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**OF LIFE AND LIMB: THE FAILURE OF FLORIDA'S WATER QUALITY CRITERIA
TO TEST FOR VIBRIO VULNIFICUS IN COASTAL WATERS AND THE NEED FOR
ENHANCED CRITERIA, REGULATION, AND NOTIFICATION TO PROTECT PUBLIC
HEALTH**

Felicia Thomas¹

I. INTRODUCTION

The climate change debate has roared on for decades as scientists of the world argue that the oceans are rising and the world is warming, yet there remain individuals² who belittle the harrowing realities on the horizon.³ These realities can no longer be ignored in the wake of climate events like Hurricane Katrina and Super Storm Sandy that battered the coasts of the United States in recent years, leaving behind billions of dollars in damage.⁴ More recently, the year 2014 was declared the warmest year on record for both the land and ocean.⁵ Scientists attribute this record warmth to the increase in temperature in the world's oceans,

¹ J.D. Candidate, Florida Agricultural & Mechanical University College of Law, 2016. The author thanks Professor Randall Abate for providing valuable insight in writing this paper.

² Florida Governor Rick Scott joined the ranks of those individuals attempting to deemphasize the grim realities that are forecasted by environmental scientists with his unwritten banning of the phrases "climate change" and "global warming" by officials in the state. Doyle Rice, *Fla. Gov. Bans the Terms Climate Change, Global Warming*, USA TODAY (Mar. 9, 2015), <http://www.usatoday.com/story/weather/2015/03/09/florida-governor-climate-change-global-warming/24660287/> ("Sea-level rise was another term that Scott prohibited, saying it should be called 'nuisance flooding,' . . .").

³ "By 2100 seas could rise as much as 6.6 feet," putting a significant portion of Miami-Dade County, Florida, underwater. "For every foot the seas rise, the shoreline would move inland 500 to 2,000 feet." The U.S. government's National Climate assessment has further predicted that "Florida will be battered in the coming decades by extreme weather—dry-season drought and rainy-season deluges" with rainy seasons being "stormier," hurricanes being "fiercer," and storm surges being "higher." Laura Parker, *Treading Water*, NAT'L GEOGRAPHIC, Feb. 2015, at 106, available at <http://ngm.nationalgeographic.com/2015/02/climate-change-economics/parker-text>.

⁴ *Hurricanes and Climate Change*, CENTER FOR CLIMATE AND ENERGY SOLUTIONS, <http://www.c2es.org/science-impacts/extreme-weather/hurricanes> (last visited Apr. 17, 2015) ("Eight of the 10 costliest hurricanes on record in the United States have occurred since 2004. Hurricanes Katrina (2005) and Sandy (2012) were by far the most damaging, costing \$125 billion and \$65 billion respectively.").

⁵ These record highs are compared against recordings as collected since 1880. *State of the Climate: Global Analysis for Annual 2014*, NOAA NAT'L CLIMATIC DATA CENTER (Dec. 2014), <http://www.ncdc.noaa.gov/sotc/global/2014/13>.

easily one degree Fahrenheit higher than the global average.⁶ While this increase may seem insignificant, increasing ocean temperatures have been directly associated with ocean stratification,⁷ tropical cyclone activity,⁸ and sea level rise.⁹

The nefarious duo of warming oceans and rising sea levels has created another menacing yet lesser-known climate change-induced problem: an increase in sea-borne diseases.¹⁰ The oceans are a natural host of many bacteria, including one lurking culprit—*Vibrio vulnificus*, a bacterium that dwells along the coasts of the United States, most notably in the tepid waters of the Gulf of Mexico, including Florida’s Gulf Coast.¹¹ *Vibrio vulnificus* can lead to disease in those unlucky enough to encounter it, either by contact between the bacteria and an open wound exposed to seawater or through consumption of contaminated seafood.¹² Most healthy individuals who come into contact with the bacteria may have no side effects from the exposure at all or suffer from “vomiting, diarrhea, and abdominal pain,” while individuals considered to be immunocompromised may face an infection of the bloodstream that causes “a severe and life-threatening illness characterized by fever and chills, decreased blood pressure (septic shock), and blistering skin lesions.”¹³ For example, the worst case scenario

⁶ *Id.*

⁷ Ocean stratification is the failure of nutrient-rich surface layers of the ocean to mix with the underlying deep layer of the ocean, caused by excess heat the oceans are absorbing. The direct result of this phenomenon is a reduction in phytoplankton, a major player in the marine ecosystem, as this organism supports the existence of many zooplankton communities that are the basis for many major fisheries. Randall S. Abate & Sarah Ellen Krejci, *Climate Change Impacts on Ocean and Coastal Law: Scientific Realities and Legal Responses*, in CLIMATE CHANGE IMPACTS ON OCEAN AND COASTAL LAW 1, 9 (Randall S. Abate ed., 2015).

⁸ *Id.* at 10 (discussing the increase of “tropical cyclone duration, intensity, and frequency” as the ocean temperatures continue to rise).

⁹ *Sea Level Rise*, NAT’L GEOGRAPHIC, <http://ocean.nationalgeographic.com/ocean/critical-issues-sea-level-rise/> (last visited Apr. 17, 2015) (attributing the rise in sea levels to three major contributors: warmer oceans, accounting for about half of the sea level rise in the past century; melting of the polar ice caps and glaciers as temperatures get increasingly higher and winters cool less; and melting of the ice sheets covering Greenland and Antarctica).

¹⁰ Robin Kundis Craig, *A Public Health Perspective on Sea-Level Rise: Starting Points for Climate Change Adaptation*, 15 WIDENER L. REV. 521, 532 (2010).

¹¹ *Id.* at 533.

¹² *Vibrio Vulnificus*, CENTERS FOR DISEASE CONTROL & PREVENTION, <http://www.cdc.gov/vibrio/vibriov.html> (last updated Oct. 21, 2013).

¹³ *Id.* (finding cases of bloodstream infection to be fatal “about 50% of the time”).

occurred for a man on a fishing trip when a cut on his leg came into contact with Gulf water in Estero Bay in Fort Myers, Florida.¹⁴ He was dead within hours.¹⁵

While the Gulf states are the usual candidates for Vibrio illnesses,¹⁶ the increase in global ocean temperatures has led to cases of *Vibrio vulnificus* being reported along the Atlantic coast in states as unlikely as Rhode Island, Delaware, and New Jersey, and even more remote are the cases being reported in Israel.¹⁷ As water temperatures around the globe continue to rise, *Vibrio* bacteria will continue their journey into new oceans and coastal areas.¹⁸ A 2012 study conducted in the Baltic Sea suggests that every one degree increase in sea surface temperature doubles the number of observed cases of *Vibrio vulnificus*.¹⁹ Thus, the one-degree Fahrenheit increase in global sea temperatures that has already occurred²⁰ could lead to the doubling of *Vibrio vulnificus* illnesses. This potential increase in the number of illnesses is significant, especially given that the disease is often unrecognized and underreported and, with warming waters, has the potential to move up the coasts to regions where health professionals are less familiar with its risks.²¹

For most, the biggest concern when diving into the ocean is a possible, though exceedingly rare, shark encounter; however, it is the unexpected, unseen risk of *Vibrio vulnificus* that poses the greater danger. Part I of this paper discusses *Vibrio vulnificus* cases along the coasts of Florida, examining both the

¹⁴ Haley Hinds, *Winter Haven Man Contracts Deadly Vibrio Vulnificus Bacteria*, FOX 13 (Oct. 5, 2015), <http://www.fox13news.com/news/local-news/30408592-story>.

¹⁵ *Id.*

¹⁶ *Vibrio Vulnificus*, *supra* note 12.

¹⁷ Craig, *supra* note 10, at 533.

¹⁸ Nina Chestney, *Bacteria Outbreak in Northern Europe Due to Ocean Warming, Study Says*, REUTERS (July 22, 2012), <http://www.reuters.com/article/2012/07/22/us-climate-oceans-bacteria-idUSBRE86L0ET20120722> (stating that, though *Vibrio* tends to prefer warmer tropical marine environments, global ocean warming is allowing *Vibrio* to thrive in regions where it could not survive in the past, including Chile, Peru, and Spain).

¹⁹ Craig Baker-Austin et al., *Emerging Vibrio Risk at High Latitudes in Response to Ocean Warming*, NATURE CLIMATE CHANGE, July 22, 2012, at 73, 75.

²⁰ *State of the Climate*, *supra* note 5.

²¹ *Vibrio Parahaemolyticus*, CENTERS FOR DISEASE CONTROL & PREVENTION, <http://www.cdc.gov/vibrio/vibriop.html> (last updated Oct. 21, 2013) (noting that infections caused by *Vibrio* species only “became nationally notifiable in 2007”).

illnesses that were contracted through exposure of open wounds to seawater and those contracted through the consumption of raw oysters from the Gulf Coast. This part also emphasizes the overwhelming lack of warning that individuals who contracted Vibrio-related illnesses received concerning the risks of the bacteria in Florida's coastal waters. Part II analyzes existing federal and state regulations regarding water quality along the coasts, including regulatory bodies that have sprung into existence to combat water quality issues and the procedures used to test coastal waters for the presence of bacteria. It also addresses the regulations governing shellfish harvesting and consumption, from Florida's cooperation with the National Shellfish Sanitation Program (NSSP) to consumer advisories that are now mandated by the state. Part II concludes with a discussion of the procedure for warning the public of Vibrio along the coasts.

Part III introduces the stringent regulation of raw oyster sales and consumption in California and the effect these regulations have had on reported cases of raw oyster-associated illness from Vibrio bacteria. Part IV proposes several methods by which existing laws and regulations could be amended or enhanced to better protect the public against the risk posed by *Vibrio vulnificus*. One method involves adding *Vibrio vulnificus* to the current bacteria criteria for water quality as a possible source of impaired waters in Florida, requiring enhancement of Florida's Beach Water Sampling Program's testing of bacterial levels along the coast to include a process that isolates Vibrio bacteria. Another proposed method suggests implementing regulations similar to those in California to warn more individuals of the bacteria's risks, and likely reduce the number of oyster-related Vibrio cases. The final proposed method involves creating a process by which Florida can notify and warn the public of the presence of *Vibrio vulnificus* in its waters and food using the existing systems of public notification already in place for other forms of bacteria.

