

**A Disconnect between Law and Science: Louisiana's Waterbottom Ownership Laws in a
Disappearing Coastline**

by
John T. Arnold

Cover illustration:
U.S. Army Corps of Engineers, Harold Fisk, [1944 sketches of Mississippi River meander](#)

A Disconnect between Law and Science: Louisiana's Waterbottom Ownership Laws in a Disappearing Coastline

It is really an object, upon which the mind dwells with complacency; the infinite number of natural canals, that everywhere pervade the state of Louisiana; near the sea coast, and the margin of large rivers, running into each other like network. Here art need only be directed by genius, and assisted by wealth, to lead to results on the future prosperity of the state, beyond the power of calculation.¹

I. Introduction

The Louisiana coastline contains a rich and diverse natural environment found in few other places. Among the most dynamic are the lowlands of south Louisiana. This region was created through a 5,000 year process of formation and degradation of delta lobes as the Mississippi River shifted courses depositing its sediment into the Gulf of Mexico.² Ultimately, these processes created a large land mass culminating into landforms and surface features recognizable today. This region has produced a cornucopia of flora and fauna attracting humans since historic and prehistoric times to collect and extract the natural bounty that the Louisiana coastal zone offers.³

The paramount role of wetland environments in the development and sustenance of cultures throughout human history is unmistakable. Since early civilization, many cultures have learned to live in harmony with wetlands and have benefited from the resources and functions they provide.⁴ European settlers recognized these values in Louisiana's coastal region and began inhabiting the area in the early 1700's. American Cajuns, descendants from French colonists of Acadia, moved to the Louisiana delta in the last half of the eighteenth century and flourished within the bayou wetlands.⁵

As settlers entered the region, they also incorporated the European ideals and principles of individual land ownership into the rules of society. However, formal delineations, subrogations, and divisions of land within the region did not occur until the 1800's when the United States surveyed and subdivided lands for governmental tax collection purposes.⁶ As land was purchased and subdivided, newly enacted laws created a basis to distinguish between private and public lands, including waterbottoms, those lands that underlie the surface waters of the state.

In drafting these rules of law, lawmakers relied upon the general scientific understanding of the region's natural setting – that landforms act as stable platforms that may undergo limited amounts of change over time. However, in reality, the natural processes that sustain the landforms in coastal Louisiana have

¹ Darby, W. (1816). "Geographical Description of the State of Louisiana." Published by John Melish, Philadelphia, p.75.

² Smith, L.M, J.B. Dunbar, and L.D. Britsch. 1986. Geomorphological Investigation of the Atchafalaya Basin Area West, Atchafalaya Delta, and Terrebonne Marsh, Volume I. Coastal Engineering Research Center, Department of the Army Waterways Experiment Station, Corps of Engineers, Vicksburg, Mississippi.

³ Coalition to Restore Coastal Louisiana. 1999. No Time to Lose: Facing the Future of Louisiana and the Crisis of Coastal Land Loss.

⁴ Nicholas, G.P. 1998. Wetlands and hunter-gatherers: A global perspective. *Current Anthropology* 39:720-731.

⁵ Mitsch, W.J. and J.G. Gosselink. 2000. *Wetlands*, 3rd ed. John Wiley & Sons, Inc. New York, NY.

⁶ Poret, O.G. 1972. *History of Land Titles in the State of Louisiana*. Louisiana State Land Office, Division of Administration, Baton Rouge, Louisiana.

remained in a constant state of change.⁷ These processes remain in motion today with rates of degradation exceeding formation.⁸ The current state of the coastal lowlands lies in stark contrast to the extent of the land mass when most of the existing laws were written.

This paper will review the historical evolution of existing waterbottom ownership laws, identify the land loss processes to which these laws are applied, and evaluate possible alternatives to address legal shortcomings associated with the application of outdated law to an evolved understanding of natural processes.

II. Historical Evolution of Louisiana Waterbottom Ownership Law

A. The Subdivision of Louisiana

The evolution of the current system of land ownership in Louisiana first began when the United States acquired the Louisiana Territory from France for \$15 million, under the Treaty of Cession on April 30, 1803.⁹ The land consisted of 544 million acres and was subsequently divided into the territories of Louisiana and Orleans by the United States Congress.¹⁰

In 1805, the United States government made its first major attempt in alienating large quantities of this land to individual landowners.¹¹ The act provided for three important phases allowing individuals to confirm legal possession to their lands and acquire new lands.

First, Congress created U.S. District Land Offices across the Territory which included offices for the Eastern Division of the Territory of Orleans at New Orleans, the Western Division of Territory of Orleans at Opelousas, and local offices at Ouachita, Natchitoches, and Greensburg.

Second, Congress created a Board of Commissioners to review the validity of French, British, or Spanish land grants issued to individuals before the United States owned the Louisiana Territory.

Third, the Surveyor General of the United States deployed surveyors into the Territory of Orleans to establish a system for sub-dividing vacant public lands. As a result, in 1807, the territory was re-divided into 19 parishes with the boundaries derived from those used by the Spanish for ecclesiastical purposes.¹²

As tracts of land became subdivided into parishes, a systematic delineation process distinguished public from private lands. Such a determination allowed the United States government and individual states to inventory their land holdings and convey certain properties to private interests.

⁷ Gagliano, S.M., H.J. Kwon, and J.L. van Beek. 1970. Deterioration and Restoration of Coastal Wetland. Coastal Studies Institute, Center for Wetland Resources, Louisiana State University.

⁸ Couvillion, B. A. B., J.A.; Steyer, G.D.; Sleavin, William; Fischer, Michelle; Beck, Holly; Trahan, Nadine; Griffin, Brad; and Heckman, David, (2011). "Land area change in coastal Louisiana from 1932 to 2010." U.S. Geological Survey Scientific Investigations Map 3164, scale 1:265,000.

⁹ Poret, O.G. 1972. History of Land Titles in the State of Louisiana. Louisiana State Land Office, Division of Administration, Baton Rouge, Louisiana.

¹⁰ Act of March 26, 1804, U. S. Statutes at Large, Vol. II, p. 283

¹¹ Act of March 2, 1805, U. S. Statutes at Large, Vol. II, p. 324

¹² Poret, O.G. 1972. History of Land Titles in the State of Louisiana. Louisiana State Land Office, Division of Administration, Baton Rouge, Louisiana.

B. State ownership via the Equal Footing and Public Trust Doctrines

As the United States formalized the Federal Constitution and states were admitted into the Union, each state acquired control and ownership of public things located within their respective borders.¹³ In 1811, beds and bottoms of all navigable waters were deemed part of the public domain and, consequently, were set aside as public highways.¹⁴

By 1845, the basis for this process became known as the Equal Footing Doctrine. The doctrine, as described in *Pollard v. Hagan*, placed states on equal footing by granting each state ownership over things deemed public to be held in the public trust for the common good of its citizens.¹⁵ The challenge became deciphering what constituted public things.

In 1894, the United States Supreme Court heard *Shively v. Bowlby* to consider whether lands underlying navigable waters of the Columbia River were indeed part of the public domain.¹⁶ The court held that when Oregon became a state, all grants and laws applicable to that territory became null and void, and that all lands became the property of the United States, from which the State and private interests could acquire title.¹⁷ As for the waterbottoms, the Court concluded:

Lands under tidewaters are incapable of cultivation or improvement in the manner of lands above high water mark. They are of great value to the public for the purposes of commerce, navigation, and fishery. Their improvement by individuals, when permitted, is incidental or subordinate to the public use and right. Therefore the title and the control of them are vested in the sovereign for the benefit of the whole people.

At common law, the title and the dominion in lands flowed by the tide were in the King for the benefit of the nation. Upon the settlement of the colonies, like rights passed to the grantees in the royal charters, in trust for the communities to be established. Upon the American Revolution, these rights, charged with a like trust, were vested in the original states within their respective borders, subject to the rights surrendered by the Constitution to the United States.

Upon the acquisition of a territory by the United States, whether by cession from one of the states, or by treaty with a foreign country, or by discovery and settlement, the same title and dominion passed to the United States for the benefit of the whole people and in trust for the several states to be ultimately created out of the territory.

The new states admitted into the union since the adoption of the Constitution have the same rights as the original states in the tidewaters and in the lands under them, within their respective jurisdictions. The title and rights of riparian or littoral proprietors in the

¹³ *Martin v. Waddell*, 41 U.S. 367 (1842)

¹⁴ Act of Congress of February 15, 1811, U. S. Statutes at Large, Vol. II, p. 617

¹⁵ *Pollard v. Hagan*, 44 U.S. 212 (U.S. 1845)

¹⁶ *Shively v. Bowlby*, 152 U.S. 1 (1894).

