

## **Enhancing protection for vulnerable waters**

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### **Supplementary Information 1:**

#### **History of the Waters of the United States**

The basis for the focus of US federal water legislation on interstate and navigable waters is the framing of the US Constitution, which gave the Federal government authority to regulate interstate waters; soon after, the US Congress began to use its Commerce Clause authority to protect navigable waters (Downing et al. 2003). The US government does not have authority to put into place regulations that would protect other waters.

In 1948, the US government introduced the Federal Water Pollution Control Act (FWPCA), the first major US law regarding water pollution. The FWPCA authorized the Surgeon General of the Public Health Service, in coordination with other federal, state and local entities, to create programs to reduce the pollution of interstate waters and tributaries to improve the water quality of surface and subsurface waters. It also authorized the Federal Works departments to assist state and local governments to construct water treatment plants to reduce the amount of sewage being released into interstate waters and tributaries.

The FWPCA was amended heavily in 1972 and became widely known as the Clean Water Act (CWA; 33 USC. §1251). The objective of the CWA is “to restore and maintain the

chemical, physical, and biological integrity of the Nation’s waters.” The CWA regulates pollutant discharges from point sources into navigable waters and regulates water quality standards for navigable waters. Under Section 502(7) of the CWA, navigable waters are defined as “the waters of the United States, including the territorial seas”. The US Environmental Protection Agency (EPA) and the US Army Corps of Engineers (Corps) have defined in regulations what constitutes waters of the United States (WOTUS), and are therefore protected under the CWA. From the late 1970s through 2015, the agencies’ regulations defined WOTUS as traditional navigable waters, interstate waters (including interstate wetlands), all other waters that could affect interstate or foreign commerce, impoundments of waters of the United States, tributaries, the territorial seas, and adjacent wetlands. (33 CFR 328.3; 40 CFR 122.2). Section 404 of the CWA defines wetlands as “areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.”

The definition of WOTUS has been further clarified by Supreme Court decisions since implementation of the CWA. From the 1970s to the 1990s most federal courts and agencies consistently interpreted a broad scope of CWA jurisdiction focused on the water quality of all aquatic systems (Downing et al. 2003). The first Supreme Court challenge on the definition of the WOTUS occurred in 1985 in *United States v. Riverside Bayview Homes* (474 US 12). The Court unanimously decided to uphold the inclusion of wetlands adjacent to traditional navigable waters within the WOTUS definition, concluding that they are “inseparably bound up” with the waters to which they are adjacent. The agencies’ longstanding definition of adjacency includes

wetlands that are “bordering, contiguous, or neighboring” waters of the United States, including wetlands separated by natural berms, constructed barriers, etc.

The definition of WOTUS was contested again in the Supreme Court in 2001 in *Solid Waste Agency of Northern Cook County (SWANCC) v. US Army Corps of Engineers* (531 US 159). This case determined whether intrastate, non-navigable, isolated waters were protected under the CWA based on their habitat for migratory birds (Downing et al. 2003; Nadeau and Rains 2007a). The Court decided, by a 5-4 margin, that use of the ponds by migratory birds was, by itself, not sufficient for CWA jurisdiction. The Court noted in making their decision that “it was the significant nexus between the wetlands and ‘navigable waters’ that informed our reading of the CWA” in *Riverside Bayview*; thus, to be considered a WOTUS required a relationship to traditional navigable waters (Nadeau and Rains, 2007b).

Five years after *SWANCC*, in 2006, the Supreme Court heard *Rapanos v. United States* and *Carabell v. United States* (which were consolidated into the *Rapanos v. United States* decision, 547 US 715 (2006)) to determine whether or not tributaries and their adjacent wetlands were provided CWA protections. The *Rapanos* case yielded five opinions, with none obtaining a majority. While all Justices agreed that CWA jurisdiction extends beyond just waters that are navigable-in-fact, they disagreed on the limits of “waters of the United States”. Justice Antonin Scalia and three other Justices comprised the plurality opinion, arguing that the scope of Clean Water Act jurisdiction includes only “relatively permanent, standing or flowing bodies of water” and wetlands with a “continuous surface connection” to such waters. That opinion further indicated that relatively permanent waters include “seasonal rivers”, but not those with “ordinary dry channels through which water occasionally or intermittently flows” or “streams whose flow is ‘coming and going’ at intervals.” Justice Anthony Kennedy concurred with the plurality to