II. THE IMPACT OF VIBRIO VULNIFICUS ON FLORIDA'S COASTS

Vibrio bacteria are varied and include those causing cholera, as well as Vibrio vulnificus's more mild relation Vibrio parahaemolyticus.²² These bacteria are found in warm surface waters with high salinities, and are most commonly present in the summer and early fall.²³ Thus, Vibrio vulnificus is a natural presence along Florida's Gulf Coast due to the Gulf's warm surface temperatures and salinity.²⁴ Because the bacteria is a natural occurrence,²⁵ it often gets little attention until it is too late. Of the Gulf States reporting Vibrio vulnificus infections, "Florida has reported the majority of the cases," with an average of fourteen a year since 1981.²⁶ The number of reported cases of Vibrio vulnificus infection has generally increased each year,²⁷ and this increase is largely attributed to climate change. As the world warms, the oceans warm, and as the oceans warm, so grows the Vibrio bacteria population.²⁸ From 2008 to December of 2014, Florida's Department of Health recorded 207 cases of Vibriosis caused

²² *Vibrio*, MARYLAND HEALTHY BEACHES, <http://www.marylandhealthybeaches.org/vibrio.html> (last visited Jan. 23, 2016). Vibrio parahaemolyticus is found in brackish saltwater and is known to cause gastrointestinal illness. It is more commonly contracted through consumption of seafood, and illness through exposure is considered rare, unlike its relative Vibrio vulnificus. Diarrhea and abdominal cramping are generally the worst symptoms reported, and most cases clear up within three days. *See Vibrio Parahaemolyticus*, *supra* note 21.

²³ *Id.*

²⁴ *Information on Vibrio Vulnificus*, FLA. DEP'T OF HEALTH ONLINE NEWSROOM (Sept. 1, 2014), <http://newsroom.doh.state.fl.us/2014/09/01/information-on-vibrio-vulnificus/> (noting that vibrios are known as "halophilic" because they require salt").

²⁵ When a biology professor who studied Vibrio vulnificus was asked about the bacteria, he simply stated: "It's normal flora in the water . . . It belongs there." *Deadly Bacteria Vibrio can Kill with Little Warning*, CBS NEWS (Oct. 24, 2013), <http://www.cbsnews.com/news/deadly-bacteria-vibrio-can-kill-with-little-warning/> (quoting Dr. James Oliver, professor of biology at the University of North Carolina).

²⁶ Carina Blackmore, *Vibrio Vulnificus*, FLA. DEP'T OF HEALTH (Oct. 26, 1999), http://www.floridahealth.gov/diseases-and-conditions/vibrio-infections/_documents/Vibrio-vulnificus.pdf.

²⁷ There were fifteen reported Vibrio vulnificus cases in 2008, twenty-four in 2009, thirty-two in 2010, thirty-five in 2011, twenty-seven in 2012, forty-one in 2013, and thirty-three in 2014. *Information on Vibrio Vulnificus*, *supra* note 24.

²⁸ *Enjoy the Water, but be Smart and Avoid the Vibrios*, GULF COAST RES. LABORATORY, <http://www.usm.edu/gcrl/microbiology/vibrio.vulnificus.threat.via.wounds.php> (last visited Apr. 17, 2015) ("The rising water temperatures promote the increase in *Vibrio vulnificus* not only in our own coastal waters. New cases of the bacterium are being found in waters where they were not previously perceived as a threat.").

by encounters with *Vibrio vulnificus*.²⁹ Of the 207 reported cases in the past 6 years, 63 resulted in fatalities.³⁰

The Gulf of Mexico is not the only hotbed of *Vibrio vulnificus* infection, as cases are being reported more often along the Atlantic Coast and in Northeast Florida.³¹ These figures, however, may not reflect the true percentage of infections that are contracted in Florida, as the state's beaches draw a number of tourists from around the nation, and oysters are shipped from the state. The sandy beaches and numerous raw shellfish bars along Florida's extended miles of coast make this state prone to both methods of contracting the *Vibrio vulnificus* infection, via seawater exposure and raw oyster consumption.

A. *Wound Infections Resulting from Exposure to Vibrio Vulnificus via Seawater*

A commonly touted piece of wisdom is that swimming in the salty waters of the ocean will help heal any minor wounds an individual may sustain. This turns out to be wildly inaccurate for some individuals who stumble upon *Vibrio vulnificus* while swimming with even a minor wound like a blister.³² Wound infections resulting from *Vibrio* exposure account for sixty percent of reported cases of the illness in the United States,³³ but only about thirty percent of the reported cases in Florida.³⁴ While the bacteria does not have quite the “flesh-eating” effect that has been attributed to it, it does make for some terrifying and lethal injuries when it invades an open wound. Health officials and Florida health agencies have waged a battle with the media—who refer to *Vibrio vulnificus* outbreaks along the coast as “flesh-eating” bacteria—to stop using the term, which is generally used to refer to the condition known as necrotizing fasciitis³⁵

²⁹ *Information on Vibrio Vulnificus*, *supra* note 24.

³⁰ *Id.*

³¹ *Deadly Bacteria*, *supra* note 25.

³² Jeff Skrzypek, *Dangerous Bacteria: Vibrio Vulnificus in Florida Ocean Hospitalizes 13, Kills 3*, ABC ACTION NEWS (Aug. 6, 2014), <http://www.abcactionnews.com/news/state/flesh-eating-bacteria-vibro-vulnificus-in-florida-ocean-hospitalizes-32-kills-10>.

³³ *Enjoy the Water*, *supra* note 28.

³⁴ Blackmore, *supra* note 26.

³⁵ Necrotizing fasciitis is the scientific name for the bacterial infection that “spreads rapidly and destroys the body’s soft tissue” and that the media has dubbed “flesh-eating.” This bacterial

that can be caused by multiple types of bacteria.³⁶ *Vibrio vulnificus* entering an open wound does have the effect, however, of painful cellulitis,³⁷ localized tissue swelling, and hemorrhagic bullae³⁸ in most patients, while the more severe cases may develop into necrotizing fasciitis.³⁹ *Vibrio vulnificus* will have little, if any, effect on healthy individuals, but may ravage the bodies of immunocompromised individuals.⁴⁰

Once a wound has been exposed to *Vibrio vulnificus* by introduction to seawater, the bacteria acts quickly to claim the surrounding tissues as its own.⁴¹ An example of a worst case scenario *Vibrio vulnificus* infection is the tragic death of Henry "Butch" Konietzky in September of 2013.⁴² While fishing in the Atlantic Intracoastal Waterway near Ormond Beach, Mr. Konietzky, who had no reported health problems or open wounds of which his wife was aware, encountered *Vibrio vulnificus* and was none the wiser until he noticed a purple lesion on his ankle the

infection is not only caused by *Vibrio vulnificus*, but can result from infections of group A strep, *E. coli*, *Clostridium*, and several others. The infecting bacteria produce toxins that destroy the tissue they are infecting, causing the tissue to die. The bacteria mainly attack tissues surrounding the body's blood vessels, muscles, fat, and nerves, known as the *fascia*. *Necrotizing Fasciitis: A Rare Disease, Especially for the Healthy*, CENTERS FOR DISEASE CONTROL & PREVENTION, <http://www.cdc.gov/Features/NecrotizingFasciitis/index.html> (last updated June 28, 2013).

³⁶ Chris Olwell, *DOH: Vibrio Not 'Flesh-Eating Disease'*, THE NEWS HERALD (July 31, 2014), <http://www.news Herald.com/news/health/doh-vibrio-not-flesh-eating-disease-1.353202?page=0> (quoting Sheri Hutchinson, Florida Department of Health press secretary, as saying, "[V]ibrio is not a flesh-eating virus.").

³⁷ "Cellulitis appears as a swollen, red area of skin that feels hot and tender, and it may spread rapidly." *Diseases and Conditions: Cellulitis*, MAYO CLINIC (Feb. 23, 2012), <http://www.mayoclinic.org/diseases-conditions/cellulitis/basics/definition/CON-20023471>.

³⁸ These blisters often appear on the limbs and can quickly evolve into necrotizing fasciitis. Gun-Wook Kim et al., *Bullae and Sweat Gland Necrosis in the Differential Diagnosis for Vibrio Vulnificus Infection in an Alcoholic Patient*, J. OF KOREAN MED. SCI. (Feb. 25, 2011), <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3051097/>.

³⁹ Michael H. Bross et al., *Vibrio Vulnificus Infection: Diagnosis and Treatment*, AM. FAM. PHYSICIAN (Aug. 15, 2007), <http://www.aafp.org/afp/2007/0815/p539.pdf>.

⁴⁰ *Vibrio Vulnificus*, *supra* note 12 ("Among healthy people, ingestion of *V. vulnificus* can cause vomiting, diarrhea, and abdominal pain. In immunocompromised persons, particularly those with chronic liver disease, *V. vulnificus* can infect the blood stream, causing a severe and life-threatening illness . . ."). See also *Enjoy the Water*, *supra* note 28 (reporting that immunocompromised individuals are eighty times more likely to develop a bloodstream infection after *Vibrio vulnificus* exposure than healthy individuals).

⁴¹ *Enjoy the Water*, *supra* note 28 ("Vibrio wound infections happen fast; symptoms may become evident in only four hours.").

⁴² *Deadly Bacteria*, *supra* note 25.

same night of his fishing trip.⁴³ Mr. Konietzky and his wife, Patty, thought little of the lesion at first, brushing it off as a spider bite, but by the next day, Mr. Konietzky was reporting painful burning near the wound and the lesion began spreading.⁴⁴ Mrs. Konietzky took her husband to the hospital, where she was informed that he had a blood infection; it took only sixty-two hours from exposure for *Vibrio vulnificus* to claim Mr. Konietzky as its victim.⁴⁵ This example is a worst case scenario of a wound infection for several reasons, one of which is the resulting fatality, because wound infections are reported as having only an eleven percent mortality rate.⁴⁶ More striking is the fact that Mr. Konietzky appeared to be, for all intents and purposes, healthy; his wife did not report him as being immunocompromised.⁴⁷

All Florida cases of *Vibrio vulnificus* do not end so tragically, but each case does leave the victim with a reminder of the lurking dangers along Florida's coasts. Eighty-four-year-old Margaret Freiwald, considered relatively healthy by her family with her only reported ailment being arthritis, encountered the bacteria while swimming in the Gulf of Mexico between the Bayport and Hernando channels.⁴⁸ Ms. Freiwald scraped her shin in her effort to get back into the boat that she and her group had taken into the Gulf, but no problem appeared until later that night, when she noticed that the wound began to look infected.⁴⁹ Three days after the minor scrape, Ms. Freiwald had her leg amputated above the knee.⁵⁰

⁴³ *Id.*

⁴⁴ *Id.*

⁴⁵ *Id.*

⁴⁶ Blackmore, *supra* note 26.

⁴⁷ *Deadly Bacteria*, *supra* note 25. Compare[Cf.] Stephanie Genuardi, *Warm-Water Ocean Bacteria can be Life-Threatening*, SUN SENTINEL (July 23, 2010), http://articles.sun-sentinel.com/2010-07-23/health/fl-mystery-bacteria-20100723_1_bacteria-vibrio-septic-shock (reporting the death of Shirley Malavenda, an eighty-six-year-old who went swimming with a small scrape on her leg in Miami-Dade in Matheson Hammock Park and was rushed to the hospital four days later, where her leg was amputated. She died in the hospital one month later, never to recover from her battle with the bacteria.).

