledge, this study was the first attempt to investigate potential effects of wind-energy development on the survival of breeding female ducks. The primary focus of our study was to assess the risk of collision for breeding females. Our goals were to 1) assess support for our predictions about survival of female ducks during breeding in wind-energy developments and 2) provide managers with useful information about relationships between survival probability of breeding females and wind-energy development in landscapes of the PPR with abundant grassland and wetland habitat.

## STUDY AREA

In 2009 and 2010, we studied adult female mallards and blue-winged teal (*Anas discors*) at the Tatanka Wind Farm (Tatanka, Acciona Energy Company, North America; hereafter TWF) and an adjacent reference site without wind turbines (hereafter REF; Fig. 1). The wind farm was located 40 km south of Kulm, North Dakota, USA (46°56′23′′N, 99°00′20′′W) and extended approximately 16.5 km on the Missouri Coteau physiographic region in Dickey County, North Dakota and McPherson County, South Dakota. The reference site was located in Dickey and McIntosh counties in North Dakota. The wind farm consisted of 120 operational wind turbines located on private lands in cropland or grassland habitat. Turbine operation at TWF began in May 2008. Each turbine (model AW-77/1500) had 3 37-m blades (76-m rotor diameter) atop an 80-m tower. The turbines operated at wind speeds between 3.5 m/s and 25 m/s and were capable of producing 1.5 MW/day (Acciona North America 2011).

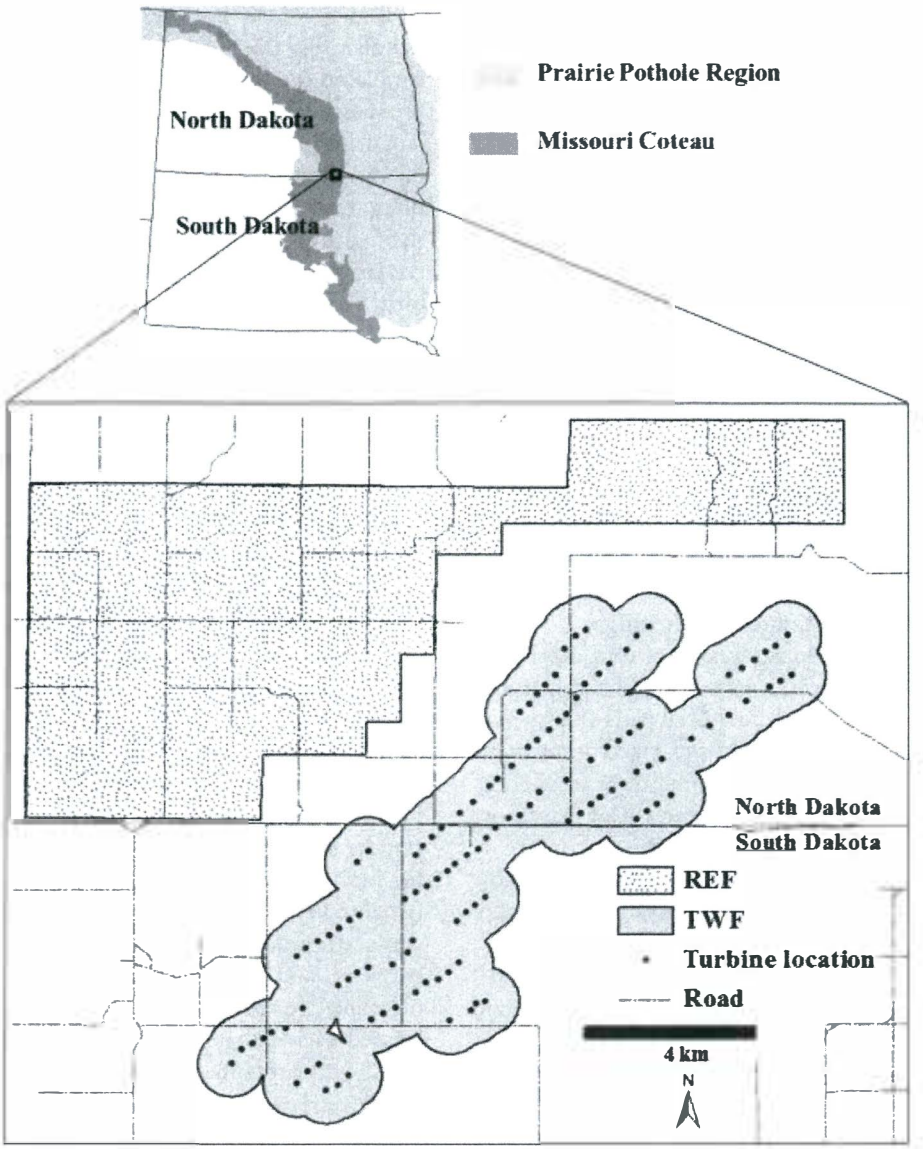



**Figure 1.** Location of the Tatanka Wind Farm (TWF) and the adjacent reference site (REF) on the Missouri Coteau of the Prairie Pothole Region in North and South Dakota, USA. A 0.8-km buffer around each wind turbine describes the extent of TWF (6,915 ha). We selected REF (8,768 ha) based on area and similarities in landscape characteristics with TWF.

Both sites were typical of the glaciated PPR landscape with moderately sloped topography (Bluemle 1979) and many temporary, seasonal, and semipermanent wetlands (Stewart and Kantrud 1971). Agricultural practices at both sites consisted primarily of livestock grazing and annually cultivated small grains and row crops. Habitat composition at TWF was 73.0% native grassland, 14.6% wetland, 6.6% cropland, 5.4% undisturbed grassland, 0.3% forest, and 0.1% hayland. Habitat composition at REF was 51.7% native grassland, 18.9% wetland, 17.0% undisturbed grassland, 12.1% cropland, 0.2% hayland, and 0.1% forest (U.S. Fish and Wildlife Service [USFWS] Region 6 Habitat and Population Evaluation Team, unpublished data). Wetlands were abundant at both sites (TWF: 23.4 basins/km$^2$, REF: 17.3 basins/km$^2$). Temporary, seasonal, and semipermanent wetlands occupied 33.3%, 33.4%, and 33.3% of the wetland area at TWF, respectfully, and 33.6%, 33.7%, and 32.7% of the wetland area at REF, respectively (USFWS 2011).

The climate at TWF and REF was continental with average monthly temperature during our study ranging between 4.83° C and 21.4° C (U.S. Department of Commerce 2011*a*). Annual precipitation at the study site averages 49.6 cm (U.S. Department of Commerce 2002). Between June and December 2008, the study sites received 54.9 cm of precipitation (U.S. Department of Commerce 2011*b*). Taken together with above average precipitation in 2009 (64.5 cm) and 2010 (53.0 cm), conditions were exceptionally wet during both years of our study (U.S. Department of Commerce 2011*b*).

## METHODS

Breeding female mallards in the PPR have home range sizes as large as 4.7 km$^2$ (Krapu et al. 1983). Blue-winged teal

have comparatively small home range sizes (0.26 $km^2$ [26 ha]; Evans and Black 1956, 0.74 $km^2$ [74 ha]; Gue 2012). However, female mallards and blue-winged teal use a small fraction of their entire home range during the egg laying and incubation period (Gilmer et al. 1975, Dwyer et al. 1979, Stewart and Titman 1980). Therefore, we assumed that if a female spent $\geq$ 50% of the breeding season within 0.8-km of a wind turbine, it adequately represented a duck that could be influenced by the presence of wind turbines. Consequently, we described the extent of TWF as all habitats within 0.8 km of each wind turbine. We selected REF boundaries based on the land area, landscape characteristics, and wetland communities of TWF (see Loesch et al. 2013). As with TWF, we assumed that if a female spent $\geq$ 50% of the breeding season within the boundaries of REF, it adequately represented a duck breeding in a similar landscape to TWF but without wind turbines.

### Capture, Radio Attachment, and Monitoring

When mallards arrived on the study area in mid-April, we placed decoy traps in temporary, seasonal, and semipermanent wetlands where we observed territorial pairs (Sharp and Lokemoen 1987, Krapu et al. 1997). We checked decoy traps each morning and afternoon. We relocated traps frequently and distributed them throughout TWF and REF based on repeated observations of pairs on wetlands to capture a representative sample of the local mallard population. Decoy trapping continued for approximately 4 weeks in 2009 and 2010.

Beginning in early May of 2009 and 2010, we nest-searched approximately 1,000 ha at TWF and REF using an all-terrain vehicle chain-drag technique (Higgins et al. 1969, Klett et al. 1986). We conducted searches between 800 and 1400 (Gloutney et al. 1993), but we postponed or cancelled searches during periods of rainfall. We captured nesting mallards and blue-winged teal with walk-in nest traps (Dietz et al. 1994) or mist nets (Bacon and Evrard 1990) during egg-laying or early in incubation.

We marked decoy- and nest-trapped females with a standard USFWS leg band and a 9-g prong-and-suture very high frequency (VHF) transmitter equipped with a mortality sensor (Model A4430, Advanced Telemetry Systems, Isanti, MN). We attached transmitters dorsally using a subcutaneous anchor and 3 sterile monofilament polypropylene sutures (DemeTech Corporation, Miami, FL; 0 metric, 40-mm reverse cutting) following local anesthetic application (1 cc bupivacaine) as described by Pietz et al. (1995). We weighed captured females using a Pesola spring scale ($\pm$10 g) prior to transmitter attachment to ensure that the transmitter did not exceed 3% of the bird's total body weight (Cochran 1980, Barron et al. 2010). In the event that we captured a breeding pair in a decoy trap, we secured the male in a ventilated enclosure until the procedure was complete. We released both members of the pair simultaneously. To reduce nest abandonment, we manually disoriented nest-trapped females post-procedure. Specifically, we tucked the female's head under her wing and slowly swayed her in a horizontal figure-eight motion until the handler felt the female's muscles relax. At which point, we placed the female on her nest and quietly retreated from the nest site. This procedure generally took $\leq$ 1 minute. Total handling time of radio-marked females averaged 22.15 minutes (SD = 5.54 min). We recorded total handling time using a wristwatch or cellular telephone and defined it as the period beginning when the observer first contacted the bird and ending when the observer released the bird. We conducted trapping, banding, and collection under USFWS special permit (06824 and 64570) and North Dakota Game and Fish license (GNF02601675). All capture and marking procedures were sanctioned by the Institutional Animal Care and Use Committee of the University of North Dakota (Protocol no. 0907-4c).

We began monitoring radio-marked females as soon as 24 hours after radio attachment. For mallards, we included data in our analysis for the subsequent 92- and 94-day sampling period after the initiation of marking in 2009 and 2010, respectively. For blue-winged teal, we included data in our analysis for the subsequent 70- and 72-day sampling period after the initiation of marking in 2009 and 2010, respectively. We used vehicle-mounted null-peak receiving systems equipped with Location Of A Signal triangulation software (LOAS, version 4.0, Ecological Software Solutions LLC, Hegymagas, Hungary) or handheld antennas and standard triangulation techniques (White and Garrott 1990) to locate radio-marked females. We generally located females between 0700 and 2100. When a female's nest was destroyed, we later increased efforts to locate individuals between 0800 and 1400, a time when females may have been most likely to be on a new nest (Gloutney et al. 1993). We located each female within every 48-hour period between capture and termination of the sampling period unless the female died or was assumed to have left the study area. When females were missing during daily tracking, we searched via road searches and aerial telemetry flights over our study area and the surrounding area within approximately 3 km of the study area boundaries. In 2009, we searched for missing birds with 1 telemetry flight on 2 July. In 2010, we searched for missing birds with 5 telemetry flights on a tri-weekly interval. Encounter histories from females that we assumed to have either left the study area, shed their transmitter before monitoring ended, or became entangled in their transmitter were censored at the time of their last known live encounter. When radio-marked females died within 7 days of capture, we assumed that negative effects of capture and handling were a contributing factor (White and Garrott 1990:37, Cox and Afton 1998, Iverson et al. 2006), and we removed these individuals from the analysis.

### Cause of Mortality

We recovered dead females as quickly as possible. Upon visual confirmation of mortality, we recorded the time, location, and cause of death. We considered carcass location (e.g., in a fox or mink den, below a raptor perch, below a wind turbine) and transmitter condition (e.g., apparent tooth or claw marks in transmitter molding, crimped antenna) when assigning the

possible cause of mortality. We took photographs and collected carcasses for further inspection. When we could not determine the cause of death in the field, we froze carcasses and submitted them to the National Wildlife Health Center (University of Wisconsin, Madison) for necropsy.

We categorized cause of death into 3 mortality factors: predation (mammal or raptor), collision (with wind turbine), and other. We identified collision mortalities based on proximity to wind turbine and carcass condition (e.g., visible appearance of trauma). We listed the cause of death as other if it was a rare occurrence for our sample, the carcass disclosed no obvious external indicators regarding the cause of death during observation in the field, or in cases where necropsy reports were inconclusive. For example, 1 female was killed by a hay swather while attending her nest. This was a rare occurrence. For another female, we could not determine the cause of death in the field, but necropsy reports suggested that the female drowned. This was also a rare occurrence. On 3 occasions, the cause of death could not be determined in the field and necropsy reports were inconclusive. One of these mortalities occurred 40 m from a wind turbine, but no evidence of trauma was visible. We categorized all 3 of these mortalities as other.

We were initially concerned that any females that struck turbines may be scavenged by predators, causing us to misclassify the mortality factor (Smallwood et al. 2010). During 2009, we used a transmitter equipped with a precise event mortality sensor that allowed us to determine the time of death to nearest 30 minutes (Advanced Telemetry Systems). In 2010, we used a simple tilt switch mortality sensor that did not record time since death. We determined the median retrieval time in 2010 using the interval between the last live encounter and the day of carcass discovery.

### Statistical Analyses

We used an information-theoretic approach (Burnham and Anderson 2002) to assess the relative support for potential relationships between survival probability of breeding females and site, year, and date. We created a set of candidate models that described the potential effect of wind turbines on adult female survival given variation between years and within each breeding season. Every female in the analysis was described by 2 binary variables: site (TWF or REF) to account for the presence or absence of wind turbines, and year (2009 or 2010) to account for annual variation in female survival (Nichols et al. 1982, Blohm et al. 1987, Johnson et al. 1992).

To test our prediction that females may be susceptible to collision prior to incubation, an ideal covariate would have described each radio-marked female as either pre-incubating, incubating, or post-incubating. Similar to Devries et al. (2003) and Hoekman et al. (2006), we initially classified the behavioral phase of each female based on within-season nesting effort of all monitored female mallards and blue-winged teal. However, we detected either very few or no mortalities for some groups of females. For example, we did not observe any mallard mortalities during the generalized pre-nesting phase at TWF in 2009 (see Gue 2012). Therefore, we used date of the season as a continuous variable to account for potential within-season trends in daily survival rate (DSR) associated with different phases in the breeding cycle. Our model set included models with date, as well as models including both date and date$^2$, which allowed daily survival to follow a curvilinear pattern. As a baseline, we predicted a concave-up curvilinear relationship between DSR, date, and date$^2$ given that female ducks are more susceptible to predation during incubation (Johnson and Sargeant 1977, Sargeant et al. 1984, Arnold et al. 2012). We predicted that if mortalities increased because of collision with wind turbines during the pre-nesting period, we would observe a positive linear relationship between DSR and date or, possibly, a concave-down curvilinear relationship between DSR, date, and date$^2$.

We used Program MARK (White and Burnham 1999) to evaluate support for our predictions and constant survival independent of variables ($S.$) We chose the most parsimonious model(s) using Akaike's Information Criterion adjusted for sample size ($AIC_c$; Burnham and Anderson 2002). Because encounter histories were of unequal length (i.e., ragged telemetry), we used the nest survival data format and nest survival module in Program MARK (Dinsmore et al. 2002) to compare survival of females at TWF and REF. This method, unlike the known-fate method, enabled us to include data of radio-marked females with uneven intervals between resightings. We reported survival estimates using 85% confidence intervals because these intervals are more appropriate for AIC-based model selection than 95% confidence intervals (Arnold 2010).

The models of DSR required that the data met the following 4 assumptions: 1) female fates were known, 2) investigator activity did not influence female fate, 3) female fates were not correlated, and 4) survival among females was not heterogeneous (Dinsmore et al. 2002, Williams et al. 2002). To avoid confusion of movement and mortality, we specifically targeted females missing from daily tracking with road searches and telemetry flights, and we right-censored capture histories of females that left the study area. To reduce potential effects of investigator disturbance on female survival, we 1) flushed radio-marked females as infrequently as possible and 2) spent as little time at radio-marked females' nests as possible.

An unbiased test and associated adjustment factor for correlation of fates and heterogeneity of survival is not available for nest survival models in Program MARK (Dinsmore et al. 2002, Rotella et al. 2007). Nevertheless, little evidence exists for correlation and heterogeneity of fates in large samples of radio-marked mallards, and previous researchers have used unadjusted estimates and model selection criteria for inference in studies of survival of radio-marked females (Devries et al. 2003, Brasher et al. 2006, Bond et al. 2009). We adopted this approach to the analysis of our smaller dataset.

## RESULTS

During our 2-year study, we marked 81 and 85 female mallards at REF and TWF, respectively. We censored 11

and 8 female mallards at REF and TWF, respectively, because they were either monitored ≤ 1 week ($n = 16$), their transmitter failed ($n = 1$), or their transmitter emitted a mortality signal on private land that we could not gain access to ($n = 2$). Thus, we analyzed 3,555 exposure days for 70 females at REF and 3,693 exposure days for 77 female mallards at TWF (see Table S1, available online at www.onlinelibrary.wiley.com). Approximately, half (75/147) of the female mallards included in the survival analysis were decoy-trapped prior to nesting. In comparison, we captured all blue-winged teal females at the nest. We marked 79 and 94 female blue-winged teal at REF and TWF, respectively. We censored 4 blue-winged teal at REF and 6 blue-winged teal at TWF because they were monitored ≤ 1 week. Thus, we analyzed 2,651.5 exposure days for 75 females at REF and 3,130.5 exposure days for 88 females at TWF (see Table S1, available online at www.onlinelibrary.wiley.com). Of the 310 female mallards and blue-winged teal included in analyses, we monitored 128 for the duration of the study period, right censored 136, and recorded 46 mortalities (Table 1). We right censored data from females that we assumed to have either left the study area ($n = 94$), shed their transmitter before monitoring ended ($n = 36$), or became entangled in their transmitter ($n = 6$).

### Cause of Mortality

Median retrieval time of all dead birds and shed transmitters in 2009 and 2010 was 49 hours ($n = 35$; range = 8–128 hr) and 48 hours ($n = 47$; range = 24–505 hr), respectively. Median retreival time of all carcasses and shed transmitters in both years at REF was 48 hours ($n = 32$; range = 8–216 hr). We recovered carcasses and shed transmitters in both years at TWF similarly with the exception of 1 female; median retrieval time was 48 hours ($n = 50$; range = 8–505 hr).

**Table 1.** Number of female mortalities by species (MALL, mallard; BWTE, blue-winged teal), site (Tatanka Wind Farm [TWF] or reference [REF]), year (2009 or 2010), and mortality factor. Mortalities caused by raptors or mammals are included as predator mortalities. We categorized mortalities in which the cause of death was rare or could not be determined in the field and necropsy reports were inconclusive as other mortalities.

| | Collision | Predator | Other | Total |
|---|---|---|---|---|
| 2009 | | | | |
| REF | | | | |
| MALL | 0 | 2 | 1 | 3 |
| BWTE | 0 | 3 | 0 | 3 |
| TWF | | | | |
| MALL | 1[a] | 1 | 0 | 2 |
| BWTE | 0 | 8 | 0 | 8 |
| 2010 | | | | |
| REF | | | | |
| MALL | 0 | 3 | 2 | 5 |
| BWTE | 0 | 5 | 0 | 5 |
| TWF | | | | |
| MALL | 1 | 7 | 5 | 13 |
| BWTE | 0 | 7 | 0 | 7 |
| Total | 2 | 36 | 8 | 46 |

[a] Mortality could not confidently be attributed to wind turbines. Other obstructions occurred in the immediate area of her carcass (e.g., barb-wire fence, power line).

Although we detected few mallard mortalities at REF and TWF in 2009, predation was the most common cause of mortality for mallards at both sites in 2009 and 2010 (TWF: 8/15, REF: 5/8; Table 1). We detected similar numbers of blue-winged teal mortalities at both sites in 2009 and 2010. Predation was the only cause of mortality for blue-winged teal at both sites (TWF: 15/15, REF: 8/8; Table 1). Among all recorded mortalities across species, predation accounted for 78.3% ($n = 36/46$) of deaths. We observed 8 mallard mortalities in which we either could not determine the cause of death in the field, necropsy reports were inconclusive, or the cause of death was rare for our sample (e.g., 1 nesting female was killed by a hay swather and another may have drowned). On 3 occasions at TWF, the cause of death could not be determined in the field and necropsy reports were inconclusive. Although 1 of these 3 mortalities occurred 40 m from a wind turbine, there was no evidence of trauma in all cases. These carcass characteristics were inconsistent with obvious external trauma that we observed for an individual female that collided with a wind turbine.

Wind turbine collision contributed to 1 of 15 mallard deaths at TWF (Table 1). We observed 1 additional mallard collision mortality at TWF, but multiple vertical obstructions in the immediate area confounded the cause of mortality (e.g., wind turbine, barbed-wire fence, power line). We observed no blue-winged teal collision-related mortalities (Table 1).

### Survival Rates

We observed support that female mallard DSR varied within the season, as the 3 most competitive models included a quadratic time trend (Table 2). We accrued evidence that mallard DSR varied by year, and we observed some evidence that DSR varied by site. Our best-approximating model indicated that mallard DSR varied by each of these factors with an interaction between site and year (Table 2). Nonetheless, we found some model selection uncertainty and the weight of evidence in support ($w_i$) of the best-

**Table 2.** Model selection results from analysis investigating female mallard daily survival rate (DSR) at the Tatanka Wind Farm (TWF) and adjacent reference site (REF) in the Prairie Pothole Region of North and South Dakota, USA. We modeled DSR as a function of year (2009 and 2010), site (TWF and REF), and time (date) within the breeding season. We modeled quadratic time trends (date + date$^2$) to investigate predictions about survival during 3 behavioral periods (pre-incubation, incubation, post-incubation) of female mallards. We selected the best model using Akaike's Information Criterion corrected for sample size ($AIC_c$). We report model weights ($w_i$), the number of parameters ($K$), and deviance for each DSR model.

| DSR model | $\Delta AIC_c$ | $w_i$ | $K$ | Deviance |
|---|---|---|---|---|
| Site × year + date + date$^2$ | 0.00 | 0.33 | 6 | 252.44 |
| Year + date + date$^2$ | 0.28 | 0.29 | 4 | 256.73 |
| Site + date + date$^2$ | 1.65 | 0.15 | 4 | 258.10 |
| Site × year | 3.38 | 0.06 | 4 | 259.82 |
| Site + year | 3.80 | 0.05 | 3 | 262.24 |
| Year | 4.01 | 0.05 | 2 | 264.46 |
| Site × year + date | 4.80 | 0.03 | 5 | 259.24 |
| Constant | 5.30 | 0.02 | 1 | 267.75 |
| Site | 5.40 | 0.02 | 2 | 265.84 |

approximating model was 0.33. According to this model, survival varied by time such that the lowest DSR occurred during the middle of the season, which generally corresponded to the highest proportion of females incubating at both sites in 2009 and 2010 (Fig. 2). The estimated 93-day survival probability of radio-marked female mallards for this model at REF was 0.83 (85% CI = 0.68–0.95) and 0.84 (85% CI = 0.72–0.94) in 2009 and 2010, respectively. According to this model, the 93-day survival probability at TWF was high in 2009 ($\hat{S}$ = 0.90, 85% CI = 0.79–0.98), but low in 2010 ($\hat{S}$ = 0.62, 95% CI = 0.46–0.79).

We observed similar levels of uncertainty in our model set for blue-winged teal and we did not observe as much support for within-season variation in survival for this species. Female blue-winged teal DSR was best described by a constant model, but we found some support for a relationship between DSR and site and year (Table 3). According to the constant model, the estimated 71-day survival probability of blue-winged teal was 0.75 (85% CI = 0.69–0.82). Extrapolated to 93 days for comparison with female mallard breeding season survival estimates, female blue-winged teal survival according to the constant model was 0.69 (85% CI = 0.61–0.77). According to the second best model, which included only the effect of site and held 0.19% of the model weight, 71-day female survival was 0.81 (85% CI = 0.73–0.89) at REF and 0.71 (85% CI = 0.62–0.79) at TWF. Estimated 93-day survival according to this model was 0.76 (85% CI = 0.66–0.86) and 0.64 (85% CI = 0.54–0.73) at REF and TWF, respectively.