¹⁷ *Shively v. Bowlby*, 152 U.S. 1, 51 (1894) - "The land laws adopted by the provisional government of Oregon, established by the people while the sovereignty was in dispute between the United States and Great Britain, regulated the occupation only. The settlers had no title in the soil. The United States, on assuming undisputed dominion over the territory, owned all the lands therein, and Congress had the right to confine its bounties to settlers within just such limits as it chose. The provisions of the general land laws of the United States were not applicable to the Oregon Territory. And before 1850, there was no statute under which any one could acquire a legal title from the United States to lands in Oregon."

soil below high water mark therefore are governed by the laws of the several states, subject to the rights granted to the United States by the Constitution.¹⁸

This precedent, which encapsulates what became known as the Public Trust Doctrine, allowed states to gain control and ownership over navigable waterways and their beds. Within its borders, title to navigable waterbottoms rest with the state, “held in trust for the people of the state, that they may enjoy the navigation of the waters, carry on commerce over them, and have liberty of fishing therein, freed from the obstruction or interference of private parties.”¹⁹

Therefore, after Louisiana’s admission into the Union in 1812, the state received its equal share of the public trust lands. These waterbottoms inured to the State, but not one acre of land was conveyed, as it had been retained by the United States government.²⁰

For Louisiana, perhaps the largest transfer of public land to private interests resulted from the Swamp Land Grant Acts of 1849 and 1850 authorizing the State to select and request title to any vacant public lands that were “swampy” in character and nature.²¹ Thus, the U.S. Congress conveyed title to approximately ten million acres of swamp lands to Louisiana.²² The majority of swamp lands selected from the United States government by the state of Louisiana were either sold to private individuals or transferred to levee boards created in various parts of the State.²³

As sections of land were sold by the state to private landowners, the state relinquished all rights to the land. The land transferred to private interests pursuant to the Swamp Land Grants included not only marsh lands, but also waterbottoms of rivers, streams, lakes, and bays.

C. Factors for determining waterbottom ownership

1. Navigability

Consistent with federal rulings regarding the public nature of navigable waters, Louisiana recognizes underlying waterbottoms of such waterways as “public things”. As early as 1870, Louisiana codified the meaning of “public things”. Today, the Louisiana Civil Code defines “public things” the following way:

Public things are owned by the state or its political subdivisions in their capacity as public persons. Public things that belong to the state are such as running waters, the waters and bottoms of natural navigable water bodies, the territorial sea, and the seashore.²⁴

A waterbody is most commonly defined as navigable if it is used or susceptible to being used for commerce.²⁵ However, “the term commerce generally refers to the transfer of goods or people for a

¹⁸ *Shively v. Bowlby*, 152 U.S. 1, 57-58 (1894).

¹⁹ *Illinois Cent. R. Co. v. State of Illinois*, 146 U.S. 387, 453 (1892)

²⁰ U. S. Statutes at Large, Vol. II, p. 617

²¹ U. S. Statutes at Large, Vol. IX, pp. 352, 519

²² Louisiana State Land Office, Biennial report, 1968-69, p9.

²³ La. R.S. 38:281, et seq.

²⁴ La. Civ. Code art. 450

²⁵ *The Daniel Ball*, 77 U.S. 557 (1870)

pecuniary gain. The term has a very broad definition and its modern use in Federal and state jurisprudence is not restricted to particular sizes of boats or types of cargo.”²⁶

This notion that all navigable waters belong to the state came under fire in 1912, when the Louisiana legislature passed Act 62 to respond to claims that the state inappropriately transferred ownership of navigable waterways to private interests. The Act required that any challenge to a state’s transfer of property to private hands must be brought within 6 years of the issuance of the patent transferring ownership. Specifically, the Act provided:

That all suits or proceedings of the State of Louisiana, private corporations, partnerships or persons to vacate and annul any patent issued by the State of Louisiana, duly signed by the Governor of the State and the Register of the State Land Office, and of record in the State Land Office, or any transfer of property by any sub-division of the State, shall be brought only within six years of the issuance of patent, provided, that suits to annul patents previously issued shall be brought within six years from the passage of this Act.²⁷

The interpretation of this Act facilitated disagreements on whether the legislature had attempted to confirm previous alienations of navigable waterbottoms from the state to private landowners. In 1953, the Louisiana Supreme Court examined the meaning of the act in *California Co. v. Price*.²⁸ In that case, the State argued the patent at issue was invalid pertaining to the bed of Grand Bay because the bottoms of navigable waters were public things and were not susceptible to private ownership. The court held that waterbottoms were susceptible to private ownership, and the State did not move to annul the patent within the six years prescriptive period. This position, which defended private ownership of navigable waterbottoms, came to be known as the “Price Doctrine”.²⁹

In 1954, the legislature responded by enacting provisions to clarify Act 62 and eliminate confusion with the Price Doctrine.³⁰ The legislature declared the state of Louisiana as owner of all navigable waterbottoms despite any previous transfer or conveyance to another person or entity. Furthermore, the legislature clarified that the intent of Act 62 was to ratify and confirm only the patents conveying waterbottoms susceptible of private ownership, but not that of navigable waterbodies or their beds.

Nonetheless, the issue remained alive, and, in 1974, the Louisiana Supreme Court handed down its ruling in the case of *Gulf Oil Corporation v. State Mineral Board*.³¹ Reversing course, the court stated that “it was held in *Illinois Central Ry. Co. v. Illinois*, that the states cannot abdicate their trust over property in which the people as a whole are interested so as to leave it entirely under the use and control of private parties.”³² The Louisiana court held that conveyances from the state to a private landowner were absolutely ineffective to the extent that the conveyances included beds of navigable water bottoms. *Gulf Oil* effectively brought an end to the notion that navigable waterbottoms could be transferred to a private landowner.

²⁶ Castille, George Joseph III. 1993. “A Geoforensic Analysis of State-Owned Waterbottoms in South Louisiana: Gauging the Geographical Impacts of Louisiana Court Decisions.” Ph.D. dissertation, Louisiana State University.

²⁷ 1912 La. Acts No. 62

²⁸ *California Co. v. Price*, 225 La. 706, 74 So. 2d 1 (1954).

²⁹ J. Madden *Federal and State Lands in Louisiana* (1973)

³⁰ *Gulf Oil Corporation v. State Mineral Board*, 317 So. 2d 576 (La. 1974).

³¹ *Gulf Oil Corporation v. State Mineral Board*, 317 So. 2d 576 (La. 1974).

³² *Gulf Oil Corporation v. State Mineral Board*, 317 So. 2d 576, 589 (La. 1974).

2. Tidally Influenced Lands

The prohibition of private ownership also applies to waterbottoms associated with the “sea and arms of the sea”³³. The Louisiana Civil Code defines “seashore” as: “the space of land over which the waters of the sea spread in the highest tide during the winter season.”³⁴ As explained by Professor Yiannopoulos, “The courts of Louisiana have regarded as ‘sea’ bodies of water known as ‘arms of the sea’.... In general, a body of water will be regarded as an arm of the sea if it is located in the immediate vicinity of the open coast and is overflowed by the tides directly.”³⁵

In 1888, in examining what constituted an “arm of the sea”, the Louisiana Supreme Court ruled in *Morgan v. Negodich* that Bayou Cook connecting Bay Bastian, on the open coast, to Bay Adam, lying further inland, was not considered an arm of the sea.³⁶ In that case, the bayou was not located in the immediate vicinity of the coast and was not directly overflowed by the tides, thereby creating a brackish marsh. In 1923, in *Buras v. Salinovich*, the court reaffirmed its previous decision in *Morgan* by stating that a body of water subject to tidal overflow does not necessarily constitute an arm of the sea.³⁷ The court considered an arm of the sea tidal waters in lakes, bays, and sounds along the open coast.

More recently, ownership of non-navigable tidelands became a significant issue in Louisiana. In 1988, the United States Supreme Court ruled in *Phillips vs. Mississippi* that state ownership of waterbottoms “extended to limits of effects of the tide, through marsh and into the barest depths of waters”.³⁸ This decision placed owners of land subject to tidal influences at risk of losing such properties to state ownership. In response, the Louisiana Legislature enacted Act 998 of 1992 in an attempt to protect landowners from the encroachment of state interests onto private property. Specifically noting the *Phillips* decision, the Legislature prohibited the divestiture of private property underlying non-navigable waters to state ownership.

The legislature hereby finds that as to lands not covered by navigable waters including the sea and its shore, which are subject to being covered by water from the influence of the tide and which have been alienated under laws existing at the time of such alienation, the Phillips decision neither reinvests the state, or a political subdivision thereof, with any ownership of such lands nor does the state, or a political subdivision thereof, acquire any new ownership of such property.³⁹

Court cases challenging the 1992 Act have not materialized. Nonetheless, this statute seemingly preserves existing state law that waterbottoms underlying non-navigable waters are susceptible of private ownership.

3. Shifting Boundaries

³³ La. Civ. Code art. 450

³⁴ La. Civ. Code art. 451

³⁵ A. N. Yiannopoulos. 1961. “Common, Public, and Private Things in Louisiana: Civilian Tradition and Modern Practice”. 21 La. Law Rev. 697, at 703.

³⁶ *Morgan v. Negodich*, 3 So. 636 (La.1887).

³⁷ *Buras v. Salinovich*, 154 La. 495 (La. 1923).