invalidate the Sixth Circuit's decisions and remand the cases to the lower courts, but did not agree with the plurality's relatively permanent standard for CWA jurisdiction. Justice Kennedy concluded that WOTUS must "possess a 'significant nexus' to waters that are or were navigable in-fact or that could reasonably be so made." According to Justice Kennedy, waters have a significant nexus if they "either alone or in combination with similarly situated lands in the region, significantly affect the chemical, physical, and biological integrity of other covered waters more readily understood as 'navigable.'" Justice Kennedy indicated that significant nexus must not be "speculative or insubstantial" and that the absence of a hydrologic connection might also confer properties that established a significant nexus. Justice John Paul Stevens and three other Justices offered a dissenting opinion, agreeing with the agencies that the waters at issue in *Rapanos* and *Carabell* were jurisdictional. Justice Stevens also noted that a water is considered WOTUS if it meets *either* the Scalia or Kennedy standard. Thus, as a result of *Rapanos*, the EPA and Corps issued guidance documents and organizational briefs that consider a water a WOTUS if it meets *either* the Scalia or Kennedy standard (Downing et al., 2007; Leibowitz et al., 2008).

The 2001 and 2006 Supreme Court decisions have created confusion about which waters are WOTUS, particularly for non-navigable tributaries, wetlands adjacent to such tributaries, and intrastate, non-navigable, isolated waters. In 2015, the US EPA and US Department of the Army promulgated the Clean Water Rule (CWR) (80 FR 37053, June 29, 2015) to provide clarity and reduce regulatory uncertainty regarding what constitutes a WOTUS (Adler, 2015). The scientific basis of the rule was based in large part on a review and synthesis of scientific evidence regarding how streams and wetlands connect to, and impact, larger, downstream waters (US EPA 2015). The CWR established eight categories of jurisdictional waters, six of which are jurisdictional in all cases: (1) traditional navigable waters; (2) interstate waters (including

wetlands); (3) the territorial seas; (4) impoundments of waters otherwise identified as WOTUS; (5) tributaries of 1-3, mentioned previously; and (6) waters adjacent to a water identified in 1-5, mentioned previously. The remaining two categories are considered jurisdictional if, on a case-by-case basis a “significant nexus” is found between the water and waters in categories 1-3 above. The rule considers a water in the following categories to have a “significant nexus” when the water, alone, or with “similarly situated waters” affects the chemical, physical, or biological integrity of categories 1-3, above. Category 7 identifies specific types of waters (prairie potholes, Delmarva and Carolina Bays, pocosins, California western vernal pools and Texas coastal prairie wetlands) that are considered “similarly situated” by rule and must be considered together in a watershed to determine a “significant nexus.” Waters that exhibit a significant nexus are jurisdictional. Category 8 specifies that waters in certain geographic settings (within the 100-year floodplain of categories 1-3, or within 1220 meters from the high tide line or ordinary high water mark of categories 1-5), may on a case-by-case basis be jurisdictional, if they have a “significant nexus” to a traditional navigable water, interstate water, or territorial sea. The rule also explicitly identifies waters not considered jurisdictional. These include waste treatment systems, prior converted cropland, specific artificial water features, certain erosional features, puddles, groundwater, and certain storm water control features.

In October of 2015, the US Court of Appeals for the Sixth Circuit stayed the Clean Water Rule nationwide and as a result, the EPA and Corps resumed use of prior regulations defining WOTUS.

