APPROVED JURISDICTIONAL DETERMINATION FORM U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD): August 02, 2017 DISTRICT OFFICE, FILE NUMBER, FILE NAME: JD Form 1 of 1; SAC-2017-00820 Pine Lakes Project Site C. PROJECT LOCATION AND BACKGROUND INFORMATION: State: South Carolina County/parish/borough: Horry City: Myrtle Beach Center coordinates of site (lat/long in degree decimal format): Lat. 33.7348° N, Long. -78.8486 ° W. Universal Transverse Mercator: NAD 83 Name of nearest waterbody: Tributary of the Atlantic Intracoastal Waterway Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: Atlantic Intracoastal Waterway Name of watershed or Hydrologic Unit Code (HUC): Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request. Check if other sites (e.g., offsite mitigation sites, disposal sites, etc...) are associated with this action and are recorded on a different JD form. D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY): Office (Desk) Determination. Date: July 21, 2017 Field Determination. Date(s): **SECTION II: SUMMARY OF FINDINGS** A. RHA SECTION 10 DETERMINATION OF JURISDICTION. There Are no "navigable waters of the U.S." within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [Required] Waters subject to the ebb and flow of the tide.

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

SECTION I: BACKGROUND INFORMATION

There Are "waters of the U.S." within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [Required]

Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce.

a.	Indica	te presence of waters of U.S. in review area (check all that	apply): ¹
		TNWs, including territorial seas	
		Wetlands adjacent to TNWs	
	$\overline{\boxtimes}$	Relatively permanent waters ² (RPWs) that flow directly or in-	directly into TNWs
		Non-RPWs that flow directly or indirectly into TNWs	
		Wetlands directly abutting RPWs that flow directly or indirect	tly into TNWs
		Wetlands adjacent to but not directly abutting RPWs that flow	v directly or indirectly into TNWs
		Wetlands adjacent to non-RPWs that flow directly or indirect	ly into TNWs
		Impoundments of jurisdictional waters	
		Isolated (interstate or intrastate) waters, including isolated we	tlands
b.		fy (estimate) size of waters of the U.S. in the review area: retland waters: 2,145 linear feet: width (ft) and/or acres.	acres.

c. Limits (boundaries) of jurisdiction based on: Established by OHWM., Pick List, Pick List

Elevation of established OHWM (if known):

2. Non-regulated waters/wetlands (check if applicable): ³ [Including potentially jurisdictional features that upon assessment are NOT waters or wetlands]

Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional. Explain: The site in question contains approximately 5.66 acres of upland excavated ornamental ponds that were

¹ Boxes checked below shall be supported by completing the appropriate sections in Section III below.

² For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).

³ Supporting documentation is presented in Section III.F.

determined to be non-jurisdictional. In addition the site contains approximately 2,288 linear of feet of ditches that were determined to have been excavated out of uplands and to drain only uplands and were therefore determined to be nonjurisdictional

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

TNW

Identify TNW: Atlantic Intracoastal Waterway.

Summarize rationale supporting determination: The Atlantic Intracoastal Waterway is a federally maintained channel, subject to the ebb and flow of the tide and currently used for interstate commerce .

Wetland adjacent to TNW

Summarize rationale supporting conclusion that wetland is "adjacent":

CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under Rapanos have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are "relatively permanent waters" (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

Characteristics of non-TNWs that flow directly or indirectly into TNW

(i) General Area Conditions:

Watershed size: Pick List; **Pick List** Drainage area: Average annual rainfall: inches Average annual snowfall: inches

(ii) Physical Characteristics:

(a) Relationship with TNW:

☐ Tributary flows directly into TNW. Tributary flows through **Pick List** tributaries before entering TNW. Project waters are **Pick List** river miles from TNW. Project waters are Pick List river miles from RPW.

Project waters are **Pick List** aerial (straight) miles from TNW. Project waters are **Pick List** aerial (straight) miles from RPW.

Project waters cross or serve as state boundaries. Explain:

⁴ Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.