## DISCUSSION

The motivation for our research was the concern that wind turbines may directly reduce survival probability of breeding females through collision with wind turbines. Collisions at TWF were uncommon. With the exception of high rates of avian collision at the Altamont Pass Wind Resource Area in California (Smallwood and Thelander 2008), other research suggests that avian collision mortality may be minor compared to other potential effects of wind farms (Leddy et al. 1999, Erickson et al. 2001, Arnett et al. 2007, Manville 2009, Loesch et al. 2013). Similarly, we observed no evidence that wind turbines at TWF directly reduced survival of breeding female mallards and blue-winged teal.

The use of telemetry allowed us to intensively study females throughout the breeding season and our capturing and monitoring techniques did not likely cause us to underestimate the number of collision mortalities. Although we nest-trapped approximately half of all mallards ($n$ = 75 of 147) and all blue-winged teal ($n$ = 163), 68.0% (51/75) and 59.5% (97/163) of nest-trapped mallards and blue-winged teal, respectively, failed at nesting. Of these failed nesters, we

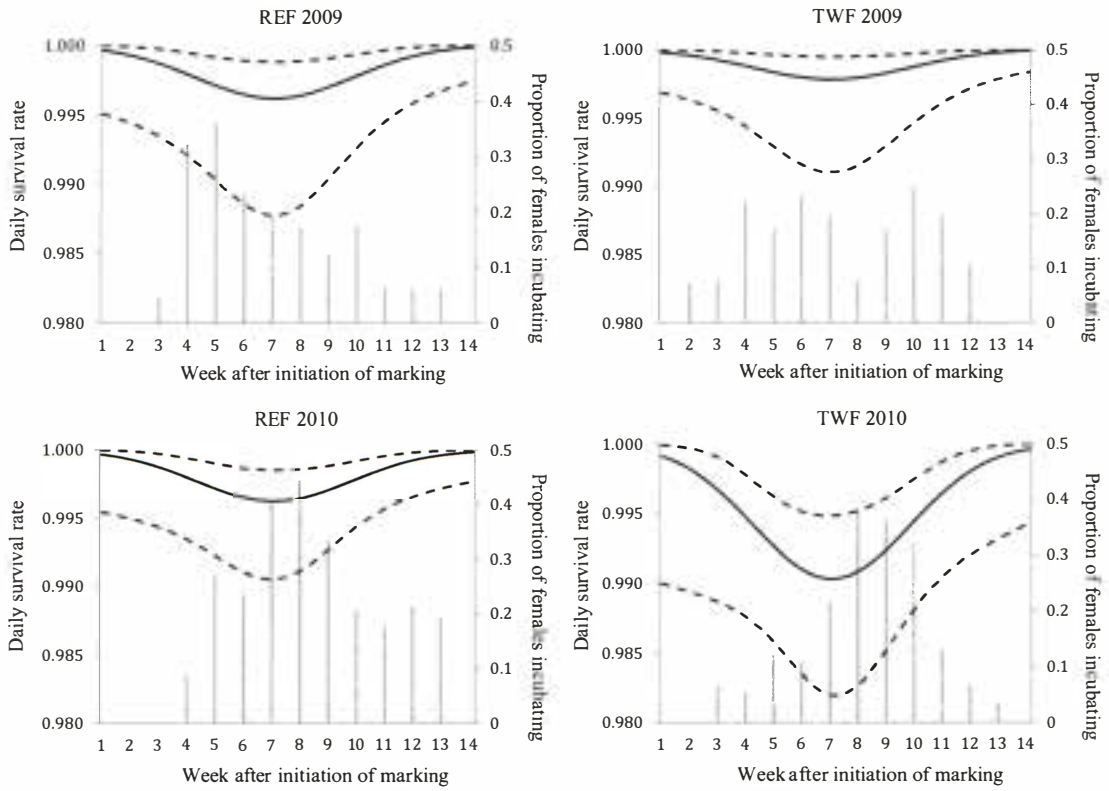



**Figure 2.** The relationship between within-season time trends as a quadratic (date + date$^2$) and daily survival rate (DSR; black line, primary $y$-axis) of female mallards at Tatanka Wind Farm (TWF) and the adjacent reference site (REF) in the Prairie Pothole Region of North and South Dakota, USA in 2009 and 2010. The estimates are predicted by the model: DSR = site × year + date + date$^2$. Dashed lines are 85% confidence limits. We include proportion of radio-marked females known to be incubating (gray bars, secondary $y$-axis) for each week of the 14-week study period (mid-Apr–mid-Jul) following the initiation of marking.

**Table 3.** Model selection results from analysis investigating female blue-winged teal daily survival rate (DSR) at the Tatanka Wind Farm (TWF) and adjacent reference site (REF) in the Prairie Pothole Region of North and South Dakota, USA. We modeled DSR as a function of year (2009 and 2010), site (TWF and REF), and time (date) within the breeding season. We modeled quadratic time trends (date + date$^2$) to investigate predictions about survival during 3 behavioral periods (pre-incubation, incubation, post-incubation) of female blue-winged teal. We selected the best model using Akaike's Information Criterion corrected for sample size ($AIC_c$). We report model weights ($w_i$), the number of parameters ($K$), and deviance for each DSR model.

| DSR model | $\Delta AIC_c$ | $w_i$ | $K$ | Deviance |
|---|---|---|---|---|
| Constant | 0.00 | 0.29 | 1 | 267.23 |
| Site | 0.84 | 0.19 | 2 | 266.07 |
| Year | 1.18 | 0.16 | 2 | 266.41 |
| Site + date + date$^2$ | 2.23 | 0.10 | 4 | 263.46 |
| Site + year | 2.23 | 0.10 | 3 | 265.46 |
| Year + date + date$^2$ | 2.35 | 0.09 | 4 | 263.57 |
| Site × year | 4.21 | 0.04 | 4 | 265.44 |
| Site × year + date + date$^2$ | 5.37 | 0.02 | 6 | 262.59 |
| Site × year + date | 5.89 | 0.02 | 5 | 265.11 |

confirmed that 43.1% (22/51) of mallards and 38.1% (37/97) of blue-winged teal renested. Thus, we monitored a sample of females attending nests and females involved in courtship behavior throughout the breeding season. In addition, we located 95.7% (44/46) of all dead radio-marked females within 7 days of their last known live encounter. Scavenging predators in the PPR did not likely remove carcasses from beneath wind turbines within this time frame (see Johnson et al. 2002), which otherwise may have caused us to misclassify the cause of death. However, local landscape characteristics may influence collision risk (Drewitt and Langston 2006, De Lucas et al. 2008). High wetland densities at TWF taken together with habitat conditions during our study may have influenced the number of collisions. Wetlands at TWF and REF were >100% full for most of the spring during both years of our study. Wetland density and area are the primary habitat factors explaining female mallard distribution (Dwyer et al. 1979, Krapu et al. 1997). Waterfowl pair densities are positively related to wetland densities (Johnson and Grier 1988, Viljugrein et al. 2005) and breeding mallards establish smaller breeding territories when pair density is high (Titman 1983). Thus, females breeding at TWF may have encountered fewer turbines during our study than expected in years of average or below average precipitation.

Previous research suggests that collision risk may vary by species (Drewitt and Langston 2006). Species-specific collision risk is likely the result of an interaction between flight behavior and body size (Barrios and Rodrguez 2004, De Lucas et al. 2008). Blue-winged teal may be less susceptible to collisions than mallards because blue-winged teal have smaller home ranges (Dzubin 1955, Evans and Black 1956) and may spend less time in the rotor swept zone while flying among wetland and grassland nesting areas (Stewart 1977). This hypothesis is weakly supported by the fact that we observed no blue-winged teal collisions at TWF. Alternatively, we may not have observed any blue-winged teal collisions because we captured them while they had active nests. However, 63.6% (56/88) of nest-trapped blue-winged teal at TWF in both years failed at nesting, and although we certainly missed some nests (see McPherson et al. 2003), we confirmed that 41.1% (23/56) of those failed nesters initiated at least 1 more nest. Re-nesting female blue-winged teal re-engaged in courtship and pre-nesting behavior, which we hypothesized to be a period when females were most vulnerable to collisions with wind turbines.

Breeding season survival of female blue-winged teal in our study was similar to that reported by other researchers. For example, Garrettson and Rohwer (1998) reported survival of backpack harness and surgical implant radio-marked blue-winged teal during the 90-day breeding season in the Canadian prairie-parklands to be 60.6 (95% CI = ±28.4%) and 72.7 (95% CI = ±27.7%), respectively. Their estimates bound the extrapolated survival probability (i.e., $DSR^{93}$) estimated from the best-approximating blue-winged teal model in our study ($\hat{S}_{(.)} = 0.69$, 85% CI = 0.61–0.77). With the exception of comparatively low breeding season survival of mallards in 2010 at TWF, our mallard survival estimates were generally high, particularly at TWF in 2009. Nonetheless, our estimates were within the range of estimates reported previously. Brasher et al. (2006) estimated 90-day breeding season female mallard survival in the Canadian prairie-parklands to be 0.78 (SE = 0.025). Devries et al. (2003) observed a range of 90-day mallard breeding season survival estimates at 19 different sites in Canada's PPR between 0.62 (SE = 0.028) and 0.84 (SE = 0.018).

We suspected that survival estimates of mallards and blue-winged teal at both sites may have been inflated in 2009 because the probability of incorrectly assuming emigration might have been higher during that year. For example, we detected no mortalities during 1 telemetry flight in 2009 and 3 mallard mortalities during 5 telemetry flights in 2010. Interestingly, these mallard mortalities occurred at TWF. However, mallard survival estimates after censoring these 3 individuals were largely unaffected ($\hat{S}_{TWF\ 2009} = 0.90$, 85% CI = 0.79–0.98), $\hat{S}_{REF\ 2009} = 0.83$, 85% CI = 0.68–0.95), $\hat{S}_{TWF\ 2010} = 0.63$, 85% CI = 0.46–0.80), $\hat{S}_{REF\ 2010} = 0.83$, 85% CI = 0.71–0.94).

Several investigations have reported that survival of female ducks during the breeding season is lowest when females are nesting and are vulnerable to predators (Devries et al. 2003, Richkus et al. 2005, Arnold et al. 2012). Consistent with these findings, survival of female mallards at TWF and REF was lowest when a high proportion of radio-marked females were incubating nests (Fig. 2). Although we accrued only limited support for site-level variation in survival for blue-winged teal, we suspect that, at both sites, most mortalities of blue-winged teal occurred while females were incubating nests.

Given that most mortality appeared to be the result of depredation at REF and TWF, differences in survival between sites for both species may reflect site-specific differences in predator foraging efficiency. Estimated permanent disturbance of habitat at TWF from wind

turbine pads and access roads was 60.9 ac (M. Erickson, USFWS, personal communication), and disturbance of waterfowl nesting habitat may create a favorable scenario for mammalian predators (Johnson and Sargeant 1977, Clark and Nudds 1991). High predation of nesting females in altered landscapes may specifically result from preference of edge habitat as travel corridors by predators (Bider 1968, Larivière and Messier 2000, Phillips et al. 2003), changes in prey density (Larivière and Messier 1998), or decreased nesting cover (Duebbert 1969, Hines and Mitchell 1983, Guyn and Clark 1997). Schmitz and Clark (1999) attributed a negative relationship between survival probabilities of female ring-necked pheasants (*Phasianus colchicus*) and edge habitat density to any 1 or a combination of these factors. Although REF had less native and undisturbed grassland habitat (68.7%) than TWF (78.4%), wind turbine access roads and pads may have indirectly reduced female survival probability at TWF as well.

Changes in local predator community composition or predator abundance may also explain differences in survival between TWF and REF. Raptors are responsible for considerable female mortality in the PPR (Sargeant et al. 1993, Richkus et al. 2005). Disturbance at wind-developed landscapes may increase the abundance of raptor prey species (Morrison and Davis 1996, Thelander et al. 2003) and because TWF began operation in 2008, this may have been a mechanism of temporal differences in raptor abundances at TWF as well. Although we observed raptors foraging at TWF and REF in both years of our study, we have no evidence of a systematic difference in predator communities between sites or years. Long-term studies may be required to elucidate indirect effects of wind development infrastructure on breeding season survival of upland-nesting ducks.

Breeding season survival of female mallards, and presumably other upland-nesting ducks, varies spatially and temporally throughout their breeding ranges (Johnson et al. 1992, Devries et al. 2003). The spatial and temporal extent of our study needs to be considered when evaluating the compatibility of waterfowl conservation strategies and wind energy in the PPR. Nonetheless, breeding females occupying wetland and grassland habitat at TWF during our study rarely collided with wind turbines. Our study also raised some questions about the breeding ecology of upland-nesting ducks at wind-developed landscapes in the PPR. For example, what are the effects of wind turbines on the local composition and abundance of duck predator communities? Is the potential for collision mortality consistent among landscapes with different habitat composition, such as in areas with lower wetland densities or in years of below average precipitation? Answers to these questions would be useful to waterfowl managers given continued wind-energy development in the PPR.

## MANAGEMENT IMPLICATIONS

Our results suggest that direct mortality of breeding female mallards and blue-winged teal due to collisions with wind turbines at TWF is probably of limited concern. Consistent with previous research, predation was the most influential mortality factor for female ducks during the breeding season at REF and TWF (Sargeant et al. 1984, Cowardin et al. 1985). Thus, conservation strategies that include protection of wetland and grassland habitat in wind-developed landscapes (see Kiesecker et al. 2011, Obermeyer et al. 2011, Fargione et al. 2012) will most likely not cause a direct reduction in survival of breeding females due to collisions with wind turbines.

## ACKNOWLEDGMENTS

We thank the many landowners at the study area for permission to access their land, and M. Bisson, A. Dinges, D. DeVito, J. Hallagan, C. King, W. Mackziewski, J. Meier, D. Oates, A. Primus, T. Ronningen, J. Tarwater, and A. Wolf for their assistance with field data collection. We received logistical support from the USFWS, Kulm Wetland Management District (especially M. Erickson, R. Holmgren, and D. Peterson) and Audubon Wetland Management District, Chase Lake Prairie Project, and the United States Geological Survey Northern Prairie Wildlife Research Center. We thank K. Kemink, T. Arnold, Associate Editor J. Schmutz, and an anonymous referee for providing critical reviews that increased the usefulness of this manuscript. This project was supported by NextEra Energy, the USFWS Region 6, Ducks Unlimited, Inc., North Dakota Game and Fish, Department of Biology at the University of North Dakota, the Esther Wheeler Research Award, and the Jeremy Kuiper Memorial Award. The findings and conclusions in this article are those of the authors and do not necessarily represent the views of the U.S. Fish and Wildlife Service. Any mention of trade names is purely coincidental and does not represent endorsement by the funding agency or the government.

## LITERATURE CITED

Acciona North America. 2011. ANA home page. <http://www.acciona-na.com>. Accessed 3 Jun 2011.

Afton, A. D., and S. L. Paulus. 1992. Incubation and brood care. Pages 62–108 *in* B. D. J. Batt, A. D. Afton, M. G. Anderson, C. D. Ankney, D. H. Johnson, J. A. Kadlec, and G. L. Krapu, editors. Ecology and management of breeding waterfowl. University of Minnesota Press, Minneapolis, USA.

American Wind Energy Association. 2010. U.S. Wind Industry Annual Market Report. <http://www2.grist.org/pdf/AWEA.pdf>. Accessed 6 May 2011.

Anderson, W. L. 1978. Waterfowl collisions with power lines at a coal-fired power plant. Wildlife Society Bulletin 6:77–83.

Arnett, E. B., D. B. Inkley, D. H. Johnson, R. P. Larkin, S. Manes, A. M. Manville, J. R. Mason, M. L. Morrison, M. D. Strickland, and R. Thresher. 2007. Impacts of wind energy facilities on wildlife and wildlife habitat. Wildlife Society Technical Review 07-2. The Wildlife Society, Bethesda, Maryland, USA.

Arnett, E. B., W. K. Brown, W. P. Erickson, J. K. Fiedler, B. L. Hamilton, T. H. Henry, A. Jain, G. D. Johnson, J. Kerns, R. R. Koford, C. P. Nicholson, T. J. O'Connell, M. D. Piorkowski, and R. D. Tankersley. 2008. Patterns of bat fatalities at wind energy facilities in North America. Journal of Wildlife Management 72:61–78.

Arnold, T. W. 2010. Uninformative parameters and model selection using Akaike's Information Criterion. Journal of Wildlife Management 74:1175–1178.

Arnold, T. W., E. A. Roche, J. H. Devries, and D. W. Howerter. 2012. Costs of reproduction in breeding female mallards: predation risk during

incubation drives annual mortality. Avian Conservation and Ecology 7(1):1. http://www.ace-eco.org/vol7/iss1/art1/

Bacon, B. R., and J. O. Evrard. 1990. Horizontal mist net for capturing upland nesting ducks. North American Bird Bander 15:18–19.

Barrios, L., and A. Rodríguez. 2004. Behavioural and environmental correlates of soaring-bird mortality at on-shore wind turbines. Journal of Applied Ecology 41:72–81.

Barron, D. G., J. D. Brawn, and P. J. Weatherhead. 2010. Meta-analysis of transmitter effects on avian behaviour and ecology. Methods in Ecology and Evolution 1:180–187.

Bellrose, F. C. 1980. Ducks, geese and swans of North America. Stackhouse, Harrisburg, Pennsylvania, USA.

Bider, J. R. 1968. Animal activity in uncontrolled terrestrial communities as determined by a sand transect technique. Ecological Monographs 38:269–308.

Blohm, R. J., R. E. Reynolds, J. P. Bladen, J. D. Nichols, J. E. Hines, K. H. Pollock, and R. T. Eberhardt. 1987. Mallard mortality rates on key breeding and wintering areas. Transactions of North American Wildlife and Natural Resources Conference 52:246–257.

Bluemle, J. P. 1979. Geology of Dickey and LaMoure Counties. North Dakota Geological Survey Bulletin 70-Part 1.

Bond, J. C., S. A. Iverson, N. B. Maccallum, C. M. Smith, H. J. Bruner, and D. Esler. 2009. Variation in breeding season survival of female Harlequin ducks. Journal of Wildlife Management 73:965–972.

Brasher, M. G., T. W. Arnold, J. H. Devries, and R. M. Kaminski. 2006. Breeding-season survival of male and female mallards in Canada's Prairie-Parklands. Journal of Wildlife Management 70:805–811.

Bureau of Land Management. 2005. Final programmatic environmental impact statement on wind energy development on BLM administered land in the western United States. U.S. Department of the Interior, Washington, D.C., USA.

Burnham, K. P., and D. R. Anderson. 2002. Model selection and multimodel inference: a practical information-theoretic approach. Second edition. Springer-Verlag, New York, New York, USA.

Clark, R. G., and T. D. Nudds. 1991. Habitat patch size and duck nesting success: the crucial experiments have not been performed. Wildlife Society Bulletin 19:534–543.

Cochran, W. W. 1980. Wildlife telemetry. Pages 507–520 *in* S. D. Schemnitz, editor. Wildlife management techniques manual. Fourth edition. The Wildlife Society, Washington, D.C., USA.

Cowardin, L. M., A. B. Sargeant, and H. F. Duebbert. 1983. Problems and potentials for prairie ducks. Naturalist 34:4–11. Northern Prairie Wildlife Research Center Online. <http://www.npwrc.usgs.gov/resource/birds/prduck/index.htm>. Accessed 20 Mar 2013.

Cowardin, L. M., D. S. Gilmer, and C. W. Shaiffer. 1985. Mallard recruitment in the agricultural environment of North Dakota. Wildlife Monographs 92:3–37.

Cox, R. R., Jr., and A. D. Afton. 1998. Effects of capture and handling on survival of female northern pintails. Journal of Field Ornithology 69:276–287.

De Lucas, M., G. F. E. Janss, D. P. Whitfield, and M. Ferrer. 2008. Collision fatality of raptors in wind farms does not depend on raptor abundance. Journal of Applied Ecology 45:1695–1703.

Devries, J. H., J. J. Citta, M. S. Lindberg, D. W. Howerter, and M. G. Anderson. 2003. Breeding-season survival of mallard females in the Prairie Pothole Region of Canada. Journal of Wildlife Management 67:551–563.

Dietz, N. J., P. J. Bergmann, and L. D. Flake. 1994. A walk-in trap for nesting ducks. Wildlife Society Bulletin 22:19–22.

Dinsmore, S. J., G. C. White, and F. L. Knopf. 2002. Advanced techniques for modeling avian nest survival. Ecology 83:3476–3488.

Drewitt, A. L., and R. H. W. Langston. 2006. Assessing the impacts of wind farms on birds. Ibis 148:29–42.

Duebbert, H. F. 1969. High nest density and hatching success of ducks on South Dakota CAP lands. Transactions of the 34th North American Wildlife and Natural Resources Conference 34:218–228.

Dwyer, T. J., G. L. Krapu, and D. M. Janke. 1979. Use of Prairie Pothole habitat by breeding mallards. Journal of Wildlife Management 43:526–531.

Dzubin, A. 1955. Some evidence of home range in waterfowl. Transactions of the North American Wildlife Conference 20:278–298.

Erickson, W. P., G. D. Johnson, M. D. Strickland, D. P. Young, K. J. Sernka, and R. E. Good. 2001. Avian collisions with wind turbines: a summary of existing studies and comparisons to other sources of avian collision mortality in the United States. National Wind Coordinating Committee, Washington, D.C., USA.

Evans, C. D., and K. E. Black. 1956. Duck production studies on the Prairie Potholes of South Dakota. U.S. Fish and Wildlife Service Special Scientific Report 32, Washington, D.C., USA.

Fargione, J., J. Kiesecker, M. J. Slaats, and S. Olimb. 2012. Wind and wildlife in the Northern Great Plains: identifying low-impact areas for wind development. PLoS ONE 7:e41468.

Fox, A. D., M. Desholm, J. Kahlert, T. K. Christensen, and I. K. Petersen. 2006. Information needs to support environmental impact assessment of the effects of European marine offshore wind farms on birds. Ibis 148:129–144.

Garrettson, P. R., and F. C. Rohwer. 1998. Reproductive effort and survival of wild blue-winged teal, *Anas discors*, with backpack harness and implant transmitters. Canadian Field Naturalist 112:212–216.

Gilbert, M. M., and A. D. Chalfoun. 2011. Energy development affects populations of sagebrush songbirds in Wyoming. Journal of Wildlife Management 75:816–824.

Gilmer, D. S., I. J. Ball, L. M. Cowardin, J. H. Riechmann, and J. R. Tester. 1975. Habitat use and home range of mallards breeding in Minnesota. Journal of Wildlife Management 39:781–789.

Gloutney, M. L., R. G. Clark, A. D. Afton, and G. J. Huff. 1993. Timing of nest searches for upland nesting waterfowl. Journal of Wildlife Management 57:597–601.

Gue, C. T. 2012. Effects of a large-scale wind farm in the Prairie Pothole Region of North and South Dakota on survival and habitat use of breeding female mallards (*Anas platyrhynchos*) and blue-winged teal (*A. discors*). Thesis, University of North Dakota, Grand Forks, USA.

Guyn, K. L., and R. G. Clark. 1997. Cover characteristics and success of natural and artificial duck nests. Journal of Field Ornithology 68: 33–41.

Higgins, K. F., L. M. Kirsch, and I. J. Ball, Jr. 1969. A cable-chain device for locating duck nests. Journal of Wildlife Management 33:1009–1011.

Hines, J. E., and G. J. Mitchell. 1983. Gadwall nest-site selection and nesting success. Journal of Wildlife Management 47:1063–1071.

Hoekman, S. T., L. S. Mills, D. W. Howerter, J. H. Devries, and I. J. Ball. 2002. Sensitivity analyses of the life cycle of midcontinent mallards. Journal of Wildlife Management 66:883–900.

Hoekman, S. T., T. S. Gabor, R. Maher, H. R. Murkin, and M. S. Lindberg. 2006. Demographics of breeding female mallards in southern Ontario, Canada. Journal of Wildlife Management 70:111–120.

Iverson, S. A., W. S. Boyd, D. Esler, D. M. Mulcahy, and T. D. Bowman. 2006. Comparison of the effects and performance of four types of radiotransmitters for use with scoters. Wildlife Society Bulletin 34:656–663.

Janss, G. F. E. 2000. Avian mortality from power lines: a morphologic approach of a species-specific mortality. Biological Conservation 95:353–359.

Johnson, D. H., and J. W. Grier. 1988. Determinants of breeding distributions of ducks. Wildlife Monographs 100:3–37.

Johnson, D. H., and A. B. Sargeant. 1977. Impact of red fox predation on the sex ratio of prairie mallards. U.S. Fish and Wildlife Service Wildlife Research Report 6, Washington, D.C., USA.

Johnson, C. J., and M.-H. St-Laurent. 2011. Unifying framework for understanding impacts of human development on wildlife. Pages 27–54 *in* D. E. Naugle, editor. Energy development and wildlife conservation in western North America. Island Press, Washington, D.C., USA.