On February 28, 2017, US President Donald Trump signed Executive Order 13778 (82 FR 12495, March 3, 2017) that calls on the EPA and Corps to review the final CWR. The Executive Order directs the EPA and Corps to “consider interpreting the term ‘navigable

waters” in a manner that is “consistent with Justice Scalia’s opinion” in the *Rapanos* case. As noted previously, that opinion calls for protection of relatively permanent waters and wetlands with continuous surface connections to relatively permanent waters. The agencies published a notice of intention to review and rescind or revise the Clean Water Rule (82 FR 12532, March 6, 2017). They are currently working to implement the Executive Order in a two-step process: (1) Reestablishing the regulatory definition of WOTUS in place prior to the 2015 rule in the *Code of Federal Regulations* (this is the definition that is currently being implemented in the Sixth Circuit’s stay of the Clean Water Rule); and (2) Proposing a new definition of WOTUS that considers the principles articulated in Justice Scalia’s *Rapanos* opinion.

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## Supplementary Information 2:

### Estimation of Ecosystem Service Values of Vulnerable Waters

#### *Headwater Streams:*

Our estimate of ecosystem services provided by first order streams is based on data provided in Hill et al. (2014). The average annual ecosystem service value provided by first order and second order stream catchments in the US was estimated to be \$14,356 per hectare per year (Hill et al., 2014). We assumed that the \$14,356 per hectare per year estimate was the same for both first and second order streams.

The average area of first order stream catchments was 936 hectares and the average length of first order streams was 2.49 kilometers in the Hill et al. (2014) dataset. The average annual benefit of each kilometer of first order stream length was estimated at \$5.40 million per kilometer per year (i.e., \$14,356 per hectare per year multiplied by 936 hectares per first order stream catchment and then multiplied by 0.402 (1/2.49) per first order stream kilometer = \$5.40 million in ecosystem services per first order stream kilometer per year).

There exists 2.90 million km of first order streams in the conterminous US plus Hawai'i (Nadeau and Rains, 2007). Therefore, the cumulative annual benefit for all first order streams was calculated to be \$15.7 trillion per year (i.e., \$5,396,472 in ecosystem services per first order stream kilometer per year multiplied by 2,900,000 first order stream kilometers = \$15.7 trillion in ecosystem services per year).



### ***Wetlands Outside of Floodplains:***

Our estimate of ecosystem services provided by wetlands outside of floodplains is based on data provided in Adusumulli (2015). These estimates are based on mitigation wetlands within the US and therefore may underestimate the ecosystem service value of wetlands as natural wetlands have been found to function at higher levels than mitigation wetlands (Moreno-Mateos et al., 2012).

The average ecosystem service value for wetlands per acre per year was \$37,915 (2010 USD) (Adusumulli, 2015). To estimate the total value of ecosystem services provided by wetlands in the conterminous US, we converted the acres to hectares, resulting in an average ecosystem service value of \$93,690 per hectare per year (2010 USD) (i.e., \$37,915 (2010 USD) multiplied by 2.471 = \$93,690 per hectare per year). The 2010 USD value was then converted to 2015 USD (1 USD in 2010 is equivalent to 1.09 USD in 2015), resulting in an average annual ecosystem service value provided by wetlands of \$102,122 per hectare per year (2015 USD).

Lane and D'Amico (2016) estimate that there are approximately 6.59 million hectares of wetlands outside of floodplains in the conterminous US. Therefore, the average annual ecosystem service value provided by wetlands outside the floodplain was estimated at \$673 billion (2015 USD) (\$102,122 per hectare per year (2015 USD) multiplied by 6,594,813 hectares = \$673 billion in ecosystem services per year).

These scaled-up estimates of ecosystem service value provided by first-order streams and non-floodplain wetlands in the conterminous US should be interpreted with caution on account of uncertainties in estimates of per area value and the total number and area of streams and wetlands. Future work will synthesize a range of annual estimates of ecosystem services of these vulnerable waters so that uncertainties in our estimates can be established.