⁴⁸ *Margaret Freiwald: Vibrio Vulnificus Bacteria in the Gulf Causes Infection, Woman has Leg Amputated*, FIRST COAST NEWS (Aug. 2, 2013), <http://www.firstcoastnews.com/news/article/322319/1/Margaret-Freiwald-Vibrio-vulnificus-bacteria-in-the-Gulf-causes-infection-woman-has-leg-amputated>.

⁴⁹ *Id.*

⁵⁰ *Id. See also* Liz Freeman & Kristine Gill, *Health Officials: Nothing Wrong with SWFL Water Despite Cases of Deadly Infections*, NAPLES DAILY NEWS (Aug. 13, 2013),

Thirteen-year-old Jacob Ahler was scalloping with his family in the Gulf of Mexico when he got a splinter while unloading the boat.⁵¹ His family treated the wound as normal, cleaning it and putting antiseptic cream on the injury, but by the next morning his foot had swollen to nearly triple its normal size and was burning hot to the touch.⁵² His test results at the hospital confirmed a *Vibrio vulnificus* infection.⁵³ Jacob's foot was saved by the timely diagnosis and administration of antibiotics provided by his doctors.⁵⁴ While *Vibrio vulnificus* does not always end in fatality, the bacteria leaves a mark on those who have had the misfortune of encountering it.⁵⁵

The above cases are just a few examples of the 207 that have been reported in the past 6 years in Florida's warm, coastal waters.⁵⁶ As the global climate warms and the oceans follow suit, *Vibrio vulnificus* will grow in number and claim new victims. It is important in this time of increasing cases and regional spread of *Vibrio vulnificus* that individuals are apprised of the danger the bacteria poses, as many treating physicians in new regions may have little experience with the bacteria and immediate treatment for the bacteria makes the difference between the worst and best case scenarios.⁵⁷ For now, the Florida Department of Health warns individuals to avoid exposing broken skin or open wounds to warm

<http://www.naplesnews.com/news/state/health-officials-nothing-wrong-with-swfl-water> (noting that *Vibrio vulnificus* impacts the elderly, not just the immunocompromised, at a higher degree and covering the recovery of Ms. Freiwald after her amputation).

⁵¹ Jennifer Titus, *2 Cases of Flesh Eating Bacteria in Sarasota*, 10 NEWS (July 31, 2014), <http://www.wtsp.com/story/news/health/2014/07/30/flesh-eating-bacteria-florida/13353945/>.

⁵² *Id.*

⁵³ *Id.*

⁵⁴ Alex DeMetrick, *Experts Warn About Flesh-Eating Bacteria in Chesapeake Bay*, CBS BALTIMORE (July 31, 2014), <http://baltimore.cbslocal.com/2014/07/31/experts-warn-about-vibrio-infection-in-chesapeake-bay/> (referring to Jacob Ahler's case as an example of the need for immediate treatment when *Vibrio vulnificus* infections are expected).

⁵⁵ Amber Castleman, daughter of eighty-four-year-old *Vibrio* victim Margaret Freiwald, told the media that she didn't think she would ever swim again after watching her mother struggle with the bacteria that subsequently caused the amputation of her leg. *Margaret Freiwald*, *supra* note 48.

⁵⁶ *Information on Vibrio Vulnificus*, *supra* note 24.

⁵⁷ *Enjoy the Water*, *supra* note 28 ("A *Vibrio vulnificus* infection can be tricky to diagnose and treat. And many clinicians and physicians have not seen a case first-hand.").

coastal or brackish waters as the best means of avoiding infection from exposure to the bacteria.⁵⁸

B. *Consuming Shellfish in Months Not Containing an “R” – Contracting Vibrio Illnesses from Eating Raw Shellfish from Florida’s Gulf Coast*

According to the United States Food and Drug Administration (FDA), *Vibrio vulnificus* is the leading cause of death in the United States resulting from shellfish consumption.⁵⁹ These deaths are largely attributed to raw oysters from the Gulf of Mexico.⁶⁰ *Vibrio vulnificus* is especially hard to detect in oysters, making the bacteria hard to regulate, because the bacteria does not change the taste, odor, or appearance of the shellfish.⁶¹ One reliable method to eliminate the risk of the bacteria is heat.⁶² The CDC recommends boiling a shelled oyster until it opens to ensure that the risk of bacteria is eliminated.⁶³ The fact remains, however, that many individuals still enjoy eating raw oysters, so much so that popular myths have sprouted from the warnings of the food item’s risks to give these individuals a false sense of security when consuming the raw shellfish. One of the most popular, and only partially correct, myths is that oysters are safe to consume so long as the month in which they are consumed contains an “r.”⁶⁴ While it has been proven that the *Vibrio vulnificus* population is more prevalent in the warmer summer months of May, June, July, and August, an overwhelming

⁵⁸ *Information on Vibrio Vulnificus*, *supra* note 24.

⁵⁹ Nicholas A. Daniels, *Vibrio Vulnificus Oysters: Pearls and Perils*, 52 CLINICAL INFECTIOUS DISEASES 788, 788 (2011), available at <http://cid.oxfordjournals.org/content/52/6/788.long>.

⁶⁰ Charles A. Kaysner & Angelo DePaola, Jr., *Vibrio*, in BACTERIOLOGICAL ANALYTICAL MANUAL 9 (8th ed. 2004), available at

<http://www.fda.gov/Food/FoodScienceResearch/LaboratoryMethods/ucm070830.htm> (“*V. vulnificus* causes septicemia and death following ingestion of seafood . . .”).

⁶¹ *Vibrio Vulnificus*, *supra* note 12.

⁶² *Vibrio Vulnificus Health Education Kit Fact Sheet*, U.S. FOOD & DRUG ADMIN., <http://www.fda.gov/Food/ResourcesForYou/HealthEducators/ucm085365.htm> (last updated Nov. 26, 2014).

⁶³ *Information on Vibrio Vulnificus*, *supra* note 24 (“For shellfish in the shell, either a) boil until the shells open and continue boiling for 5 more minutes, or b) steam until the shells open and then continue cooking for 9 more minutes. Do not eat those shellfish that do not open during cooking.”).

⁶⁴ *Raw Oyster Myths*, U.S. FOOD & DRUG ADMIN., <http://www.fda.gov/Food/ResourcesForYou/HealthEducators/ucm085385.htm> (last updated Nov. 26, 2014).

forty percent of *Vibrio vulnificus* cases are reported in the colder months from September through April, thus leaving no truly safe month for raw oyster consumption.⁶⁵

The bulk of Florida's reported cases of *Vibrio vulnificus* infection result from the consumption of raw shellfish.⁶⁶ Infection from ingestion of the bacteria through oysters normally ranges from mild gastroenteritis⁶⁷ to the more severe cases of primary septicemia,⁶⁸ which has a mortality rate of more than fifty percent.⁶⁹ Gastroenteritis is the likely outcome of a healthy individual encountering *Vibrio vulnificus* in a raw oyster, while groups considered at risk⁷⁰ are the likely candidates for septicemia.⁷¹ Since 1997, 110 cases of *Vibrio vulnificus* resulting from oyster consumption have been reported by individual Florida counties.⁷²

⁶⁵ *Id.* (dispelling other oyster myths such as hot sauce and alcohol having the ability to kill bacteria found in the shellfish and that oysters only contain *Vibrio vulnificus* if cultivated from polluted waters).

⁶⁶ A study of Florida *Vibrio vulnificus* cases from 1981, when reporting began, to 1993 showed that over half (fifty-three percent) of the cases reported were from ingestion of raw oysters. Blackmore, *supra* note 26.

⁶⁷ "Gastroenteritis is characterized by complaints (in descending order of frequency) of abdominal pain or cramps, nausea, vomiting, diarrhea, fever, and chills." Michael A. Horseman & Salim Surani, *A Comprehensive Review of Vibrio Vulnificus: An Important Cause of Severe Sepsis and Skin and Soft-Tissue Infection*, 15 INT'L J. INFECTIOUS DISEASES, no. 3, Mar. 2011, at 157, 161-62.

⁶⁸ Primary septicemia is marked by reports of nausea, vomiting, abdominal pain, fever, chills, and, in some instances, necrotic ulcers. In many, this illness will progress into septic shock, or extraordinarily low blood pressure, and in more than half of the cases, as stated above, the final stage of the illness is death. Some patients have even reported mental status changes like lethargy or disorientation. *Id.*

⁶⁹ *Id.* at 162.

⁷⁰ The FDA includes in the group of high-risk individuals for septicemia those suffering from disease of the liver (like cirrhosis or hepatitis), diabetes, cancer, iron overload disease (hemochromatosis), alcoholism, and any other illness which may cause an individual to be immunocompromised, like HIV. *Fact Sheet*, *supra* note 62.

⁷¹ Horseman & Surani, *supra* note 67, at 162.

⁷² *Food and Waterborne Disease Outbreak Data Search*, FLA. HEALTH, [\(last visited Apr. 17, 2015\).](http://www.floridahealth.gov/diseases-and-conditions/food-and-waterborne-disease/food-waterborne-outbreak-data-search.html?appSession=904352671017896&RecordID=&PageID=2&PrevPageID=1&cpiPage=4&CPISortType=&CPIorderBy=)

One such case, reported in 2009, began with a couple celebrating their pending nuptials and ended with a double amputation of the victim's legs.⁷³ Darrell Dishon, a diabetic, and his bride-to-be were vacationing in Panama City when he decided to try a raw oyster.⁷⁴ Within a day of the consumption, Mr. Dishon became violently ill and was taken to the hospital where his diagnosis was confirmed as Vibriosis and, likely because of his immunocompromised susceptibility, he developed septicemia.⁷⁵ Mr. Dishon slipped into a coma and woke up two weeks later with both of his legs amputated, an effort made by his treating physicians to halt the spread of the infection.⁷⁶ Mr. Dishon's recovery seemed to be going well, as he was transferred to a hospital in his home state of Ohio and ultimately released on orders of physical therapy, until his legs became infected again and his kidneys and liver began to fail.⁷⁷ In December of 2009, six months after eating those fateful raw oysters, Mr. Dishon lost his battle to *Vibrio vulnificus*.⁷⁸

A survey, conducted in 2004, estimated that roughly twenty-seven percent of households in Florida eat raw oysters, and approximately fifteen percent of those surveyed would qualify as being at a higher risk for contracting shellfish-related illnesses.⁷⁹ Nearly fifty percent of those surveyed expressed no concern at all over the risks presented by consuming raw oysters.⁸⁰ An overwhelming ninety-

⁷³ Lyndsey Layton, *Industry, FDA at Odds on Raw Oysters*, WASH. POST (Nov. 10, 2009), <http://www.washingtonpost.com/wp-dyn/content/article/2009/11/09/AR2009110903339.html>.

⁷⁴ Joe Satran, *Vibriosis, Deadly Disease Associated with Raw Oysters, May Get More Common as Ocean Warms*, HUFFINGTON POST (Feb. 7, 2013), http://www.huffingtonpost.com/2013/02/07/vibriosis-oysters_n_2617262.html (reporting that while Mr. Dishon's bride-to-be consumed ten raw oysters, he only ate two).