³⁸ *Delacroix Corp. v. Jones-O’Brien, Inc.*, 597 So.2d 65 (La. 1992)

³⁹ 1992 La. Acts No. 998

Louisiana law also accommodates ownership transfers associated with physical changes in the landscape over time. More specifically, Louisiana law recognizes erosion on three types of natural features: lakeshores; banks of rivers, bayous, and streams; and seashores. Although the physical process of erosion functions similarly with all these types of natural features, the legal consequences of erosion differ depending on the type of waterbody.

Louisiana civil code article 500 addresses shoreline changes associated with sea and lake shores. The article provides that a riparian landowner shall take no additional property rights to land exposed by a gradual receding of the sea or a lake (“dereliction”) nor in the gradual build-up of sediment on such shores (“alluvion”).⁴⁰ Furthermore, Louisiana courts have provided that the state owns the bottom of a navigable lake up to the high-water mark.⁴¹ Therefore, erosion on the shores of the sea and navigable lakes have the effect of increasing state ownership as the beds of those water bodies expand. Likewise, the state retains ownership of any new land forming on lake and sea shores.

In *Miami Corp. vs. State Mineral Board*, for example, the claimant alleged he was the owner of the disputed lake bottom evidenced by a patent issued by the State to the claimant’s predecessor in title.⁴² The area at issue, at Grand Lake in Cameron Parish, had become part of the bed of the lake through erosion. On appeal, the court concluded that title to the bottoms of navigable bodies of water belonged to the State as a result of its inherent sovereignty and were unsusceptible of private ownership under the provisions of articles 450 and 453 of the Louisiana Civil Code.⁴³ The court’s rationale was based on the fact that the land had itself become the bed of the lake, and consequently, transformed into the property of the State as a matter of law.

Louisiana law treats erosion along navigable rivers and streams differently than erosion along navigable lakes and seashores. Riparian landowners own the bank of a navigable river or stream to the mean low water level as measured on both banks.⁴⁴ Opposed to navigable lakes and seashores, rights to slow and imperceptible dereliction or alluvion are granted to the private riparian landowner.⁴⁵ However, “if erosive forces cause a sudden or avulsive change, the legal implications are quite different from those of imperceptible changes.”⁴⁶ The court in *Fitzsimmons v. Cassity* clarified the rule, stating “When a river changes its course and for this purpose appropriates private property for its new bed, the lawmaker, out of a spirit of justice and fairness, has wisely ordained, in effect, that the owner of the appropriated land shall be compensated for his loss by becoming owner of the abandoned bed”.⁴⁷ Such a rule has been deemed to ensure “predictable legal consequences in the wake of an avulsive change.”⁴⁸

Thus, determinations of the type of waterbody have important implications on the property rights of landowners. In *State v. Placid Oil Co.*, the state instituted an action to determine the ownership of waterbottoms underlying Six Mile Lake located in St. Mary Parish.⁴⁹ The disputed lands laid along the bankline. Therefore, the classification of the type of waterbody became a central issue. If considered a

⁴⁰ La. Civ. Code art. 500

⁴¹ *State v. Placid Oil Co.*, 300 So.2d 154 (1973)

⁴² *Miami Corp. vs. State Mineral Board*, 186 La. 784, 173 So. 315 (1937).

⁴³ La. Civ. Code arts. 450 & 453

⁴⁴ See, *Smith v. Dixie Oil Co.*, 156 La. 691, 101 So. 24 (1924).

⁴⁵ La. Civ. Code art. 501

⁴⁶ The Legal Implications of Coastal Erosion in Louisiana. 1981. Louisiana Coastal Law, Eds. Mike Wascom and Paul Hribernick, LCL No. 43, Dec. 1981.; See, La. Civ. Code art. 504.

⁴⁷ *Fitzsimmons v. Cassity*, 172 So. 824, 829 (La. App. 1937).

⁴⁸ The Legal Implications of Coastal Erosion in Louisiana. 1981. Louisiana Coastal Law, Eds. Mike Wascom and Paul Hribernick, LCL No. 43, Dec. 1981.; Other La. Civ. Code articles related to changes in ownership due to actions of waters include: art. 502 & 503.

⁴⁹ *State v. Placid Oil Co.*, 300 So.2d 154 (1973)

lake, the state would claim ownership up to the ordinary high water mark. If a river, the riparian landowner would have ownership over the lands at issue. The court devised a new, multi-faceted test for waterbody classification.

In our opinion, the jurisprudence, as well as the expert testimony, supports a multiple-factor test for classifying a water body as a lake or a stream. A judgment must be based upon a consideration of pertinent characteristics. Among these are the size, especially its width as compared to the streams that enter it; its depth; its banks; its channel; its current, especially as compared to that of streams that enter it; and its historical designation in official documents, especially on official maps.⁵⁰

In classifying Six Mile Lake as a lake, the court analyzed its physical characteristics and found that the record supported such a classification.⁵¹

The *Placid* decision is still used today to make determinations of waterbody types and, ultimately, ownership.

D. Reclamation

1. Ownership of Reclaimed Land

It is a public policy of the state to protect, administer, and conserve public waterways to best ensure full public navigation, fishery, recreation, and other interests.⁵² However, the state has also allowed private landowners the opportunity to reclaim ownership of their lands lost to open water via restoration. Reclamation is defined as:

...the raising of land through filling or other physical works which elevate the surface of the theretofore submerged land as a minimum above the level of ordinary low water in the case of rivers or streams and above the level of ordinary high water in the case of bodies of water other than rivers and streams, to such heights as may be prescribed in regulations or forms adopted by the administrator of the State Land Office to ensure reasonably permanent existence of the reclaimed lands.⁵³

The Louisiana State Constitution of 1974 specifically refers to the reclamation of submerged lands along navigable waterbodies. It prohibits the state from selling or transferring beds of navigable water bottoms; however, it specifically allows an exception for a riparian landowner to recover ownership of eroded land through his own efforts.

The legislature shall neither alienate nor authorize the alienation of the bed of a navigable water body, except for purposes of reclamation by the riparian owner to recover land lost through erosion. This Section shall not prevent the leasing of state lands or water bottoms

⁵⁰ *State v. Placid Oil Co.*, 300 So.2d 154, 175 (1973)

⁵¹ *State v. Placid Oil Co.*, 300 So.2d 154, 175 (1973) – “In summary, Grand Lake-Six Mile Lake is a wide, irregularly shaped body of water of great size, relatively shallow in depth, with a current substantially slower than that of the inflowing river. In its main characteristics, it is similar to Lake Pontchartrain and Lake Calcasieu. Historically, it has always been designated as a lake.”

⁵² La. R.S. 41:1701

⁵³ La. R.S. 41:1702(F)

for mineral or other purposes. Except as provided in this Section, the bed of a navigable water body may be reclaimed only for public use.⁵⁴

Louisiana Revised Statute 41:1702 specifically grants private landowners owning land contiguous to and abutting public waters the right to reclamation:

Pursuant to the authority of Article IX, Section 3 of the Constitution of Louisiana, owners of land contiguous to and abutting navigable waters, bays, arms of the sea, the Gulf of Mexico, and navigable lakes belonging to the state shall have the right to reclaim or recover land, including all oil, gas, and mineral rights, except as otherwise provided in Subsection E of this Section, lost through erosion, compaction, subsidence, or sea level rise occurring on and after July 1, 1921, in accordance with the procedures set forth in this Title for the fixing of boundaries by mutual consent and, also, those procedures applicable to contested boundaries.⁵⁵

Thus, if the riparian owner reclaims the bed of a navigable waterbody, the ownership of that bed will transfer from the state to the riparian landowner. Conversely, the state will retain ownership of any land reclaimed through efforts taken by the state. In other words, if the state accepts the responsibility of reclaiming a navigable waterbottom bed, then the state will retain ownership of that land after the reclamation process is completed. In practice, this means that if erosion converts land into waterbottom susceptible to state ownership, and, thus, transfers ownership from private hands to the state, the state could then—on its own initiative—refill and rebuild said waterbottom to retain ownership without having to transfer it back to the private hands it previously took ownership from.⁵⁶

For example, private lands eroded away at the mouth of Wax Lake Outlet in St. Mary Parish are being rebuilt by sediments diverted from the Atchafalaya Basin through the outlet. Properties along the shores of Atchafalaya Bay subject to private reclamation are being reclaimed by the state via the Wax Lake Outlet delta.⁵⁷

Nonetheless, the constitutional provision requires the state to reclaim navigable water bodies for a public use. A “public use” can be defined “as the right of the public to use a parcel of land, whether the property is under private or public ownership.”⁵⁸ The state could satisfy the public use standard by demonstrating that the land resulting from the reclamation could somehow benefit the public, thereby vesting title to those lands in the state. This gives the state a wide berth to reclaim lands under the guise of coastal restoration projects designed and constructed to benefit the public through flood control, storm protection, and natural resource conservation.

2. Mineral Rights Associated with Reclamation Activities

Louisiana laws related to reclamation also address mineral interests. The Louisiana Constitution provides that the state may retain ownership of mineral rights in the context of reclamation, in certain circumstances:

⁵⁴ La. Const. art. IX, § 3

⁵⁵ La. R.S. 41:1702(B)(1).