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### **Supplementary Information 3:**

#### **Estimation of continental wetland loss**

Previous estimates of continental wetland loss vary substantially (e.g., Supplementary Table 3.1). In this paper, we used total wetland areas published in Junk *et al.* (2013) as the current wetland area for 2013. The following assumptions were made when calculating this paper's wetland loss estimates:

1. The area proportion of Russia in Europe was multiplied by the wetland area of Russia, and assigned to Europe's wetland area to get a Europe wetland area estimate;
2. The remaining wetland area of Russia was then added to the China and Tropical Asia wetland area to get an Asia wetland area estimate;
3. Africa and Sub-Saharan Africa wetland areas were collapsed to get an overall Africa wetland area estimate;
4. We used the minimum area estimates for those wetland extent estimates in Junk *et al.* 2013 (i.e., if it was given as  $> 3,000,000 \text{ km}^2$ , then  $3,000,000 \text{ km}^2$  was used);
5. The "all wetlands" average rate of area change for 20<sup>th</sup> and 21<sup>st</sup> centuries published in Davidson (2014) was used to mathematically backtrack to a 1900 wetland area estimate, using our calculations based on Junk *et al.* (2013) as the 2013 baseline. This assumes a linear rate of change.

**Supplementary Table 3.1:** Continental and Oceania wetland estimates

Region	Davidson, 2014	Dixon et al., 2016	Hu et al., 2017	This paper - based on Junk et al., 2013 and Davidson, 2014
	Long-term average	1970-2008	Until 2009	1900-2014
World	54-57%	31%	33%	NA
Asia	45%	29%	27%	82%
Africa	43%	27%	16%	65%
Europe	56%	50%	45%	70%
North America	56%	17%	8%	38%
South America	NA		32%	89%
Oceania	44%	17%	18%	70%

**References Cited:**

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## **Supplementary Information 4:**

### **A State-by-State Summary of Regulations for Vulnerable Waters in the United States**

#### **Definitions:**

Perennial stream (P): Stream with year-round flow during a typical year.

Intermittent stream (I): Stream that has flow during the year when it is intercepted by the ground water table during high flow. During dry periods, intermittent streams may have no water.

Ephemeral stream (E): Stream which has water for only a short time during the year, typically after precipitation events.

Geographically Isolated Wetland (GIW): Wetlands completely surrounded by upland with no permanent surface inflow or outflow

**Supplementary Table 4.1:** Presence of regulations for GIWs and streams based on stream type (P, I, or E; modified from Zollitsch and Christie (2014)) in each State. We reached out to states in 2017 to verify there have been no changes to state regulations. Those states that responded are indicated with an ‘\*’ next to their name. Note that protection categories (Y = yes, N = no, S = some) do not describe the degree or strength of protection afforded to the resource; rather, they signify whether streams or GIWs are protected to some extent, as defined by each state. Blanks indicate no data were available for that state and/or resource.

State	<u>Stream protection</u>				<u>Wetland protection</u>	
	P	I	E	Details	GIW	Details
Alabama	Y	Y	Y		N	
Alaska*	Y	Y	Y	Streams are protected by state water quality standards. No specific designation of stream type as perennial, intermittent, or ephemeral is used to differentiate type of streams.	N	
Arizona*	Y	Y	Y		N	
Arkansas	Y	S	S	Streams are only protected if there is a presence of water (e.g., some streams can be protected ONLY at certain times of the year).	N	
California*	Y	Y	Y	Under the Porter-Cologne Water Quality Control Act, “waters of the state” mean any surface water or groundwater, including saline waters, within the boundaries of the state. Under this Act, the California Water Board protects the beneficial uses of waters of the state by establishing and enforcing water quality objectives. Timing of flows does not qualify protection under the Act.	Y	Under the Porter-Cologne Water Quality Control Act, GIWs are protected from discharges, which includes dredging, filling, or excavating (State of California, no date).
Colorado*	Y	Y	Y	All streams with or without flow are protected by water quality standards.	Y	All wetlands including GIWs are protected by water quality standards.
Connecticut*	Y	Y	S	Ephemeral streams could be protected under intermittent definition.	Y	In 1972, the state of Connecticut’s legislature created the Inland Wetlands and Watercourses Act (IWWA). The IWWA applies to all wetlands and watercourses in the state. Wetlands are identified by the state of Connecticut through soil assessment (poorly drained, very poorly drained, alluvial, and floodplain classes) so that GIWs can be identified even when they are not wet (State of Connecticut Department of Energy and Environmental Protection, 2016). Under the state’s definition, approximately 17% of the state’s land area is