⁷⁵ *Id.* See also Gardiner Harris, *Food Agency Delays Ban on Oysters After Outcry*, N.Y. TIMES (Nov. 10, 2009), http://www.nytimes.com/2009/11/14/health/policy/14oyster.html?_r=0 (noting that Mr. Dishon was hospitalized on the day of his planned wedding).

⁷⁶ Layton, *supra* note 73 (reporting Mr. Dishon as stating: "You sit down for dinner with your family, and the next thing you know you're in a wheelchair for the rest of your life. Or worse.").

⁷⁷ Satran, *supra* note 74 ("Facing a lifetime of dialysis, he . . . decided not to pursue further treatment.").

⁷⁸ *Id.*

⁷⁹ INTERSTATE SHELLFISH SANITATION CONF., RAW OYSTER CONSUMER FOLLOW-UP SURVEY: 2004 TECHNICAL REPORT 18 (2004), available at http://www.issc.org/client_resources/publications/2004%20raw%20oyster%20consumer%20survey.pdf.

⁸⁰ *Id.* at 69.

five percent of those responding to the survey denied taking any extra steps to avoid bacteria and other risks associated with eating raw oysters, like avoiding consumption of the raw shellfish in warmer summer months.⁸¹ Considering these statistics together, the individuals that are significantly more susceptible to contracting *Vibrio vulnificus* in Florida fail to take any extra precautions to preserve their health when they decide to consume raw oysters. This data is troubling when Florida's approach to remedying the risk of *Vibrio vulnificus* in raw oysters revolves around spreading awareness of the risks through educational endeavors, thus placing the weight of preventing illness on the shoulders of the consumer.

C. *The Problem with Public Notification of Vibrio Vulnificus*

There is no easy method to address the threat of *Vibrio vulnificus* from Florida's coasts, as it is a natural presence in the state's coastal waters.⁸² While the state cannot hope to expel the bacteria from its waters, it can protect the public from possible infection by warning residents and tourists of the risks posed by *Vibrio vulnificus* from all possible avenues of contracting the possibly life-threatening bacteria. Unfortunately, for recreational risks of *Vibrio vulnificus*, the warning often comes after infections have already been reported.⁸³ Moreover, raw oyster consumers receive general risk warnings of illness associated with shellfish, but such warnings only appear in restaurants that serve raw shellfish.⁸⁴

⁸¹ *Id.* at 84.

⁸² *Information on Vibrio Vulnificus*, *supra* note 24.

⁸³ Jaime Martinez-Urtaza et al., *Climate Anomalies and the Increasing Risk of Vibrio Parahaemolyticus and Vibrio Vulnificus Illnesses*, 43 CLIMATE CHANGE & FOOD SCI., no. 7, Aug. 2010, at 1780, 1788, available at <http://www.sciencedirect.com/science/article/pii/S0963996910000980> (noting that public health would be better served by a proactive testing protocol, rather than relying on studies conducted after illness outbreaks).

⁸⁴ *Division of Hotels and Restaurants Public Food Service Signs and Charts*, FLA. DEP'T OF BUS. & PROF. REG., http://www.myfloridalicense.com/dbpr/HR/forms/sign_and_charts.html#oysters (last updated Nov. 15, 2013).

1. No Warning for Beachgoers

The stories of wound infections from *Vibrio vulnificus* all vary to some degree, but one common thread these incidents share is the total lack of warning or knowledge the individuals who contracted the bacteria had about the bacteria's presence in the waters they enjoyed before they fell ill.⁸⁵ One reported victim of *Vibrio vulnificus* was aware of the bacteria before she fell ill, but only after the media began to report other cases of infection occurring along Florida's coasts.⁸⁶ Kelly Johnson, a St. Augustine resident, had opted out of her daily swim for a week after hearing about a *Vibrio* outbreak on the news, but when she did return to the water, a small sore in her ear became infected with the bacteria.⁸⁷ In an attempt to get the word out, many more victims and their relatives are speaking out about their respective experiences with *Vibrio vulnificus*,⁸⁸ some arguing that they hope that by telling others of the risk, they or their loved ones will not have suffered in vain.⁸⁹

There is no true warning system before an outbreak of *Vibrio vulnificus* because it is not one of the items for which the state's health department tests.⁹⁰ Juan A. Suarez, from the Florida Department of Health, was interviewed about the lack of warning given to beachgoers regarding the risk of wading in the waters

⁸⁵ See, e.g., *Deadly Bacteria*, *supra* note 25 (quoting the wife of a *Vibrio* victim as having no knowledge of the bacteria before her husband was infected, although she and her husband had grown up in Florida and spent much of their lives in its coastal waters); Genuardi, *supra* note 47 (reporting that the son of a *Vibrio* victim had grown up in Miami and never heard of the bacteria); Skrzypek, *supra* note 32 (revealing that an interviewed beachgoer had little knowledge about *Vibrio* bacteria).

⁸⁶ Pat Fallon, *Vibrio Vulnificus: The Deadly Bacteria in Florida Waters*, FLAGLER C. GARGOYLE (Nov. 7, 2013), <http://gargoyle.flagler.edu/2013/11/vibrio-vulnificus-the-deadly-bacteria-in-florida-waters/>.

⁸⁷ *Id.* (noting that Ms. Johnson was unaware that *Vibrio vulnificus* was a recurring problem along Florida's coasts).

⁸⁸ Tamara Lush, *10 in Florida Die from Bacteria Found in Saltwater*, SEATTLE TIMES (Oct. 11, 2013), http://seattletimes.com/html/health/202202747_killerseawaterxml.html (repeating Diane Holm, spokeswoman for the Lee County Health Department, who differentiated the cases in 2013 from other years based on the fact that more individuals were speaking to the media about their experiences with *Vibrio*).

⁸⁹ Genuardi, *supra* note 47 (quoting the son of a *Vibrio* victim: "I hope my mom didn't die in vain.").

⁹⁰ *Id.*

with *Vibrio vulnificus*: “We don’t want to scare people away who have no risk . . . it doesn’t affect everyone. Most healthy people will not respond to the organism. They are probably not at risk.”⁹¹ While there is some debate over whether *Vibrio vulnificus* infections are “rare”⁹² or just “uncommon,”⁹³ what is not arguable is that the rate of infection is increasing, and as the oceans warm, the *Vibrio* population will grow and spread and, arguably, so will the risk of infection.⁹⁴ In this thread, support exists for the proposition, known as the precautionary principle, that scientific uncertainty should not be used as grounds to postpone preventative measures when there exists “serious or irreversible threats to the health of humans or ecosystems.”⁹⁵ Thus, though illness resulting from *Vibrio vulnificus* may be rare, the danger it presents to the life and limb of Florida’s public suggests that rarity is not a grounds to refuse preventative measures, like mandated notification.

2. Mandated Education Programs and Consumer Advisories

The risk of *Vibrio vulnificus* associated with eating raw oysters is more widely known than the risk of wound infections, as education measures regarding the risks of oysters are mandated in states that report two or more cases of related *Vibrio vulnificus* infection.⁹⁶ The state of Florida also requires a consumer

⁹¹ *Id.* (quoting Mr. Suarez, who works for the Florida Department of Health as an environmental epidemiologist).

⁹² *Information on Vibrio Vulnificus*, *supra* note 24.

⁹³ Fallon, *supra* note 86 (“Professionals say it is uncommon to contract the bacteria, but that people with weak immune systems and preexisting health conditions are much more at risk to the bacteria entering the blood stream and contracting the bug and its side effects.”).

⁹⁴ L. Vezzulli et al., *Long-Term Effects of Ocean Warming on the Prokaryotic Community: Evidence from the Vibrios*, ISME J., 2012, at 21, 22, available at <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3246245/pdf/ismej201189a.pdf> (“There is substantial evidence that *Vibrio*-associated diseases are increasing worldwide with climate warming.”).

⁹⁵ Marco Martuzzi & Joel Tickner, *Introduction to WORLD HEALTH ORGANIZATION, THE PRECAUTIONARY PRINCIPAL: PROTECTING PUBLIC HEALTH, THE ENVIRONMENT AND THE FUTURE OF OUR CHILDREN* 7, 7-8 (Marco Martuzzi & Joel Tickner eds., 2004) (“The principal originated as a tool to bridge uncertain scientific information and a political responsibility to act to prevent damage to human health and to ecosystems.”).

⁹⁶ Jennifer Flattery & Michelle Bashin, *A Baseline Survey of Raw Oyster Consumers in Four States*, ISSC VIBRIO VULNIFICUS EDUCATION ON POINT 1 (2004), available at http://www.issc.org/client_resources/education/BaselineSurvey.pdf.

warning to be posted in establishments that serve raw oysters in an attempt to educate consumers about the possible risk.⁹⁷ Despite these measures, a survey conducted in 2004 recorded that thirty-eight percent of survey participants in Florida were unaware of any risk at all associated with eating raw oysters; of the individuals aware of a risk, only twenty-six percent were aware of all three survey groups that face a higher risk of infection.⁹⁸ About half of the individuals aware of the risk were so educated by either posted notices or via the television after news of infection outbreaks spread to the media.⁹⁹

More startling is that less than thirty percent of individuals are told by their doctors that their health condition makes eating raw oysters a risky undertaking for them.¹⁰⁰ Fifty-seven-year-old Vincent Rhodes was in the beginning stage of his battle with cirrhosis of the liver when he visited Florida in July of 2012.¹⁰¹ His doctor had not warned him of the risk raw oysters presented to him because of his condition, and while in Tampa, Mr. Rhodes decided to consume a dozen oysters with his wife at a beachside restaurant.¹⁰² Within hours, Mr. Rhodes fell violently ill and had to be taken to the hospital where he remained in the Intensive Care Unit for several days, fighting off the Vibrio-induced illness.¹⁰³ While raw oyster risks are more widely known than that of wound infections, cases like Mr. Rhodes' continue to occur, and such agonizing¹⁰⁴ battles are largely avoidable with proper education for those at risk and streamlining the notification processes already in place. "Increasing consumer awareness is an important first step" toward addressing this problem and protecting the health of

⁹⁷ *Division of Hotels*, *supra* note 84.

⁹⁸ Flattery & Bashin, *supra* note 96, at 9 (counting as at-risk groups those suffering from liver disease, diabetes, or any other disease that would render the individual immunocompromised).

⁹⁹ *Id.* at 11.

¹⁰⁰ *Id.*

¹⁰¹ Satran, *supra* note 74 (reporting that Mr. Rhodes was largely asymptomatic at the time of his visit).

¹⁰² *Id.*

¹⁰³ *Id.* (describing Mr. Rhodes as being "completely gray" after contracting the bacteria, his developing a hernia from such violent vomiting, and the rapid progression of his underlying illness from tangling with Vibrio, pushing him into the need for a liver transplant).