		Identify flow route to TNW ⁵ : Tributary stream order, if known:
	(b)	General Tributary Characteristics (check all that apply): Tributary is: Natural Artificial (man-made). Explain: Manipulated (man-altered). Explain:
		Tributary properties with respect to top of bank (estimate): Average width: feet Average depth: feet Average side slopes: Pick List.
		Primary tributary substrate composition (check all that apply): Silts Sands Concrete Cobbles Gravel Muck Bedrock Vegetation. Type/% cover: Other. Explain:
		Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain: Presence of run/riffle/pool complexes. Explain: Tributary geometry: Pick List. Tributary gradient (approximate average slope): %
	(c)	Flow: Tributary provides for: Pick List Estimate average number of flow events in review area/year: Pick List Describe flow regime: Other information on duration and volume:
		Surface flow is: Pick List. Characteristics: Subsurface flow: Pick List. Explain findings: Dye (or other) test performed:
		Tributary has (check all that apply): Bed and banks OHWM ⁶ (check all indicators that apply): clear, natural line impressed on the bank changes in the character of soil destruction of terrestrial vegetation the presence of wack line sediment sorting sediment deposition matted down, bent, or absent leaf litter disturbed or washed away sediment deposition multiple observed or predicted flow events abrupt change in plant community other (list):
		☐ Discontinuous OHWM. ⁷ Explain: .
		If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply): High Tide Line indicated by: Oil or scum line along shore objects In fine shell or debris deposits (foreshore) Physical markings/characteristics In tidal gauges Other (list): Mean High Water Mark indicated by: Survey to available datum; Physical markings; Vegetation lines/changes in vegetation types.
(iii)	Cha	emical Characteristics: racterize tributary (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.). Explain: .tiffy specific pollutants, if known:

⁵ Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW. ⁶A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break. ⁷Ibid.

	(iv)	Biological Characteristics. Channel supports (check all that apply): Riparian corridor. Characteristics (type, average width): Wetland fringe. Characteristics: Habitat for: Federally Listed species. Explain findings: Fish/spawn areas. Explain findings: Other environmentally-sensitive species. Explain findings: Aquatic/wildlife diversity. Explain findings:
2.	Cha	racteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW
	(i)	Physical Characteristics: (a) General Wetland Characteristics: Properties: Wetland size: acres Wetland type. Explain: Wetland quality. Explain: Project wetlands cross or serve as state boundaries. Explain:
		(b) General Flow Relationship with Non-TNW: Flow is: Pick List. Explain:
		Surface flow is: Pick List Characteristics: .
		Subsurface flow: Pick List . Explain findings:
		(c) Wetland Adjacency Determination with Non-TNW: Directly abutting Not directly abutting Discrete wetland hydrologic connection. Explain: Ecological connection. Explain: Separated by berm/barrier. Explain:
		(d) Proximity (Relationship) to TNW Project wetlands are Pick List river miles from TNW. Project waters are Pick List aerial (straight) miles from TNW. Flow is from: Pick List. Estimate approximate location of wetland as within the Pick List floodplain.
	(ii)	Chemical Characteristics: Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain: Identify specific pollutants, if known:
	(iii)	Biological Characteristics. Wetland supports (check all that apply): Riparian buffer. Characteristics (type, average width): Vegetation type/percent cover. Explain: Habitat for: Federally Listed species. Explain findings: Fish/spawn areas. Explain findings: Other environmentally-sensitive species. Explain findings: Aquatic/wildlife diversity. Explain findings:
3.	Cha	racteristics of all wetlands adjacent to the tributary (if any) All wetland(s) being considered in the cumulative analysis: Pick List Approximately () acres in total are being considered in the cumulative analysis.