State	<u>Stream protection</u>				<u>Wetland protection</u>	
	P	I	E	Details	GIW	Details
						considered to be wetlands - under the federal definition, about half of this estimate.
Delaware*	Y	Y	N	Must be flowing and navigable (state definition).	N	
Florida*	Y	Y	Y	Ephemeral streams are regulated based on water quality standards.	Y	The Environmental Resource Permitting (ERP) Program regulates virtually all alterations to the landscape that exceed permitting thresholds or that are not otherwise exempt by statute or rule from regulation. Surface water management systems include activities involving the construction, alteration, operation, maintenance or repair, removal, and abandonment of dams, impoundments, reservoirs, and appurtenant works, which include dredging and filling in wetlands and other surface waters (including isolated wetlands) and alterations of uplands.
Georgia*	Y	Y	S	Streams are waters of the state based on the presence of “wrested vegetation”, influenced by water flow or wave action.	N	
Hawai’i*	Y	Y	Y	All streams are protected by state water quality standards. Streams are defined as seasonal or continuous water flowing unidirectionally down altitudinal gradients in all or part of natural or modified channels as a results of either surface water runoff or ground water influx, or both. Streams may be either perennial or intermittent and include all natural or modified watercourses.	Y	All wetlands are protected by state water quality standards. Wetlands include fresh, brackish, or saline and include swamps, marshes, bogs, and associated ponds and pools, mud flats, isolated seasonal ponds, littoral zones of standing water bodies, and alluvial floodplains.
Idaho*	Y	Y	Y		N	Idaho Department of Environmental Quality’s regulatory authority only pertains to WOTUS; the Army Corps of Engineers has regulatory authority when it

State	<u>Stream protection</u>				<u>Wetland protection</u>	
	P	I	E	Details	GIW	Details
						comes to evaluating potential impacts to wetlands and providing appropriate protection.
Illinois	S	S	S	Public waters and waters that flow into them are regulated. Only flooding is regulated for non-public waters	S	A GIW can be protected in Illinois under the Interagency Wetland Policy Act of 1989, which regulates state-funded projects and activities that affect GIWs.
Indiana*	Y	Y	S	Regulated if defined bed and bank exists under Federal Clean Water Act. No state regulations specifically regulating discharges of dredged or fill material into streams. State water quality standards in place for National Pollutant Discharge Elimination System discharges. Indiana Department of Natural Resources regulates certain activities in the floodway of streams that drain more than 259 hectares.	S	Indiana has a law in place to regulate wetlands the Army Corps of Engineers determines to be isolated. Certain exemptions exist based on class and size. If a wetland does not meet an exemption, then all size impacts are regulated (Indiana Department of Environmental Management, 2017).
Iowa*	Y	S	N	Intermittent streams are regulated and assumed to meet fishable/swimmable uses until a use assessment is conducted and a stream-specific designation is issued.	N	
Kansas*	Y	Y	Y	Defined bed and bank required. All beneficial use water withdrawals as well as stream modifications and flood plain activities are regulated under the authority of the Kansas Department of Agriculture.  All classified waters in KS Surface Water Register have designated uses and applicable numeric or specific water quality standards. Those waters not on the Register are protected through the general narrative water quality standards applied to waters of the state. Furthermore, any	N	Surface water quality standards and designated uses applicable to lakes in the KS Surface Water Register apply to identified wetlands. Privately held wetlands not identified on the Register may be protected under the general narrative water quality standards as deemed warranted. There are no specific “state wetland protection regulations” in Kansas, except a strict condition on discharging wastewater into or immediately above a wetland.