Johnson, D. H., J. D. Nichols, and M. D. Schwartz. 1992. Population dynamics of breeding waterfowl. Pages 446–485 *in* B. D. J. Batt, A. D. Afton, M. G. Anderson, C. D. Ankney, D. H. Johnson, J. A. Kadlec, and G. L. Krapu, editors. Ecology and management of breeding waterfowl. University of Minnesota Press, Minneapolis, USA.

Johnson, G. D., W. P. Erickson, M. D. Strickland, M. F. Shepherd, D. A. Shepherd, and S. A. Sarappo. 2002. Collision mortality of local and migrant birds at a large-scale wind-power development on Buffalo Ridge, Minnesota. Wildlife Society Bulletin 30:879–887.

Kaminski, R., and M. W. Weller. 1992. Breeding habitats of nearctic waterfowl. Pages 568–589 *in* B. D. J. Batt, A. D. Afton, M. G. Anderson, C. D. Ankney, D. H. Johnson, J. A. Kadlec, and G. L. Krapu, editors. Ecology and management of breeding waterfowl. University of Minnesota Press, Minneapolis, USA.

Kiesecker, J. M., J. S. Evans, J. Fargione, K. Doherty, K. R. Foresman, T. H. Kunz, D. Naugle, N. P. Nibbelink, and N. D. Niemuth. 2011. Win–win for wind and wildlife: a vision to facilitate sustainable development. PLoS ONE 6:e17566.

Klett, A. T., H. F. Duebbert, C. A. Faanes, and K. F. Higgins. 1986. Techniques for studying nest success of ducks in upland habitats in the Prairie Pothole Region. U.S. Fish and Wildlife Service Resource Publication 158, Washington, D.C., USA.

Krapu, G. L., A. T. Klett, and D. G. Jorde. 1983. The effect of variable spring water conditions on mallard reproduction. Auk 100:689–698.

Krapu, G. L., R. J. Greenwood, C. P. Dwyer, K. M. Kraft, and L. M. Cowardin. 1997. Wetland use, settling patterns, and recruitment in mallards. Journal of Wildlife Management 61:736–746.

Larivière, S., and F. Messier. 1998. Effect of density and nearest neighbours on simulated waterfowl nests: can predators recognize high-density nesting patches? Oikos 83:12–20.

Larivière, S., and F. Messier. 2000. Habitat selection and use of edges by striped skunks in the Canadian prairies. Canadian Journal of Zoology 78:366–372.

Leddy, K. L., K. F. Higgins, and D. E. Naugle. 1999. Effects of wind turbines on upland nesting birds in conservation reserve program grasslands. Wilson Bulletin 111:100–104.

Loesch, C. R., J. A. Walker, R. E. Reynolds, J. S. Gleason, N. D. Niemuth, S. E. Stephens, and M. A. Erickson. 2013. Effects of wind energy development on breeding duck densities in the Prairie Pothole Region. Journal of Wildlife Management 77:587–598.

Manville, A. M. II. 2009. Towers, turbines, power lines, and buildings—steps being taken by the U.S. Fish and Wildlife Service to avoid or minimize take of migratory birds at these structures. Pages 262–272 *in* T. D. Rich, C. Arizmendi, D. W. Demarest, C. Thompson, editors. Tundra to tropics: connecting birds, habitats and people. Proceedings of the 4th International Partners in Flight Conference, 13–16 Feb 2008, McAllen, Texas, USA.

McPherson, R. J., T. W. Arnold, L. M. Armstrong, and C. J. Schwarz. 2003. Estimating the nest-success rate and the number of nests initiated by radiomarked mallards. Journal of Wildlife Management 67:843–851.

Meseguer, J. 2007. Preface *in* M. de Lucas, G. F. E. Janss, and M. Ferrer, editors. Birds and wind farms: risk assessment and mitigation. Quercus, Madrid, Spain.

Morrison, M. L., and H. Davis. 1996. Protocols for evaluation of existing wind developments and determination of bird mortality. Proceedings of National Avian-Wind Power Planning Meeting II, 20–22 Sep 1995, Palm Springs, California, USA.

Morrison, M. L., W. M. Block, M. D. Strickland, B. A. Collier, and M. J. Peterson. 2008. Wildlife study design. Second edition. Springer-Verlag, New York, New York, USA.

National Renewable Energy Lab. 2011. 80-meter wind maps and wind resource potential. <http://www.windpoweringamerica.gov/wind_maps.asp>. Accessed 14 Jan 2011.

Nichols, J. D., R. S. Pospahala, and J. E. Hines. 1982. Breeding-ground habitat conditions and the survival of mallards. Journal of Wildlife Management 46:80–87.

North American Waterfowl Management Plan Committee. 2012. North American Waterfowl Management Plan. U.S. Fish and Wildlife Service, Washington, D.C., USA.

Obermeyer, B., R. Manes, J. Kiesecker, J. Fargione, and K. Sochi. 2011. Development by design: mitigating wind development's impacts on wildlife in Kansas. PLoS ONE 6:e26698.

Phillips, M. L., W. R. Clark, M. A. Sovada, D. J. Horn, R. R. Koford, and R. J. Greenwood. 2003. Predator selection of prairie landscape features and its relation to duck nest success. Journal of Wildlife Management 67:104–114.

Pietz, P. J., D. A. Brandt, G. L. Krapu, and D. A. Buhl. 1995. Modified transmitter attachment method for adult ducks. Journal of Field Ornithology 66:408–417.

Richkus, K. D., F. C. Rohwer, and M. J. Chamberlain. 2005. Survival and cause-specific mortality of female northern pintails in southern Saskatchewan. Journal of Wildlife Management 69:574–581.

Rotella, J. J., M. L. Taper, S. E. Stephens, and M. S. Lindberg. 2007. Extending methods for modeling heterogeneity in nest-survival data using generalized mixed models. Studies in Avian Biology 34: 34–44.

Sargeant, A. B., S. H. Allen, and R. T. Eberhardt. 1984. Red fox predation on breeding ducks in midcontinent North America. Wildlife Monographs 89:3–41.

Sargeant, A. B., R. J. Greenwood, M. A. Sovada, and T. L. Shaffer. 1993. Distribution and abundance of predators that affect duck production in the Prairie Pothole Region. U.S. Fish and Wildlife Service Resource Publication 194, Washington, D.C., USA.

Schmitz, R. A., and W. R. Clark. 1999. Survival of ring-necked pheasant hens during spring in relation to landscape features. Journal of Wildlife Management 63:147–154.

Sharp, D. E., and J. T. Lokemoen. 1987. A decoy trap for breeding-season mallards in North Dakota. Journal of Wildlife Management 51:711–715.

Siegfried, W. R. 1972. Ruddy ducks colliding with wires. Wilson Bulletin 84:486–487.

Smallwood, K. S., and C. G. Thelander. 2008. Bird mortality in the Altamont Pass Wind Resource Area, California. Journal of Wildlife Management 72:215–223.

Smallwood, K. S., D. A. Bell, S. A. Snyder, and J. E. Didonato. 2010. Novel scavenger removal trials increase wind turbine-caused avian fatality estimates. Journal of Wildlife Management 74:1089–1096.

Smith, A. G., J. H. Stoudt, and J. B. Gallop. 1964. Prairie potholes and marshes. Pages 39–50 *in* J. P. Linduska, editor. Waterfowl tomorrow. U.S. Fish and Wildlife Service, Washington, D.C., USA.

Stewart, G. R. 1977. Territorial behaviour of prairie pothole blue-winged teal. Thesis, McGill University, Montreal, Canada.

Stewart, R. E., and H. A. Kantrud. 1971. Classification of natural ponds and lakes in the glaciated prairie region. U.S. Fish and Wildlife Service Resource Publication 92, Washington, D.C., USA.

Stewart, G. R., and R. D. Titman. 1980. Territorial behaviour by prairie pothole blue-winged teal. Canadian Journal of Zoology 58:639–649.

Stewart, G. B., A. S. Pullin, and C. F. Coles. 2007. Poor evidence-base for assessment of windfarm impacts on birds. Environmental Conservation 34:1–11.

Thelander, C. G., K. S. Smallwood, and L. M. Rugge. 2003. Bird risk behaviors and fatalities at the Altamont Pass Wind Resource Area. Report to the National Renewable Energy Laboratory, Golden, Colorado, USA.

Titman, R. D. 1983. Spacing and three-bird flights of mallards breeding in pothole habitat. Canadian Journal of Zoology 61:839–847.

U.S. Department of Commerce. 2002. Monthly station normals of temperature, precipitation, and heating and cooling degree days 1971–2000, North Dakota. No 81. National Climatic Data Center, Asheville, North Carolina, USA.

U.S. Department of Commerce. 2011*a*. Annual climatological summary, Ashley, North Dakota. <http://cdo.ncdc.noaa.gov/ancsum/ACS>. Accessed 16 Dec 2011.

U.S. Department of Commerce. 2011*b*. Annual climatological summary, Forbes NW10, North Dakota. <http://cdo.ncdc.noaa.gov/ancsum/ACS>. Accessed 16 Dec 2011.

U.S. Fish and Wildlife Service [USFWS]. 2011. National Wetlands Inventory website. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C., USA. <http://www.fws.gov/wetlands/>. Accessed 1 Nov 2010.

Viljugrein, H., N. C. Stenseth, G. W. Smith, and G. H. Steinbakk. 2005. Density dependence in North American ducks. Ecology 86:245–254.

Walker, B. L., D. E. Naugle, and K. E. Doherty. 2007. Greater sage-grouse population response to energy development and habitat loss. Journal of Wildlife Management 71:2644–2654.

White, G. C., and K. P. Burnham. 1999. Program MARK: survival estimation from populations of marked animals. Bird Study 46:120–138.

White, G. C., and R. A. Garrott. 1990. Analysis of wildlife radio-tracking data. Academic Press, San Diego, California, USA.

Williams, B. K., J. D. Nichols, and M. J. Conroy. 2002. Analysis and management of animal populations: modeling, estimation, and decision making. Academic Press, San Diego, California, USA.

*Associate Editor: Joel Schmutz.*

## SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article at the publisher's web-site.

**Table S1.** Number of females and exposure days (in parentheses) included in the survival analysis by species (MALL, mallard; BWTE, blue-winged teal), site (Tatanka Wind Farm [TWF] or reference [REF]), and year (2009 or 2010).

*Research Article*

# Effect of Wind Energy Development on Breeding Duck Densities in the Prairie Pothole Region

**CHARLES R. LOESCH,**[1] *Habitat and Population Evaluation Team, U.S. Fish and Wildlife Service, 3425 Miriam Avenue, Bismarck, ND 58501, USA*

**JOHANN A. WALKER,** *Great Plains Regional Office, Ducks Unlimited, 2525 River Road, Bismarck, ND 58503, USA*

**RONALD E. REYNOLDS,**[2] *Habitat and Population Evaluation Team, U.S. Fish and Wildlife Service, 3425 Miriam Avenue, Bismarck, ND 58501, USA*

**JEFFREY S. GLEASON,**[3] *Kulm Wetland Management District, U.S. Fish and Wildlife Service, 1 First Street SW, Kulm, ND 58546, USA*

**NEAL D. NIEMUTH,** *Habitat and Population Evaluation Team, U.S. Fish and Wildlife Service, 3425 Miriam Avenue, Bismarck, ND 58501, USA*

**SCOTT E. STEPHENS,**[4] *Great Plains Regional Office, Ducks Unlimited, 2525 River Road, Bismarck, ND 58503, USA*

**MICHAEL A. ERICKSON,** *Kulm Wetland Management District, U.S. Fish and Wildlife Service, 1 First Street SW, Kulm, ND 58546, USA*

**ABSTRACT** Industrial wind energy production is a relatively new phenomenon in the Prairie Pothole Region and given the predicted future development, it has the potential to affect large land areas. The effects of wind energy development on breeding duck pair use of wetlands in proximity to wind turbines were unknown. During springs 2008–2010, we conducted surveys of breeding duck pairs for 5 species of dabbling ducks in 2 wind energy production sites (wind) and 2 paired reference sites (reference) without wind energy development located in the Missouri Coteau of North Dakota and South Dakota, USA. We conducted 10,338 wetland visits and observed 15,760 breeding duck pairs. Estimated densities of duck pairs on wetlands in wind sites were lower for 26 of 30 site, species, and year combinations and of these 16 had 95% credible intervals that did not overlap zero and resulted in a 4–56% reduction in breeding pairs. The negative median displacement observed in this study (21%) may influence the prioritization of grassland and wetland resources for conservation when existing decision support tools based on breeding-pair density are used. However, for the 2 wind study sites, priority was not reduced. We were unable to directly assess the potential for cumulative impacts and recommend long-term, large-scale waterfowl studies to reduce the uncertainty related to effects of broad-scale wind energy development on both abundance and demographic rates of breeding duck populations. In addition, continued dialogue between waterfowl conservation groups and wind energy developers is necessary to develop conservation strategies to mitigate potential negative effects of wind energy development on duck populations. 

**KEY WORDS** *Anas discors, A. platyrhynchos*, blue-winged teal, breeding population, mallard, Prairie Pothole Region, wind energy development, wind turbines.

Millions of glaciated wetlands and expansive grasslands make the Prairie Pothole Region (PPR) the primary breeding area for North America's upland nesting ducks (Batt et al. 1989). Wetland and grassland loss in the PPR due to settlement and agriculture has been extensive (Dahl 1990, Mac et al. 1998), and conversion to agriculture continues to reduce available habitat for breeding waterfowl and other wetland- and grassland-dependent birds (Oslund et al. 2010, Claassen et al. 2011). During recent years, anthropogenic impacts in the PPR have expanded to include energy development (e.g., wind, oil, natural gas; see Copeland et al. 2011: table 2.1). From 2002 to 2011, industrial wind energy production has increased 1,158% (i.e., 769–9,670 MW), 205% during the past 5 years (United States Department of Energy [USDOE] 2011). Impacts from wind energy development including direct mortality from strikes and avoidance of wind towers and associated infrastructure have been widely documented for many avian species, including raptors, passerines, upland gamebirds, shorebirds, and waterfowl, as well as bats (Drewitt and Langston 2006; Arnett et al. 2007, 2008; Kuvlesky et al. 2007).

Received: 16 March 2012; Accepted: 20 August 2012

*Additional supporting information may be found in the online version of this article.*

[1]*E-mail: chuck_loesch@fws.gov*

[2]*Present address: Retired, 14622 246th Avenue Northwest, Zimmerman, MN 55389, USA.*

[3]*Present address: P.O. Box 808, Folsom, LA 70437, USA.*

[4]*Present address: Ducks Unlimited Canada, Oak Hammock Marsh Conservation Centre, P.O. Box 1160, Stonewall, Manitoba, Canada R0C 2Z0.*

Wetland habitats in the PPR annually attract and support >50% of the breeding waterfowl population in North America (Bellrose 1980). The productivity and subsequent use of prairie wetlands by breeding ducks in the PPR are critical for the maintenance of continental duck populations (Batt et al. 1989, van der Valk 1989). Because of the potential for extensive wind energy development (USDOE 2008, 2011, Kiesecker et al. 2011), understanding the potential effect of wind power development on the use of wetland habitat by breeding duck pairs in the region is critical.

The potential impacts of wind energy development on breeding ducks are similar to other wildlife reviewed in Kuvlesky et al. (2007). Breeding pairs may abandon otherwise suitable wetland habitat, display behavioral avoidance thereby reducing densities of pairs using wetlands near wind turbines, and experience mortality from collision with turbines and associated infrastructure. Additionally, indirect effects on breeding ducks potentially include avoidance of associated grassland by nesting females, increased predation, or reduced reproduction. Wind towers and supporting infrastructure generally do not directly affect the wetlands that provide habitat for breeding ducks. However, ducks are sensitive to many forms of disturbance (Dahlgren and Korschgen 1992, Madsen 1995, Larsen and Madsen 2000). Avoidance related to the presence of towers, movement of blades (e.g., shadow flicker), blade noise (Habib et al. 2007), infrastructure development including roads and transmission lines (Forman and Alexander 1998, Ingelfinger and Anderson 2004, Reijnen and Foppen 2006), and maintenance activities have been documented for other avian species and may similarly affect breeding pairs and reduce the use of wetlands within and adjacent to wind farms.

The presence of wind energy development in high density wetland and breeding pair habitat in the PPR is relatively recent, and previous studies of the effects of land-based wind development on waterfowl (*Anatidae*) have focused primarily on collision mortality (Winkelman 1990, Johnson et al. 2000, Gue 2012) and the effect of wind farms on foraging behavior of wintering and migrating waterfowl (Winkelman 1990, Larsen and Madsen 2000, Drewitt and Langston 2006, Kuvlesky et al. 2007, Stewart et al. 2007). Wind development appears to cause displacement of wintering or migrating Anseriformes, and bird abundance may decrease over time (Stewart et al. 2007). However, habituation has been reported for foraging pink-footed geese (*Anser brachyrhynchos*) during winter (Madsen and Boertmann 2008). Displacement of duck pairs due to wind development could affect population dynamics similar to habitat loss (Drewitt and Langston 2006, Kuvlesky et al. 2007). However, little information exists on how land-based wind development affects the settling patterns, distribution, and density of duck pairs during the breeding season.

The number and distribution of breeding duck pairs in the PPR is related to annual wetland and upland conditions (Johnson et al. 1992; Austin 2002; Reynolds et al. 2006, 2007; U.S. Fish and Wildlife Service [USFWS] 2012). Wetland conditions in the PPR vary both spatially and temporally (Niemuth et al. 2010) and during dry years in the PPR, waterfowl are displaced to lesser quality habitats farther north (USFWS 2012) where productivity is generally reduced (Bellrose 1980). The long-term sustainability of breeding duck populations is dependent on availability and use of productive wetlands in the PPR that provide local breeding pair habitat when they are wet (Johnson and Grier 1988). Avoidance of wetlands near wind energy development by breeding ducks on otherwise suitable wetland habitat may result in displacement to lesser quality habitats similar to the effect of displacement during dry years. Given the relatively large development footprint (i.e., unit area/GW) for energy produced from wind relative to other energy sources such as coal (e.g., 7.4 times; wind = 72.1 $km^2$/TW-hr/yr, coal = 9.7 $km^2$/TW-hr/yr; McDonald et al. 2009) and the projected growth of the industry (USDOE 2008), a relatively large land area and subsequently a large number of wetlands and associated duck pairs in the PPR can potentially be affected.

We assessed the potential effects of wind energy development and operation on the density of 5 common species of breeding ducks in the PPR of North Dakota and South Dakota: blue-winged teal (*Anas discors*), gadwall (*A. strepera*), mallard (*A. platyrhynchos*), northern pintail (*A. acuta*), and northern shoveler (*A. clypeata*). Our objective was to determine whether the expected density of breeding duck pairs differed between wetlands located within land-based wind energy production sites (hereafter wind sites) and wetlands located within paired sites of similar wetland and upland composition without wind development (hereafter reference sites). We predicted that if disturbance due to wind energy development caused avoidance of wetlands by breeding duck pairs, then expected density of breeding pairs would be lower on wind energy development sites. We interpreted differences in estimated breeding pair densities between paired wind energy development sites and reference sites in the context of the current Prairie Pothole Joint Venture (PPJV) waterfowl conservation strategy for the United States PPR (Ringelman 2005).

## STUDY AREA

We selected operational wind energy and paired reference sites as a function of the geographic location, the local wetland community and its potential to attract breeding pairs (i.e., ≥40 pairs/$km^2$; Reynolds et al. 2006), and wetland conditions. In 2008, 11 wind farms were operational in the PPR of North and South Dakota, USA. Of those, only 3 were located in areas with the potential to attract relatively large numbers of breeding duck pairs for the 5 species in this study (Loesch et al. 2012, OpenEnergyInfo 2012). We identified 2 existing wind energy production sites in the Missouri Coteau physiographic region (Bluemle 1991) of south-central North Dakota, USA, and north-central South Dakota, USA (Fig. 1). Both wind sites contained wetland communities with the potential to attract an estimated 46 breeding duck pairs/$km^2$ (mean density = 8.5 pairs/$km^2$ for the PPR; Reynolds et al. 2006, Loesch et al. 2012). The Kulm-Edgeley (KE) wind energy development consisted of 41 towers in a cropland-dominated landscape (e.g., 83% of

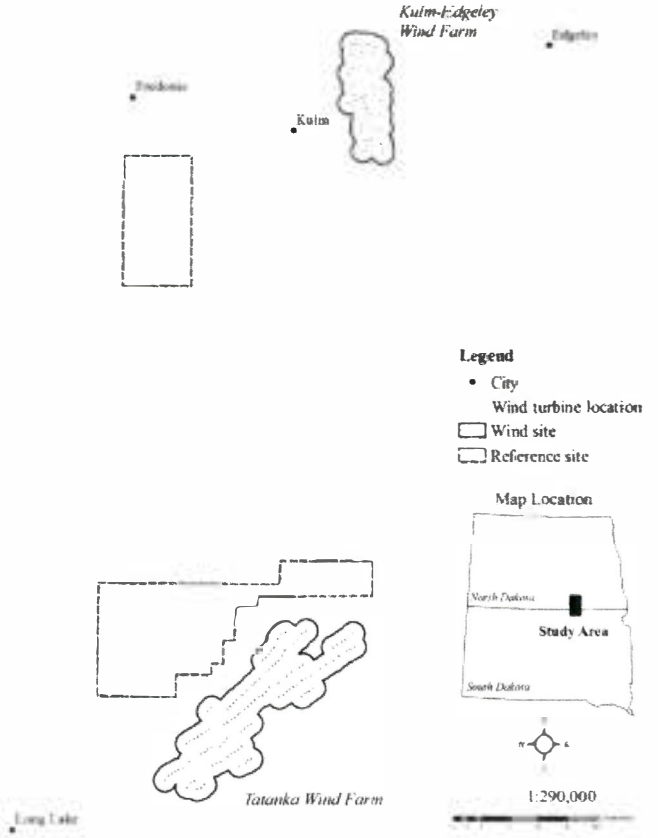



**Figure 1.** Paired study sites with and without wind energy development surveyed for breeding waterfowl pairs in North Dakota and South Dakota, USA, 2008–2010.

uplands were cropland; Table 1) and was located 3.2 km east of Kulm, North Dakota, USA. The Tatanka (TAT) wind energy development, consisted of 120 towers in a perennial cover-dominated landscape (e.g., 92% of uplands were perennial cover; native grassland, idle planted tame grass, alfalfa hay; Table 1) and was located 9.7 km northeast of Long Lake, South Dakota, USA. The KE site began operation in 2003; approximately 50% of the TAT towers were operational by 28 April 2008 and all were operational by 21 May 2008. Turbine locations were on-screen digitized using ESRI ArcGIS 9.2 software (ArcGIS Version 9.2, Environmental Systems Research Institute, Redlands, CA) and United States Department of Agriculture National Aerial Imagery Program (NAIP) imagery (ca. 2007).

The potential zone of influence for breeding waterfowl from a wind turbine to a wetland during the breeding season is unknown. The limited research that has been conducted to measure displacement of birds in grassland landscapes has primarily targeted migratory grassland passerines, and has identified relatively short (e.g., 80–400 m) distances (Leddy et al. 1999, Johnson et al. 2000, Shaffer and Johnson 2008, Pearce-Higgins et al. 2009). Compared to grassland passerines, waterfowl have relatively large breeding territories and mallards use multiple wetlands within their home range (e.g., 10.36 $km^2$ generalized to a circle based on a 1,608 m radius; Cowardin et al. 1988). Because the objective of this study was to test the potential effects of wind energy development on breeding duck pair density and not to identify a potential zone of influence, we chose a buffer size with the objective to spatially position sample wetlands in proximity to 1 or many turbines where a potential effect of wind energy development would likely be measurable. Consequently, we used the generalized home range of a mallard hen and buffered each wind turbine by 804 m (i.e., half the radius of a circular mallard home range; Cowardin et al. 1988), to ensure overlap of breeding territories with nearby wind turbines. The wind sites contained different numbers of turbines and as a result the sites were not equally sized (KE wind site = 2,893 ha; TAT wind site = 6,875 ha; Fig. 1).

We derived wetland boundaries from digital USFWS National Wetlands Inventory (NWI) data. We post-processed NWI wetlands to a basin classification (Cowardin et al. 1995, Johnson and Higgins 1997) where we combined complex wetlands (i.e., multiple polygons describing a basin) into a single basin and then classified them to the most permanent water regime (Cowardin et al. 1979). Wetlands partially or completely within the buffer areas were considered treatment wetlands.