¹⁰⁴ *Id.* ("I'd rather have 20 more liver transplants than have vibrio again -- that's how bad I felt," Rhodes told The Huffington Post.").

these individuals from the risk presented by Vibriosis when consuming raw oysters.¹⁰⁵

III. EXISTING LEGAL PROTECTIONS FOR PUBLIC HEALTH – WATER QUALITY STANDARDS AND GULF SHELLFISH REGULATION

While it is true that *Vibrio vulnificus* is an omnipresent, natural flora dotting the Florida coasts, protections may exist within the current legal framework to better prepare the public for the risks associated with their favorite beach activities or raw shellfish hors d’oeuvres. *Vibrio vulnificus* is not the subject of many enacted laws or regulations, but it is possible to monitor the bacteria and risks to the public through various existing state and federal laws.

One of the Environmental Protection Agency’s (EPA) duties is the protection of beaches and public health thereon. It promulgates and enforces water quality regulations.¹⁰⁶ Additionally, the Interstate Shellfish Sanitation Conference (ISSC) was formed to promote cooperation between the federal and state governments in making shellfish safer for public consumption,¹⁰⁷ which it accomplishes by working with the FDA to manage the National Shellfish Sanitation Program (NSSP).¹⁰⁸ The state of Florida has implemented the EPA’s requisite water quality laws as federally mandated, enforced its own separate sampling policies to preserve water quality, and enacted certain guidelines from

¹⁰⁵ Flattery & Bashin, *supra* note 96, at 4 (noting that awareness in Florida is higher than in most states, but the behaviors associated with that knowledge are ineffective to prevent contracting the bacteria—like avoiding shellfish in the summer months or only getting oysters from trusted venues).

¹⁰⁶ *LEARN: EPA’s Role in Protecting Beaches*, U.S. ENVTL. PROTECTION AGENCY, <http://www2.epa.gov/beaches/learn-epas-role-protecting-beaches> (last updated July 30, 2014) (“Following the BEACH Act of 2000, EPA expanded the focus of its efforts to improve the quality of coastal recreation waters and protect the health of beach goers.”).

¹⁰⁷ INTERSTATE SHELLFISH SANITATION CONF., <http://www.issc.org/> (last visited Apr. 17, 2015) (“The Interstate Shellfish Sanitation Conference (ISSC) was formed in 1982 to foster and promote shellfish sanitation through the cooperation of state and federal control agencies, the shellfish industry, and the academic community.”).

¹⁰⁸ *National Shellfish Sanitation Program (NSSP)*, U.S. FOOD & DRUG ADMIN., <http://www.fda.gov/Food/GuidanceRegulation/FederalStateFoodPrograms/ucm2006754.htm> (last updated Sep. 30, 2014) (“The purpose of the NSSP is to promote and improve the sanitation of shellfish (oysters, clams, mussels and scallops) moving in interstate commerce through federal/state cooperation and uniformity of State shellfish programs.”).

the NSSP to protect the sanitation of shellfish. Many laws could be used in the effort to promote awareness of the bacteria, either as written or with minor modifications to shape the law as one that meets the demands of *Vibrio* risks. This patchwork of laws and regulations has proven ill-equipped to prevent or even decrease public exposure to *Vibrio vulnificus*.

A. *The BEACH Act and Florida's Health-Based Bacteria Standards*

Several existing federal and state laws regulate and protect the water quality of recreational waters. The Clean Water Act (CWA) was enacted to achieve, among other goals, “wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water.”¹⁰⁹ Congress amended the Clean Water Act with the Beaches Environmental Assessment and Coastal Health Act (BEACH Act) of 2000, which requires states with coastal waters used for recreation to adopt bacteria-based water quality standards to better protect human health.¹¹⁰ This Act could potentially apply to the hazards that *Vibrio vulnificus* presents to public health.

The BEACH Act amendments require states to submit and enforce water quality standards for certain pathogens¹¹¹ as applicable to their coastal recreational waters, as well as monitor those pathogens’ effects on indigenous shellfish population.¹¹² In developing these water quality criteria, the BEACH Act mandates that states conduct studies to assess the “potential human health risks resulting from exposure to pathogens in coastal recreation waters” and appropriate

¹⁰⁹ Clean Water Act, 33 U.S.C. § 1251(a)(2).

¹¹⁰ Beaches Environmental Assessment and Coastal Health Act of 2000, Pub. L. No. 106-284, 114 Stat. 870-77 (2000). See also EPA Proposes More Protective Water Quality Standards for Bacteria, U.S. ENVTL. PROTECTION AGENCY (July 2004), <http://water.epa.gov/lawsregs/lawsguidance/beachrules/bacteria-rule-fs.cfm>.

¹¹¹ The Clean Water Act, as amended by the BEACH Act in 2000, requires each state to develop testing measures and report on certain pathogens found in surface waters and how they influence “plankton, fish, shellfish, wildlife, plant life, shorelines, beaches, esthetics, and recreation,” as well as “the concentration and dispersal of pollutants, or their byproducts, through biological, physical, and chemical processes; and on the effects of pollutants on biological community diversity, productivity, and stability.” 33 U.S.C. § 1314(a)(1).

¹¹² *Id.* § 1314(a)(5)(B) (explaining the purpose of the water quality requirement as protecting public health and indigenous marine populations from possible pollutants).

indicators for detecting such harmful pathogens.¹¹³ Seeking to protect the health and safety of individuals in their pursuit of recreation along the coasts, as well as the integrity of coastal shellfish, the BEACH Act provides a valuable foundation for monitoring the presence and effect of *Vibrio vulnificus* along the coasts. However, because the BEACH Act's aim is monitoring pathogenic bacteria introduced to recreational waters via fecal contamination, the naturally-occurring vibrio bacteria have not made the list.¹¹⁴

One of the most important aspects of the BEACH Act is its requirement that all states develop their own bacteria standards as part of their water quality criteria, or adopt the standards promulgated by the EPA.¹¹⁵ Under the BEACH Act, states are given the responsibility of writing the standards for pathogens in recreational waters through three options: the states can adopt the criteria set forth by the EPA, modify the EPA's criteria to reflect the state's specific conditions, or adopt its own criteria that is "as protective as" EPA recommendations "based on scientifically-defensible methods."¹¹⁶ States have the option to develop more stringent water quality standards than EPA requires.¹¹⁷

Seeking only to make its water quality criteria "as protective as" that of the EPA, Florida codified its surface bacteria water quality criteria,¹¹⁸ testing for fecal coliform bacteria based on an earlier standard set by the EPA.¹¹⁹ Fecal coliform bacteria are widespread bacteria found in human feces, as well as in animal waste and soil, and were used as indicator bacteria by the EPA for the likelihood of other disease-causing bacteria; the presence of these bacteria

¹¹³ *Id.* § 1254(v)(1)-(2).

¹¹⁴ U.S. ENVTL. PROTECTION AGENCY, NATIONAL BEACH GUIDANCE AND REQUIRED PERFORMANCE CRITERIA FOR GRANTS, 2014 EDITION 7 (2014).

¹¹⁵ *2004 Bacteria Rule for Coastal and Great Lakes Recreation Waters*, U.S. ENVTL. PROTECTION AGENCY, <http://water.epa.gov/lawsregs/lawsguidance/beachrules/bacteria-rule.cfm> (last updated Aug. 8, 2013) ("Although states are required to write the standards, [the EPA has] to approve them.").

¹¹⁶ *Id.*

¹¹⁷ 40 C.F.R. § 131.4(a).

¹¹⁸ See generally FLA. ADMIN. CODE ANN. § 62-302.530 (listing, in table form, the specific items that are monitored in surface waters by the state of Florida, including arsenic, biological integrity, and nitrate).

¹¹⁹ *5.11 Fecal Bacteria*, U.S. ENVTL. PROTECTION AGENCY, <http://water.epa.gov/type/rsl/monitoring/vms511.cfm> (last updated Mar. 6, 2012).

indicate that swimming in these regions or consuming shellfish harvested therefrom may not be safe.¹²⁰ As of 1986, the EPA no longer recommends using this bacteria as an indicator, however, and has since recommended switching to the use of E. coli and enterococci bacteria to test waters for the presence of dangerous pathogens, specifying enterococci as the best choice for saltwater regions.¹²¹

The Florida Healthy Beaches Program, administered by the Florida Department of Health and funded by a grant from the EPA, tests waters using both the previously recommended fecal coliform and current indicator enterococci bacteria, although the state's code has yet to reflect a legal requirement to use the better indicator.¹²² This program tests designated areas weekly, and regions with elevated levels of enterococci are given a "poor" rating coupled with an advisory being issued for the site.¹²³ The problem with using any of these bacteria to determine the presence of pathogens in selected waters is that the tests used are unable to distinguish between enteric (fecal) bacteria and environmental bacteria, like Vibrio, in the sampled waters.¹²⁴

The CWA requires all states to submit to the EPA "biennial water quality reports," known as 305(b) reports, to describe the extent to which the state's waters are achieving their designated uses.¹²⁵ Waters that are not meeting their

¹²⁰ *Id.*

¹²¹ U.S. ENVTL. PROTECTION AGENCY, AMBIENT WATER QUALITY CRITERIA FOR BACTERIA – 1986 5-6 (1986).

¹²² *Florida Healthy Beaches Program*, FLA. HEALTH, <http://www.floridahealth.gov/environmental-health/beach-water-quality/index.html> (last visited Apr. 17, 2015) (describing the founding of the program as a pilot program in 1998 in five counties of Florida on a grant from the EPA, which was extended to all of the state's thirty-four coastal counties in 2000).

¹²³ *Id.* ("If an enterococci result were observed to exceed 104 colony forming units per 100 milliliters of beach water sampled and a resampling result also exceeds this value, then an 'Advisory' would be issued for the sampling site.").

¹²⁴ FLA. DEP'T OF ENVTL. PROTECTION, DIV. OF ENVTL. ASSESSMENT AND RESTORATION, BACTERIA CRITERIA TECHNICAL ADVISORY COMMITTEE MEETING 13 (Aug. 20, 2013), *available at* http://www.dep.state.fl.us/water/wqssp/docs/bacteria/0813tac/bacteria_criteria_background_whiting.pdf.

¹²⁵ DIVISION OF ENVTL. ASSESSMENT AND RESTORATION, FLA. DEP'T OF ENVTL. PROTECTION, INTEGRATED WATER QUALITY ASSESSMENT FOR FLORIDA: 2014 SECTIONS 303(d), 305(b), AND

designated purposes are considered “impaired.”¹²⁶ Under the current sampling and testing procedures that use only fecal bacteria as indicators, only about four percent of beach locations in Florida return impaired results, meaning that either recreational use or shellfish harvesting would not be safe as a designated use for the region.¹²⁷ The Florida Department of Health does not currently test for *Vibrio vulnificus* as part of the Florida Healthy Beaches Program because the bacteria is natural to the marine environment,¹²⁸ and the bacteria is not regulated via the water quality criteria for the state.¹²⁹ However, *Vibrio vulnificus* often causes the same type of harm as the pathogens¹³⁰ for which the Program currently tests to preserve human health and public safety in shellfish consumption and coastal recreational activities. The failure to test for *Vibrio vulnificus* may cause these numbers to be unrepresentative of the risk associated with these activities.