State	<u>Stream protection</u>				<u>Wetland protection</u>	
	P	I	E	Details	GIW	Details
				wastewater discharge to any type of stream raises the stream's standing to a classified water with full protection.		
Kentucky*	Y	Y	S	Surface water and evidence of flow (constant or intermittent) and defined banks and beds required. Ephemeral streams are covered under general certification; duration of impact on stream water quality is considered for certification.	N	
Louisiana					N	
Maine	Y	S	N	Must meet two of the following criteria: (1) US topographic blue dotted line; (2) Continuous flow for more than two months; (3) scoured channel bed; (4) aquatic animals; (5) aquatic vegetation.	Y	Under the Natural Resources Protection Act wetlands are considered to be a "resource of state significance" (Maine Department of Environmental Protection, no date). Dredging, draining or heavily modifying a GIW requires a permit under this Act.
Maryland*	Y	Y	N	Maryland's Waterway Construction Division requires permits for activities that change the course, current or cross section of intermittent and perennial waterways. Maryland's National Pollutant Discharge Elimination System Program requires permits for discharges to ephemeral, intermittent and perennial waterways. The 100-year floodplain of nontidal streams is also considered "waters of the State."	Y	The Maryland Nontidal Wetlands Protection Act regulates activities in all GIWs within Maryland by regulating filling, excavating, changes to water level, or destruction or removal of plant life, both within the wetland and the adjoining 7.62 m nontidal wetland buffer (30.50 m buffer in certain areas). (Maryland Department of the Environment, no date).
Massachusetts*	Y	S	S	Intermittent and ephemeral streams are regulated when they are downgradient of bogs, swamps, wet meadows, and marshes. Intermittent and ephemeral streams that do not flow throughout the year and are upgradient of wetlands are not protected under the Wetlands Protection Act.	S	GIWs in Massachusetts are protected under the state's Wetlands Protection Act only when they meet certain criteria such as the definition of Isolated Land Subject to Flooding. GIWs are protected under the state's 401 Water Quality Certification regulations (314 CMR 9.00) when they meet the criteria of isolated vegetated wetlands or

State	<u>Stream protection</u>				<u>Wetland protection</u>	
	P	I	E	Details	GIW	Details
						vernal pool, and jurisdiction has been established by the Corps of Engineers.
Michigan	Y	Y	S	Defined banks, a bed, and evidence of continued flow or continued occurrence of water required.	S	Under the Geomare-Anderson Wetlands Protection Act of 1979, a GIW can be protected in Michigan if it is more than two hectares in size or if it is determined to be essential to the preservation of the state's natural resources (Michigan Department of Environmental Quality, no date). Permits are required for activities in GIWs deemed to be jurisdictional.
Minnesota*	Y	Y	Y	State permits are required for activities affecting streams having a total watershed greater than 5.18 ha. State water quality standards apply to essentially all waters in the state.	Y	Wetlands are protected under the Wetlands Conservation Act, passed in 1991 in Minnesota. This Act was put into place due to the high amount of non-federally protected wetland loss occurring. Under this Act, wetlands are not to be drained or filled unless this loss is replaced through wetland restoration or creation (Minnesota Board of Water and Soil Resources, no date).
Mississippi	Y	Y	Y	Ephemeral streams protected under water quality criteria.	N	
Missouri*	Y	Y	Y	Ephemeral streams protected under water quality criteria.	N	
Montana*	Y	Y	Y		N	
Nebraska	Y	Y	Y	Nebraska regulates systems not associated with storm water.	Y	GIWs are protected in Nebraska under water quality standards.
Nevada*	Y	Y	S	Ephemeral streams can be regulated based on water quality standards.	S	Wetlands can be regulated based on water quality standards.
New Hampshire	Y	Y	S	Regulates systems that ebb and flow. Ephemeral streams can be covered if associated with wetlands.	S	Wetlands in New Hampshire are regulated by the Wetlands Act, which requires permits for activities that affect all wetlands in the state. A wetland is jurisdictional in New Hampshire if it has hydric soils, hydrophytic vegetation, and if it is "inundated with water either