For each of the 2 wind sites, we employed a rule-based process to select paired sites to control for differences in wetland and landscape characteristics among sites. We first

**Table 1.** Characteristics of wetland (i.e., number, area [ha], % of total wetland area) and upland (i.e., area [ha], % of total upland area) areas in development (wind) and paired reference sites in North Dakota and South Dakota, USA, where we surveyed wetlands for breeding duck pairs during spring 2008, 2009, and 2010. Sites included Kulm-Edgely (KE) and Tatanka (TAT) Wind Farms.

| | KE wind | | | KE reference | | | TAT wind | | | TAT reference | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Class | Number | Area | % | Number | Area | % | Number | Area | % | Number | Area | % |
| Wetland | | | | | | | | | | | | |
| Temporary | 272 | 41.4 | 9 | 283 | 41.7 | 7 | 362 | 29.9 | 3 | 462 | 97.3 | 8 |
| Seasonal | 372 | 167.2 | 37 | 240 | 347.3 | 55 | 917 | 253.5 | 29 | 815 | 419.9 | 36 |
| Semi-permanent | 37 | 239.5 | 53 | 37 | 242.9 | 38 | 322 | 581.7 | 67 | 231 | 636.5 | 55 |
| Total | 681 | 448.1 | | 560 | 631.9 | | 1,601 | 865.0 | | 1,508 | 1,153.7 | |
| Upland | | | | | | | | | | | | |
| Perennial cover[a] | | 416.3 | 16 | | 1,324.4 | 37 | | 5,428.4 | 92 | | 6,039.7 | 85 |
| Cropland | | 2,120.5 | 83 | | 2,232.8 | 63 | | 455.3 | 8 | | 1,064.1 | 15 |
| Other | | 6.6 | <1 | | 13.4 | <1 | | 18.3 | <1 | | 11.4 | <1 |
| Total | | 2,543 | | | 3,570.6 | | | 5,902.1 | | | 7,115.2 | |

[a] Includes native grassland, undisturbed grassland, and alfalfa hay landcover classes.

considered physiographic region and proximity to wind sites when identifying potential reference sites. To reduce the potential for environmental variation, especially wetness (Niemuth et al. 2010), between wind and reference sites, we only considered sites <25 km from the nearest turbine and within the Missouri Coteau physiographic region. Additionally, we assumed that wetlands >2.5 km from the nearest turbine were beyond a potential zone of influence. Using the distance and physiographic region criteria, we identified 3 potential reference sites of similar size for each wind site based on upland land use (i.e., proportion of cropland and perennial cover) and wetland density. For the 6 potential sites, we compared the wetland number and area (ha) for each class (i.e., temporary, seasonal, semi-permanent) between each potential reference site and the respective wind site to select the most similar reference site (Table 1). The KE reference site was located 11.3 km west of the KE wind site and the TAT reference site was located 3.2 km northwest of the TAT wind site (Fig. 1).

We identified 5,146 wetland basins encompassing 3,410 ha from NWI data within the wind and reference sites and considered each wetland a potential sample basin. Only temporary, seasonal, and semi-permanent basins were present at the wind sites so we did not survey lake wetlands at reference sites. We did not survey basins that extended >402 m from the boundary of a site to eliminate linear wetlands that potentially extended long distances from the wind and reference sites.

## METHODS

### Surveys

We surveyed sample wetlands during spring 2008, 2009, and 2010 to count local breeding duck pairs. We used 2 survey periods (i.e., 28 April–18 May, early; and 21 May–7 June, late) to account for differences in settling patterns for the 5 species (Stewart and Kantrud 1973, Cowardin et al. 1995) and to reduce potential bias associated with differences in breeding chronology among species (Dzubin 1969, Higgins et al. 1992, Naugle et al. 2000). We divided the wind and reference sites into 3 crew areas to spatially distribute survey effort across the sites, and crews of 2 observers conducted surveys on each of the 3 crew areas daily. The detection probability of duck pairs was likely not equal among observers (Pagano and Arnold 2009) and we minimized potential confounding of detection, observer, and survey area by rotating observers among crew areas and partners daily. Additionally, our analytical approach was not to compare population estimates for wind and reference sites, which may require development of correction factors (Brasher et al. 2002, Pagano and Arnold 2009), but rather to compare expected rates of pair abundance. Consequently, we assumed non-detection of ducks to be equal among all sites.

We surveyed wetlands within each crew area in a 2.59-km grid pattern based on public land survey sections (PLSS). We used maps with NAIP imagery and wetland basin perimeters from NWI to assist orientation and navigation to survey wetlands. Permission, accessibility, wetness, numbers of wetlands, size of wetlands, and numbers of birds affected the rate at which we surveyed PLSS. Surveys began at 0800 hours and continued until 1700 hours and were discontinued during steady rainfall or winds exceeding 48 km/hr. We surveyed most wetlands twice each year, once during each survey period. We visited all sample wetlands during the early survey period. We did not revisit wetlands that were dry during the early survey. Annual changes in access permission and wetland conditions due to precipitation resulted in some basins being surveyed during only 1 of the survey periods.

During the breeding season, waterfowl assemble into various social groupings that are influenced by sex ratios, breeding phenology, and daily activities (Dzubin 1969). We counted social groups of the 5 target species using established survey protocols (Hammond 1969, Higgins et al. 1992, Cowardin et al. 1995, Reynolds et al. 2006) and recorded observations for all sample wetlands that contained surface water regardless of whether birds were present or absent. We summarized field observations into 7 social groupings that we subsequently interpreted to determine the number of indicated breeding pairs for each species, basin, and survey period (Dzubin 1969, Cowardin et al. 1995). On average, the first count period (late April–early May) is regarded as an acceptable approximation of the breeding population for mallard and northern pintail (Cowardin et al. 1995, Reynolds et al. 2006). Consequently, we used observations during the early survey period to determine the number of indicated breeding pairs for mallard and northern pintail. Similarly, the second count period (late May–early June) is generally used to approximate the breeding population of blue-winged teal, gadwall, and northern shoveler (Cowardin et al. 1995, Reynolds et al. 2006) and we used observations during the late survey period to determine the number of indicated breeding pairs for these 3 species. We used indicated breeding pairs as the response variable in our models of estimated duck pairs.

We reduced disturbance during surveys by observing wetlands from 1 or more distant, strategic positions. We approached and surveyed portions of basins that were obscured by terrain or vegetation on foot. We noted birds leaving the wetland because of observer disturbance to minimize recounting on wetlands that we had not yet surveyed. We estimated the proportion of the wetland that was wet by visually comparing the surface water present in the basin relative to the wetland extent displayed on the field map. We recorded basins with no surface water as dry and not surveyed.

We used NAIP (ca. 2009) and on-screen photo-interpretation to develop a categorical variable describing the landcover of uplands (i.e., cropland, native grassland, idle planted tame grass, alfalfa hayland) adjacent to or surrounding all wetlands on the wind and reference sites. For wetlands touching multiple upland landcover classes, we assigned the class based on the largest wetland perimeter length. The exception was for idle planted tame grass, where we assigned the class if it touched any length of a wetland perimeter because of the limited presence of this class in

the landscape and its positive influence on pair settling densities (Reynolds et al. 2007).

**Data Analysis**

The objective of our analysis was to compare estimates of expected wetland-level abundance of breeding pairs on the wind and reference sites among years. We used past analyses of breeding duck pairs in the United States PPR and their relationship to wetland and upland parameters to inform the selection of candidate covariates (Cowardin et al. 1988, 1995; Reynolds et al. 1996). Wetland-level covariates included wetland class (i.e., seasonal, semi-permanent, or temporary; Johnson and Higgins 1997), surface area of water in NWI basin (wet area), and square root (sqrt) of wet area to reflect the non-linear response to wetland area demonstrated by breeding ducks in the PPR (Cowardin et al. 1988, 1995; Reynolds et al. 2006). We used a categorical variable for upland landcover (i.e., perennial cover, cropland) adjacent to the wetland for the only upland covariate (Reynolds et al. 2007).

Generalized linear models with Poisson errors provided an appropriate statistical framework for the analysis (McCullagh and Nelder 1989, McDonald et al. 2000). Preliminary summaries of the breeding pair data showed, however, that all 5 species displayed indications of over-dispersion relative to standard Poisson assumptions (i.e., both excess zeros and infrequent large counts; Appendix A, available online at www.onlinelibrary.wiley.com; Zuur et al. 2007). We addressed these challenges, while maintain an approach consistent with past studies by conducting a 2-stage analysis. We began by selecting appropriate models and subsets of the covariates using a likelihood-based approach. Then we used a simulation-based Bayesian approach to estimate parameters of species-specific statistical models, site- and year-level contrasts between wind and reference sites, and lack-of-fit statistics. Our combined approach allowed us to take advantage of the strengths of both approaches (Royle and Dorazio 2008:74–75) to provide a thorough analysis of the data.

We analyzed indicated breeding pairs from counts for each of the 5 study species using separate models. Full Poisson regression models described expected breeding pairs as a log-linear function of site, year, wetland class, landcover, wet area, and sqrt (wet area). We used Akaike's Information Criterion (AIC) differences (Burnham and Anderson 2002) to compare full Poisson models with Zero-Inflated Poisson (ZIP) models. The ZIP models partially accounted for potential excess zeros due to 2 sources: 1) non-detections and 2) unoccupied, but suitable, wetlands. The ZIP models described the data as a mixture of the counts described by the log-linear model and a mass of excess zeros described by a logit-linear model (Zuur et al. 2007). We conducted a comparison of Poisson and ZIP models between the full Poisson model and ZIP model that included a single additional parameter describing the expected probability of a false zero. When AIC differences indicated the ZIP model was more appropriate (i.e., $AIC_{Poisson} - AIC_{ZIP} \geq 4$), we used ZIP models for all subsequent analysis. When ZIP models were selected, the full logit-linear model for excess zeros included covariates describing the upland vegetation cover class associated with each wetland (cover class; Stewart and Kantrud 1973), the area of the NWI basin covered by water (wet area), and the square root of wet area.

We expected that the full models would likely be most appropriate for the study species, as they were parameterized with covariates that have been identified as useful predictors of pair abundance in the Four-Square-Mile Breeding Waterfowl Survey (FSMS) dataset, which has been collected by the USFWS National Wildlife Refuge System since 1987 (Cowardin et al. 1995; Reynolds et al. 2006, 2007). Nonetheless, we sought to efficiently use the information in our less-extensive dataset by ensuring that we had selected a parsimonious subset of the covariates for each species-specific model. We removed a single covariate, or group of covariates in the case of factor variables, from the full model, ran the resulting reduced model, and recorded its AIC value (Chambers 1992, Crawley 2007:327–329). We repeated this procedure for every covariate. This resulted in a vector of AIC values that described, for each covariate, or covariate group, the effect of its removal on the AIC value of the full model. Reduced models for each species contained the set of covariates in the full model or the subset of covariates that resulted in increases in AIC values greater than 2 units per estimated parameter when they were removed from the full model (Arnold 2010).

After selecting a model structure for each species, we estimated the posterior distributions of model parameters with Markov Chain Monte Carlo (MCMC) simulation (Link and Barker 2009) in the Bayesian analysis software WinBUGS 1.4.1 (Spiegelhalter et al., 2003). The structure of the Bayesian ZIP models differed from the maximum likelihood models in 2 ways. The 12 site and year combinations were hierarchically centered and parameterized as normally distributed displacements from a common intercept (Gelman et al. 2004, Congdon 2005), and extra-Poisson variation due to large wetland-level counts was accommodated by a normally distributed error term (Appendix B, available online at www.onlinelibrary.wiley.com).

We conducted all statistical analyses in the R environment (R Development Core Team 2011). We used the generalized linear models capability of base R and the contributed package pscl (Jackman 2008) to estimate likelihoods and AIC values for Poisson and ZIP models. When selecting models and subsets of the covariates, we considered AIC differences greater than 4 to provide good evidence in favor of the model with the smaller value (Burnham and Anderson 2002). To generate Bayesian estimates of model parameters, we used the contributed R2WinBugs (Sturtz et al. 2005) package to run MCMC simulations in WinBUGS via R. For each model, we ran 2 Markov chains for 500,000 iterations and discarded the first 100,000 iterations from each chain to minimize the influence of starting values and prior distributions. We used minimally informative prior distributions and random starting values for model parameters and random effects. We evaluated convergence to the posterior distribution by examining plots of sequential draws for

each parameter and also by the Gelman–Rubin statistic (Gelman et al. 2004). We estimated the number of uncorrelated samples generated by each Markov Chain by the Effective Sample Size (ESS; Kass et al. 1998, Streftaris and Worton 2008). We required at least 200 uncorrelated samples per chain for inference. We considered a model to have converged when its Gelman–Rubin statistic was <1.1 and the plots of sequential draws indicated that the chains had stabilized and were sampling from a similar space (Gelman et al. 2004). We tested for lack-of-fit of the model using a posterior predictive test (Gelman et al. 2004). Specifically, we compared the variance-mean ratio for the observed data to the variance-mean ratio of simulated data generated from the posterior draws of model parameters. We concluded that the model fit the data if the posterior proportion of simulated variance-mean ratios that exceeded the observed variance-mean ratio was greater than 0.01 and less than 0.99 (Congdon 2005). We then used the CODA (Plummer et al. 2009) package to summarize the posterior distributions of model parameters, convergence diagnostics, and derived quantities like lack-of-fit statistics and back-transformed estimates of abundance. Using the 800,000 posterior simulations from each model, modal values of categorical covariates, and median values of continuous covariates, we calculated species-, site-, and year-specific medians and 95% credible intervals of 1) the estimated posterior distribution of the log-scale model parameters, 2) the estimated posterior distribution of expected pair abundance on wetlands of median area, and 3) the estimated posterior distribution of the back-transformed contrast in expected pair abundance between wind and reference sites in each year. These quantities provided the basis for comparison of pair abundance between wind and reference sites.

We used point estimates of pair density for the median seasonal wetlands size (i.e., 0.2 ha) in grassland to assess the potential effect of wind energy development on breeding duck pair densities. We selected seasonal wetlands because they were the most numerous wetlands in our sample (58%) and because breeding duck pairs use seasonal wetlands at greater rates than other wetland classes (see Reynolds et al. 2006, 2007; Loesch et al. 2012); most pairs (54%) were observed on seasonal wetlands.

We evaluated the potential impact of wind energy development from both a statistical and biological perspective. We compared point estimates of density among sites and within years to either support or reject an effect. We assessed the potential biological impact of breeding pair avoidance of wind sites by calculating the proportional change in the estimated density of pairs between wetlands in wind and reference sites for each species and year. The percent change reflects the potential impact to breeding duck populations in the presence of wind energy development.

## RESULTS

As a result of variable wetland conditions both within and among years, and annual changes in access to private land, we surveyed different numbers and area of wetland basins each year. Water levels in wetlands were low during 2008 and 35% of wetland basins visited during the early count contained water and generally were only partially full (e.g., seasonal regime, mean = 54% full, $n$ = 684). Water levels increased in 2009 and 2010 and only 15% of 2,464 and 12% of 3,309 wetland basins, respectively, were dry during the early count. Basins containing water were also more full during 2009 (e.g., seasonal basin mean = 103% full, $n$ = 1,089) and 2010 (e.g., seasonal basin mean = 93% full, $n$ = 1,407). We conducted 5,339 wetland visits during the early count and 4,999 wetland visits during the late count. During the early count, we observed 5,287 indicated breeding pairs of mallard (3,456 [range = 146–552]) and northern pintail (1,831 [range = 51–310]), and 10,473 indicated breeding pairs of blue-winged teal (5,886 [range = 180–984]), gadwall (2,839 [range = 75–506]), and northern shoveler (1,748 [range = 55–318]) during the late count.

### Model Selection and Estimation

Our ZIP models provided a substantially better fit than Poisson models for every species. Differences in AIC ($AIC_{poisson} - AIC_{zip}$) were 426 for blue-winged teal, 137 for gadwall, 218 for mallard, 384 for northern pintail, and 78 for northern shoveler. All of the covariates in the full model were retained for mallard, northern pintail, blue-winged teal, and northern shoveler. Wetland class was dropped for gadwall. Differences in AIC between the full model and the nearest reduced model were 11 for blue-winged teal, 3 for gadwall, 26 for mallard, 6 for northern pintail, and 29 for northern shoveler. The MCMC simulations converged for every species-specific model, indicating that the parameter estimates and credible intervals from these models provided a sound basis for inference. The maximum upper 95% credible interval of all R-hat values for any structural parameter was 1.01 for blue-winged teal, 1.01 for gadwall, 1.01 for mallard, 1.02 for northern pintail, and 1.04 for northern shoveler. The posterior predictive test indicated that the models fit the data for every species. The proportion of simulated variance-mean ratios that exceeded the observed variance-mean ratio was 0.52 for blue-winged teal, 0.75 for gadwall, 0.61 for mallard, 0.59 for northern pintail, and 0.72 for northern shoveler. Minimum effective sample sizes were 709 for blue-winged teal, 553 for gadwall, 307 for mallard, 346 for northern pintail, and 612 for northern shoveler.

### Estimates

Differences in estimated breeding duck pair densities in a wind site and a reference site varied among site pairs (2), years (3), and species (5), and posterior median values of these 30 contrasts ranged from −0.281 to 0.130 (Table 2). Estimated patterns of contrasts for expected breeding duck pair density between wind and reference sites were similar for all species. Given median wet area and the mode of the categorical covariates, expected, basin-level densities of duck pairs for the 5 species was either statistically indistinguishable (14 of 30) between wind and reference sites or was lower (16 of 30) on wind sites than reference sites depending on site, year, and species (Fig. 2). Regardless of whether 95% credible intervals overlapped zero, density estimates were

**Table 2.** Log-scale estimated posterior medians and 95% of the estimated posterior distribution from the count portion of a zero-inflated, overdispersed Poisson model of indicated blue-winged teal (*Anas discors* [BWTE]), gadwall (*A. strepera* [GADW]), mallard (*A. platyrhynchos* [MALL]), northern pintail (*A. acuta* [NOPI]), and northern shoveler (*A. clypeata* [NSHO]) pairs on seasonal wetland basins for development (wind) and paired reference sites in North Dakota and South Dakota, USA. Sites are Kulm-Edgely (KE) and Tatanka (TAT) for years 2008 (08), 2009 (09), and 2010 (10).

| | | | Reference | | | Wind | | |
|---|---|---|---|---|---|---|---|---|
| Species | Site | Year | Median | 2.5% | 97.5% | Median | 2.5% | 97.5% |
| MALL | KE | 08 | 0.47 | 0.21 | 0.73 | 0.15 | −0.13 | 0.43 |
| | KE | 09 | −0.49 | −0.78 | −0.22 | −0.90 | −1.17 | −0.64 |
| | KE | 10 | −0.42 | −0.66 | −0.20 | −0.77 | −1.04 | −0.51 |
| | TAT | 08 | 0.29 | 0.02 | 0.56 | 0.41 | 0.17 | 0.65 |
| | TAT | 09 | −0.38 | −0.61 | −0.14 | −0.63 | −0.89 | −0.38 |
| | TAT | 10 | −0.33 | −0.55 | −0.10 | −0.47 | −0.71 | −0.22 |
| BWTE | KE | 08 | −0.13 | −0.25 | −0.00 | 0.22 | 0.01 | 0.45 |
| | KE | 09 | −0.46 | −0.66 | −0.27 | −0.52 | −0.74 | −0.32 |
| | KE | 10 | −0.13 | −0.30 | 0.04 | −0.58 | −0.78 | −0.39 |
| | TAT | 08 | 0.25 | 0.06 | 0.45 | 0.18 | 0.01 | 0.36 |
| | TAT | 09 | −0.15 | −0.32 | 0.02 | −0.39 | −0.58 | −0.21 |
| | TAT | 10 | 0.03 | −0.12 | 0.19 | −0.19 | −0.36 | −0.02 |
| NOPI | KE | 08 | −0.25 | −0.61 | 0.12 | −0.80 | −1.24 | −0.39 |
| | KE | 09 | −0.80 | −1.16 | −0.45 | −1.54 | −1.93 | −1.17 |
| | KE | 10 | −0.72 | −1.01 | −0.42 | −1.20 | −1.56 | −0.87 |
| | TAT | 08 | −0.10 | −0.46 | 0.27 | 0.16 | −0.15 | 0.48 |
| | TAT | 09 | −0.35 | −0.63 | −0.06 | −0.76 | −1.07 | −0.44 |
| | TAT | 10 | −0.15 | −0.41 | 0.13 | −0.38 | −0.67 | −0.07 |
| GADW | KE | 08 | 0.09 | −0.17 | 0.37 | −0.13 | −0.43 | 0.18 |
| | KE | 09 | −0.52 | −0.77 | −0.28 | −0.91 | −1.19 | −0.64 |
| | KE | 10 | −0.61 | −0.83 | −0.38 | −1.42 | −1.72 | −1.14 |
| | TAT | 08 | 0.07 | −0.18 | 0.34 | 0.17 | −0.05 | 0.41 |
| | TAT | 09 | −0.46 | −0.69 | −0.22 | −0.55 | −0.81 | −0.29 |
| | TAT | 10 | −0.69 | −0.92 | −0.46 | −0.62 | −0.86 | −0.38 |
| NSHO | KE | 08 | −0.35 | −0.61 | −0.08 | −0.49 | −0.79 | −0.18 |
| | KE | 09 | −0.91 | −1.17 | −0.67 | −1.00 | −1.29 | −0.73 |
| | KE | 10 | −0.78 | −1.00 | −0.57 | −1.11 | −1.39 | −0.85 |
| | TAT | 08 | −0.23 | −0.49 | 0.00 | −0.30 | −0.52 | −0.08 |
| | TAT | 09 | −0.59 | −0.80 | −0.37 | −0.99 | −1.25 | −0.74 |
| | TAT | 10 | −0.36 | −0.55 | −0.16 | −0.69 | −0.90 | −0.47 |

lower on sites with wind development for 26 of the 30 combinations (i.e., mallard and blue-winged teal: 12 combinations, 11 negative [range −6% to −36%]), 7 did not overlap zero; gadwall, northern pintail, northern shoveler: 18 combinations, 15 negative [range −5% to −56%], 9 did not overlap zero). The general pattern of results were similar for all species, consequently, we chose a representative early and late arriving species with the largest number of indicated breeding pairs, mallard and blue-winged teal, respectively, for detailed presentation of results.

### Mallard and Blue-Winged Teal

Mallard and blue-winged teal comprised 59% of the indicated breeding pair observations (i.e., 3,473 mallard; 5,928 blue-winged teal). Full models were retained for both mallard and blue-winged teal, and the point estimate of density was greatest in 2008 for both KE and TAT sites, but varied among years and sites (mallard: wind median = 0.42 [range = 0.30–1.03], reference median = 0.41 [range = 0.21–0.97]; blue-winged teal: wind median = 0.51 [range = 0.42–0.94], reference median = 0.66 [range = 0.47–0.96]). For mallard, estimated breeding pair densities on seasonal wetlands at wind sites were lower for 5 of the 6 site-year combinations (median = 0.11, range = −0.28 to 0.11) and error bars representing 95% of the posterior distribution of the estimate did not overlap zero for 4 of the 6 site-year comparisons (Fig. 2A). Similarly, for blue-winged teal in 5 of the 6 site-year combinations, estimated pair densities were lower for seasonal wetlands on wind sites (median = −0.14, range = −0.24 to <0.01) and error bars representing 95% of the posterior distribution of the estimate did not overlap zero for 3 of the 6 site-year comparisons (Fig. 2B). Only 1 site-year combination for each of mallard and blue-winged teal suggested greater pair densities on wind sites, but in both cases 95% confidence intervals overlapped zero.

The estimated proportional change of mallard pair densities for wetlands in wind sites was negative in 5 of 6 site-year combinations (median = −10%, range = 13% [TAT 2008] to −34% [KE 2009]; Fig. 3A). The proportional change for blue-winged teal was also negative in 5 of 6 site-year combinations (Fig. 3B). The median estimate of proportional change for blue-winged teal densities between wind and reference sites was −18% (range 0% [KE 2009] to −36% [KE 2010]).