Vibrio vulnificus could be added to the list of water quality standards in Florida by the Water Quality Standards Program (WQSP), administered by the Florida Department of Environmental Protection.¹³¹ The WQSP reviews, establishes, and revises the state’s water quality standards.¹³² These tasks are

314 REPORT AND LISTING UPDATE 1 (Apr. 2014), available at http://www.dep.state.fl.us/water/docs/2014_integrated_report.pdf (referring to designated uses as anything from recreation to shellfish harvesting).

¹²⁶ *Id.* at 3 (noting that only sampled waters listed as a category five are considered to be impaired, meaning that the sample shows that “at least one designated use is not being supported or is threatened”).

¹²⁷ *Id.* at 25 (“[P]rimary contact and recreation use support and shellfish harvesting use support are sometimes limited by the presence of bacteria in the water column”). *Contra Testing the Waters 2014*, NATURAL RES. DEFENSE COUNCIL, <http://www.nrdc.org/water/oceans/ttw/fl.asp> (last updated June 2, 2014) (using a more stringent enterococci level notification requirement recommended by the EPA, this study reflected that ten percent of Florida beaches would be considered impaired due to bacteria levels).

¹²⁸ *Our Gulf Environment*, FLA. DEP’T OF HEALTH IN SARASOTA COUNTY, <https://ourgulfenvironment.scgov.net/Pages/Bacteria.aspx> (last visited Apr. 17, 2015).

¹²⁹ As noted by the absence of *Vibrio vulnificus* on the table delineating water quality criteria for Florida. FLA. ADMIN. CODE ANN. § 62-302.530.

¹³⁰ *Our Gulf Environment*, *supra* note 128 (“When . . . enteric bacteria are detected in high concentrations in recreational waters, there is a risk of illness and infections. Some people who swallow water while swimming or have contact with water entering the skin through a cut or sore may become ill with gastrointestinal illnesses, infections or rashes.”).

¹³¹ *Water Quality Standards Program*, FLA. DEP’T OF ENVTL. PROTECTION, <http://www.dep.state.fl.us/water/sas/> (last updated Aug. 25, 2015).

¹³² *Id.*

carried out by the Standards Development Section (SDS) of the WQSP, which conducts triennial reviews of Florida's surface water quality standards and proposes revisions to these rules.¹³³ The SDS considers the economic impact of a revision to the water quality standards, gives public workshops on the proposed revision, and allows a period for public comment on the potential revision.¹³⁴ The revisions, once adopted and certified by the state, must then be approved by the EPA.¹³⁵ Florida could utilize this process, coupled with its ability to enact more stringent water quality standards, to regulate environmental bacteria like *Vibrio vulnificus*.

*B. Federal and State Regulations on the Harvesting of Gulf Coast Oysters and *Vibrio Vulnificus**

Shellfish are invaluable to the economy of Florida, bringing in over \$20 million annually and employing over 2,500 people.¹³⁶ Reflecting this value are the extensive laws, regulations, and agencies in place to monitor the harvesting and processing of shellfish items, including oysters. The NSSP is the primary source of guidelines for state regulation of shellfish procedures, and it establishes the minimum necessary requirements for such regulation, as well as the protection of the public health of consumers.¹³⁷ The Program's guidelines for harvesting procedures, outbreaks of shellfish-related illnesses, and the *Vibrio Vulnificus*

¹³³ *Surface Water Quality Standards*, FLA. DEP'T OF ENVTL. PROTECTION, <http://www.dep.state.fl.us/water/wqssp/index.htm> (last updated July 2, 2015). Triennial reviews are required by federal law. 40 C.F.R. § 131.20(a).

¹³⁴ FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION, PUBLIC WORKSHOPS FOR FLORIDA'S TRIENNIAL REVIEW OF WATER QUALITY STANDARDS 4-8 (Sept. 2015). Public participation in water quality revisions is required by the EPA under federal law. See 40 C.F.R. § 131.20(b).

¹³⁵ 40 C.F.R. § 131.20(c).

¹³⁶ *Shellfish: A Valuable and Renewable Natural Resource*, FLA. DEP'T OF AGRIC. & CONSUMER SERVICES, <http://www.freshfromflorida.com/Divisions-Offices/Aquaculture/Agriculture-Industry/Shellfish> (last visited Apr. 17, 2015) (classifying as shellfish only oysters, mussels, and clams).

¹³⁷ NAT'L SHELLFISH SANITATION PROGRAM, GUIDE FOR THE CONTROL OF MOLLUSCAN SHELLFISH 2013 REVISION 10-11 (2013), available at <http://www.fda.gov/downloads/Food/GuidanceRegulation/FederalStateFoodPrograms/UCM415522.pdf> ("Participants in the NSSP include agencies from shellfish producing and non-producing States, FDA, EPA, NOAA, and the shellfish industry. Under international agreements with FDA, foreign governments also participate in the NSSP.").

Control Plan are all important for the Florida Gulf coast's oysters.¹³⁸ Some portions of the NSSP guidelines are mandatory for states, even if the state does not formally adopt all provisions in its regulation of shellfish.¹³⁹

The NSSP guidelines require that surveys are taken of the water quality in oyster-growing areas prior to the harvesting of any oysters for human consumption. The survey is then used to classify the growing area as approved or restricted.¹⁴⁰ In Florida, the Shellfish Harvesting Program, administered by the Florida Department of Agriculture and Consumer Services,¹⁴¹ is responsible for undertaking this process¹⁴² and subsequently giving growing areas status classifications—either open, closed, or inactive for purposes of harvesting—based on the presence of bacteria or pathogens in the waters.¹⁴³ All states are required to ensure that oysters and other shellfish are only harvested from those areas classified as open, or with approval in areas classified as prohibited, restricted, or conditionally restricted.¹⁴⁴ The NSSP guidelines require states to monitor and enforce approved harvesting practices by patrolling growing areas, licensing shellfish harvesters, identifying areas where harvesting is not permitted, and assessing penalties against those who do not comply with harvesting regulations.¹⁴⁵

¹³⁸ See generally *id.*

¹³⁹ *Id.* at 39 (including the sanitary standards for shellfish growing areas as a mandatory provision for compliance).

¹⁴⁰ *Id.* (noting that growing areas can receive one of the following statuses based on the sanitation survey, “approved, conditionally approved, restricted or conditionally restricted,” based on levels of fecal coliform bacteria).

¹⁴¹ *Division of Aquaculture, FLA. DEP’T OF AGRIC. & CONSUMER SERVICES,* <http://www.freshfromflorida.com/Divisions-Offices/Aquaculture> (last visited Jan. 24, 2016).

¹⁴² *FLA. DEP’T OF ENVTL. PROTECTION, supra* note 124, at 7.

¹⁴³ Open status growing areas may be harvested subject to the approved, conditionally approved, or conditionally restricted classification that it may be assigned. Closed status growing areas may obtain this designation temporarily due to emergency circumstances, the presence of pathogens that are dangerous to the public health, or failure to conduct a survey. Inactive growing areas are those where harvesting no longer occurs, and these areas will be closed. *NAT’L SHELLFISH SANITATION PROGRAM, supra* note 137, at 45.

¹⁴⁴ *Id.* at 66-71.

¹⁴⁵ *Id.* (noting that licensing of shellfish harvesters is required only for those involved in commercial harvest and requires that “the harvester [] sell only to dealers listed on the Interstate Certified Shellfish Shippers List,” and that the state is required to “chart, describe, and mark the boundaries of growing areas classified as restricted, conditionally restricted, or prohibited, or in a closed status,” with fixed objects, landmarks, or easily recognizable descriptions).

As a member of the ISSC, Florida implements the NSSP-required classification and management regulations via the Shellfish Environmental Assessment Section (SEAS) of the Department of Agriculture and Consumer Services, which samples coastal waters using fecal coliform bacteria as indicator pathogens for those that would be considered dangerous to human health.¹⁴⁶ The state codified the NSSP's regulations for oyster harvesting areas in its Administrative Code in 2006, delineating the approved methods for classifying these areas.¹⁴⁷ Florida law requires, as of July 2015, that those commercially harvesting oysters have a special designation on their valid saltwater products license, which shall be earned after completing an approved shellfish harvesting course.¹⁴⁸

The NSSP guidelines extend beyond regulating oyster harvesting and set standards for shellfish-related illness outbreaks.¹⁴⁹ The Program's guidelines require any state in which two or more individuals contract an oyster-implicated illness to review the stricken individual's food history, handling practices, and symptoms to determine if the illness was, in fact, caused by shellfish.¹⁵⁰ If the illness was caused by consuming oysters, and it is clear that the contamination of the oyster occurred before it was harvested, the state must declare the harvesting area closed, notify any receiving states, the ISSC, and the FDA that there is a health risk with oysters cultivated from that region, and initiate recall procedures, including all products possibly contaminated before harvesting.¹⁵¹ If the oyster contamination was the result of a naturally occurring pathogen, the area will remain closed until it is ascertained that the pathogen is not a public health

¹⁴⁶ *Shellfish*, *supra* note 136 (describing SEAS, a division of the Bureau of Aquaculture Environmental Services, as being located in Tallahassee and responsible for “the 1,200 bacteriological sampling stations in 39 shellfish harvesting areas, encompassing 1,430,854 acres”).

¹⁴⁷ FLA. ADMIN. CODE ANN. § 5L-1.003.

¹⁴⁸ *Id.* § 68B-27.018 (excepting from the special designation requirement for harvesting those that have a valid Apalachicola Bay oyster harvesting license as well as a valid saltwater products license).

¹⁴⁹ NAT'L SHELLFISH SANITATION PROGRAM, *supra* note 137, at 23 (noting once more that states must comply with this provision regardless of whether it has been codified by the state).

¹⁵⁰ *Id.*

¹⁵¹ *Id.* (requiring the harvesting area be closed only if the contamination of the oyster occurred prior to harvesting; post-harvesting contamination only requires the notification stated above and a possible voluntary recall).

concern.¹⁵² The NSSP guidelines specifically regulate Vibrio illnesses as they relate to shellfish production, requiring states to record annually the number of Vibrio illnesses relating to shellfish consumption.¹⁵³

The NSSP mandated a *Vibrio vulnificus* Control Plan in 2012 for those states reporting two or more septicemia illnesses reportedly linked to the bacteria via consumption of raw or undercooked shellfish.¹⁵⁴ The Control Plan requires these states to evaluate the risk of the bacteria annually to consider the seasonality of outbreaks, number of illness cases associated with the consumption of commercially harvested shellfish, and levels of the bacteria growing in the water.¹⁵⁵ The Plan further requires the state to identify triggers affecting risks of the bacteria¹⁵⁶ and implement control measures to reduce the risk of illnesses.¹⁵⁷ Florida implements the required *Vibrio vulnificus* Control Plan by requiring the shellfish industry to follow a “rigid time-temperature matrix” involving timely deliveries and refrigeration of raw oysters.¹⁵⁸ Florida also regulates the seasons in which oysters may be harvested on a regional basis, putting a general moratorium on harvesting oysters from the first of July to the thirtieth of September each year,

¹⁵² *Id.* at 24.