State	<u>Stream protection</u>				<u>Wetland protection</u>	
	P	I	E	Details	GIW	Details
						permanently or periodically or the soil is saturated to the surface at some time during the growing season of the prevalent vegetation” (New Hampshire Department of Environmental Services, no date).
New Jersey*	Y	S	S	Streams protected if they drain more than 20 hectares. If they drain less than 20 hectares and have no discernable channel or are confined in a structure or are cut off from a regulated water, they are not regulated.	Y	The Freshwater Wetlands Protection Act regulates the freshwater wetlands and requires a permit for discharging, dredging, and filling wetlands, including GIWs.
New Mexico*	Y	Y	Y		Y	Wetlands including isolated wetlands are considered water of the State and state water quality standards apply (New Mexico Administrative Code 20.6.4 NMAC)
New York*	Y	S	S	Streams must be designated as a protected class, or be navigable to be regulated. Some others would be regulated under wetlands law. Some intermittent are regulated, ephemeral are largely not regulated, but some are.	S	Wetlands are only protected in New York if they are five hectares or larger, or if they are considered to be locally and unusually important. Wetlands must be shown on the regulatory maps to be regulated. Estimates are that currently about 50% of the wetlands that should be regulated actually are regulated because of incomplete and inaccurate maps. (New York State Department of Environmental Conservation, no date).
North Carolina	Y	Y	N		Y	Activities that will impact GIWs in North Carolina require an Isolated and Other Non-404 Jurisdictional Wetlands and Waters permit (North Carolina Department of Environmental Quality, 2017).
North Dakota	Y	Y	S	Ephemeral streams are regulated if defined as Class III under the state’s water quality criteria.	N	
Ohio*	Y	Y	Y	If a stream has a defined bed and bank, a permit is required	Y	In Ohio, anyone who wishes to discharge dredge or fill

State	<u>Stream protection</u>				<u>Wetland protection</u>	
	P	I	E	Details	GIW	Details
				to impact the stream. Ohio regulates all jurisdictional streams through Section 401, non-jurisdictional streams have some protections if they meet the water of the state definition.		material into a non-jurisdictional wetland requires a permit from the Ohio Environmental Protection Agency under the Isolated Wetlands Law. These permits are required for all wetlands that are not protected under the CWA (Ohio Environmental Protection Agency, 2017).
Oklahoma	Y	Y	S		N	
Oregon*	Y	Y	N	Protection if stream has flow. Perennial streams must have continuous flow in parts or all of their bed during periods of normal participation. Intermittent stream jurisdiction is subject to a two part test: (1) the stream must flow during a portion of every year; and (2) it must provide rearing or food-producing areas for food and game fish.	Y	Wetlands in Oregon are considered jurisdictional if they meet Oregon’s definition “wetland” and can be delineated using the Corps of Engineers Wetland Delineation Manual. All jurisdictional wetlands including GIWs in Oregon are protected under the state’s removal-fill law. Under this law, the state has a 50 cubic yard threshold of fill and/or removal before a permit is required except in designated Essential Indigenous Anadromous Salmonid Habitat (ESH), State Scenic Waterways and mitigation sites where the 50 cubic threshold does not apply.
Pennsylvania*	Y	Y	S	A channel or conveyance of surface water having defined bed and banks, whether natural or artificial, with perennial and intermittent flow are protected (some ephemeral streams could be protected under the intermittent definition).	Y	Activities in wetlands are regulated under the Clean Streams Law (1937), the Dam Safety and Encroachment Act (1978), and 25 Pa Code Chapter 105. Under these Acts/regulation, the Pennsylvania Department of Environmental Protection regulates two categories of wetlands: (1) exceptional value wetlands, and (2) other wetlands.
Rhode Island	Y	Y	S	Perennial rivers are protected if a river fits the USGS definition. Intermittent streams defined by flow and channel characteristics. Ephemeral	Y	Freshwater wetlands (including GIWs) are covered under the Rhode Island Freshwater Wetland Act (Rhode Island Department of