For each wetland, specify the following:



Summarize overall biological, chemical and physical functions being performed:

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its proximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:

- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and
 other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

- 1. Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs. Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D:
- 2. Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs. Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D:
- 3. Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW. Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D:

 $Documentation\ for\ the\ Record\ only:\ Significant\ nexus\ findings\ for\ seasonal\ RPWs\ and/or\ wetlands\ abutting\ seasonal\ RPWs:$

D.	DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL
	THAT APPLY):

1.	TNWs and Adjacent Wetlands.	Check all that app	ly and provide size estimates in review area:
	TNWs: linear feet	width (ft), Or,	acres.
	☐ Wetlands adjacent to TNWs:	acres.	

2. RPWs that flow directly or indirectly into TNWs.

Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial: The tributary was determined to be a RPW with perennial flow by review of site photographs

depicts low elevations and a defined channel. The tributary was determined to be a RPW with perennial flow in approved JD SAC 2006-01678-3JB issued on 9/14/2011. NWIs depict a riverine feature at the location of the RPW. Based on the previously mentioned evidence, this perennial RPW was determined to have flow at least 90% of the year under normal conditions. Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: Provide estimates for jurisdictional waters in the review area (check all that apply): Tributary waters: 2,145 linear feet 15-17 width (ft). Other non-wetland waters: acres. Identify type(s) of waters: Non-RPWs⁸ that flow directly or indirectly into TNWs. Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C. Provide estimates for jurisdictional waters within the review area (check all that apply): Tributary waters: linear feet width (ft). Other non-wetland waters: acres. Identify type(s) of waters: Wetlands directly abutting an RPW that flow directly or indirectly into TNWs. Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands. Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: Provide acreage estimates for jurisdictional wetlands in the review area: Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs. Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisidictional. Data supporting this conclusion is provided at Section III.C. Provide acreage estimates for jurisdictional wetlands in the review area: acres. Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs. Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C. Provide estimates for jurisdictional wetlands in the review area: acres. Impoundments of jurisdictional waters.9 As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional. Demonstrate that impoundment was created from "waters of the U.S.," or Demonstrate that water meets the criteria for one of the categories presented above (1-6), or Demonstrate that water is isolated with a nexus to commerce (see E below). Explain: E. ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):10

submitted by the agent, Horry County 2009 LiDAR, soil survey information, NWIs, previous jurisdictional determinations and USGS topographic maps. Photos depict a well-defined channel free of leaf litter and debris with continuous ordinary high water mark, the USGS topographic maps depict a solid blue line feature which is the symbol for perennial flow, Horry County soil surveys depict Leon soils which is a 100% hydric soil. Horry County LiDAR

⁸See Footnote # 3

 $^{^{\}rm 9}$ To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.

	which are or could be used by interstate or foreign travelers for recreational or other purposes. from which fish or shellfish are or could be taken and sold in interstate or foreign commerce. which are or could be used for industrial purposes by industries in interstate commerce. Interstate isolated waters. Explain: Other factors. Explain:
	Identify water body and summarize rationale supporting determination:
	Provide estimates for jurisdictional waters in the review area (check all that apply): Tributary waters: linear feet width (ft). Other non-wetland waters: acres. Identify type(s) of waters: Wetlands: acres.
F.	NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY): If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements. Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce. Prior to the Jan 2001 Supreme Court decision in "SWANCC," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR). Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: Other: (explain, if not covered above):
	Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply): Non-wetland waters (i.e., rivers, streams): 2,288 linear feet width (ft). Lakes/ponds: 5.66 acres. Other non-wetland waters: acres. List type of aquatic resource: Wetlands: acres. Provide acreage estimates for non-jurisdictional waters in the review area that do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction (check all that apply): Non-wetland waters (i.e., rivers, streams): linear feet, width (ft). Lakes/ponds: acres.
	Other non-wetland waters: acres. List type of aquatic resource: Wetlands: acres.
SEC	CTION IV: DATA SOURCES.
A.	SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall be included in case file and, where checked and requested, appropriately reference sources below): Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: The site in question is shown on the depiction titled "SAC 2017-00820 / Pine Lakes Project / Pine Lakes Development Company / Horry County, SC" and dated July 25, 2017.
	Data sheets prepared/submitted by or on behalf of the applicant/consultant. ☐ Office concurs with data sheets/delineation report. ☐ Office does not concur with data sheets/delineation report. ☐ Data sheets prepared by the Corps: ☐ Corps navigable waters' study: ☐ U.S. Geological Survey Hydrologic Atlas: ☐ USGS NHD data. ☐ USGS 8 and 12 digit HUC maps. ☐ U.S. Geological Survey map(s). Cite scale & quad name: Ocean Forest Quad; The USGS topographic survey information within Ocean Forest Quad and the line fortune situated in a naturally law laine.
	within Ocean Forest Quad depicts the project area as forested uplands. A solid blue line feature situated in a naturally low lying drainage area bisects the project area. This feature was determined to be a pRPW. USDA Natural Resources Conservation Service Soil Survey. Citation: Horry County Soil Survey Sheet 84; USDA NRSC Soil maps depict the project area as being comprised of a combination of 3.9 % Centenary fine sand, 8.4% Echaw sand, and 87.7 % Leon fine sand. Leon fine sand which makes up the majority of the project area is poorly drained hydric soil. National wetlands inventory map(s). Cite name: PFO4B; NWIs depict the project area as containing saturated palustrine forest adjacent to a rivering feature in the southwestern portion. Site photos and data sheet provided by the agent revealed that