⁵⁶ Marc C. Hebert, *Coastal Restoration Under CWPPRA and Property Rights Issues*, 57 La. L. Rev. (1997)

⁵⁷ Louisiana Department of Natural Resources, Strategic Online Natural Resources Information System (See, <http://sonris.com/>)

⁵⁸ Marc C. Hebert, *Coastal Restoration Under CWPPRA and Property Rights Issues*, 57 La. L. Rev. (1997), pg. 1185.

A. *Reservation of Mineral Rights.* --The mineral rights on property sold by the state shall be reserved, except when the owner or person having the right to redeem buys or redeems property sold or adjudicated to the state for taxes. The mineral rights on land, contiguous to and abutting navigable waterbottoms reclaimed by the state through the implementation and construction of coastal restoration projects shall be reserved, except when the state and the landowner having the right to reclaim or recover the land have agreed to the disposition of mineral rights, in accordance with the conditions and procedures provided by law.⁵⁹

This Constitutional provision allows the state to retain ownership of the mineral rights in any navigable waterbottom that the state of Louisiana reclaims via the implementation and construction of a coastal restoration project, subject to any agreement that the state may enter with a private landowner that has the right to reclaim the waterbottom at issue.

The Louisiana Legislature has recognized the practicality of such an agreement. Louisiana statute provides that a private landowner can forego any rights of reclamation in the subject property in exchange for ownership in mineral rights granted by the state.⁶⁰

Thus, the private landowner has an incentive to cooperate with the state's reclamation efforts and to facilitate the quick and efficient implementation and construction of the related coastal restoration project. The state would utilize this agreement process to gain access to the existing private land needed to initiate and construct the restoration project. In other words, state restoration efforts would be handicapped without access to private land.⁶¹

This process whereby mineral rights revert to the owner of the reclaimed land also applies to private landowners who choose to perform reclamation efforts. Subject to certain exceptions, a private landowner can reacquire ownership of minerals by reclaiming lands lost to natural forces. More specifically, Subsection (E) of R.S. 41:1702 states:

...upon emergence of any land within a permitted reclamation area or within an area subject to an agreement entered into pursuant to Subsection D of this Section, said land or any subsurface mineral right created pursuant to Subsection D of this Section shall be reacquired and owned by the riparian owner....⁶²

Furthermore, this section renders the mineral rights related to the reclamation area subject to the "freezing statute" of R.S. 9:1151. The freezing statute and subsection E ensure the ownership of mineral rights of the area of reclamation remains with the owner of a currently existing oil, gas, or mineral lease, and the mineral and royalty rights of the lessors of the current lease remains unchanged by the formation of the new emergent land. The freezing statute states:

⁵⁹ La. Const. art. IX, § 4

⁶⁰ La. R.S. 41:1702(D)(2)(a)(i)

⁶¹ See, Marc C. Hebert, *Coastal Restoration Under CWPPRA and Property Rights Issues*, 57 La. L. Rev. (1997); See, Ryan M. Seidemann, *Curious Corners of Louisiana Mineral Law: Cemeteries, School Lands, Erosion, Accretion, and Other Oddities*. 23 Tul. Envtl. L.J. 93.; At the Lake Hermitage project complex, state and federal agencies worked with the private landowner to gain access and rebuild marshes (pers. comms. Kevin Roy, USFWS, 1/16/2014 & John Jurgensen, NRCS, 11/9/2014)

⁶² La. R.S. 41:1702(E)

In all cases where a change occurs in the ownership of land or water bottoms as a result of the action of a navigable stream, bay, lake, sea, or arm of the sea, in the change of its course, bed, or bottom, or as a result of accretion, dereliction, erosion, subsidence, or other condition resulting from the action of a navigable stream, bay, lake, sea, or arm of the sea, the new owner of such lands or water bottoms, including the state of Louisiana, shall take the same subject to and encumbered with any oil, gas, or mineral lease covering and affecting such lands or water bottoms, and subject to the mineral and royalty rights of the lessors in such lease, their heirs, successors, and assigns; the right of the lessee or owners of such lease and the right of the mineral and royalty owners thereunder shall be in no manner abrogated or affected by such change in ownership.⁶³

In other words, the rights of any leaseholder currently owning rights to minerals in a reclamation area before the waterbottom becomes emergent land remains unchanged. Therefore, there is no transfer of mineral rights once the land becomes established. However, it is presumed that once these active leases are no longer in effect, the mineral interests under the land reverts to the current owner of the property or waterbottom.⁶⁴

3. Process of Reclamation

Louisiana Revised Statute 41:1702(C) & (D) and the Louisiana Administrative Code outline the process which a private landowner must follow to initiate and complete a reclamation project.

Section (C) outlines the documentation needed to begin the application process. An application of an interested landowner meeting the requirements of R.S. 41:1702(B)(1) must provide a deed of ownership or a certified map or plat of survey prepared by a professional land surveyor qualified and currently licensed by the Louisiana Professional Engineering and Land Surveying Board. This document must define the boundary between lands belonging to the state and those of riparian owners along with the exact extent of land claimed to be lost through erosion, compaction, subsidence, or sea level rise.

Section (D) provides detailed information on how state agencies are integrated into the reclamation process. To initiate and develop a reclamation project, an interested landowner must apply for a permit with the State Land Office. The State Land Office has the responsibility of regulating permit applications and specifying required application documents.⁶⁵ The issuance of the permit is contingent upon the submittal of the plans and specifications of the work to the parish in which the proposed project is located, the Department of Transportation and Development, the Department of Wildlife and Fisheries, and the Department of Natural Resources for review and comment not less than sixty days prior to the issuance of such permit.

The Department of Natural Resources may enter into agreements primarily related to mineral interests to facilitate the development, design, and implementation of coastal conservation, restoration and protection plans and projects, including hurricane protection and flood control.

Even in instances where a riparian landowner has the right to reclaim a navigable waterbody bed, a complete restriction on such activities may be instituted if “in the determination of the Department of Natural Resources, State Land Office, or the attorney general, such activity would unreasonably obstruct

⁶³ La. R.S. 9:1151.

⁶⁴ See, Ryan M. Seidemann. *Curious Corners of Louisiana Mineral Law: Cemeteries, School Lands, Erosion, Accretion, and Other Oddities*. 23 Tul. Envtl. L.J. 93.

⁶⁵ La. Admin. Code 20:2101 (2015).

or hinder the navigability of any waters of the state or impose undue or unreasonable restraints on the state rights which have vested in such areas pursuant to Louisiana law...".⁶⁶ Yet, in the event such substantive agency decision aggrieves any person, an immediate judicial review of the agency action may be sought. Proceedings for review of decisions by the Department of Natural Resources or the State Land Office may be instituted by filing a petition in the Nineteenth Judicial District Court within thirty days after mailing of notice of the final decision by the administrator or secretary. Any party may request and be granted a trial de novo.⁶⁷

III. Land Loss Processes Realized

A. Anthropogenic Inducement of Natural Land Loss Processes

The origin and formation of the Louisiana coastal landforms occurred through a series of delta lobe formations. Suspended sediment carried by floodwaters of the Mississippi River settled from the water column creating elevated land that invaded coastal bays and open gulf waters. As trunk channels of the river changed courses through time, different delta lobes became abandoned and others created. Abandoned lobes would subsequently enter into a natural phase of degradation. This cycle of delta lobe formation and degradation serves as the foundation for land formation in coastal Louisiana.⁶⁸

Judging from maps of the Louisiana coast drawn by European explorers and surveyors, the coast was in a condition of net gain during the late eighteenth and nineteenth centuries.⁶⁹

However, beginning in the 1960s, scientists began to quantify land changes along the coast.⁷⁰ This research revealed that the Louisiana coast was losing significant amounts of land, contrary to what many believed. Studies over the next several decades confirmed that rates of land loss had drastically increased, resulting from a number of natural and artificial causes.⁷¹

This reduction in size of the land area began largely as a consequence of anthropogenic factors. Construction of flood control and storm protection features interrupted a long interval of land building by forcing the available sediment supply into the main drainage system, making it unavailable for deposition. By the mid-1800s, levees paralleled both sides of the Mississippi River near New Orleans, totaling over 1,000 miles.⁷² Today, this levee system extends along the Mississippi River and its tributaries for 3,787

⁶⁶ La. R.S. 41:1702(H)

⁶⁷ La. R.S. 41:1702(I)

⁶⁸ Russell, R. J. 1940. "Quaternary History of Louisiana." *Bulletin of the Geological Society of America* 51: 1199-1234.; Fisk, H.N., 1944. *Geological Investigation of the Alluvial Valley of the Lower Mississippi River*: U. S. Army Corps of Engineers, Mississippi River Commission, Vicksburg, Mississippi.

⁶⁹ Darby, William. 1816. *A Map of the State of Louisiana with Part of the Mississippi Territory*, 2nd edition.; Graham, C. 1842. *Map of a Military Reconnaissance of the approaches to New Orleans on the East Side of the Mississippi River.*; Leach and Turtle. 1887. *Map of the Alluvial Valley of the Mississippi River from the Head of St. Francis Basin to the Gulf of Mexico showing lands subject to overflow, location of levees, and trans-alluvial profiles.*

⁷⁰ Gagliano, S. M., H. J. Kwon, et al. (1970). "Deterioration and Restoration of Coastal Wetlands." 12th Coastal Engineering Conference.