State	<u>Stream protection</u>				<u>Wetland protection</u>	
	P	I	E	Details	GIW	Details
				streams only protected if they connect to a wetland.		Environmental Management, 2008).
South Carolina*	Y	Y	S	A permit to discharge fill into ephemeral streams is regulated only if US Army Corps determines they are jurisdictional.	N	A permit to discharge fill into GIWs regulated only if US Army Corps determines they are jurisdictional.
South Dakota	S	S	S	Protects all types of streams if they meet specific state-defined fishery or water quality criteria.	N	
Tennessee*	Y	Y	N	Stream is defined as “a surface water that is not a wet weather conveyance (ephemeral)”. To be regulated must have sustained flow and at least one of these characteristics: (1) two obligate lotic organisms; (2) a channel; (3) presence of water.	Y	Tennessee regulates GIWs through the Tennessee Water Control Act of 1977. Through this Act, a permit is required for any activities within a wetland (Seay, 2011).
Texas*	Y	Y	Y	Ephemeral streams are typically covered under the state’s definition of surface water in the state.	S	Texas regulates discharges to surface waters in the state-including discharges to playa lakes. Regarding discharge of dredge and fill material, Texas regulates waterbodies covered under the CWA.
Utah*	Y	Y	N	Discharges to perennial streams are regulated, with established beneficial uses and associated water quality parameters that need to be maintained. Intermittent streams are monitored for their 305(d) report. However, administrative code specifies that water quality standards that are violated due to low water (termed intermittent waters) aren't cause for action: “Failure of a stream to meet water quality standards when stream flow is either unusually high or less than the 7-day, 10-year minimum flow shall not be cause for action against persons discharging wastes which meet both the requirements of R317-1 and	N	

State	<u>Stream protection</u>				<u>Wetland protection</u>	
	P	I	E	Details	GIW	Details
				the requirements of applicable permits.” (US EPA, 1988)		
Vermont*	Y	S	N	Regulate perennial systems for dredge and fill; intermittent streams are covered under water quality standards.	S	The Vermont Wetland Rules protect wetlands with significant function or value regardless if they are isolated or not. Isolated wetlands are less likely to have significant function but many are protected as headwater wetlands or significant natural communities such as bogs, fens, and vernal pools.
Virginia	Y	Y	Y		Y	Virginia generally regulates isolated wetlands like non-isolated wetlands. The Virginia Water Protection Permit Program regulates activities within GIWs including dredging, filling, and excavating. However, the state defines “isolated wetlands of minimal ecological value”, which are less than 0.04 ha in size and can be filled (up to 0.04 ha) without a permit (Dorney et al., 2012).
Washington	S	S	S	Regulations tied to fish, habitat, and water quality.	Y	The state of Washington covers GIWs (those not covered under the CWA). The state’s Water Pollution Control Act and water quality regulations protect GIWs and a permit is required for activities that affect these ecosystems (State of Washington Department of Ecology, 2017).
West Virginia*	Y	S	S	Regulated if it has a defined bed and bank.	S	Some GIWs in West Virginia can be protected under the Water Pollution Control Act. The Department of Environment decides on a case-by-case basis whether to allow filling of isolated wetlands based on their effects on water quality.
Wisconsin*	Y	Y	S	Regulation based on state definition of navigable waters.	Y	Under the 2011 Wisconsin Act 118, the Department of

State	<u>Stream protection</u>				<u>Wetland protection</u>	
	P	I	E	Details	GIW	Details
						Natural Resources is required to issue permits for activities discharging into wetlands.
Wyoming*	Y	Y	S	State regulations protect all “Waters of the state” which includes all surface and ground waters, including waters associated with wetlands. “Surface waters of the state” include all perennial, intermittent, and ephemeral defined drainages. Discharges of fill to streams that are not “WOTUS” are not regulated.	Y	Point source discharges of pollution to isolated wetlands are regulated under the State’s National Pollutant Discharge Elimination System delegated authority. Losses of isolated wetlands (due to fill) in excess of 0.4 hectare are authorized by a statewide general permit. The general permit requires notification and an approved mitigation plan. Activities causing losses less than 0.4 hectare of isolated wetlands are not regulated. Isolated wetlands that do not meet the definition of a water of the United States, may be protected under the state’s definition (Wyoming Department of Environmental Quality, 2016).

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