¹⁵³ *Id.* at 26 (applying to both *Vibrio vulnificus* and its less violent sibling, *Vibrio parahaemolyticus*).

¹⁵⁴ *Id.* at 29.

¹⁵⁵ NAT’L SHELLFISH SANITATION PROGRAM, *supra* note 137, at 29.

¹⁵⁶ The state may choose one or more of the following triggers, as listed by the NSSP guideline: area water temperatures, air temperatures, salinity, harvesting techniques, or other factors that would indicate a risk. *Id.*

¹⁵⁷ *Id.* at 29-31 (requiring a state to employ one or more of the following measures to reduce the risk of illness associated with *Vibrio vulnificus*: labeling oysters with a warning that shucking should be conducted by a certified dealer when the water temperature exceeds seventy degrees Fahrenheit; requiring all oysters intended for the raw market to undergo approved post-harvest processing when the water temperature exceeds seventy degrees Fahrenheit; reducing the time the oysters are exposed to open air; or alternative controls the state may deem fit).

¹⁵⁸ Florida Department of Agriculture and Consumer Services, *Interstate Shellfish Sanitation Conference Yields Regulatory Changes*, 87 FLA. AQUACULTURE 1, 3 (Feb. 2014) (requiring refrigeration of the shellfish). From May to July, oysters must be delivered to dealers by 11:30 AM, and from August to October, by noon. Oysters must be kept between fifty-five degrees and sixty-five degrees Fahrenheit depending on the cooling system employed. *See generally* FLA. ADMIN. CODE ANN. 5L-1.008 (explaining the time-temperature matrix).

making an exception for Apalachicola Bay,¹⁵⁹ where certain regions are deemed open for harvesting throughout the year.¹⁶⁰

In 2009, the FDA considered a ban on raw oysters from the Gulf Coast for eight months of every year, arguing this unilateral move as “necessary to protect public health” because *Vibrio vulnificus* sickens, on average, approximately thirty people each year.¹⁶¹ Presumably because of the economic impacts this would have on the industry, the FDA has since postponed the measure.¹⁶² This was a hotly contested proposal, with those involved in the shellfish industry and raw oyster lovers seeking to stop what they saw as a devastatingly restrictive measure.¹⁶³ On the other side of the battle are the family members, and in some cases, victims of *Vibrio vulnificus* illnesses associated with raw oyster consumption who see these recurring illnesses, and sometimes deaths, as entirely preventable.¹⁶⁴

Despite efforts to refrigerate shellfish to avoid bacteria growth and close oyster growing areas during the hottest summer months—though these closures are limited and many exceptions apply—individuals are still contracting the bacteria through the consumption of raw or undercooked oysters from the Gulf Coast, and reported cases of *Vibrio vulnificus* appear to be increasing.¹⁶⁵ Education and notification, which currently are the consumer’s responsibility,

¹⁵⁹ Approximately ninety percent of Florida’s oysters are produced in Apalachicola Bay. FLA. FISH & WILDLIFE CONSERVATION COMM’N, 2012-2013 FLA. GULF COAST OYSTER DISASTER REPORT (May 2013), *available at* http://www.sarasota.wateratlas.usf.edu/upload/documents/Florida_oyster_disaster_report-2013.pdf.

¹⁶⁰ FLA. ADMIN. CODE ANN. 68B-27.019.

¹⁶¹ Press Release, East Coast Shellfish Growers Association, U.S. FDA Ban on Raw Oysters Will Put Thousands of Gulf Coast Men and Women out of Work, and Threaten Other Regions (Oct. 22, 2009), *available at* http://www.ecsga.org/Pages/Issues/Human_Health/FDA_OysterBanPressRelease10-09.pdf.

¹⁶² *Id.* (arguing that the law would have perilous effects on the economy, given that the unemployment rate at the time was near ten percent).

¹⁶³ Gardiner Harris, *U.S. Plans Raw Warm-Water Oyster Ban*, N.Y. TIMES (Nov. 11, 2009), http://www.nytimes.com/2009/11/12/health/policy/12oyster.html?partner=rss&emc=rss&_r=0.

¹⁶⁴ *Id.* (reporting the statements of the daughter of a *Vibrio* victim: “They know that in 2010, 15 people will die like my father did even though there’s a surefire way to prevent that . . . [o]f course the F.D.A. should step in.”).

¹⁶⁵ Bross et al., *supra* note 39 (“*V. vulnificus* is one of the few foodborne illnesses with an increasing incidence.”).

appear to be the best strategy to avoid contracting the bacteria and its subsequent illnesses. While these regulations are a step in the right direction, taking this foundation a step further, as seen in the third part of this article discussing the California regulations, could potentially avoid the preventable illnesses induced by the *Vibrio* bacteria.

C. *Notification Requirements for Vibrio Vulnificus in Florida*

Keeping those at risk abreast of the presence of *Vibrio vulnificus* along their shores and in their food is an important step to reducing the reported cases of illness from the bacteria. A significant percentage of the population remains unaware of the risk posed by *Vibrio vulnificus*, or even the presence of the possibly lethal bacteria.¹⁶⁶ While consumers of raw oysters are provided some warning, beachgoers need to know where to look to find notification of bacteria in the waters they intend to enjoy.

1. Beach Warnings and Advisories

Because Florida does not test specifically for the presence of *Vibrio vulnificus* along its coasts, there is no advance warning or advisory system for this particular bacteria.¹⁶⁷ The public often receives notice of the bacteria after an outbreak of associated illness is reported, and the warnings are generally proliferated through the local media where the outbreak occurred.¹⁶⁸ Though public warnings for *Vibrio* are not required, both federal and state regulations do require notification of other bacteria lurking along the coast, and amending these to apply to *Vibrio vulnificus* could solve the problem of lack of notification. As a starting point, the BEACH Act provides for mandatory, “prompt notification of the public [and] local governments” of excess or likely excess of water quality

¹⁶⁶ *Enjoy the Water*, *supra* note 28.

¹⁶⁷ *Florida Healthy Beaches Program*, *supra* note 122.

¹⁶⁸ See generally Skrzypek, *supra* note 32; Mary Beth Quirk, *Gulf Coast Health Officials Warning Swimmers After Flesh-Eating Bacteria Kills 10, Hospitalizes 32*, CONSUMERIST (July 30, 2014), <http://consumerist.com/2014/07/30/gulf-coast-health-officials-warning-swimmers-after-flesh-eating-bacteria-kills-10-hospitalizes-32/>; *Flesh-Eating Bacteria Kills 10th Victim in Florida*, SPACE COAST DAILY (July 30, 2014), <http://spacecoastdaily.com/2014/07/flesh-eating-bacteria-kills-10th-victim-in-florida/>.

standards in recreational waters.¹⁶⁹ The BEACH Act also requires those states that receive a federal grant under the Act to report data collected on water quality and measures taken to notify the public when water quality standards are not met.¹⁷⁰

The Florida legislature has codified the authority of the Department of Health to issue public warnings or advisories regarding water quality, specifically when coastal or intracoastal waters exceed bacterial standards.¹⁷¹ The law requires that when a public health advisory is issued warning against swimming in coastal waters due to elevated levels of bacteria, the issuing authority must also notify the local county or municipality, as well as the local Department of Environmental Protection, of the advisory.¹⁷² The Florida Healthy Beaches Program (FHPB) was given authority, under the statute, to monitor coastal waters and issue advisories when the waters exceed given standards; the data and advisories are then posted to the Beach Advisory and Closing On-Line Notification (BEACON) system on the FHPB website.¹⁷³ When the FHPB samples coastal waters and enterococci bacteria are elevated, it issues an “advisory”, and when fecal coliform levels are elevated, the Program issues a “warning.”¹⁷⁴

The issuing of public health advisories or warnings is conducted by county health departments, which then report these matters to local officials and the State Health office and may resample the monitored areas for the conditions requiring the advisories and/or warnings.¹⁷⁵ Public notification is conducted by the county health departments via three methods: notifying the media; posting sampling results and advisory data on the county FHPB website or the county’s Department of Health website; and posting signs at the failing sample location on the beach

¹⁶⁹ 33 U.S.C. § 1346(a)(1)(B).

¹⁷⁰ *Id.* § 1346(b)(3)(A).

¹⁷¹ FLA. STAT. § 514.023(1)-(3) (“The department may adopt and enforce rules to protect the health, safety, and welfare of persons using the beach waters and public bathing places of the state.”).

¹⁷² *Id.* § 514.023(4) (stating that the local Department of Environmental Protection is then required to investigate the occurrence and possible causes).

¹⁷³ Bart Bibler, Chief, Bureau of Water Programs, Florida Health Beaches Program 2-7 (2005), available at http://coastalconference.org/h20_2005/pdf/2005/2005_10-26-Wednesday/Session_1B-Beach_Water_Quality/Bibler-Floridas_Healthy_Beaches_Program.pdf.

¹⁷⁴ *Id.* at 14.

¹⁷⁵ *Id.* at 16 (basing type of public notification on type of bacteria).

and at points of public beach access nearby.¹⁷⁶ These are measures that could be easily adapted to warn the public of the risks of *Vibrio vulnificus* and help reduce the amount of *Vibrio*-related wound infections.

2. Raw Oyster Consumer Advisories

Due to the higher incidence and fatality rates of *Vibrio vulnificus* as contracted through raw oysters,¹⁷⁷ more direct means of public notification exist to warn would-be consumers and high-risk individuals of the dangers of eating raw shellfish. The NSSP guidelines require states to notify “receiving states, the ISSC and the FDA Regional Shellfish Specialist” of a potential health risk associated with oysters when there has been an illness outbreak of two or more individuals related to oyster consumption.¹⁷⁸ Should a recall of the oyster product be deemed necessary, the guidelines suggest the state “issue public warnings if necessary to protect public health.”¹⁷⁹ Under the guidelines, the FDA also has the authority to determine that public warning is necessary, and if the state fails to implement effective warning measures, the FDA can issue public warnings “when appropriate.”¹⁸⁰ The NSSP has stressed the importance of public warnings of shellfish-related illness as being foundational to protecting public consumers from shellfish that may be harboring bacteria.¹⁸¹ The NSSP has required states with two or more reported cases of *Vibrio vulnificus* from oysters to implement a “*Vibrio vulnificus* Risk Management Plan,” with consumer education being a primary, mandatory element of the state’s plan.¹⁸²

¹⁷⁶ *Id.* at 17 (picturing the issued advisory, which reads: “ADVISORY: HIGH BACTERIAL LEVELS HEALTH RISK AT THIS TIME SWIMMING NOT RECOMMENDED”).