⁷¹ Penland, S., I. Mendelsohn, et al. (1996). "Natural and Human Causes of Coastal Land Loss in Louisiana." MAY 29, 1996 WORKSHOP SUMMARY.; Britsch, L. D. and J. B. Dunbar (1996). "Land Loss in Coastal Louisiana." Technical Report GL-90-2.

⁷² Barry, J. 1997. "Rising Tide: The Great Mississippi Flood of 1927 and How it Changed America". Simon & Schuster, New York, NY. p.40.

miles.⁷³ Moreover, sediments trapped behind dams on the upper reaches of these river systems reduced the sediment supply by 50 percent during the last 150 years.⁷⁴

Corresponding with the high rates of land loss beginning in the 1930s, oil and gas exploration and production dominated many parts of the coastal landscape. Access and pipeline canals infiltrated inland marshes allowing intrusion of saltwater into freshwater marshes and creating a more energy intensive hydrologic regime, each of which contributed to high land loss rates.⁷⁵ By 1970, over 4,500 miles of such canals had been dredged throughout the state's coastal zone.⁷⁶

These anthropogenic alterations, among others, enhanced the physical natural forces that lead to land loss, notably subsidence and erosion.⁷⁷ Subsidence undermines the foundation of coastal lowlands by lowering surface elevations and, thus, exposing wetlands, ridges, and human infrastructure to the forces of the Gulf of Mexico that erode away the land. Indeed, from 1932 to 2010, nearly 1,800 square miles, or about 25% of Louisiana's coast (mostly wetlands), have eroded away.⁷⁸ As a result, both the deltaic and chenier plain systems are badly degraded. The Deltaic plain, composing southeast Louisiana, in particular has lost, and continues to lose, subsystem components and is approaching a condition of system collapse.

However, probably the least understood subsidence-related process, and the most ignored by land use planners, is fault-induced land loss. As possibly one of the biggest drivers of large-scale land loss, this natural and artificially-induced process likely accounts for a large percentage of land loss that occurs along the coast.⁷⁹ Thus, it deserves particular attention.

B. Fault-Induced Subsidence

Louisiana is in a geologically active, fault-lined basin that makes constant vertical and horizontal adjustments. Systematic study of surface expressions of faults, measurements of vertical movement from

⁷³ U.S. Army Corps of Engineers. 2014. "Mississippi River and Tributaries Project: Levee System Evaluation Report for the National Flood Insurance Program". United States Army Corps of Engineers, Mississippi Valley Division.

⁷⁴ Morang, A., J. D. Rosati, et al. (2013). "Regional Sediment Processes, Sediment Supply, and Their Impact on the Louisiana Coast." *Journal of Coastal Research* SI 63: 141-165.

⁷⁵ McGinnis, J. T., R. A. Ewing, et al. (1972). "Final Report on Environmental Aspects of Gas Pipeline Operations in the Louisiana Coastal Marshes." Prepared by Battelle, for Offshore Pipeline Committee.; USACE (1973). "Final Environmental Statement, Crude Oil and Natural Gas Production and Other Mining Operations in Navigable Waters Along the Louisiana Coast." Prepared by U.S. Army Engineer District, New Orleans, Corps of Engineers.; Turner, R. E. (1997). "Wetland Loss in the Northern Gulf of Mexico: Multiple Working Hypotheses." *Estuaries* 20(1): 1-13.

⁷⁶ Barrett, B. (1970). "Water Measurements of Coastal Louisiana." Published by Louisiana Wild Life and Fisheries Commission, Division of Oysters, Water Bottoms and Seafoods.

⁷⁷ Penland, S., I. Mendelsohn, et al. (1996). "Natural and Human Causes of Coastal Land Loss in Louisiana." MAY 29, 1996 WORKSHOP SUMMARY.; Britsch, L. D. and J. B. Dunbar (1996). "Land Loss in Coastal Louisiana." Technical Report GL-90-2.; Penland, S., L. Wayne, et al. (2000). "Process classification of coastal land loss between 1932 and 1990 in the Mississippi River delta plain, southeastern, Louisiana." U.S. Geological Survey Open-File Report 00-418.

⁷⁸ Couvillion, B. A. B., J.A.; Steyer, G.D.; Sleavin, William; Fischer, Michelle; Beck, Holly; Trahan, Nadine; Griffin, Brad; and Heckman, David, (2011). "Land area change in coastal Louisiana from 1932 to 2010." U.S. Geological Survey Scientific Investigations Map 3164, scale 1:265,000.

⁷⁹ Some debate within the scientific community exists over the extent to which these processes contribute to land loss. *See*, Turner, R. E. (2014). "Discussion of: Olea, R.A. and Coleman, J.L., Jr., 2014. A Synoptic Examination of Causes of Land Loss in Southern Louisiana as Related to the Exploitation of Subsurface Geological Resources. *Journal of Coastal Research*, 30(5), 1025–1044." *Journal of Coastal Research* 30(6): 1330-1334.

tide gauge records and resurveyed bench mark elevations provide a basis for quantification of land loss as a result of modern tectonic events.⁸⁰

Results of research from several disciplines are converging into a unified model of fault and earthquake activity called the linked tectonic system.⁸¹ Four tectonic provinces lie along the Northern Gulf of Mexico: Western, Central, Eastern, and Far-Eastern.⁸² South Louisiana and Southeast Texas sit atop the Eastern and Central Provinces.

The geologic record indicates that growth fault movement has always been a driving force for the sea invading the land. Two notable examples of fault-induced land subsidence in Louisiana are found in Plaquemines Parish near Empire and Buras. Movement in 1974-1975 along the Bastian Bay Fault – a 4.6 mile long segment of the Golden Meadow Fault Zone – created a 23,600 acre bay with water depths of 3 to 4 feet. A few years later in 1976-1978, similar movement along the neighboring 4.8 mile long Empire Fault added a 12,400 acre bay with water depths of 3.5 to 4.0 feet. Other similar fault events have left zones of open water along the major growth faults along the coast.⁸³

⁸⁰ Wallace, W. E. (1966). "Fault and Salt Map of South Louisiana." *Gulf Coast Association of Geological Societies Transactions* 16: 373-373.; Penland, S., Ramsey, K.E., McBride, R.A., Moslow, T.F. and Westphal, K.A., 1988. *Relative Sea Level Rise and subsidence in Louisiana and the Gulf of Mexico: Louisiana Geological Survey, Baton Rouge, Louisiana.* 65 p.; Gagliano, S. M. (1999). "Faulting, Subsidence and Land Loss in Coastal Louisiana." In: *Coast 2050: Toward a Sustainable Coastal Louisiana, The Appendices.* Louisiana Department of Natural Resources. Baton Rouge, La. Prepared for U.S. Environmental Protection Agency Region 6, Dallas, TX, Contract No. 68-06-0067.; Gagliano, S. M., I. E. Burton Kemp, et al. (2003). "ACTIVE GEOLOGICAL FAULTS AND LAND CHANGE IN SOUTHEASTERN LOUISIANA: A Study of the Contribution of Faulting to Relative Subsidence Rates, Land Loss, and Resulting Effects on Flood Control, Navigation, Hurricane Protection and Coastal Restoration Projects." Prepared for U. S. Army Corps of Engineers, New Orleans District 7400 Leake Avenue New Orleans, LA 70118 Contract No. DACW 29-00-C-0034.; Gagliano, S. M., E. B. K. III, et al. (2003). "NEO-TECTONIC FRAMEWORK OF SOUTHEAST LOUISIANA AND APPLICATIONS TO COASTAL RESTORATION." *Transactions of the 53rd Annual convention of the The Gulf Coast Association of Geological Societies and The Gulf Coast Section SEPM 2003, Baton Rouge, Louisiana October 22-24, 2003 LII: 262-272.*; Shinkle, K. D. and R. K. Dokka (2004). "Rates of Vertical Displacement at Benchmarks in the Lower Mississippi Valley and the Northern Gulf Coast." U.S. DEPARTMENT OF COMMERCE, National Oceanic and Atmospheric Administration, National Ocean Service.; Dokka, R. K. (2005). "Geologic implications of geodetic evidence of major subsidence and inundation of the Gulf Coast." *Coastal Zone 2005 Proceedings: Charleston, South Carolina, National Ocean Service, National Oceanic and Atmospheric Administration, United States Department of Commerce,* 5 p.

⁸¹ Kolker, A. S., M. A. Allison, et al. (2011). "An evaluation of subsidence rates and sea-level variability in the northern Gulf of Mexico." *Geophysical Research Letters* 38(L21404).; Karegar, M. A., T. H. Dixon, et al. (2015). "A three-dimensional surface velocity field for the Mississippi River Delta: Implications for coastal restoration and flood potential." *Geology* 43: 519-522.; Blum, M. D. and H. H. Roberts (2012). "The Mississippi Delta Region: Past, Present, and Future." *Annual Review Earth Planet* 40: 655-83.