## DISCUSSION

All 5 of our dabbling duck study species demonstrated a negative response to wind energy development and the reduced abundance we observed was consistent with behavioral avoidance. Avoidance of land-based wind energy development has been observed for numerous avian species during

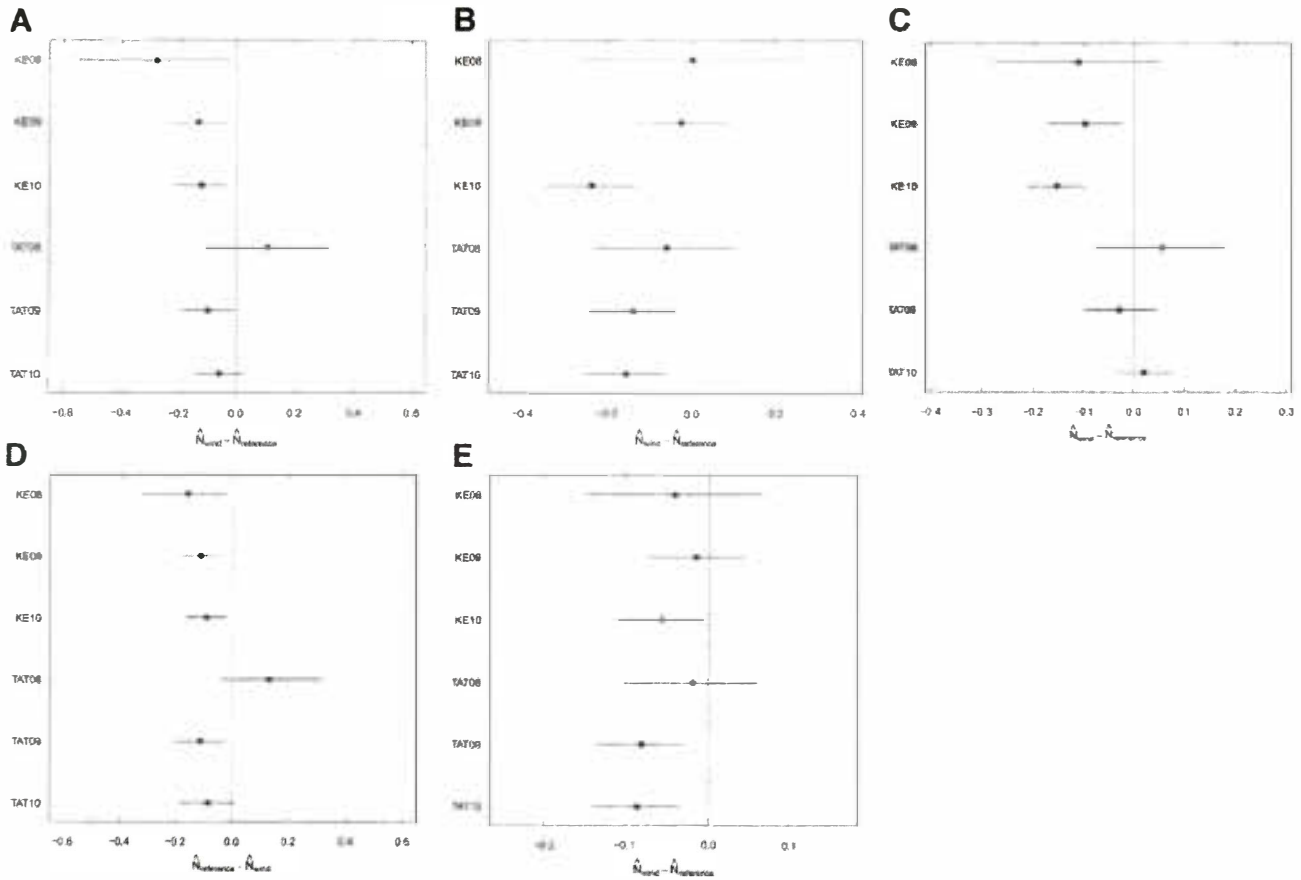



**Figure 2.** Year-specific estimated differences between estimated posterior median abundance of mallard (*Anas platyrhynchos*; A), blue-winged teal (*A. discors*; B), gadwall (*A. strepera*; C), northern pintail (*A. acuta*; D), and northern shoveler (*A. clypeata*; E) on a seasonal wetland of median area (0.2 ha) embedded in perennial cover on a wind site and its corresponding reference site in North Dakota and South Dakota. Error bars represent 95% of the posterior distribution of the estimate. Site-year combinations are Kulm-Edgely (KE) and Tatanka (TAT) for 2008 (08), 2009 (09), and 2010 (10).

breeding (Leddy et al. 1999, Johnson et al. 2000, Walker et al. 2005, Shaffer and Johnson 2008, see Madders and Whitfield 2006), and does not imply complete abandonment of an area but rather the reduced use of a site (Schneider et al. 2003). This is consistent with our results, where breeding pairs continued to use wetland habitat at the wind sites but at reduced densities.

Our selection of paired wind and reference sites and analytical approach were designed to control for differences in site characteristics and annual variation in habitat conditions, and to use well-understood relationships between breeding duck pairs and wetlands (Cowardin et al. 1995; Reynolds et al. 2006, 2007). Despite the large amount of breeding pair data we collected, discerning if the presence of wind energy development was the ultimate cause of the lower estimated pair abundance on the wind versus reference sites is difficult. However, we did detect a directional effect of wind energy development sites over a 3-year period at the 2 sites that are representative of areas with greater estimated duck densities, and adds to the body of evidence suggesting a negative effect of wind energy development. Reduced wetland use in high density wetland areas with the potential to attract and support relatively greater densities of breeding duck pairs is of concern to waterfowl biologists and managers because when wet, these areas are vital to the sustainability of North American duck populations. The somewhat limited temporal and geographic scope of our study and confounding between land use and duration of development prevents us from drawing strong conclusions about cumulative effects of wind energy development on breeding ducks (see Krausman 2011). Nonetheless, a 10–18% reduction in addition to other stressors is potentially substantial.

We observed larger negative displacement for most species and years in the KE wind site when compared to the TAT wind site. We found 2 notable differences in the wind sites that may have contributed to these results, the land use and age of development. The KE site was predominantly cropland and older than the grassland-dominated TAT site. The combination of multiple stressors, in this case agriculture and wind energy development, may have resulted in a greater impact to breeding ducks using wetlands in agricultural settings. Differences in estimated pair abundance between the cropland and grassland site suggest that greater habitat quality measured by the percent of grassland area and lack of cropping history in associated wetlands within a site may reduce avoidance of wind development when compared to agricultural landscapes. Breeding waterfowl may occupy wetlands at greater rates in grassland than cropland (Reynolds et al. 2007), nest success is generally greater in grasslands (Greenwood et al. 1995, Reynolds et al. 2001, Stephens et al.

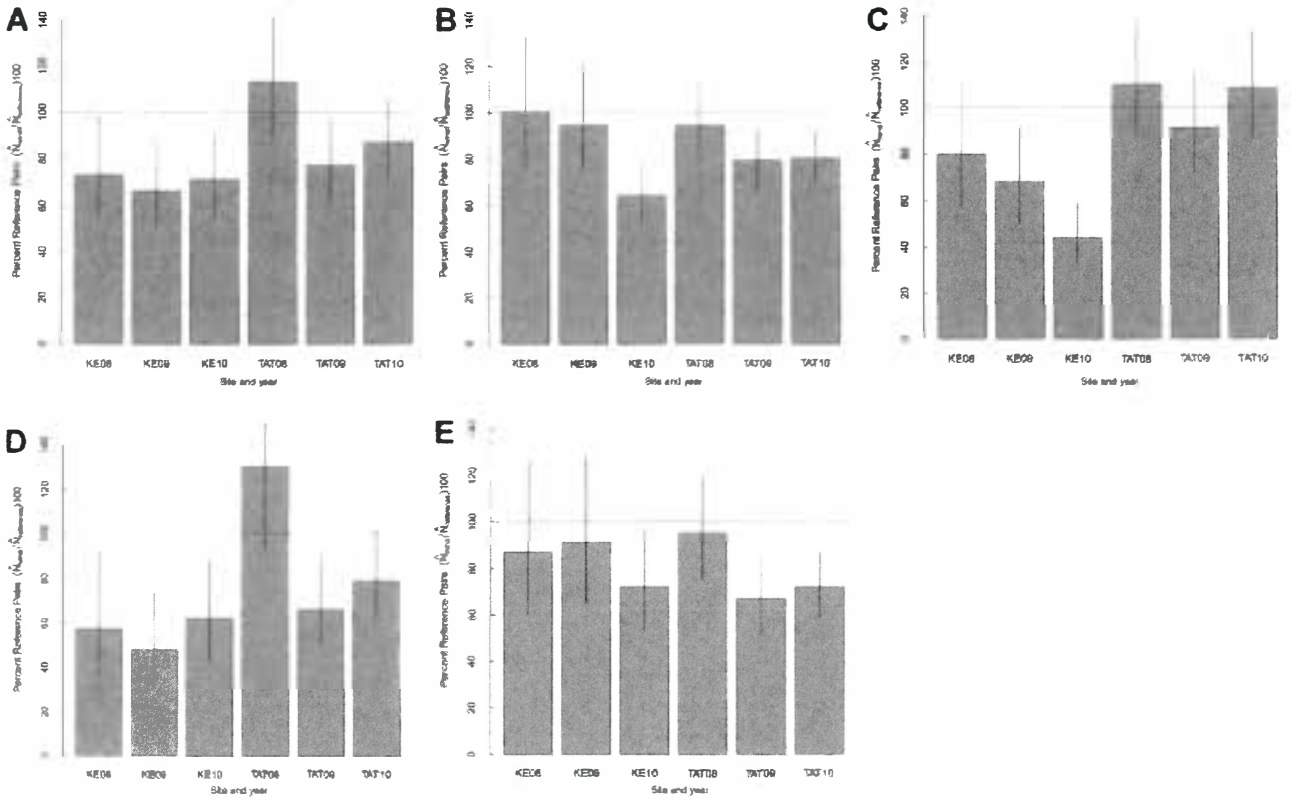



**Figure 3.** Year-specific estimated number of mallard (*Anas platyrhynchos*; A), blue-winged teal (*A. discors*; B), gadwall (*A. strepera*; C), northern pintail (*A. acuta*; D), and northern shoveler (*A. clypeata*; E) on a seasonal wetland of median area (0.2 ha) embedded in perennial cover on a wind site expressed as a percentage of pairs expected on the same wetland in the corresponding reference site in North Dakota and South Dakota. Error bars represent 95% of the posterior distribution of the estimate. Site-year combinations are Kulm-Edgely (KE) and Tatanka (TAT) for 2008 (08), 2009 (09), and 2010 (10).

2005), and wetlands in grass landscapes have greater occupancy rates by duck broods (Walker 2011), suggesting an overall greater productivity potential for breeding ducks in grassland versus cropland landscapes. The ability of intact habitat to reduce impacts of energy development is supported in current literature. In Wyoming, sage-grouse (*Centrocercus urophasianus*) residing in a fragmented landscape showed a 3 times greater decline in active leks at conventional coal bed methane well densities (1 well per 32 ha) than those in the most contiguous expanses of Wyoming big sagebrush (*Artemisia tridentata*) in North America (Doherty et al. 2010). A similar relationship has been document for large mammals. In the Boreal forest, woodland caribou (*Rangifer tarandus caribou*) populations could sustain greater levels of industrial development and maintain an increasing population when they resided in large forest tracts that were not fragmented by wildfires (Sorensen et al. 2008).

Our ability to support the hypothesis that habitat quality mitigates impacts could be confounded by time-lags in detecting impacts, as well as the potential for ducks to habituate to wind energy development over time but at a cost to individual fitness (Bejder et al. 2009). The KE wind site was cropland-dominated and began operation in 2003, whereas the TAT wind site was grassland-dominated and began operation in 2008, and was 3 years old during the final field season. Many recent studies for a variety of species and ecosystems have shown time lags between dates of first construction and full biological impacts. In Wyoming impacts to sage-grouse in some instances doubled 4 years post-development versus the initial year of development (Doherty et al. 2010) and lags varied from 2 to 10 years (Harju et al. 2010). In some instances, full biological impacts may not be apparent for decades. For example, 2 decades passed before impacts of forest logging resulted in woodland caribou population extirpation within 13 km of logging (Vors et al. 2007). In a review paper on the effects of wind farms to birds on 19 globally distributed wind farms using meta-analyses, time lags were important in detecting impacts for their meta-analyses with longer operating times of wind farms resulting in greater declines in abundance of Anseriformes (Stewart et al. 2007). Pink-footed geese foraging during spring appear to have habituated to the presence of wind turbines in Europe (Madsen and Boertmann 2008). We therefore cannot distinguish between these 2 competing hypotheses without additional study.

Wind resources are both abundant and wide-spread in the PPR in the United States (Heimiller and Haymes 2001, Kiesecker et al. 2011), and the development of an additional 37 GW of wind energy capacity in the PPR states is necessary to meet 20% of domestic energy needs by 2030 (USDOE 2008). The projected wind farm footprint in PPR states to support this target is approximately 39,601 $km^2$. Even if recommendations for siting energy development outside of intact landscapes suggested by

Kiesecker et al. (2011) are implemented by the wind industry, millions of wetlands occur in agricultural landscapes and our results indicate that wind energy development will likely reduce their use by breeding duck pairs.

Waterfowl conservation partners in the PPR use strategic habitat conservation (Reynolds et al. 1996, 2006; Ringelman 2005; USFWS 2006; Loesch et al. 2012) in an adaptive management framework to target protection, management, and restoration based on biological and landscape information, primarily in response to habitat loss from agricultural activities. From a habitat quality and conservation perspective, wind energy development should be considered as another stressor relative to the cumulative effects of anthropogenic impacts on limiting factors to breeding waterfowl populations.

The protection of remaining, high priority grassland and wetland resources in the United States PPR is the primary focus of waterfowl habitat conservation (Ringelman 2005, Niemuth et al. 2008, Loesch et al. 2012). Population goals and habitat objectives were established to maintain habitat for breeding pairs and the current productivity of the landscape (Ringelman 2005, Government Accounting Office 2007). Spatially explicit decision support tools (Reynolds et al. 1996, Niemuth et al. 2005, Stephens et al. 2008, Loesch et al. 2012) have been used effectively to target and prioritize resources for protection. New stressors such as energy development in the PPR that negatively affect the use of wetland resources have ramifications to breeding waterfowl populations (i.e., potential displacement to lower quality wetland habitat) and their conservation and management. Thus, population and habitat goals, and targeting criteria may need to be revisited if large-scale wind development occurs within continentally important waterfowl conservation areas like the PPR.

## MANAGEMENT IMPLICATIONS

Balancing the development of wind energy and current conservation efforts to protect habitat for migratory birds is complex because most conservation and wind energy development in the region occur on private land (USFWS 2011). Given that breeding duck pairs do not completely avoid wetlands in and adjacent to wind energy developments and resource benefits remain, albeit at reduced levels, the grassland and wetland protection prioritization criteria used by conservation partners in the PPR (Ringelman 2005) could be adjusted to account for avoidance using various scenarios of acceptable impact. For example, the wind sites used in our study are in high priority conservation locations (Ringelman 2005, Loesch et al. 2012). After accounting for effects of duck displacement by wind development, their priority was not reduced for either site. Consequently, wind-development does not necessarily preclude these sites from consideration for protection. Additionally, using the measured negative impact of wind energy development and production on breeding duck pairs, opportunities to work with wind energy industry to mitigate the reduced value of wetlands in proximity to wind towers should be investigated. Continued partnership by the wind energy industry and wildlife conservation groups will be critical for continued research. Further, we suggest expanding our research both spatially and temporally to better address cumulative impacts, zone of influence, impacts on vital rates, potential habituation or tolerance, and/or lag effects of long-term exposure to wind energy development.

## ACKNOWLEDGMENTS

We would like to thank the numerous landowners in the project area for granting permission to access their land to conduct breeding duck pair surveys. T. Mitacek, A. Geisler, C. T. Gue, J. Foth, J. Rehar, A. Northrup, B. Hall, D. W. Brant, J. Weiler, H. P., D. Oates, D. LaRochelle, J. Korkos, K. A. Peterson, M. D. McClanahan, M. A. Fellin, and S. W. Cunningham conducted the field surveys and entered the data. Thanks to the U.S. Fish and Wildlife Service, Kulm Wetland Management District Staff, especially R. Holmgren and D. Peterson for logistical support, and Audubon Wetland Management District and Chase Lake Prairie Project for providing logistical support. We would also like to thank NextEra Energy, the U.S. Fish and Wildlife Service, and Ducks Unlimited for financial support of this project. Finally, we thank W. Meeks and K. Doherty for helpful comments on earlier drafts of this paper. The findings and conclusions in this article are those of the author(s) and do not necessarily represent the views of the U.S. Fish and Wildlife Service.

## LITERATURE CITED

Arnett, E. B., W. K. Brown, W. P. Erickson, J. K. Fielder, B. L. Hamilton, T. H. Henry, A. Jain, G. D. Johnson, J. Kerns, R. R. Koford, C. P. Nicholson, T. J. O'Connell, M. D. Piorkowski, and R. D. Tankersley. 2008. Patterns of bat fatalities at wind energy facilities in North America. Journal of Wildlife Management 72:61–78.

Arnett, E. B., D. B. Inkley, D. H. Johnson, R. P. Larkin, S. Manes, A. M. Manville, J. R. Mason, M. L. Morrison, M. D. Strickland, and R. Thresher. 2007. Impacts of wind energy facilities on wildlife and wildlife habitat. Wildlife Society Technical Review 07-2. The Wildlife Society, Bethesda, Maryland, USA.

Arnold, T. W. 2010. Uninformative parameters and model selection using Akaike's Information Criterion. Journal of Wildlife Management 74:1175–1178.

Austin, J. E. 2002. Responses of dabbling ducks to wetland conditions in the Prairie Pothole Region. Waterbirds 25:465–473.

Batt, B. D. J., M. G. Anderson, C. D. Anderson, and F. D. Caswell. 1989. The use of prairie potholes by North American ducks. Pages 204–227 *in* A. van der Valk, editor. Northern prairie wetlands. Iowa State University Press, Ames, USA.

Bejder, L., A. Samuels, H. Whitehead, H. Finn, and S. Allen. 2009. Impact assessment research: use and misuse of habituation, sensitization and tolerance in describing wildlife responses to anthropogenic stimuli. Marine Ecology Progress Series 395:177–185.

Bellrose, F. C. 1980. Ducks, geese, and swans of North America. Second Edition. Stackpole Books, Harrisburg, Pennsylvania, USA.

Bluemle, J. P. 1991. The face of North Dakota. North Dakota Geological Survey, Educational Series 21, Bismarck, USA.

Brasher, M. G., R. M. Kaminski, and L. W. Burger, Jr. 2002. Evaluation of indicated breeding pair criteria to estimate mallard breeding populations. Journal of Wildlife Management 66:985–992.

Burnham, K. P., and D. R. Anderson. 2002. Model selection and multimodel inference: a practical information-theoretic approach. Springer-Verlag, New York, New York, USA.

Chambers, J. M. 1992. Linear models. Pages 99–116 *in* J. M. Chambers and T. J. Hastie, editors. Statistical models. S. Wadsworth & Brooks/Cole, Belmont, California, USA.

Claassen, R., F. Carraizo, J. C. Cooper, D. Hellerstein, and K. Ueda. 2011. Grassland to cropland conversion in the Northern Plains: the role of crop insurance, commodity, and disaster programs. U.S. Department of Agriculture Economic Research Service Economic Research Report 120, Washington, D.C., USA.

Congdon, P. 2005. Bayesian models for categorical data. John Wiley and Sons, Chichester, West Sussex, England.

Copeland, H. E., A. Pocewicz, and J. M. Kiesecker. 2011. Geography of energy development in western North America: potential impacts on terrestrial ecosystems. Pages 7–25 *in* D. E. Naugle, editor. Energy development and wildlife conservation in western North America. Island Press, Washington D.C., USA.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service, Office of Biological Science-79/31, Washington, D.C., USA.

Cowardin, L. M., D. H. Johnson, T. L. Shaffer, and D. W. Sparling. 1988. Applications of a simulation model to decisions in mallard management. U.S. Department of the Interior Fish and Wildlife Service Technical Report 17, Washington, D.C., USA.

Cowardin, L. M., T. L. Shaffer, and P. M. Arnold. 1995. Evaluations of duck habitat and estimation of duck population sizes with a remote-sensing-based approach. Biological Science Report No. 2. U.S. Department of the Interior, Washington, D.C., USA.

Crawley, M. J. 2007. The R book. John Wiley and Sons, Chichester, West Sussex, England.

Dahl, T. E. 1990. Wetlands losses in the United States 1780's to 1980's. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C., USA.

Dahlgren, R. B., and C. E. Korschgen. 1992. Human disturbances of waterfowl: an annotated bibliography. U.S. Fish and Wildlife Service Resource Publication 188, Washington, D.C., USA.

Doherty, K. E., D. E. Naugle, and B. L. Walker. 2010. Greater sage-grouse nesting habitat: the importance of managing at multiple scales. Journal of Wildlife Management 74:1544–1553.

Drewitt, A. L., and R. H. W. Langston. 2006. Assessing the impacts of wind farms on birds. Ibis 148:29–42.

Dzubin, A. 1969. Assessing breeding populations of ducks by ground counts. Pages 178–230 *in* Saskatoon Wetlands Seminar. Canadian Wildlife Service Report 6, Ottawa, Canada.

Forman, R. T. T., and L. E. Alexander. 1998. Roads and their major ecological effects. Annual Review of Ecological Systems 29:207–231.

Gelman, A., J. B. Carlin, H. S. Stern, and D. B. Rubin. 2004. Bayesian data analysis. Second Edition. Chapman and Hall/CRC Press, Boca Raton, Florida, USA.

Government Accounting Office. 2007. Prairie Pothole Region: at the current pace of acquisitions, the U.S. Fish and Wildlife Service is unlikely to achieve its habitat protection goals for migratory birds. Report to the Subcommittee on Interior, Environment, and Related Agencies, Committee on Appropriations, House of Representatives. United States Government Accountability Office. 07-1093, Washington, D.C., USA.

Greenwood, R. J., A. B. Sargeant, D. H. Johnson, L. M. Cowardin, and T. L. Shaffer. 1995. Factors associated with duck nest success in the Prairie Pothole Region of Canada. Wildlife Monographs 128.

Gue, C. T. 2012. Effects of a large-scale wind farm in the Prairie Pothole Region of North and South Dakota on survival and habitat use of breeding female mallards (*Anas platyrhynchos*) and blue-winged teal (*A. discors*). Thesis, University of North Dakota, Grand Forks, USA.

Habib, L., E. M. Bayne, and S. Boutin. 2007. Chronic industrial noise affects pairing success and age structure of ovenbirds *Seiurus aurocapilla*. Journal of Applied Ecology 44:176–184.

Hammond, M. C. 1969. Notes on conducting waterfowl breeding population surveys in the north central states. Pages 238–254 *in* Saskatoon Wetlands Seminar. Canadian Wildlife Service Report 6, Ottawa, Canada.

Harju, S. M., M. R. Dzialak, R. C. Taylor, L. D. Hayden-Wing, and J. B. Winstead. 2010. Thresholds and time lags in effects of energy development on greater sage-grouse populations. Journal of Wildlife Management 74:437–448.

Heimiller, D. M., and S. R. Haymes. 2001. Geographic information systems in support of wind energy activities at NREL. National Renewable Energy Laboratory, Golden, Colorado, USA.

Higgins, K. F., L. M. Kirsch, A. T. Klett, and H. W. Miller. 1992. Waterfowl production on the Woodworth Station in south-central North Dakota, 1965–1981. U.S. Fish and Wildlife Service, Resource Publication 180, Washington, D.C., USA.

Ingelfinger, F., and S. Anderson. 2004. Passerine response to roads associated with natural gas extraction in a sagebrush steppe habitat. Western North American Naturalist 64:385–395.

Jackman, S. 2008. pscl: classes and methods for R developed in the Political Science Computational Laboratory, Stanford University. Department of Political Science, Stanford University, Stanford, California, USA.

Johnson, D. H., and J. W. Grier. 1988. Determinants of breeding distributions of ducks. Wildlife Monographs 100.

Johnson, D. H., J. D. Nichols, and M. D. Schwartz. 1992. Population dynamics of breeding waterfowl. Pages 446–485 *in* B. D. J. Batt, A. D. Afton, M. G. Anderson, C. D. Ankney, D. H. Johnson, J. A. Kadlec, and G. L. Krapu, editors. Ecology and management of breeding waterfowl. University of Minnesota Press, Minneapolis, USA.

Johnson, G. D., W. P. Erickson, M. D. Strickland, M. F. Shepard, and D. A. Shepard. 2000. Avian monitoring studies at the Buffalo Ridge, Minnesota wind resource area: results of a 4-year study. Final report. West Ecosystems Technology, Inc., Cheyenne, Wyoming, USA.

Johnson, R. R., and K. F. Higgins. 1997. Wetland resources of eastern South Dakota. South Dakota State University, Brookings, USA.

Kass, R. E., B. P. Carlin, A. Gelman, and R. M. Neal. 1998. Markov chain Monte Carlo in practice: a roundtable discussion. American Statistician 52:93–100.

Kiesecker, J. M., J. S. Evans, J. Fargione, K. Doherty, K. R. Foresman, T. H. Kunz, D. Naugle, N. P. Nibbelink, and N. D. Niemuth. 2011. Win-win for wind and wildlife: a vision to facilitate sustainable development. PLoS ONE 6:e17566.

Krausman, P. R. 2011. Quantifying cumulative effects. Pages 47–64 *in* P. R. Krausman and L. K. Harris, editors. Cumulative effects in wildlife management—impact mitigation. CRC Press, Boca Raton, Florida, USA.

Kuvlesky, W. P., L. A. Brennan, M. L. Morrison, K. K. Boydston, B. M. Ballard, and F. C. Bryant. 2007. Wind energy development and wildlife conservation: challenges and opportunities. Journal of Wildlife Management 71:2487–2498.