 $^{^{10}}$ Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA $\it Memorandum~Regarding~CWA~Act~Jurisdiction~Following~Rapanos.$

	s at this location contained greater that 30% uncoated sand grains and lacked indicators of hydrology. The riverine feature icted on the NWIs was determined to be a pRPW.
	State/Local wetland inventory map(s): .
	FEMA/FIRM maps: .
	100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)
\boxtimes	Photographs: Aerial (Name & Date): Horry County Aerial Index 99:11226:50, SCDNR 2006, Google Earth 2016.
	or 🛮 Other (Name & Date): Site photos submitted by the agent depict soils throughout the site as containing
_	ater than 30% uncoated sand grains. Photos depicting the pRPW onsite reveal an Ordinary High Water Mark, bed and
bar	ık, and channel clear of vegetation and debris. Spoil piles .
\boxtimes	Previous determination(s). File no. and date of response letter: Approved JD SAC 2006-01678-3JB issued on 9/14/2011.
	Applicable/supporting case law: .
	Applicable/supporting scientific literature: .
\boxtimes	Other information (please specify): Horry County 2009 LiDAR with Hillshade Overlay supports the delineation.
	NHD plus flow lines in Google Earth depicts the pRPW as a primary drainage feature

B. ADDITIONAL COMMENTS TO SUPPORT JD: This form addresses a 129.3 acre tract that was determined to contain approximately 2,145 linear feet of tributary with perennial flow. The tributary was determined to be a RPW with perennial flow by review of site photographs submitted by the agent, Horry County 2009 LiDAR, soil survey information, NWIs, previous jurisdictional determinations and USGS topographic maps. Photos depict a well-defined channel free of leaf litter and debris with continuous ordinary high water mark, the USGS topographic maps depict a solid blue line feature which is the symbol for perennial flow, and Horry County soil surveys depict Leon soils which is a 100% hydric soil. Horry County LiDAR depicts low elevations and a defined channel. The tributary was determined to be a RPW with perennial flow in approved JD SAC 2006-01678-3JB issued on 9/14/2011. NWIs depict a riverine feature at the location of the RPW. Based on the previously mentioned evidence, this perennial RPW was determined to have flow at least 90% of the year under normal conditions.

The site in question contains approximately 5.66 acres of upland excavated ornamental ponds that were determined to be non-jurisdictional. In addition the site contains approximately 2,288 linear of feet of ditches that were determined to have been excavated out of uplands and to drain only uplands and were therefore determined to be non-jurisdictional.

Information submitted by the agent depicted uplands on site as having soils with greater than 30% uncoated sand grains and lacking indicators of hydrology.

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