⁸² Peel, F.J., Travis, C.J.H. and Hossack, J.R., 1995. *Genetic Structural Provinces and Salt Tectonics of the Cenozoic Offshore U.S. Gulf of Mexico: A Preliminary Analysis:* p. 153-175 in Jackson, M.P.A., Roberts, D.G. and Snelson, S., eds., *Salt Tectonics, A Global Perspective: American Association of Petroleum Geologists Memoir* 65.

⁸³ Gagliano, S. M., I. E. Burton Kemp, et al. (2003). "ACTIVE GEOLOGICAL FAULTS AND LAND CHANGE IN SOUTHEASTERN LOUISIANA: A Study of the Contribution of Faulting to Relative Subsidence Rates, Land Loss, and Resulting Effects on Flood Control, Navigation, Hurricane Protection and Coastal Restoration Projects." Prepared for U. S. Army Corps of Engineers, New Orleans District 7400 Leake Avenue New Orleans, LA 70118 Contract No. DACW 29-00-C-0034.; Gagliano, S. M., E. B. K. III, et al. (2003). "NEO-TECTONIC FRAMEWORK OF SOUTHEAST LOUISIANA AND APPLICATIONS TO COASTAL RESTORATION." *Transactions of the 53rd Annual convention of the The Gulf Coast Association of Geological Societies and The Gulf Coast Section SEPM 2003, Baton Rouge, Louisiana October 22-24, 2003 LII: 262-272.*

However, despite this evidence, additional scientific research has revealed that oil and gas exploration and production has resulted in the re-activation or acceleration of fault movement. Most prominently, the USGS has found evidence that “long-term, large-volume hydrocarbon production along the Gulf Coast resulted in land-surface subsidence, reactivation of deep-seated faults, and wetland loss in Texas and Louisiana”.⁸⁴ This scenario is not dissimilar from the increasing occurrences of earthquakes in areas of high-frequency hydraulic fracking operations where the USGS “found that at some locations the increase in seismicity coincides with the injection of wastewater in deep disposal wells”.⁸⁵

Robert Morton, a U.S. Geological Survey scientist, found that in the deltaic plain “average historical rates of subsidence between 1965 and 1993 were about 8-12 mm/yr, whereas average geological rates of subsidence for the past 5,000 years were about 1-5 mm/yr.”⁸⁶ In surveying certain hot spots of recent rapid subsidence, Morton found “The rapid acceleration and unexpected decline in wetland losses in the Mississippi delta plain are difficult to explain on the basis of most physical and biogeochemical processes. There are, however, close temporal and spatial correlations among regional wetland loss, high subsidence rates, and large-volume fluid production from nearby hydrocarbon fields. The decreased rates of wetland loss since the 1970s may be related to decreased rates of subsidence caused by significantly decreased rates of subsurface fluid withdrawal”.⁸⁷

The manipulation of formation pressures result in fault movement has been recognized by industry scientists for many years.⁸⁸

The first documented evidence of artificially-induced subsidence occurred at Goose Creek oil and gas field near the Houston-Galveston area in Texas.⁸⁹ In 1918, at the Gaillard peninsula, operators began to observe the submergence of land where wells were extracting millions of barrels of oil.

Beginning in 1918 it became apparent that Gaillard Peninsula, near the center of the field, and other nearby low land was becoming submerged. Elevated plank roadways or walks were built from the mainland to the derricks. Derrick floors had to be raised. Vegetation was flooded and killed, and finally all of the peninsula disappeared beneath the water...In the little town of Pelley on the northern edge of the oil field, cracks appeared in the ground running beneath houses, across streets, and through lawns and gardens.⁹⁰

⁸⁴ See, USGS, St. Petersburg Coastal and Marine Science Center, Subsidence and Wetland Loss Related to Fluid Energy Production, Gulf Coast Basin (<http://coastal.er.usgs.gov/gc-subsidence/induced-subsidence.html>)

⁸⁵ See, USGS, Man-Made Earthquakes Update (http://www.usgs.gov/blogs/features/usgs_top_story/man-made-earthquakes/)

⁸⁶ Morton, R. A., J. C. Bernier, et al. (2005). "Rapid Subsidence and Historical Wetland Loss in the Mississippi Delta Plain: Likely Causes and Future Implications." Open-File Report 2005-1216.

⁸⁷ Robert A. Morton, Ginger Tiling, and Nicholas F. Ferina. 2003. Causes of hot-spot wetland loss in the Mississippi delta plain. *Environmental Geosciences*, v. 10, no. 2, pp. 71–80.

⁸⁸ Burley, J. D. and A. H. Drouin (1971). "A Solution to Ground Subsidence Problems In Casing Strings and Wellheads." *Journal of Petroleum Technology*; Bruno, M. S. (1992). "Subsidence-Induced Well Failure." *SPE Drilling Engineering*; Wingen, N. V. and B. I. Meikonian (1960). "Review of California Waterflooding Operations." *Journal of Petroleum Technology*; Murchey, G. N. (1955). "Problems In Casing Collapse." 30th Annual Fall Meeting, Petroleum Branch of the American Institute of Mining and Metallurgical Engineers, New Orleans, October 2-5, 1955 519-G

⁸⁹ Pratt, W. E. and D. W. Johnson (1926). "Local Subsidence of the Goose Creek Oil Field." *The Journal of Geology* 34(7): 577-590.

⁹⁰ Pratt, W. E. and D. W. Johnson (1926). "Local Subsidence of the Goose Creek Oil Field." *The Journal of Geology* 34(7): 577-590, pg. 578.

The Chief Geologist of Humble Oil and Refining Co. soundly concluded that the extraction of oil, water, gas, and sand caused the subsidence. As of 1926, the subsidence had reached three feet and the area affected stretched 2.5 miles long by 1.5 miles wide.⁹¹

A better understanding between fault movement, land loss, and shoreline change is fundamental to long term restoration and multiple use management of the Louisiana coast.⁹² Remarkably, there has been an information disconnect between the geologists and geophysicists working in the petroleum industry and the community of scientists, engineers and planners engaged in coastal restoration. Restoration efforts do not consider the effects of fault activity on surface features or the projects they attempt to implement.

Scientists now realize this tectonic framework serves as a major driving factor in landscape-scale subsidence.⁹³ Until the 20th century, aggradations resulting from river derived sediment deposition and accumulation of organic materials masked the movement of growth faults within the coastal area. Surface traces of faults became exposed by patterns of erosion and marsh deterioration, primarily after artificial interruption of sediment dispersal and the inception of oil and gas activity along the coast.⁹⁴ Accelerated by fluid withdrawal and revealed by river levees and dredging operations, these fault movements implicate land loss processes on a major scale not contemplated by waterbottom ownership laws.

IV. The Disconnect between Law and Science

A. Civil Code Dormancy

The Louisiana Civil Code is primarily based on the civil law system initiated when Roburt Cavellier, Sieur de la Salle claimed the present day Louisiana for France in 1682, and named the French possession “Louisiana” in honor of King Louis XIV. In 1712, Louis XIV granted a charter to Antoine Crozat which required government of the territory by a collection of customary rules originally used in and around Paris. The territory subsequently ceded to Spain in 1762 by the treaty of Fontainbleau. The United States took possession of the territory in 1803. Much debate exists over whether Spanish or French law was

⁹¹ Pratt, W. E. and D. W. Johnson (1926). "Local Subsidence of the Goose Creek Oil Field." *The Journal of Geology* 34(7): 577-590, pg. 578.

⁹² Stephens, B. P. (2009). "Basement controls on subsurface geologic patterns and coastal geomorphology across the northern Gulf of Mexico: Implications for subsidence studies and coastal restoration." *GCAGS Transactions* 59: 729-751.; Stephens, B. P. (2010). "Basement Controls on Subsurface Geologic Patterns and Near-Surface Geology across the Northern Gulf of Mexico: A Deeper Perspective on Coastal Louisiana." Adapted from poster presentation at AAPG Convention, New Orleans, Louisiana, April 11-14, 2010.

⁹³ Kuecher, G. J. (1995). "The dominant processes responsible for subsidence of coastal wetlands in south Louisiana." Argonne National Laboratory, Center for Environmental Restoration Systems, Argonne, Illinois 60439 (USA).; Olea, R. A. and J. L. Coleman (2014). "A Synoptic Examination of Causes of Land Loss in Southern Louisiana as They Relate to the Exploitation of Subsurface Geologic Resources." *Journal of Coastal Research* 30(5): 1025-1044.; NOGS (2015). "Oil and Gas Industry Infrastructure in Coastal Louisiana: A proposal to assess the impacts of relative sea level rise due to subsidence using industry knowledge base, data and technology." *The New Orleans Geological Society*.; Dokka, R. K. (2011). "The role of deep processes in late 20th century subsidence of New Orleans and coastal areas of southern Louisiana and Mississippi." *Journal of Geophysical Research* 116.; Chan, A. W. and M. D. Zoback (2007). "The Role of Hydrocarbon Production on Land Subsidence and Fault Reactivation in the Louisiana Coastal Zone." *Journal of Coastal Research* 23(3): 771-786.