Larsen, J. K., and J. Madsen. 2000. Effects of wind turbines and other physical elements on field utilization by pink-footed geese (*Anser brachyrhynchus*): a landscape perspective. Landscape Ecology 15:755–764.

Leddy, K. L., K. F. Higgins, and D. E. Naugle. 1999. Effects of wind turbines on upland nesting birds in Conservation Research Program grasslands. Wilson Bulletin 111:100–104.

Link, W. A., and R. J. Barker. 2009. Bayesian inference with ecological applications. Academic Press, Burlington, Massachusetts, USA.

Loesch, C. R., R. E. Reynolds, and L. T. Hansen. 2012. An assessment of re-directing breeding waterfowl conservation relative to predictions of climate change. Journal of Fish and Wildlife Management 3:1–22.

Mac, M. J., P. A. Opler, C. E. Puckett Haecker, and P. D. Doran. 1998. Status and trends of the nation's biological resources. U.S. Department of the Interior, U.S. Geological Survey, Reston, Virginia, USA.

Madders, M., and D. P. Whitfield. 2006. Upland raptors and the assessment of wind farm impacts. Ibis 148:43–56.

Madsen, J. 1995. Impacts of disturbance on migratory waterfowl. Ibis 137:S67–S74.

Madsen, J., and D. Boertmann. 2008. Animal behavioral adaptation to changing landscapes: spring staging geese habituate to wind farms. Landscape Ecology 23:1007–1011.

McCullagh, P., and J. A. Nelder. 1989. Generalized linear models (Monographs on statistics and applied probability 37). Chapman Hall, London, England.

McDonald, R. I., J. Fargione, J. Kiesecker, W. M. Miller, and J. Powell. 2009. Energy sprawl or energy efficiency: climate policy impacts on natural habitat for the United States of America. PLoS ONE 4(8):e6802.

McDonald, T. L., W. P. Erickson, and L. L. McDonald. 2000. Analysis of count data from before-after control-impact studies. Journal of Agricultural, Biological, and Environmental Statistics 5:262–279.

Naugle, D. E., R. R. Johnson, T. R. Cooper, M. M. Holland, and K. F. Higgins. 2000. Temporal distribution of waterfowl in eastern South Dakota: implications for aerial surveys. Wetlands 20:177–183.

Niemuth, N. D., G. W. Beyersbergen, and M. R. Norton. 2005. Waterbird conservation planning in the northern prairie and parkland region: inte-

gration across borders and with other bird conservation initiatives. Pages 184–189 *in* J. C. Ralph and T. D. Rich, editors. Bird conservation implementation and integration in the Americas: proceedings of the third international partners in flight conference. Volume 1 General Technical Report PSW-GTR-191. U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, Albany, California, USA.

Niemuth, N. D., R. E. Reynolds, D. A. Granfors, R. R. Johnson, B. Wangler, and M. E. Estey, 2008. Landscape-level planning for conservation of wetland birds in the U.S. Prairie Pothole Region. Pages 533–560 *in* J. J. Millspaugh and F. R. Thompson, III, editors. Models for planning wildlife conservation in large landscapes. Elsevier Science: Burlington, Massachusetts, USA.

Niemuth N. D., B. Wangler, and R. E. Reynolds. 2010. Spatial and temporal variation in wet area of wetlands in the Prairie Pothole Region of North Dakota and South Dakota. Wetlands 30:1053–1064.

OpenEnergyInfo. 2012. Openenergyinfo homepage. <http://en.openei.org>. Accessed 6 Aug 2012.

Oslund, F. T., R. R. Johnson, and D. R. Hertel. 2010. Assessing wetland changes in the Prairie Pothole Region of Minnesota from 1980 to 2007. Journal of Fish and Wildlife Management 1:131–135.

Pagano, A. M., and T. W. Arnold. 2009. Detection probabilities for ground-based breeding waterfowl surveys. Journal of Wildlife Management 73:392–398.

Pearce-Higgins, J. W., S. Leigh, R. H. W. Langston, I. P. Bainbridge, and R. Bullman. 2009. The distribution of breeding birds around upland wind farms. Journal of Applied Ecology 46:1323–1331.

Plummer, M., N. Best, K. Cowles, and K. Vines. 2009. coda: output analysis and diagnostics for MCMC. Version 0.13-4. R Development Core Team, Vienna, Austria.

R Development Core Team. 2011. R: a language and environment for statistical computing. Version 2.13.1. R Development Core Team, Vienna, Austria.

Reijnen, R., and R. Foppen. 2006. Impact of road traffic on breeding bird populations. Pages 255–274 *in* J. Davenport and J. L. Davenport, editors. The ecology of transportation: managing mobility for the environment. Environmental Pollution volume 10. Springer, Dordrecht, The Netherlands.

Reynolds, R. E., D. R. Cohan, and M. A. Johnson. 1996. Using landscape information approaches to increase duck recruitment in the Prairie Pothole Region. Transactions of the North American Wildlife and Natural Resources Conference 61:86–93.

Reynolds, R. E., C. R. Loesch, B. Wangler, and T. L. Shaffer. 2007. Waterfowl response to the Conservation Reserve Program and Swampbuster Provisions in the Prairie Pothole Region, 1992–2004. U.S. Department of Agriculture RFA 05-IA-04000000-N34, Bismarck, North Dakota, USA.

Reynolds, R. E., T. L. Shaffer, C. R. Loesch, and R. R. Cox. Jr., 2006. The Farm Bill and duck production in the Prairie Pothole Region: increasing the benefits. Wildlife Society Bulletin 34:963–974.

Reynolds, R. E., T. L. Shaffer, R. W. Renner, W. E. Newton, and B. D. J. Batt. 2001. Impact of the Conservation Reserve Program on duck recruitment in the U.S. Prairie Pothole Region. Journal of Wildlife Management 65:765–780.

Ringelman, J. K., editor. 2005. Prairie Pothole Joint Venture 2005 implementation plan. U.S. Fish and Wildlife Service, Denver, Colorado, USA.

Royle, J. A., and R. M. Dorazio. 2008. Hierarchical modeling and inference in ecology: the analysis of data from populations, metapopulations and communities. Academic Press, Burlington, Massachusetts, USA.

Schneider, R. R., J. B. Stelfox, S. Boutin, and S. Wasel. 2003. Managing the cumulative impacts of land uses in the Western Canadian Sedimentary Basin: a modeling approach. Conservation Ecology 7:8.

Shaffer, J. A., and D. H. Johnson. 2008. Displacement effects of wind developments on grassland birds in the northern Great Plains. Pages 57-61 *in* Proceedings of wind wildlife research meeting VII. National Wind Coordinating Collaborative, Washington, D.C., USA.

Sorensen, T., P. D. McLoughlin, D. Hervieux, E. Dzus, J. Nolan, B. Wynes, and S. Boutin. 2008. Determining sustainable levels of cumulative effects for boreal caribou. Journal of Wildlife Management 72:900–905.

Spiegelhalter, D., A. Thomas, N. Best, and D. Lunn. 2003. WinBUGS user manual, version 1.4. Cambridge: MRC Biostatistics Unit, Cambridge, United Kingdom.

Stephens, S. E., J. J. Rotella, M. S. Lindberg, M. L. Taper, and J. K. Ringelman. 2005. Duck nest survival in the Missouri Coteau of North Dakota: landscape effects at multiple spatial scales. Ecological Applications 15:2137–2149.

Stephens, S. E., J. A. Walker, D. R. Blunck, A. Jayaraman, D. E. Naugle, J. K. Ringleman, and A. J. Smith. 2008. Predicting risk of habitat conversion in native temperate grasslands. Conservation Biology 22:1320–1330.

Stewart, G. B., A. S. Pullin, and C. F. Coles. 2007. Poor evidence-base for assessment of windfarm impacts on birds. Environmental Conservation 34:1–11.

Stewart, R. E., and H. A. Kantrud. 1973. Ecological distribution of breeding waterfowl populations in North Dakota. Journal of Wildlife Management 37:39–50.

Streftaris, G., and B. J. Worton. 2008. Efficient and accurate approximate Bayesian inference with an application to insurance data. Computational Statistics and Data Analysis 52:2604–2622.

Sturtz, S., U. Ligges, and A. Gelman. 2005. R2WinBUGS: a package for running WinBUGS from R. Journal of Statistical Software 12: 1–16.

United States Department of Energy [USDOE]. 2008. 20% wind energy by 2030 increasing wind energy's contribution to U.S. electricity supply. Department of Energy, Office of Scientific and Technical Information, Oak Ridge, Tennessee, USA.

United States Department of Energy [USDOE]. 2011. Wind Power America homepage. <http://www.windpoweringamerica.gov>. Accessed 6 Aug 2012.

U.S. Fish and Wildlife Service [USFWS]. 2006. Strategic habitat conservation plan: final report of the National Ecological Assessment Team. Department of the Interior, Washington, D.C., USA.

U.S. Fish and Wildlife Service [USFWS]. 2011. Annual report of lands under the control of the U.S. Fish and Wildlife Service. Department of the Interior, U.S. Fish and Wildlife Service Division of Realty, Washington D.C., USA.

U.S. Fish and Wildlife Service [USFWS]. 2012. Waterfowl population status, 2012. U.S. Department of the Interior, Washington, D.C., USA.

van der Valk. A. G., editor. 1989. Northern prairie wetlands. Iowa State University Press, Ames, USA.

Vors, L. S., J. A. Schaefer, B. A. Pond, A. R. Rodgers, and B. R. Patterson. 2007. Woodland caribou extirpation and anthropogenic landscape disturbance in Ontario. Journal of Wildlife Management 71:1249–1256.

Walker, D., M. McGrady, A. McCluskie, M. Madders, and D. R. A. McLeod. 2005. Resident golden eagle ranging behaviour before and after construction of a wind farm in Argyll. Scottish Birds 25:24–40.

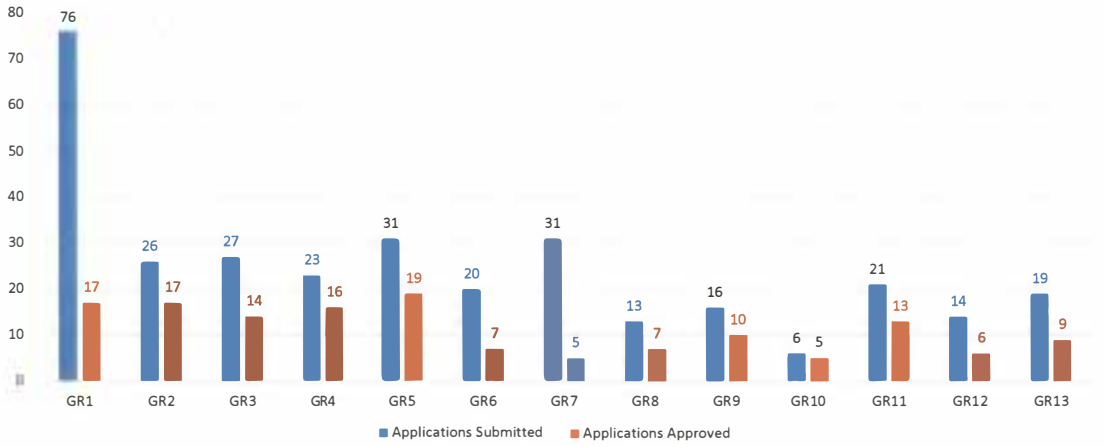
Walker, J. A. 2011. Survival of duck nests, distribution of duck broods, and habitat conservation targeting in the Prairie Pothole Region. Dissertation, University of Alaska Fairbanks, USA.

Winkelman, J. E. 1990. Impact of the wind park near Urk, Netherlands, on birds: bird collision victims and disturbance of wintering fowl. International Ornithological Congress 20:402–403.

Zuur, A. F., E. N. Ieno, and G. M. Smith. 2007. Analysing ecological data. Springer Verlag, New York, New York, USA.

*Associate Editor: Michael Chamberlain.*

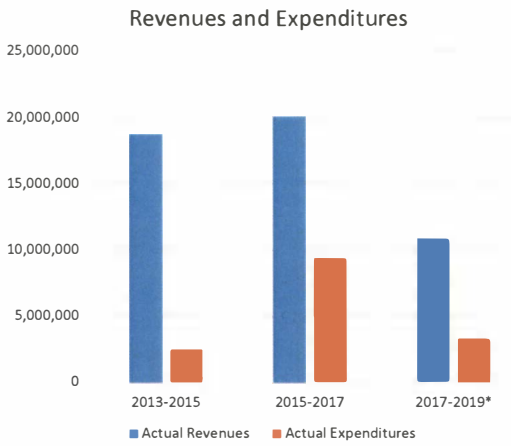
# Applications Submitted and Funded

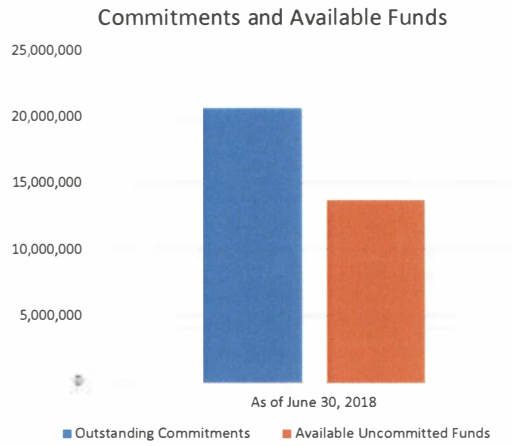



# Amount Requested and Awarded

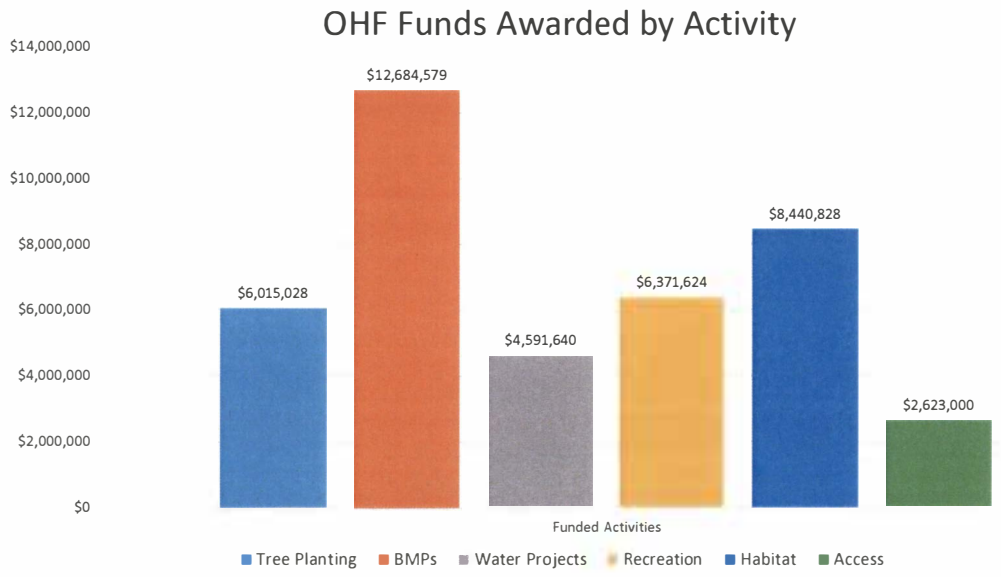

*In millions.

# OHF Financial Summary



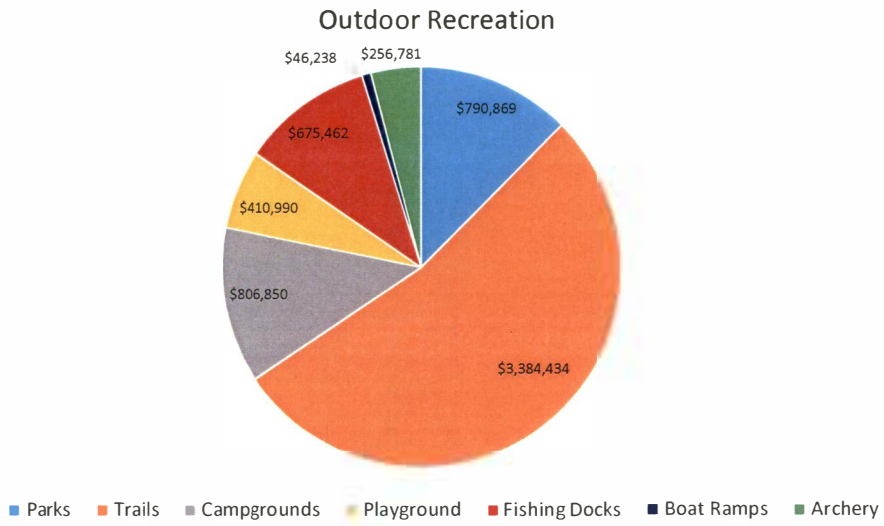

*Through June 30, 2018




*Through R13

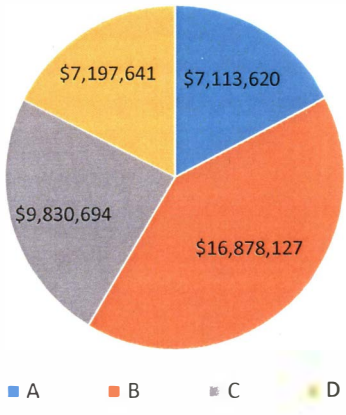
*Projects that were approved and subsequently withdrawn by recipient not included. Tree planting occurs in small amounts in other activities. Examples of BMPs include: perimeter fencing, cross fencing, wells, tanks, pipelines, cover crops, and grass planting.

# Outdoor Recreation – $6,371,624




*Through R13

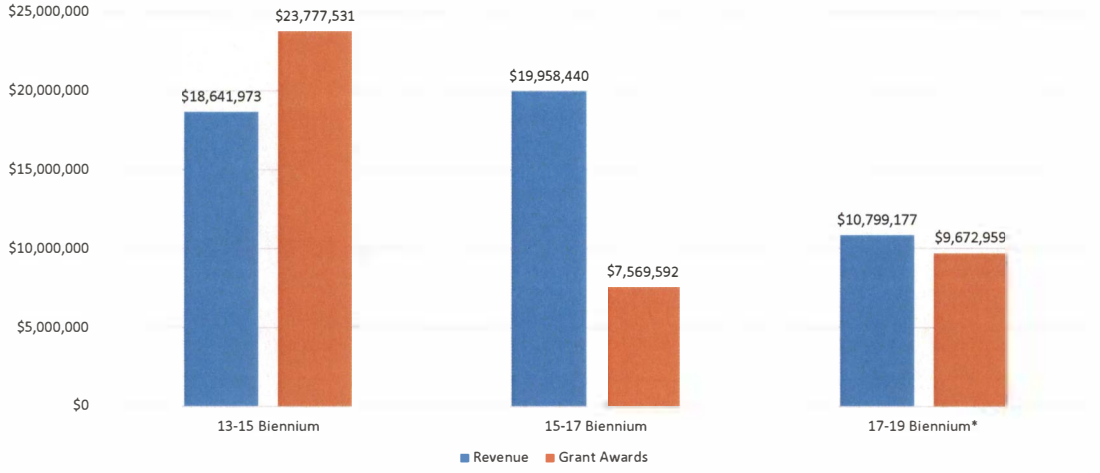
# OHF Funds Awarded By Directive




- Directive A - Providing access to private and public lands for sportsmen, including projects that create fish and wildlife habitat and provide access for sportsmen;
- Directive B - Improving, maintaining and restoring water quality, soil conditions, plant diversity, animal systems, and by supporting other practices of stewardship to enhance farming and ranching;
- Directive C - Developing, enhancing, conserving and restoring wildlife and fish habitat on private and public lands; and
- Directive D - Conserving natural areas and creating other areas for recreation through the establishment and development of parks and other recreation areas.

*Through R13

# OHF Funds Received and Awarded by Biennium




*Funds received through 10/2018

| Round | Directive | Title | Applicant | Summary | NDIC Approved Funding |
|---|---|---|---|---|---|
| 1 | B | Sheyenne River Sedimentation Reduction Project | Barnes County Soil Conservation District | Project is designed to provide technical, financial and educational assistance to all agriculture producers and landowners with riparian acreage and/or upland cropland at high risk of erosion within the Sheyenne River watershed in Barnes County. Goal is to restore the aquatic life uses and to maintain the recreational uses of the Sheyenne River and its tributaries. | $126,000 |
| 1 | B | Antelope Creek Wild Rice Corridor Watershed Restoration Project | Richland Soil Conservation District | Restore the recreational uses of the impaired reaches of the Antelope Creek and Wild Rice River. Offer cash share match to encourage landowners /participants to replace the declining field windbreaks in Richland County. | $105,000 |
| 1 | B | Ransom County Water Quality Improvement Project | Ransom County Soil Conservation District | To restore the recreational and aquatic uses of the Sheyenne and Maple River watersheds in Ransom County. This will be accomplished by containing livestock manure runoff from 5 animal feeding operations in Ransom County and implementation of nutrient management plans for each operation. | $115,000 |
| 1 | B | The Marcus Friskop Nature Center | Hankinson Public School | The Marcus Friskop Nature Center will provide intergenerational, year- round educational opportunities focusing on the environment, including restoration and protection of plant and wildlife ecosystems. | $30,000 |
| 1 | B | ND Statewide Conservation Tree Planting Initiative | ND Association of Soil Conservation Districts | Engage stewards to embrace conservation practices that promote the ecological services trees provide. Focus on encouraging and providing financial assistance to implement agroforestry practices in ND including farmstead, feedlot and field windbreaks; forestry, wildlife and riparian plantings, buffers, and living snow fences. | $1,878,000 |
| 1 | B | Enhanced Grazing Lands & Wildlife Habitat (Phase 1) | Ducks Unlimited, Inc. | Enroll 20,000 additional grassland acres in the Environmental Quality Incentive Program over the next year, while offering increased public access on approximately 3,750 acres. | $828,000 |
| 2 | B | Bald Hill Creek Watershed Project | Griggs County Soil Conservation District | OHF funds will be used strictly to reduce the landowners cost of implementing best management practices to meet the overall goal of restoring the aquatic life uses and to maintain the recreational uses of the Bald Hill Creek and its tributaries. | $300,000 |
| 2 | B | Stutsman County Manure Management Project | Stutsman County Soil Conservation District | Restore & maintain recreational and aquatic uses to priority water bodies in Stutsman County through the proper handling of livestock wastes through either spreading out winter feeding areas (30 winter rotational grazing/feeding systems) and addressing Animal Feeding Operations (5 full Manure Management Systems). | $300,000 |
| 2 | B | Red River Riparian Project | Red River Regional Council | OHF Funds will be used to solely supplement cost share to landowners for projects that will enhance riparian areas and improve water quality in the targeted watersheds of the Middle Sheyenne, Forest and Park Rivers. | $230,000 |
| 2 | B | Turtle Creek Watershed Project Water & Habitat Initiative | South McLean County Soil Conservation District | Funds will be used to provide a portion of the non-federal match for Best Management Practices (BMP) that mitigate impact of animal feeding operations, create additional non-aquatic habitat in addition to improving water quality of surface water or preserve the integrity of existing or newly established riparian ecosystems within the Turtle Creek watershed | $138,000 |

SB 2261 1.25.19 #1

| Round | Directive | Title | Applicant | Summary | NDIC Approved Funding |
|---|---|---|---|---|---|
| 2 | B | North Dakota Pollinator Partnership | Pheasants Forever, Inc. | Funds will be used to pay for the increased cost associated with customized and optimal seed mixes for pollinators on newly established 30-year Wetland Reserve Program (WRP) and used to upgrade existing WRP contracts which are currently dominated by stands of monotypic cover. Will include best practices of site preparation, seed, seeding, and clipping in order to establish high diversity plantings. Impact on 1,250 acres of WRP acres | $173,750 |
| 3 | B | Wild Rice River Restoration & Riparian Project Phase II | Wild Rice Soil Conservation District | Improve, maintain and restore water quality, soil conditions through best management practices. The best practice being proposed is the use of the tool -- Light Detection and Ranging (LIDAR) technology and includes the establishment of vegetative riparian buffer zones. Outdoor Heritage Fund dollars would be used to partially pay for an easement to develop and implement 363 acres (approximately 10 miles) of riparian easement along the Wild Rice River | $9,937 |
| 4 | B | Riparian Grazing Systems Project | Stutsman County Soil Conservation District | Restore proper vegetative balance in riparian areas; proper rotation of grazing animals through use of a multi-celled grazing system; restore and maintain water quality | $253,500 |
| 5 | B | Sheyenne River Sedimentation Reduction Project Phase II | Barnes County Soil Conservation District | Promote the use of best management practices to restore the aquatic life uses and to maintain the recreational uses of the Sheyenne River and its tributaries. OHF used to reduce landowner costs of implementing best management practices by 60%. | $200,000 |
| 5 | B | Homme Dam Watershed 319 Project | Walsh County Three River Soil Conservation District | Restore water quality and beneficial uses of recreation and aquatic life to the Homme Dam Reservoir in Walsh County through implementation of best management practices such as riparian vegetation cover, prescribed grazing systems, riparian forest buffers, streambanks/shoreline stabilization | $65,000 |
| 5 | B | North Dakota Statewide Windbreak Renovation Initiative | North Dakota Forest Service | Reduce the number of windbreaks destroyed by offering incentives to replace dead/deteriorating windbreaks, incorporate species diversity and select species most suitable, administer a simple, effective, statewide cost-share program that leverages landowner's match with a source of grant funds for a variety of windbreak renovation practices. | $1,800,000 |
| 5 | B | Marcus Friskop Learning Center (Phase 2) | Hankinson Public School | Access to South Lake Elsie (Phase 2), primitive campsites. | $7,000 |
| 5 | B | Beginning Farmer Enhancement | North Dakota Natural Resources Trust | Implement projects identified by landowners participating in the Natural Resources Trust Beginning Farmer Assistance Program which include installation of fencing, installation of wind break panels, installing water quality management practices, drilling of new water wells, installing solar pumps, water tanks and pipelines, planting of cover crop. | $132,884 |
| 5 | B | Emmons County Grassland & Cropland Conservation Effort | Emmons County Soil Conservation District | To provide funding for landowners and operators to implement conservation practices which address grassland and cropland resource needs. Payments to applicant will not exceed 60% of the actual cost. | $630,000 |

| Round | Directive | Title | Applicant | Summary | NDIC Approved Funding |
|---|---|---|---|---|---|
| 6 | B | ND Statewide Conservation Tree Planting Initiative | ND Association of Soil Conservation Districts (NDASCD) | Continuance for two-years of this Initiative that promotes and provides financial assistance to implement agroforestry practices in ND including farmstead, feedlot and field windbreaks; forestry, wildlife and riparian plantings, buffers and living snow fences. Includes funding for staffing costs. | $2,050,000 |
| 6 | B | Alkali Lake Habitat Enhancement | Audubon Dakota | Implementation of a prescribed grazing system on the Audubon's Edward M. Brigham III Alkali Lake Ranch/use cattle in a managed rotational system to increase nesting, brooding and feeding cover for grassland birds, and create more hunting and outdoor recreation opportunities. Involves 1,000 acres of grassland and wetland habitat | $135,169 |
| 6 | B | Working Grassland Partnership | North Dakota Natural Resources Trust & 3 co-applicants | OHF funding will be used to provide land development assistance to landowners interested in livestock fencing and livestock water development on SAFE and adjacent acres with a project area focus that is important for grassland birds with declining populations (funding for fencing costs and water development costs). Includes funding for project staff. | $1,097,250 |
| 7 | B | O-M-G Grassland Improvement Project | Morton County SCD, Grant County SCD, Oliver County SCD | Providing technical and financial assistance for the implementation of livestock water systems, cross-fencing, grassland plantings and grazing plans - 16,000 grassland acres | $900,000 |
| 8 | B | Grasslands Enhancement Pilot Project | Ducks Unlimited, Inc. & ND Natural Resources Trust | Providing necessary infrastructure to improve grazing systems (rotational grazing systems) on school trust and public lands while providing private lands with necessary rest recovery time. | $230,000 |
| 8 | B | The Bee Integrated Demonstration Project | Keystone Policy Center | Demonstrate how effective best practices for bee forage and nutrition, crop pest control, varroa mite management, and farmer/beekeeper cooperation can be effectively combined and implemented into an integrated program. | $94,768 |
| 8 | B | Cass County Cover Crop Project | Cass County Soil Conservation | Provide financial assistance and technical assistance for establishing conservation cover crops in Cass County. This program is designed to help promote conservation cover crops and provide cost share to willing participants. | $60,000 |
| 8 | B | Logan County Natural Resource Program | Logan County Soil Conservation District | Providing technical and financial assistance for the implementation of conservation crop rotations with increased high residue crops, seeding fall crops to increase nesting cover over winter, planting season long cover crops with multi species, implementing prescribed grazing plans and converting cropland to grassland. Implementing conservation practices to address cropland and grassland resource needs for the benefit of livestock production, soil health and wildlife management. | $210,000 |
| 9 | B | Southwest Grazing Lands Improvement Project | Pheasants Forever, Inc. | Installation of grazing systems to promote rotational grazing on approximately 6,000 acres of private land. Grazing systems will include cross fencing, pipelines and watering facilities and grass plantings. | $216,900 |

| Round | Directive | Title | Applicant | Summary | NDIC Approved Funding |
|---|---|---|---|---|---|
| 9 | B | Red River Riparian Program - Phase 6 | Red River Regional Council | Cost share assistance for 60% of total projects costs related to implementation of certain best management practices to restore, protect and employ effective management of riparian areas as well as livestock and farmland along the Red River riparian corridor. Cost share assistance of 21% of the total project costs for the native prairie restoration project. | $584,200 |
| 9 | B | Cover Crop & Livestock Integration Project | Ducks Unlimited, Inc. | Provides a 60% cost share for cover crop implementation and grazing infrastructure necessary for livestock integration on cropland on more than 5,280 acres in southeast ND and enhances an additional 1,900 acres of grassland. Five year agreements will be required with the landowner | $625,395 |
| 9 | B | Give Me Back My Acres | Towner County Soil Conservation District | Seeding of specific cover crop on a maximum of 40 salinity acres. (2.5 acres maximum per producer) | $3,334 |
| 10 | B | Working Grassland Partnership (Phase II) | ND Natural Resources Trust & ND Associaton of Soil Conservation Districts, Ducks Unlimited, Pheasants Forever | Providing livestock water and fencing cost-share assistance to landowners to retain CRP acres in grasslands and develop technical rotational grazing plans to utilize livestock as the primary management tool. This phase includes Barnes, Ransom, Richland and Sargent Counties. | $903,750 |
| 11 | B | Middle Sheyenne River Watershed Project | Wells County SCD | Improve Sheyenne watershed through 2 grazing management plans and one field windbreak planting. | $38,040 |
| 11 | B | McHenry County Conservation Program | North McHenry SCD | Assist with the installations of 20-25 grazing systems and complete 3-5 grass plantings, impacting a total of 12,000 acres. | $250,000 |
| 12 | B | Painted Woods Lake Flood Damage Reduction Project | McLean County Water Resource Board | Construction of Phase 1 of a high flow channel on Painted Woods Lake and construction of wildlife enhancements | $211,732 |
| 12 | B | Bowman-Slope SCD Grazing Conservation Program | Bowman-Slope SCD | Assist 3 producers with grazing BMP's including fencing, wells, pipelines, and tanks impacting 5,000 acres. | $112,354 |
| 13 | B | North Central Soil Health & Habitat | Pheasants Forever | Work with 10-20 growers over 3 years to impact 3250 grower designated salt impacted acres from annual crop production and establish deep rooted salt tolerant perennial vegetation. The use of cover crops on adjacent acres will be an additional practice to further promote soil health and salinity management. Workshops will also be held. | $52,500 |
| 13 | B | Cover Crop & Livestock Integration Project II | Ducks Unlimited | Provide cost share for implementation of livestock fencing & water, and cover crop seed costs. | $1,250,790 |
| 13 | B | Central Coteau Prairie Management Toolbox | Audubon Dakota | Provide landowners with financial and/or technical assistance to promote conservation practices on approximately 2,700 acres of grazing lands, prairie enhancement and restoration on 750 acres, and control invasive species on 600 acres. Partner in-kind match will control invasive species on a 9,000 additional acres. Counties include Burleigh, McLean, and Sheridan. | $529,874 |
| | | | | | **$16,878,127** |

SB 2261
2.14.19
#1

19.0936.02001

Sixty-sixth
Legislative Assembly
of North Dakota

# SENATE BILL NO. 2261

Introduced by

Senators Unruh, Cook, Wardner

Representatives Keiser, Lefor, Schmidt

A BILL for an Act to create and enact a new section to chapter 49-22 and a new section to chapter 49-22.1 of the North Dakota Century Code, relating to mitigating adverse ~~direct and indirect~~ environmental impacts.

**BE IT ENACTED BY THE LEGISLATIVE ASSEMBLY OF NORTH DAKOTA:**

**SECTION 1.** A new section to chapter 49-22 of the North Dakota Century Code is created and enacted as follows:

**Mitigating adverse ~~direct and indirect~~ environmental impacts.**

~~1.~~ The commission or any state agency with jurisdiction over any aspect of a proposed site, corridor, route, or facility, may not require an applicant to provide payment to any person for the mitigation of any assessed adverse direct or indirect environmental or wildlife impact of a proposed site, corridor, route, or facility.

~~2. An applicant may not provide payment to any person for the mitigation of any assessed adverse indirect environmental or wildlife impact of a proposed site, corridor, route, or facility.~~

~~3. Any payment made by an applicant for mitigation of any assessed adverse direct environmental or wildlife impact of a proposed site, corridor, route, or facility must be deposited in the outdoor heritage fund unless directed otherwise by the applicant.~~

**SECTION 2.** A new section to chapter 49-22.1 of the North Dakota Century Code is created and enacted as follows:

**Mitigating adverse ~~direct and indirect~~ environmental impacts.**

~~1.~~ The commission or any state agency with jurisdiction over any aspect of a proposed site, corridor, route, or facility, may not require an applicant to provide payment to any person for the mitigation of any assessed adverse direct or indirect environmental or wildlife impact of a proposed site, corridor, route, or facility.

SB 2261
2.14.19
#1

~~2. An applicant may not provide payment to any person for the mitigation of any assessed adverse indirect environmental or wildlife impact of a proposed site, corridor, route, or facility.~~

~~3. Any payment made by an applicant for mitigation of any assessed adverse direct environmental or wildlife impact of a proposed site, corridor, route, or facility must be deposited in the outdoor heritage fund unless directed otherwise by the applicant.~~

#1
SB2261
3/8/19

North Dakota Senate

State Capitol
600 East Boulevard Avenue
Bismarck, ND 58505-0360

Senator Jessica Unruh
District 33
1224 First Avenue NE
Beulah, ND 58523-6301

jkunruh@nd.gov

Committees:
Energy and Natural Resources, Chairman
Finance and Taxation

03/07/2019

Senate Bill 2261 addresses the authority of the North Dakota Public Service Commission and their authority to require mitigation payments for environmental impacts during the siting process. This bill expressly states in both siting acts (addressing all types of energy development) that mitigation payments for environmental impacts cannot be required for approval of a project.

I've attached some documents to explain the history on this topic. I'll refer to them now.

This bill does not change what the Commission can consider when siting a project. Direct and indirect environmental and economic impacts are still tools the Commission would still have when siting a project and that is very important.

Mitigation efforts are best completed on the land that is affected and in cooperation with that specific land owner. That is currently how the Commission handles mitigation in their orders and would continue to do in the future, engaging land owners and the companies applying for the permit.

As a professional in this area, I can say one thing for certain - it is almost impossible to use the scientific and economic analysis process to adequately and fairly quantify and assign a value to indirect environmental impacts. It's not fair to our land owners and allowing a payment to be attached to them is irresponsible of us at this time. We need this legislation to provide direction and clarity not only for the landowners, but for the Commission and the companies involved. And we need to avoid increasing the cost of energy to ratepayers, which is the real end result of required mitigation payments.

The solution to this problem is complicated, as we all have learned. My hope is to hear from all the parties affected today and that we can all head in the same direction together.

19.9416.01000

#1
SB 2261
3/8/19

# North Dakota Legislative Council

STATE CAPITOL, 600 EAST BOULEVARD, BISMARCK, ND 58505-0360



October 3, 2018

Honorable Jessica Unruh
State Senator
1224 First Avenue NE
Beulah, ND 58523-6301

Dear Senator Unruh:

This letter is in response to your inquiry regarding the Public Service Commission's (PSC) authority to require direct and indirect mitigation payments when companies request siting permits.

In 1975 the Legislative Assembly passed Senate Bill No. 2050, the North Dakota Energy Conversion and Transmission Facility Siting Act (Appendix A). Section 9 of the bill, codified as North Dakota Century Code Section 49-22-09, lists the factors the PSC must consider when evaluating an application and designation of sites and corridors. The factors include an evaluation of the adverse direct and indirect environmental effects that cannot be avoided if the proposed site, corridor, or route is accepted. The factors also include an analysis of the direct and indirect economic impact of a proposed energy conversion facility and transmission facility.

Senate Bill No. 2233 (1979) (Appendix B) amended Section 49-22-09 to remove "corridor" from consideration of the adverse direct and indirect environmental effects factor. The bill replaced the phrase "energy conversion facility and transmission facility" with "facility" in the analysis of the direct and indirect economic impact factor.

The 1979 legislation also amended Section 49-22-08, which governs the certificate application requirements, by requiring an application for a certificate also must include a description of mitigative measures that must be taken to minimize all foreseen adverse impacts resulting from the location, construction, and operation of the proposed facility. The bill also added the same requirement to Section 49-22-08.1, which governs an application for a route permit.

House Bill No. 1144 (2017) separated the siting requirements for electric energy facilities and the gas or liquid facilities into two chapters in Title 49. The bill created Chapter 49-22.1 to address gas or liquid transmission facilities and gas or liquid energy conversion facilities while amending Chapter 49-22 to pertain only to electric transmission and electric energy conversion facilities. The factors the PSC must consider when evaluating an application and designation of sites and corridors; however, remained unchanged in Section 49-22-09 for electric energy conversion and transmission facilities. Section 49-22-09 was duplicated and codified into the newly created gas or liquid transmission facilities and energy conversion facilities chapter as Section 49-22.1-09.

To summarize, Chapters 49-22 and 49-22.1 do not grant the PSC the authority to require direct or indirect mitigation payments from companies applying for siting permits. However, when evaluating an application for a permit or certificate, Chapters 49-22 and 49-22.1 require the PSC to consider the adverse direct and indirect environmental effects that cannot be avoided if the proposed site, corridor, or route is accepted. By

#1
SB 2261
3/8/19

law, the PSC also is required to consider the mitigative measures that must be taken to minimize all foreseen adverse direct and indirect impacts resulting from the location, construction, and operation of the proposed facility.

Attached as Appendix C is the information you requested relating to the amount the PSC has required a company to pay toward direct or indirect mitigation payments for siting permit purposes and where the money from these mitigation payments has been allocated. The PSC reports it only has required direct and indirect mitigation on one wind energy project. The company worked with the North Dakota Game and Fish Department to determine the significance of any impact and developed a plan and signed an agreement with the Game and Fish Department to mitigate those impacts as identified in the attachment. As indicated in the agreement, the company involved made a one-time payment of $557,000 to the Ducks Unlimited Great Plains Regional Office for the purpose of implementing long-term, "on-the-ground" native prairie conservation actions. The implementation of the agreement is being monitored by the Game and Fish Department.

We hope this answers your inquiry. If you would like additional information or have any other questions, please contact us.

Sincerely,

Christopher S. Joseph
Counsel

CJ/JJB
Encs.

#1
SB2261
3/8/19

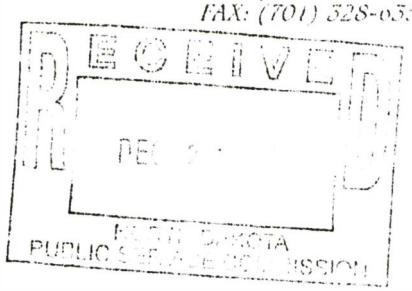
# NORTH DAKOTA GAME & FISH DEPARTMENT

"Variety in Hunting and Fishing"

GOVERNOR, Doug Burgum

DIRECTOR, Terry Steinwand
DEPUTY, Scott A. Peterson

100 North Bismarck Expressway
Bismarck, North Dakota 58501-5095
Phone: (701) 328-6300
FAX: (701) 328-6352




December 20, 2017

ND Public Service Commission
600 E. Boulevard, Dept. 408
Bismarck, ND 58505-0480

RE: Case PU-17-284 Foxtail Wind Energy Center – Dickey County, North Dakota

In a November 6, 2017 letter to the PSC, the North Dakota Game and Fish Department (Department) acknowledged NextEra's important role of assisting in the development of state specific wind energy guidelines for offsetting impacts to fish and wildlife resources, but expressed a number of concerns specific to the Foxtail project due to the loss of some of the highest value, unbroken prairie remaining in the state. The Department recommended NextEra develop an offset package for the permanent impact of roads and turbine pads that are to be constructed within unbroken prairie habitat ≥ 160 acres and any CRP-SAFE tracts (a program designed to maintain or increase populations of high-value or high priority wildlife species). The Department recommended that this offset package include direct effects of development features (i.e. turbines, roads, buildings), as well as indirect effects of the fragmentation of the unbroken prairie habitat of up to 100 meters from new or improved roads and 200 meters of turbine sites.

Since the Foxtail project hearing, NextEra and the Department have been working collaboratively in an attempt to address this offset package. Using peer reviewed literature and existing, vetted mitigation guidelines, the Department determined what we believe is an appropriate offset for the loss of high value, native grassland habitat associated with the Foxtail project. However, we also recognize and acknowledge the development of state voluntary guidelines were in a transitional period and not fully agreed upon when this project was filed and heard.

NextEra has committed to a financial contribution for long-term, "on-the-ground" offsets for the direct disturbance of 293.6 acres and indirect disturbance of 2004.5 acres resulting from the Foxtail project.

#1
SB 2261
3/8/19

This equates to less than 60% of the economic value of the acreage (based on $500/ac.) recommended for offsets by the Department. However, because a comprehensive framework for determining offsets has not been completely developed and finalized, full compensation of impacts on this project would not be reasonable at this time. We anticipate this science-based framework to be completed and shared with wind interests in the very near future. The Department intends to use it to determine wildlife resource impacts and recommend avoidance, minimization, and full offsets for future wind development. We commend NextEra's commitment to the stewardship of our wildlife resources and their collaborative spirit as we move forward with these state guidelines. In good faith, the Department believes that the project should move forward.

Sincerely,

Terry Steinwand

Terry Steinwand
Director

CC: North Dakota Governor's Office
Kimberly Wells, NextEra Energy Resources, Inc.
Kevin Shelley, US Fish and Wildlife Service ESA
Representative Mike Brandenburg, District 28

#1
SB2261
3/8/19



**Cooperative Agreement and Memorandum of Understanding**

This Cooperative Agreement and Memorandum of Understanding ("**MOU**"), dated April 17, 2018, is between Foxtail Wind, LLC ("**Foxtail**") and North Dakota Game and Fish Department ("**NDGFD**") (Foxtail and NDGFD, jointly the "**Parties**"). The purpose of this MOU is to address the anticipated impacts to native prairie caused by the Project (as defined herein), as requested by the North Dakota Public Service Commission ("**PSC**").

The Foxtail Wind Project (the "**Project**") is a 150 MW wind energy project located in southeastern Dickey County, North Dakota that received certification from the PSC in January 2018. Foxtail anticipates that the Project will be owned, constructed and operated by Northern States Power Company ("**NSP**"), a subsidiary of Xcel Energy. This MOU is subject to Foxtail obtaining all certifications and permits required to construct the Project.

Since October of 2016, Foxtail, along with other participants in the wind industry, has been participating in a voluntary, industry-led collaborative effort referred to as the North Dakota Wind and Wildlife Collaborative ("**NDWWC**") with both the NDGFD and the U.S. Fish and Wildlife Service ("**USFWS**"). The purpose of this collaborative effort is to balance responsible wind development with protection for wildlife and native habitats, and to provide improved predictability in the permitting process through the PSC. In letters dated November 6 and 14, respectively, from the NDGFD and the USFWS to Foxtail submitted to the PSC Docket (PU-17-284), both agencies recognized the efforts of Foxtail as a key participant in the NDWWC.

NDWWC is developing, but has not yet completed, an approach to protect wildlife and native habitats, specifically one that addresses avoidance, minimization, and formal offsets where appropriate. Notwithstanding, NDGFD and USFWS acknowledge that Foxtail is a transitional, late-stage development project that should not establish a precedent, or otherwise be subject to the full application of any framework requiring consistency with any as-yet undeveloped formal offset principles.

In its letter dated November 6, 2017, NDGFD recommended that permanent impacts be defined to include unbroken prairie habitat greater than 160 acres or impacts on CRP SAFE tracks associated with roads and turbines. In addition, indirect fragmentation impacts on native prairie (defined as 100 meters from new or improved roads and 200 meters from turbines) were also recommended for inclusion in the offset package.

In light of the transitional stage of the NDWWC recommendations and Foxtail's continued collaboration with both agencies, Foxtail agrees to make a one-time offset payment in the amount of $557,000.00 to Ducks Unlimited Great Plains Regional Office for the purposes of implementing long-term, "on the ground" native prairie conservation actions (the "***Conservation Payment***").

Payment for this offset package is contingent on the Project receiving all final approvals to begin construction and will be paid within 60 days of Foxtail filing a Notice of Intent to Begin Construction with PSC.

#1
SB2261
3/8/19

Respectfully submitted,

**Foxtail Wind, LLC**

John Di Donato

Vice President

Acknowledged and agreed this 17th day of April, 2018

**North Dakota Department of Game and Fish**

Terry Steinwand

Director

#2
SB 2261
3/8/19

COMMISSIONER
DOUG GOEHRING

NORTH DAKOTA
DEPARTMENT OF AGRICULTURE
STATE CAPITOL
600 E BOULEVARD AVE DEPT 602
BISMARCK, ND 58505-0020

ndda@nd.gov
www.nd.gov/ndda

**Testimony of Doug Goehring, Agriculture Commissioner**
**North Dakota Department of Agriculture**
**Senate Bill 2261**
**House Agriculture Committee**
**Peace Garden Room**
**March 8, 2019**

Chairman Johnson and members of the House Agriculture Committee, I am Agriculture Commissioner Doug Goehring. Thank you for the opportunity to appear before the committee. I am here today in support of SB 2261.

SB 2261 brings to light the issue of indirect mitigation injustices that are occurring, and we believe this is a step in the right direction to correct this issue.

Chairman Johnson, thank you for your consideration of SB 2261 and I would be happy to answer any questions.

#3
SB2261
3/8/19

WIND
Wind Industry of North Dakota

**House Agriculture Committee**

**March 8, 2019**

**Support SB 2261**

Chairman Johnson and Members of the Committee,

For the record my name is Mike Krumwiede, and I'm here today representing Wind Industry of ND, or WIND. We are a coalition of industry members and supporters formed in 2018 that advocates for the continued support of wind as one of North Dakota's valuable energy resources. Our current coalition includes:

- American Wind Energy Association (AWEA)
- Apex Clean Energy
- Capital Power
- EDF Renewable Energy
- Enel Green Power North America Inc.
- Invenergy
- NextEra Energy Resources
- Tenaska
- Tradewind
- Wanzek Construction, Inc.

These members came together because we believe wind is an abundant asset in our state which should be harnessed for the continued benefit of our local communities and residents. North Dakota currently ranks 5th in share of electricity generated from wind. Wind farms now reside in 27 counties and those 29 commercial wind farms in North Dakota generated 3000mw of power in 2016. The Wind industry currently accounts for three to four thousand permanent direct, indirect, and manufacturing jobs in ND with a total business activity of $174 million in 2016. In that same year the wind industry paid property taxes of $7.7 million and $14.4 million in lease payments to North Dakota Landowners. The result of all this activity is that Wind now comprises approximately 27% of the energy mix used by utilities in North Dakota.

WIND supports 2261 because the science of indirect environmental impacts is inconclusive and, accordingly, the PSC should not require mitigation of those impacts. We're primarily supportive of any bill that maximizes the flexibility of companies to mitigate environmental and wildlife impacts as the company sees fit. We're not in favor of public policy that handcuffs us to certain means of mitigation.

For these reasons, we respectfully request a Do Pass recommendation on SB 2261. Thank you for your time.

#4
SB2261
3/8/19

**Senate Bill 2261**

**Presented by:** **Randy Christmann, Commissioner**
**Public Service Commission**

**Before:** **House Agriculture Committee**
**The Honorable Dennis Johnson, Chairman**

**Date:** **March 8, 2019**

**TESTIMONY**

Mr. Chairman and committee members, I am Commissioner Randy Christmann with the Public Service Commission and I appear before you to testify on behalf of the Commission in opposition to SB 2261.

In 1975, the legislature tasked the Public Service Commission with implementing the Siting Act to ensure that certain energy infrastructure projects produce "minimal adverse effects on the environment and the welfare of the citizens of this state." That goal – minimal adverse effects on the environment and the welfare of the citizens– is at the heart of every siting permit application. In seeking that balance, the Commission does not weigh one side more than the other. We look at the public interest as a whole. The public has an interest in reliable energy, in the jobs and economic impact of the energy industry, in a fair and predictable regulatory process that allows for business development, in preserving the environment, and in maintaining our clean, peaceful landscape. The companies who apply, and the commission in making our decision, try to balance all of these factors and more, and the siting law currently provides the flexibility to do so.