⁹⁴ Gagliano, S. M., I. E. Burton Kemp, et al. (2003). "ACTIVE GEOLOGICAL FAULTS AND LAND CHANGE IN SOUTHEASTERN LOUISIANA: A Study of the Contribution of Faulting to Relative Subsidence Rates, Land Loss, and Resulting Effects on Flood Control, Navigation, Hurricane Protection and Coastal Restoration Projects." Prepared for U. S. Army Corps of Engineers, New Orleans District 7400 Leake Avenue New Orleans, LA 70118 Contract No. DACW 29-00-C-0034.

retained, but in 1808, the Louisiana Civil Code was adopted and published in French and English versions.⁹⁵

In 1817, the Louisiana Supreme Court decided that the Civil Code of 1808 was to be relied upon only as an incomplete digest of existing laws. “The various Spanish compilations and Spanish jurisprudence in general, the Custom of Paris, the United States and Louisiana Constitutions, Acts of Congress, territorial legislation, and the 1808 Code thus became ‘inextricably mixed and entangled in a baffling mélange of legal perplexity and uncertainty. It was impossible to know which codes, or what parts of them, had the force of law.’”⁹⁶ This confusion prompted the enactment of the Louisiana Civil Code of 1825 intended to distinguish itself from the past. But as the code of 1808 fell from favor, so did the code of 1825. A push for change and revision resulted from effects of the Civil War, adoption of a new constitution, and the accumulation of civil law legislation that remained outside the 1825 code.

In 1870, the legislature adopted a new code titled “The Revised Civil Code of the State of Louisiana”. This code was substantially similar to that of its earlier predecessor with changes related to “the elimination of provisions concerning slavery, the incorporation of amendments made since 1825, and the integration of acts passed since 1825, which dealt with matters regulated in the Code without officially amending it.”⁹⁷ Again in 1948, the Louisiana legislature was interested in revising the Civil Code and instructed the Louisiana State Law Institute to begin addressing the proposal. The institute ultimately decided to revise individual titles and chapters of the Civil Code with the purpose of focusing on particular issues and areas of law.

The Louisiana Civil Code is composed of individual “Books”. Each Book pertains to a different subject matter: Book I – Of Persons; Book II – Things and the Different Modifications of Ownership; Book III – Of the Different Modes of Acquiring the Ownership of Things; and Book IV – Conflict of Laws. Book I, II, and III have all undergone changes but only Book II has been brought to completion.⁹⁸

Book II contains the provisions relative to waterbottom ownership. However, none of these provisions have been substantively changed since 1870.⁹⁹

⁹⁵ Raphael J. Rabalais, *The Influence of Spanish Laws and Treatises on the Jurisprudence of Louisiana; 1762-1828*, 42 La. L. Rev. (1982)

⁹⁶ A.N. Yiannopoulos, *The Civil Codes of Louisiana*, 1 CIV. L. COMMENT. 1, 1 (2008) p.11 (citing, Groner, *Louisiana Law: Its Development in the First Quarter-Century of American Rule*, 8 La.L.Rev. 350, 375 (1948)).

⁹⁷ A.N. Yiannopoulos, *The Civil Codes of Louisiana*, 1 CIV. L. COMMENT. 1, 1 (2008).

⁹⁸ A.N. Yiannopoulos, *The Civil Codes of Louisiana*, 1 CIV. L. COMMENT. 1, 1 (2008); Book IV was added to the Louisiana Civil Code in 1991.

⁹⁹ CC 450, Public Things: Comment (a) – “The first two paragraphs of this provision reflect the definition of public things in Article 453 of the Louisiana Civil Code of 1870. The third paragraph reproduces the substance of Article 454 of the same Code. This provision does not change the law.”; CC 499, Alluvion and dereliction: Comment (a) – “The first paragraph of this provision reproduces the substance of Article 509 of the Louisiana Civil Code of 1870. It does not change the law”. Comment (b) – “The second paragraph of this provision reproduces the substance of the first paragraph of Article 510 of the Louisiana Civil Code of 1870, as interpreted by Louisiana jurisprudence. It does not change the law.”; CC 500, Shore of the sea or of a lake: Comment – “This provision reproduces the substance of the last paragraph of Article 510 of the Louisiana Civil Code of 1870 as interpreted by Louisiana jurisprudence. It does not change the law”; CC 501, Division of alluvion: Comment (a) – “This provision is based on Article 516 of the Louisiana Civil Code, as interpreted by Louisiana jurisprudence”; CC 502, Sudden action of waters: Comment – “This provision reproduces the substance of Article 511 of the Louisiana Civil Code of 1870. It does not change the law.”; CC 503, Island formed by river opening a new channel: Comment – “This provision reproduces the substance of Article 517 of the Louisiana Civil Code of 1870. It does not change the law.”; CC 504, Ownership of abandoned bed when river changes course: Comment – “This provision reproduces the substance of Article 518 of the Louisiana Civil Code of 1870. It does not change the law.”; CC 505, Islands and

B. Civil Code Realities

Civil law principles can be frozen into codes and act as a rigid doctrine. The Civil Code has undergone two revisions within a single century and three times since its original version, primarily resulting from changed conditions of life and realities that made prior laws ineffective, obsolete, or impractical. “The 1808 code was revised in 1825, and again in 1870. As revised and amended by special legislation, it is still the fountainhead of our private law.”¹⁰⁰ Nonetheless, the relevant articles pertaining to waterbottom ownership have not been amended for well over 100 years.

The purpose of the revisions finds its origin in the obligation to “establish a clear correspondence between the legal precepts in the Code and in actual practice.”¹⁰¹ Changes in the law are most poignant when the law “no longer is responsive to the needs of society”.¹⁰² “The Civil Code is an integrated piece of legislation”, and thus does not amend itself well to changes.¹⁰³ But, when instances of social demands and realities arise, the law should be somewhat adapted to reflect the changes of society.

This is no truer than when the law is founded upon a general scientific understanding of natural processes and functions. As the knowledge within the scientific community expands and evolves, so too should the law which uses this knowledge to regulate interactions and disputes between parties. If the law does not correspond with the realities of the natural environment, its application to civilization and society will suffer by ignoring principles of fairness and justice. This notion becomes evident when examining individual Civil Code Articles related to land ownership and changes of the natural landscape.

The existing articles do not specifically address natural processes such as subsidence, compaction, salt water intrusion, sea level rise, and fault activity. The enactment of existing laws occurred prior to a sound understanding of the causes for land changes and increased rates of loss within the region, and during a time of land building, not deterioration.

Thus, the civil code provides a framework to accommodate determinations of ownership responding to small scale and imperceptible natural changes on individual parcels, but this legal system is inadequate to appropriately cope with the ongoing widespread transformation of a marsh dominated landscape into an open water environment.

In other words, Louisiana property laws provide no mechanism to appropriately address the potential mass ownership conversion process that may ultimately occur if laws are not enacted that coincide with the changing patterns of the landscape. Thus, the current legal system will convert title from private ownership to the public trust without considering the comprehensive progression of degradation of the coastal zone and its effects on the economy, individual landowners, commerce, and society in general.

sandbars in navigable rivers: Comment (a) – “This provision reproduces the substance of Article 512 of the Louisiana Civil Code of 1870. It does not change the law.”; CC 506, Ownership of beds of nonnavigable rivers or streams: Comment (a) – “This provision is new. It is based in part on Articles 513, 514 and 515 of the Louisiana Civil Code of 1870, as interpreted by Louisiana jurisprudence. It clarifies the law.”

¹⁰⁰ A.N. Yiannopoulos, *The Civil Codes of Louisiana*, 1 CIV. L. COMMENT. 1, 1 (2008) p.7.

¹⁰¹ A.N. Yiannopoulos, *The Civil Codes of Louisiana*, 1 CIV. L. COMMENT. 1, 1 (2008) p.19.

¹⁰² A.N. Yiannopoulos, *The Civil Codes of Louisiana*, 1 CIV. L. COMMENT. 1, 1 (2008) p.19.

¹⁰³ A.N. Yiannopoulos, *The Civil Codes of Louisiana*, 1 CIV. L. COMMENT. 1, 1 (2008) p.20.

C. Civil Code Inequities

Considering the long term projected amount of land loss for the Louisiana coast, the state would seemingly acquire an enormous amount of waterbottom acreage. Projections predict that an additional 700 square miles could be lost under moderate environmental scenarios in the next 50 years or an additional 1,750 square miles under less optimistic scenarios.¹⁰⁴ Thus, as the Gulf encroaches inland and interior marshes continue to degrade, many private landowners with properties along the coast will likely face the real possibility that their lands will become state owned. With an approximately 80% of coastal wetlands in private ownership, this conversion would involve the transfer of huge acreages into state ownership.¹⁰⁵

Federal, state, and local governments began implementing coastal restoration plans and projects in an effort to thwart the growing problem of a sinking landscape along coastal Louisiana. This orchestrated attack on coastal land loss has led to significant expenditures of time, money, and effort by numerous public agencies and private entities. However, as planning efforts to restore coastal wetlands proceed, current restoration techniques and financial limitations will not facilitate the recreation of the coastline to its former state.¹⁰⁶

Furthermore, upon claiming title to submerged lands, the state asserts its interest over any oil and gas mineral leases not covered by the freeze statute. These future profits could suddenly be transferred from private landowners to the state. Such transfers provide an incentive for the state to claim ownership of waterbottoms to capture future oil and gas revenues derived from wells located on submerged property.