Since the enactment of the Siting Act, the growth of energy conversion and transmission infrastructure has been truly breathtaking. Just to provide some

context of the volume and size of investments, I have attached a list of sited infrastructure from just the past 17 years. Throughout the past four decades, the Siting Act has been an effective framework for the Commission to accomplish the task requested and has provided the flexibility to accommodate the growth of infrastructure while minimizing negative impacts on the environment and the people living in and around this infrastructure.

It is because of the Siting Act's success and through the Commission's experience that the Commission views these substantive changes proposed by SB 2261 with skepticism. We understand the concerns related to direct and indirect offset payments. However, we believe that the changes are misplaced, create ambiguity and difficulty in application, and may result in unintended consequences.

One concern relates to the erosion of the Siting Act's flexibility. We need to remember that the siting process is a legal exercise which involves procedure, due process, and making determinations based upon the record. Prior to a hearing, the Commission publishes notice to the public and solicits testimony from 27 different agencies. The Commission often receives comments from a number of agencies including the Department of Health, State Water Commission, Department of Transportation, Parks and Recreation Department, and even the Department of Agriculture.

During public hearings, the public and agencies bring to light issues that were not foreseeable to the Commission or the applicant throughout the planning phase. Many landowner, political subdivision, and other stakeholder issues do not fit neatly within a box. The current law provides flexibility to consider issues

#4
SB2261
3/8/19

presented and it offers opportunities for reasoned and reasonable accommodations. Legislation denying us the ability to acknowledge voluntary mitigation efforts leaves us with orders that, if they approve a project, fail to acknowledge and address those concerns. Thus, those approvals are ripe for appeals to the court system which mean construction delays, or not receiving a certificate at all.

The Commission also has a concern with Century Code Chapter 49-22 containing a prohibition directed toward other state agencies. Many agencies have jurisdiction over the construction, operation, and maintenance of an "aspect of a proposed site, corridor, route, or facility." Although an agency may choose not to provide feedback through our formal siting process, they still maintain permitting authority under their own area of century code. If there are areas of jurisdiction, whether based in a federal program or state law, that may require payment for mitigation of assessed impacts, it is likely that other agencies would miss this prohibition if it is listed under 49-22.

Another concern relates to SB 2261's use of the term "payment." Narrowing the term to a specific application would be worthwhile to differentiate it from a payment through a fine, penalty, fee, a payment to a contractor for construction and compliance inspections, or other types of activities that may require a company to contract to mitigate effects of construction on a site. If this legislation proceeds, the Commission requests that "payment" be narrowed in application and origin.

#4
SB2261
3/8/19

The Commission has powers given to it by the legislature. I want to be clear that we will work to implement any task or responsibility that the legislature asks the Commission to undertake, but it is worth clarifying that the Commission has not ordered a company to provide offset payments for direct or indirect impacts and currently does not consider it within its authority to do so. As it is written, SB 2261 is a cause for concern. We have discussed possible amendments and are happy to discuss them if proposed.

Mr. Chairman, this concludes my testimony. Thank you for your consideration. I will be happy to answer any questions.

#4
SB 2261
3/8/19

North Dakota Public Service Commission Approved Siting Projects

2002-Current

## Electric Transmission:

| Company | Type | Cost Investment |
|---|---|---|
| • Emmons-Logan Wind | 230kV | $20,000,000 |
| • Northern States Power | 230 kV | $50,500,000 |
| • Oliver Wind III | 230 kV | $11,400,000 |
| • Brady Wind | 230 kV | $20,500,000 |
| • Basin Electric Coop. | 345 kV | $135,000,000 |
| • Antelope Hills Wind | 345 kV | $9,000,000 |
| • Allete Inc. | 250 kV Line Reroute | $500,000 |
| • MDU/Otter Tail Power | 345 kV | $50,000,000 |
| • Allete Inc. | 250 kV Line Reroute | $1,800,000 |
| • Great River Energy | 230 kV Line Reroute | $2,891,000 |
| • Basin Electric Coop. | 345 kV | $300,000,000 |
| • Basin Electric Coop. | 345 kV | $3,000,000 |
| • Allete Inc. | 230 kV | $10,000,000 |
| • Montana-Dakota Utilities | 230 kV | $14,500,000 |
| • Oliver Wind III | 230 kV | $3,500,000 |
| • Otter Tail Power | 230 kV | $260,000 |
| • Minnkota Power | 345 kV | $310,000,000 |
| • Allete Inc. | 230 kV | $13,000,000 |
| • M-Power LLC | 230 kV | $4,550,000 |
| • Ashtabula Wind | 230 kV | $3,000,000 |
| • Minnkota Power | 230 kV | $29,000,000 |
| • Otter Tail Power | 230 kV | $260,000 |
| • Northern States Power | 345 kV | $390,000,000 |
| • Basin Electric Coop. | 230 kV | $25,500,000 |
| • Basin Electric Coop. | 230 kV | $33,000,000 |
| • Tatanka Wind Power | 230 kV | $7,300,000 |
| • FPL Energy Oliver Wind | 230 kV | $2,000,000 |
| • PPM Energy | 230 kV | $2,750,000 |
| • FPL Energy | 230 kV | $5,000,000 |

**Total Investment = $1,458,211,000**

#4
SB 2261
3/8/19

## Generating Stations:

| Company | Type | Cost Investment |
|---|---|---|
| • Basin Electric Coop. | 45 MW Gas-Fired Station | $99,000,000 |
| • Basin Electric Coop. | 111 MW Gas-Fired Station | $161,200,000 |
| • Basin Electric Coop. | 90 MW Gas-Fired Station | $115,000,000 |
| • Basin Electric Coop. | 45 MW Gas-Fired Station | $102,000,000 |
| • Montana-Dakota Utilities | 88 MW Gas-Fired Station | $56,600,000 |

**Total Investment = $533,800,000**

## Oil and Gas Refinement:

| Company | Type | Cost Investment |
|---|---|---|
| • Hiland Partners | Gas Processing Plant Expansion | $234,000,000 |
| • ONEOK Rockies Midstream | Gas Processing Plant Expansion | $250,000,000 |
| • Arrow Field Services | Gas Processing Plant | $136,000,000 |
| • Oasis Midstream | Gas Processing Plant Expansion | $150,000,000 |
| • Targa Badlands LLC | Gas Processing Plant Expansion | $140,000,000 |
| • ONEOK Rockies Midstream | Gas Processing Plant | $642,000,000 |
| • ONEOK Rockies Midstream | Gas Processing Plant | $280,000,000 |
| • Tioga Gas Plant | Gas Processing Plant Expansion | $325,000,000 |
| • Whiting Oil & Gas | Gas Processing Plant Expansion | $3,000,000 |
| • ONEOK Rockies Midstream | Gas Processing Plant | $160,000,000 |
| • Bear Paw Energy | Gas Processing Plants | $273,000,000 |
| • Bear Paw Energy | Gas Processing Plant | $175,000,000 |
| • Hess Corporation | Gas Processing Plant Expansion | $500,000,000 |
| • Bear Paw Energy | Gas Processing Plant | $142,000,000 |

**Total Investment = $3,410,000,000**

#4
SB2261
3/8/19

## Pipelines (2005 to present):

| Company | Type | Cost Investment |
|---|---|---|
| • Enbridge Pipelines | Pump Station Upgrades | $8,900,000 |
| • Andeavor Field Services | 8" and 6" NGL Pipelines | $46,000,000 |
| • Hess North Dakota | Gathering System Conversion | $107,000,000 |
| • ONEOK Rockies Midstream | 12" NGL Pipeline Conversion | $1,800,000 |
| • Cenex Pipeline | 10" Refined Fuels Pipeline | $115,000,000 |
| • NuStar Pipeline Operating | Mapleton Terminal | $8,500,000 |
| • Arrow Field Services | 10" and 8" NGL Pipeline | $6,300,000 |
| • Savage Bakken Connector | 10" Crude Oil Pipeline | $6,000,000 |
| • Targa Badlands | 8" Crude Oil Pipeline Conversion | $85,000,000 |
| • Epping Transmission Co. | 12.75" Crude Oil Pipeline | $7,000,000 |
| • Caliber Bear Den | 12.75" Crude Oil Pipeline | $12,000,000 |
| • NST Express | 8" Crude Oil Pipeline | $6,800,000 |
| • Hess North Dakota | 12"Crude Oil Pipeline | $4,500,000 |
| • Plains Terminal ND | 24" Crude Oil Pipeline | $5,000,000 |
| • Bakken Oil Express | 20" Crude Oil Pipeline Reroute | $14,400,000 |
| • BOE Pipeline | 16" Crude Oil Pipeline | $55,000,000 |
| • ONEOK Bakken Pipeline | 8" NGL Pipeline | $45,000,000 |
| • Cenex Pipeline | Terminal Project | $17,000,000 |
| • Sacagawea Pipeline Co. | 16" Crude Oil Pipeline | $22,800,000 |
| • Oasis Midsteam Services | 10.75" Crude Oil Pipeline | $13,000,000 |
| • ONEOK Bakken Pipeline | Pump Station Project | $8,000,000 |
| • Tesoro High Plains | 12" Crude Oil Pipeline | $8,900,000 |
| • ONEOK Bakken Pipeline | 16" NGL Pipeline | $19,520,000 |
| • NuStar Pipeline Operating | 8" Refined Products Pipeline | $12,000,000 |
| • Sacagawea Pipeline Co. | 12" Crude Oil Pipeline | $18,000,000 |
| • Plains Pipeline | Crude Oil Pipeline Reroute Project | $7,000,000 |
| • Hiland Crude | Crude Oil Pipeline Conversion | $3,600,000 |
| • Hiland Crude | 8" Crude Oil Pipeline | $15,000,000 |
| • NST Express | 12" Crude Oil Pipeline | $80,000,000 |
| • Vantage Pipeline US | 8" Ethane Pipeline | $20,000,000 |
| • ONEOK Bakken Pipeline | 8" NGL Pipeline | $6,000,000 |
| • Sacagawea Pipeline Co. | 16" Crude Oil Pipeline | $125,000,000 |
| • Bridger Pipeline | 16" Crude Oil Pipeline | $10,400,000 |
| • Plains All American Pipeline | 8" Crude Oil Pipeline | $9,000,000 |
| • Hess North Dakota | NGL Pipeline Conversion | $2,190,000 |
| • Hess North Dakota | 12" Crude Oil Pipeline | $104,700,000 |
| • Dakota Access LLC | Crude Oil Pipeline | $1,410,000,000 |
| • Hiland Crude | 12" Crude Oil Loop Pipeline | $10,500,000 |

#4
SB 2261
3/8/19

| | | |
|---|---|---|
| • Meadowlark Midstream Co. | 10" Crude Oil Pipeline | $33,000,000 |
| • Meadowlark/Epping | Conversion & Station Expansion | $18,000,000 |
| • Tesoro High Plains | Storage Hub & Tank Storage | $31,500,000 |
| • Caliber Midstream Partners | 6" NGL Pipeline | $1,800,000 |
| • Targa Badlands | 8" Crude Oil Pipeline Conversion | $41,000,000 |
| • ONEOK Bakken Pipeline | 6" NGL Pipeline | $6,000,000 |
| • Meadowlark Midstream Co. | 8" Crude Oil Pipeline | $21,000,000 |
| • Belle Fourche Pipeline | 10" Crude Oil Pipeline | $7,900,000 |
| • Enbridge Pipelines | 24" Crude Oil Pipeline | $1,300,000,000 |
| • Bakken Oil Express | 16" Crude Oil Pipeline | $14,000,000 |
| • Dakota Prairie Refining | Crude Oil Pipeline | $5,000,000 |
| • Hiland Crude LLC | Crude Oil Pipeline | $55,300,000 |
| • Dakota Gasification Co. | 10" Natural Gas Pipeline | $9,000,000 |
| • Basin Transload | 10" Crude Oil Pipeline | $4,500,000 |
| • Hess Corporation | Crude Oil Pipeline | $1,000,000 |
| • Basin Transload | 8" Crude Oil Pipeline | $2,500,000 |
| • Hiland Operating | 6" Natural Gas Pipeline | $1,500,000 |
| • Magellan Midstream | Petroleum Product Pipeline Reroute | $1,342,500 |
| • Plains Pipeline | 10.75" Crude Oil Pipeline | $13,600,000 |
| • ONEOK Rockies Midstream | 10.75" NGL Pipeline | $6,000,399 |
| • Montana-Dakota Utilities | 10" Natural Gas Pipeline | $18,400,000 |
| • Enbridge Pipelines | Crude Oil Connection & Upgrade | $34,000,000 |
| • Enbridge Pipelines | Pump Station Upgrade | $35,000,000 |
| • Enbridge Pipelines | Pipeline Expansion Project | $102,500,000 |
| • Vantage Pipelines | 10 to 12" NGL Pipeline | $60,000,000 |
| • Hess Corporation | 6" and 8" LPG Pipeline | $5,000,000 |
| • Whiting Oil and Gas | 8" Crude Oil Pipeline | $3,360,000 |
| • Arrow Field Services | 8" Crude Oil Pipeline | $2,000,000 |
| • Bear Paw Energy | 10.75" NGL Pipeline | $24,000,000 |
| • Rangeland Energy | 8" Crude Oil Pipeline | $15,000,000 |
| • Plains Pipeline | 12.75" Crude Oil Pipeline | $200,000,000 |
| • Enbridge Pipelines | 16" Crude Oil Pipeline | $132,600,000 |
| • Enbridge Pipelines | Crude Oil Pipeline Expansion | $73,100,000 |
| • Hiland Operating | 8" Natural Gas Pipeline | $3,400,000 |
| • Hiland Operating | 6" Natural Gas Pipeline | $4,000,000 |
| • BakkenLink Pipeline | 10" to 16" Crude Oil Pipeline | $250,000,000 |
| • Enbridge Pipelines | Crude Oil Pipeline Upgrade | $8,900,000 |
| • Bridger Pipeline | 10" Crude Oil Pipeline | $25,000,000 |
| • Hawthorn Oil Transportation | 8" Crude Oil Pipeline | $2,500,000 |
| • Whiting Oil & Gas Corp. | 8" Crude Oil Pipeline | $6,100,000 |
| • Whiting Oil & Gas Corp. | 6" Natural Gas Pipeline | $3,300,000 |

| | | |
|---|---|---|
| • Enbridge Pipelines | Pump Station Upgrades | $6,000,000 |
| • Enbridge Pipelines | Pump Station Upgrades | $119,700,000 |
| • Enbridge Pipelines | 8" Crude Oil Pipeline Reroute | $500,000 |
| • Belle Fourche Pipeline Co. | 8" Crude Oil Pipeline | $10,200,000 |
| • Dakota Gasification Co. | 14" CO2 Pipeline Reroute | $10,500,000 |
| • Enbridge Energy | 36" Liquid Petroleum Pipeline | $90,700,000 |
| • Enbridge Pipelines | 20" Crude Oil Pipeline | $31,528,800 |
| • TransCanada Keystone | 30" Crude Oil Pipeline | $400,000,000 |
| • Enbridge Pipelines | Crude Oil Pump Stations | $16,995,000 |
| • Enbridge Pipelines | 10" Crude Oil Pipeline | $25,122,200 |
| • Enbridge Pipelines | Pump Station Upgrades | $16,450,000 |
| • Enbridge Pipelines | Pump Station Upgrades | $3,200,000 |
| • Plains Pipeline | 10" Crude Oil Pipeline | $1,500,000 |
| • Plains Pipeline | 10" Crude Oil Pipeline | $750,000 |

**Total Investment = $5,772,058,899**

## Solar Generation:

| Company | Type | Cost Investment |
|---|---|---|
| • Harmony Solar ND | 200 MW Solar Facility | $250,000,000 |

**Total Investment = $250,000,000**

## Wind Generation:

| Company | Type | Cost Investment |
|---|---|---|
| • Emmons-Logan Wind | 298.1 MW Wind Energy Center | $415,000,000 |
| • Langdon Wind | Siting Exclusion Certification | $113,000,000 |
| • Allete Clean Energy | Wind Farm Expansion | $80,000,000 |
| • Foxtail Wind | 150 MW Wind Energy Center | $400,000,000 |
| • MDU/Thunderspirit Wind | Wind Farm Expansion | $86,500,000 |
| • Glacier Ridge Wind | 300.15 MW Wind Energy Center | $202,000,000 |
| • Oliver Wind III | 100 MW Wind Energy Center | $153,000,000 |
| • Brady Wind II | Wind Energy Center | $250,000,000 |

#4
SB 2261
3/8/19

| | | |
|---|---|---|
| • Brady Wind | 150 MW Wind Energy Center | $250,000,000 |
| • Lindahl Wind Project | 150 MW Wind Energy Center | $248,500,000 |
| • Rolette Power Development | 100.4 MW Wind Energy Center | $175,000,000 |
| • Antelope Hills Wind Project | 172 MW Wind Energy Center | $250,000,000 |
| • Sunflower Wind Project | 110 MW Wind Energy Center | $200,000,000 |
| Allete, Inc. Bison 4 | 210 MW Wind Energy Center | $400,000,000 |
| • Courtenay Wind Farm | 200.5 MW Wind Energy Center | $170,000,000 |
| • Lake Region State College | 1.6 MW Wind Energy Project | $4,300,000 |
| • Allete Clean Energy | 100 MW Wind Energy Center | $200,000,000 |
| • Wilton Wind IV | 99 MW Wind Energy Center | $165,000,000 |
| • Thunder Spirit Wind | 150 MW Wind Energy Center | $300,000,000 |
| • Oliver Wind III | 48 MW Wind Energy Center | $81,000,000 |
| • Allete Bison 3 Project | 105 MW Wind Energy Center | $160,000,000 |
| • Meadowlark Wind I | 99 MW Wind Energy Center | $180,000,000 |
| • Allete Bison 2 Project | 105 MW Wind Energy Center | $160,000,000 |
| • Ashtabula Wind III | 70 MW Wind Energy Center | $140,000,000 |
| • Baldwin Wind | 99 MW Wind Energy Center | $200,000,000 |
| • CPV Ashley Renewable | 487.6 MW Wind Energy Center | $440,000,000 |
| • Allete Bison I Project | 75.9 MW Wind Energy Center | $170,000,000 |
| • Rough Rider Wind I | 175 MW Wind Energy Center | $310,000,000 |
| • EDF Renewable/NSP | 150 MW Wind Energy Center | $400,000,000 |
| • Sequoia Energy US/NSP | 150 MW Wind Energy Center | $300,000,000 |
| • Basin Electric Power Coop. | 115.5 MW Wind Energy Center | $240,000,000 |
| • M-Power LLC | 150 MW Wind Energy Center | $300,000,000 |
| • Ashtabula Wind | 200 MW Wind Energy Center | $350,000,000 |
| • Langdon Wind | 40 MW Wind Farm Expansion | $73,000,000 |
| • Just Wind | 368 MW Wind Energy Center | $285,000,000 |
| • Langdon Wind | 160 MW Wind Energy Center | $250,000,000 |
| • PPM Energy | 150 MW Wind Energy Center | $170,000,000 |

**Total Investment = $8,271,300,000**

**Total Investment in Approved Siting Projects (all categories) = $19,695,369,899**

#5
SB2261
3/8/19

House Agriculture Committee
Testimony on SB 2261

North Dakota Game and Fish Department
Scott Peterson, Deputy Director
March 8, 2019

Chairman Johnson and members of the House Agriculture Committee, for the record, my name is Scott Peterson and I'm the Deputy Director of the North Dakota Game and Fish Department. I'm testifying today on behalf of the Game and Fish Department in opposition of SB 2261.

If passed, this bill would appear to have the following ramifications regarding any opportunity to seek mitigation when public resources are impacted:

- As stated, this bill would prohibit any commission, such as the Public Service Commission, or any state agency, such as the Game and Fish Department, from seeking payment, mitigation, or an offset for any adverse environmental or wildlife impact, either direct or indirect, caused by the siting of an actual energy conversion facility, gas/liquid conversion facility, or transmission facility, as well as impacts associated with its transmission corridor or route.

- In the case of the Game and Fish Department, a sizeable portion of our Wildlife Management Area (WMA) system was purchased or is currently managed with federal Wildlife and Sport Fish Restoration Program funds. Stipulations accompanying these funds require that any negative impacts to fish and wildlife resources on these lands be mitigated or made whole. This legislation appears to create a law that conflicts with federal statute vital to our agency. Permitting the siting of such facilities on Department WMA's without replacement compensation would be a breach of our federal aid agreements and a diversion of funds. Such an action would jeopardize millions of federal funds, making up nearly half of our agency's revenue stream.

Chairman Johnson and Committee Members, the Department respectfully requests a DO NOT PASS on SB 2261.

#6
SB 2261
3/8/19

**Testimony**
**Senate Bill 2261**
**House Agriculture Committee**
**March 8, 2019, 10:00 a.m.**
**North Dakota Department of Health**

Good morning Chairman Johnson and members of the House Agriculture Committee. My name is Karl Rockeman, and I am the Director of the Division of Water Quality within the North Dakota Department of Health's Environmental Health Section, soon to be the North Dakota Department of Environmental Quality. The Division of Water Quality protects and monitors our water resources to ensure the quality of surface and groundwater for the public's use.

We are concerned that this bill may cause some unintended consequences and inadvertently limit our ability to require spills be cleaned up.

The inclusion of the language "any state agency with jurisdiction over any aspect of a proposed site, corridor, route or facility" would appear to expand this bill to affect actions outside of those under NDCC 49-22 Energy Conversion and Transmission Facility Siting Act.

In addition, the terms "mitigation" and "adverse environmental impact" are not defined, and they may be interpreted by some to refer to the cleanup from a spill that violates the state's water pollution control law.

We would ask that clarifying language be included stating these sections only apply to actions under NDCC 49-22. I have provided you a copy of the amendment for clarification. I am happy to answer any questions you may have.

#6
SB 2261
3/8/19

PROPOSED AMENDMENTS TO ENGROSSED SENATE BILL NO. 2261

Page 1, line 8, before "The commission" insert "For the purpose of siting under this Chapter,"

Page 1, line 15, before "The commission" insert "For the purpose of siting under this Chapter,"

#7
SB 2261
3/8/19

North Dakota Grain Growers Association

You Raise. We Represent. www.ndgga.com

# North Dakota Grain Growers Association
# Testimony on HB 2261
# House Agriculture Committee
# March 8, 2019

Chairman Johnson, members of the House Agriculture Committee, for the record my name is Dan Wogsland, Executive Director of the North Dakota Grain Growers Association (NDGGA). Through our contracts with the North Dakota Wheat Commission and North Dakota Barley Council NDGGA engages in domestic policy on behalf of North Dakota's 19,000 wheat and 4000 barley farmers in the state. I appear today on behalf of NDGGA in support of SB 2261.

SB 2261 is a step in the right direction in dealing with indirect environmental impacts that are assessed in energy development by state agencies. NDGGA feels the assessment of indirect environmental impacts is an arbitrary regulatory over-reach by North Dakota state agencies that interferes with landowner/energy development company relations in the state. This ultimately results in increased costs, both emotional and financial, to both landowners and energy development companies as well as diminished energy development for North Dakota and the nation.

Therefore the North Dakota Grain Growers Association appears today in support of SB 2261 and would ask the House Agriculture Committee to concur with a Do Pass recommendation.

#1
4/4/19

19.0936.03001
Title.

Prepared by the Legislative Council staff for
Senator Unruh

March 21, 2019

PROPOSED AMENDMENTS TO ENGROSSED SENATE BILL NO. 2261

Page 1, line 1, after "A BILL" replace the remainder of the bill with "for an Act to amend and reenact subsection 5 of section 49-22-08 of the North Dakota Century Code, relating to conditions imposed on the designation of sites, corridors, and routes.

**BE IT ENACTED BY THE LEGISLATIVE ASSEMBLY OF NORTH DAKOTA:**

**SECTION 1. AMENDMENT.** Subsection 5 of section 49-22-08 of the North Dakota Century Code is amended and reenacted as follows:

5. The commission may designate a site or corridor for a proposed facility following the study and hearings provided for in this chapter. Any designation shall be made in accordance with the evidence presented at the hearings, an evaluation of the information provided in the application, the criteria established pursuant to section 49-22-05.1, and the considerations set out in section 49-22-09 in a finding with reasons for the designation, and shall be made in a timely manner no later than six months after the filing of a completed application for a certificate of site compatibility or no later than three months after the filing of a completed application for a certificate of corridor compatibility. The time for designation of a site or corridor may be extended by the commission for just cause. The failure of the commission to act within the time limits provided in this section shall not operate to divest the commission of jurisdiction in any certification proceeding. The commission shall indicate the reasons for any refusal of designation. Upon designation of a site or corridor, the commission shall issue a certificate of site compatibility or a certificate of corridor compatibility with such terms, conditions, or modifications deemed necessary. The commission may not condition the issuance of a certificate or permit on the applicant providing a mitigation payment assessed or requested by another state agency or entity to offset a negative impact on wildlife habitat."

Renumber accordingly