Also, in many instances, the state claims ownership of waterbottoms concurrently with the private landowner. To ensure royalties and other payments are made to the proper party, operators commonly initiate concursus proceedings to force the state and private landowner to resolve ownership issues. These suits commonly end in compromise with the state and private landowner each agreeing to a certain percentage of ownership.

This framework gives the state a windfall; a windfall, in part, created by the state itself. Landowners should not be held accountable for land loss largely attributable to government projects, industry activities, and the state's promotion of such activities. Nor should landowners lose title to lands as a result of government projects designed to restore lands lost by those same activities.

Lawmakers and governmental policymakers must make the decision to take the first step in changing the current ideas, theories, and fundamental guiding principles that will adapt to the changing landscape. Existing law is premised upon the notion that tradition and culture would persist. This fundamental idea is threatened as water encroaches inland and families move to towns and states less vulnerable to extreme damages from hurricanes and loss of property. The tradition and culture upon which the state prides itself is being lost. As people move, so do income, jobs, houses, and communities.¹⁰⁷ This emigration of whole

¹⁰⁴ Master Plan, pg. 82

¹⁰⁵ Marc C. Hebert, *Coastal Restoration Under CWPPRA and Property Rights Issues*, 57 La. L. Rev. (1997).

¹⁰⁶ Davis, M., H. Vorhoff, et al. (2015). "Financing the Future, Turning Coastal Restoration and Protection Plans into Realities: How Much Is Currently Funded?" Tulane Institute on Water Resources Law & Policy, New Orleans, LA.; Barnes, S., C. Bond, et al. (2015). "Economic Evaluation of Coastal Land Loss in Louisiana." Louisiana State University, Economics & Policy Research Group, The RAND Corporation.

¹⁰⁷ The transfer in ownership also has indirect effects on the state and local governments. Large landholdings of a private landowner require significant annual tax payments to local and state governments. "The property tax is a major source of revenue for Louisiana's political subdivisions and is levied by the political subdivision in which the taxable property is located." As the Gulf incrementally encroaches inland and land owners lose their property to

communities from the coast creates an empty landscape and further diminishes efforts to preserve the lifestyle and traditions unique to coastal Louisiana. If policy and laws are not changed, the culture along the coast will change.¹⁰⁸

V. Potential Legislative Remedies

A. Notice of state claim

An inherent conflict arises when the state claims ownership to waterbottoms previously occupied by privately-held lands. In many instances, the state or federal government issued patents to private landowners transferring ownership decades or centuries ago. The subsequent conversion of these lands to open water creates this potential conflict between the state and the private landowner.

Prior to making an ownership determination, the state should implement a formal evaluation process with notice to the landowner. Such notice should specify the acreage under consideration, identify the data the state is considering for its ownership determination, and provide a date on which the determination becomes considered final. This formal process ensures the state makes an informed decision with its claim for ownership.

This process would also provide landowners the opportunity to respond to the state with evidence relevant to the ownership determination. Such evidence would include historical maps, surveys, and expert analysis related to whether the waterbottom is subject to state ownership. This procedural framework would allow private landowners an opportunity to respond to the state's action and protect their private interests.

B. Incorporation of Reclamation into the State Master Plan

Coastal Louisiana is currently in a state of degradation with the coastal wetlands once dominating the coastline disappearing at an alarming rate. Land loss rates peaked during the 1950s through the 70s and large acreages of marshes continue to become submerged.¹⁰⁹ The formation stage has been eliminated in lieu of benefits of flood control and navigation. Resultantly, natural processes continue to proceed in their Godly designs which places the coastal lowlands in a constant state of degradation unless the formation stage is "re-inserted" into the cycle.

Appropriations of large sums of federal and state monies are committed to building the coast and restoring the natural marshes and ridges to their former state. Government agencies have initiated and developed coastal wetland restoration techniques and projects to inhibit marsh erosion, supplement sediment deposition, and create marsh, among other objectives.¹¹⁰ However, current limitations of

state ownership, the amount of tax revenues accrued by governmental entities will decrease. (See, The Louisiana Tax Commission. 2014. "Louisiana Property Tax Basics")

¹⁰⁸ For an in-depth discussion of this problem, see Davis, D.W. 2010. "Washed Away? The Invisible Peoples of Louisiana's Wetlands". University of Louisiana at Lafayette Press.

¹⁰⁹ Couvillion, B. A. B., J.A.; Steyer, G.D.; Sleavin, William; Fischer, Michelle; Beck, Holly; Trahan, Nadine; Griffin, Brad; and Heckman, David, (2011). "Land area change in coastal Louisiana from 1932 to 2010." U.S. Geological Survey Scientific Investigations Map 3164, scale 1:265,000.

¹¹⁰ Louisiana's Comprehensive Master Plan for a Sustainable Coast. 2012

funding resources and the current economic climate assures that many projects will remain unfunded and unconstructed.¹¹¹

In addition to governmental efforts, private landowners have the opportunity to restore and reclaim ownership of submerged water bottoms currently under state ownership. To promote private efforts in restoration strategies, the state has enacted laws that allow landowners to gain ownership of submerged navigable waterways currently owned by the state through reclamation activities. Sections 3 & 4 of the Louisiana State Constitution provide for the distribution of ownership of land and mineral rights related to reclamation activities, and lay the foundation for reclamation statutes and regulations promulgated by the state legislature and natural resource agencies.

With much of the coast owned by private interests, private reclamation efforts could partly supplement coastal restoration efforts made by federal and state governments.¹¹² However, “it is highly unlikely that many riparian owners of land lost to erosion on the Louisiana Gulf Coast will take steps towards reclamation of their lost land. The main reason being the high cost of reclamation activities and continued maintenance of such emergent lands.”¹¹³

A state-sponsored reclamation fund could incentivize such projects by using matching funds to assist landowners with remediation costs. Recognizing the role industries have played on the deterioration of the coastline, responsible industries could contribute to funding the program. Such a formalized system would encourage landowners to reclaim their property and retain their private property interests.

C. Ownership retention via continued use and alternative reclamation techniques.

Submerged property remains a viable resource for private landowners. A submerged tract of land offers several revenue-generating opportunities, including recreational and commercial fishing, and revenues from oil and gas exploration and production. Landowners allowed to retain ownership of these properties could realize these benefits while paying property taxes providing benefits to society without governmental intervention.

Potential legislation could allow landowners to retain their private property interests through continued use and construction of alternate reclamation techniques. Such a measure could function similarly to the freeze statute, except applied to all natural resources, where ownership is retained by the existing owner until such time the property is no longer in use.

In the 2015 legislative session, House Bill No. 680 presented a proposal that would have allowed an artificial oyster reef to be considered a reclamation project. The Bill did not pass.

However, if passed, such a law would supplement coastal restoration efforts consistent with the State’s Master Plan, allow landowners the ability to continue to retain their private property rights, and allow

¹¹¹ Louisiana’s Comprehensive Master Plan for a Sustainable Coast. 2012; Amy Wold, Nov. 6, 2015. “Louisiana’s plan for coastal restoration and protection will require more money to work, report says” The Advocate.; Mark Schleifstein, Nov. 6, 2015. “More money needed, but coastal plan on track, official says”. The Times-Picayune.

¹¹² Marc C. Hebert, *Coastal Restoration Under CWPPRA and Property Rights Issues*, 57 La. L. Rev. (1997), pg. 1183.

¹¹³ Marc C. Hebert, *Coastal Restoration Under CWPPRA and Property Rights Issues*, 57 La. L. Rev. (1997), pg. 1184.

landowners to use their property for economic gain as was initially intended in the dispersal of public property to private interests in the 1800s.

VI. Conclusion

Creation and implementation of property laws pertaining to waterbottom ownership requires an informed understanding of the functions and processes of wetlands balanced with legal, institutional, and economic realities.¹¹⁴ The physical processes that influence land loss have become well-known, but laws designating ownership in this dynamic landscape remain unchanged.

Large-scale land loss processes occurring in the Louisiana coastal zone are not recognized in the Louisiana Civil Code. The failure to address these factors may result in the mass conversion of property from the private realm into the public trust which has major implications for land ownership, and on widespread economic and social scales.

As a result of the massive rates of land loss within Louisiana's coastal zone, determinations of waterbottom ownership have become increasingly contentious. With more land converting to open water every day, the potential for disputes over the ownership of waterbottoms, and corresponding mineral interests, will become increasingly common as application of antiquated laws convert private lands into public. This widespread conversion of property from private ownership to public presents a number of risks detrimental to the existence of the coast, its people, and culture.

¹¹⁴ Mitsch, W.J. and J.G. Gosselink. 2000. *Wetlands*, 3rd ed. John Wiley & Sons, Inc. New York, NY.