¹⁷⁷ *Enjoy the Water*, *supra* note 28 (“According to FDA, 90% of all *Vibrio vulnificus* illnesses (mortalities and mortalities) in the U.S. result from consumption of raw Gulf coast oysters.”).

¹⁷⁸ NAT’L SHELLFISH SANITATION PROGRAM, *supra* note 137, at 23.

¹⁷⁹ *Id.* at 24.

¹⁸⁰ *Id.*

¹⁸¹ *Id.* at 151 (“Documentation of the information supporting growing area classification, proper tagging and record keeping, expeditious follow-up on reported illnesses, effective recall of implicated product and public warning announcements are all requisite to protecting public health.”).

¹⁸² Flattery & Bashin, *supra* note 96, at 1 (reporting the main criteria for success for such state plans as the increase of consumer awareness by forty percent and the proportion of consumers who are at high-risk for illness who stop eating raw oysters by fifteen percent).

Florida's plan to reduce the risk of *Vibrio vulnificus* for raw oysters lists consumer education as its primary and most important tool in reducing shellfish illnesses.¹⁸³ Other than brochures and media exposure, one important way Florida has decided to educate and warn consumers of the risks of raw oysters is through outreach programs,¹⁸⁴ mainly educational workshops conducted by the state with the help and funding of the ISSC.¹⁸⁵ In the past, workshops were conducted by the state and the ISSC for food handlers and inspectors at the retail level,¹⁸⁶ as well as with healthcare providers, an important link in the education scheme for at-risk individuals, in order to better educate these officials on the risks and recommendations for dealing with *Vibrio*.¹⁸⁷ These presentations recommend that healthcare providers urge individuals considered at risk to avoid eating raw oysters, and if they are going to eat any shellfish, to make sure it is thoroughly cooked or to eat those items that have been treated post-harvest to reduce *Vibrio* risks.¹⁸⁸ The programs also endeavor to acquaint healthcare providers with the symptoms of *Vibrio* illnesses, as timely treatment is important to saving lives and limbs.¹⁸⁹ Florida also holds conferences to distribute *Vibrio vulnificus* informational items and provides pamphlets to liver disease support groups, a group that has a higher risk of contracting a *Vibrio* illness.¹⁹⁰

The most beneficial aspect of consumer warning is the mandatory consumer advisories for Gulf shellfish. Florida has required any restaurant serving

¹⁸³ William Huth et al., ISSC Vibrio Education Subcommittee, Oyster Demand Adjustments to Alternative Consumer Education and Post Harvest Processes in Response to *Vibrio Vulnificus* (May 5, 2009), available at http://www.issc.org/client_resources/huth-martin%20issc%20presentation%205-5-2009.pdf.

¹⁸⁴ See generally Roberta M. Hammond, Food and Waterborne Disease Coordinator, Bureau of Environmental Epidemiology, *Vibrio Vulnificus: A Health Professional's Guide to Infection, Prevention, and Treatment* (2005), available at <http://fycs.ifas.ufl.edu/foodsafety/2005/adobe/vv%20health%20care%202004.pdf>.

¹⁸⁵ INTERSTATE SHELLFISH SANITATION CONFERENCE, COOPERATIVE AGREEMENT # MX-97417201-0 "EDUCATING THE AT-RISK CONSUMER" 3 (2005), available at http://www.issc.org/client_resources/publications/educatingtheatriskconsumerfinalreport.pdf.

¹⁸⁶ *Id.* at 4.

¹⁸⁷ Hammond, *supra* note 184, at 28.

¹⁸⁸ *Id.* at 39.

¹⁸⁹ *Id.* at 18.

¹⁹⁰ *Id.* at 40.

raw oysters to post or display on the menu, a visible placard, or other viable location, the following consumer advisory warning:

Consumer Information: There is risk associated with consuming raw oysters. If you have chronic illness of the liver, stomach or blood or have immune disorders, you are at greater risk of serious illness from raw oysters, and should eat oysters fully cooked. If unsure of your risk, consult a physician.¹⁹¹

This same label is required to be placed on all containers of fresh, raw shellfish that leave packing or processing plants.¹⁹² Even with these measures, each year a greater number of individuals contract the bacteria through consumption. The following section delineates exactly how more stringent regulation could prevent such illnesses by using recent California regulations as a model of effective means of combatting *Vibrio vulnificus*.

IV. CALIFORNIA'S MODEL FOR REGULATION OF RAW OYSTERS TO PREVENT ILLNESS AND INFECTION

Vibrio vulnificus has a presence far greater than the coasts of Florida, as the bacteria touches any area unfortunate enough to get a shipment of oysters from the Gulf of Mexico that are contaminated with the bacteria. In a seven-year study from 2001 to 2008, California reported 828 cases of Vibriosis—though only a few of these were caused by *Vibrio vulnificus*, as California suffers from a high incidence rate of *Vibrio parahaemolyticus*.¹⁹³ However, in 2003, after two years of increased *Vibrio vulnificus* cases that resulted in sixteen infections and ten deaths despite increased education measures highlighting the risk of consuming

¹⁹¹ FLA. ADMIN. CODE ANN. § 61C-4.010.

¹⁹² § 5L-1.007(9).

¹⁹³ DIANA S. DOOLEY & RONALD W. CHAPMAN, CAL. DEP'T OF PUBLIC HEALTH, EPIDEMIOLOGIC SUMMARY OF NON-CHOLERA VIBRIOSIS IN CALIFORNIA, 2001-2008 71-72 (2011), available at <http://www.cdph.ca.gov/programs/ssss/Documents/Epi-Summaries-CA-2001-2008-083111.pdf#page=73> ("*V. parahaemolyticus* infection causes acute gastroenteritis with fever that usually occurs after an incubation period of 24 hours. Symptoms usually last 1 to 7 days and are often self-limited.").

raw oysters, California decided to pass unprecedented regulation on the sale of oysters harvested in the Gulf of Mexico from April to October.¹⁹⁴

California's 2003 legislation dramatically restricted the sale of raw oysters from Alabama, Florida, Louisiana, Mississippi, and Texas, the states considered to produce "Gulf oysters."¹⁹⁵ California requires dealers of raw oyster products to refuse those containers of oysters coming from the Gulf states that have not been clearly labeled with harvest location and date.¹⁹⁶ The regulation also requires any raw oysters coming from the Gulf States to be "subjected to an oyster treatment process;" in the event they are not, the oysters must be cooked before being consumed.¹⁹⁷ The FDA has approved several treatment methods for reducing or eliminating *Vibrio vulnificus* from raw oysters, including: "low-temperature pasteurization, high-pressure processing, and irradiation."¹⁹⁸ The regulations take these precautions one step further and require dealers or restaurants offering raw oysters to refuse Gulf oysters that were harvested from April through October altogether.¹⁹⁹ Such oysters are deemed by California law to be adulterated unless they are properly treated and consistently labeled, and the seller of the raw oyster must have paperwork verifying the oysters were treated.²⁰⁰

Part of California's 2003 Gulf oyster legislation involved warning potential consumers of the risks associated with enjoying raw oysters, tailoring the warning to at-risk groups, including those suffering from illness of the liver, cancer, and chronic immune illnesses.²⁰¹ The law regulates, in depth, how this

¹⁹⁴ Gitika Panicker, Michael L. Myers & Asim K. Bej, *Rapid Detection of Vibrio Vulnificus in Shellfish and Gulf of Mexico Water by Real-Time PCR*, 70 APPLIED & ENVTL. MICROBIOLOGY 498, 506 (2004).

¹⁹⁵ CAL. CODE REGS. tit. 17, § 13675(a)(2).

¹⁹⁶ *Id.* § 13675(c)(1)-(3)(C).

¹⁹⁷ *Id.* § 13675(c)(3)(D) (requiring oysters to be treated in such a manner as to reduce the level of *Vibrio vulnificus* to an undetectable level).

¹⁹⁸ Daniels, *supra* note 59, at 791.

¹⁹⁹ CAL. CODE REGS. tit. 17, § 13675(c)(5).

²⁰⁰ *Id.* § 13675(c)(5)(A)-(B).

²⁰¹ *Id.* § 13675(b)(1) ("WARNING: THIS FACILITY OFFERS RAW OYSTERS FROM THE GULF OF MEXICO. EATING THESE OYSTERS MAY CAUSE SEVERE ILLNESS AND EVEN DEATH IN PERSONS WHO HAVE LIVER DISEASE (FOR EXAMPLE ALCOHOLIC CIRRHOSES), CANCER OR OTHER CHRONIC ILLNESSES THAT WEAKEN THE

warning should be provided to the public, requiring a written warning to any person ordering raw oysters, worded in English and Spanish and prominently placed so that potential consumers can easily see the sign prior to finalizing their order.²⁰² The law delineates the size, coloring, spacing, and font of the warning that must be displayed for raw oysters purchased over the counter.²⁰³ The regulation also requires restaurants serving oysters to have the warning printed on all of the menus listing oysters as available for purchase or, in the alternative, on “tent cards” on the dining tables in the establishment.²⁰⁴

A survey conducted approximately a decade after California enacted this legislation studied the effect of the regulations on reported cases of illness and death resulting from *Vibrio vulnificus*.²⁰⁵ The study showed that the number of reported cases of *Vibrio vulnificus* fell from fifty-seven in the years from 1991 to 2002, to four during 2003 through 2010.²⁰⁶ There was also a marked drop in *Vibrio vulnificus* deaths after the regulation, from thirty-eight in the years preceding the legislation to one in the seven-year period after the enactment of the strict regulations.²⁰⁷ The survey credited the success in combatting *Vibrio vulnificus* to the 2003 regulations, attributing many cases of the illness to raw oysters and effectively showing a reduction—and near elimination—of reported

IMMUNE SYSTEM. If you eat raw oysters and become ill, you should seek immediate medical attention. If you are unsure if you are at risk, you should consult your physician.”).

²⁰² *Id.* § 13675(b)(1)-(2).

²⁰³ *Id.* § 13675(b)(2)(A)-(E) (requiring that the sign be a square that is at least ten inches on each side or a rectangle that measures at least 11 inches high and 8.5 inches wide; the sign has to be printed in contrasting colors with at least one third of an inch of space on each side of the notice; “warning” must be in all bold, upper case letters, underlined, and no smaller than a 35 point font; the first two sentences of the issued warning must be bolded and at least size 30 font type).

²⁰⁴ *Id.* § 13675(b)(3) (allowing warnings on menus to be shortened to the first two sentences, but still requiring the portion of the warning that addresses those individuals at a higher risk of illness subsequent to consuming raw oysters).

²⁰⁵ Duc J. Vugia et al., *Impact of 2003 State Regulation on Raw Oyster-Associated Vibrio Vulnificus Illnesses and Deaths, California, USA*, 19 EMERGING INFECTIOUS DISEASES 1276, 1276 (Aug. 2013), available at <http://wwwnc.cdc.gov/eid/article/19/8/pdfs/12-1861.pdf>.

²⁰⁶ *Id.* at 1278 (“The median annual number of cases dropped from 5.5 (range 1–9; total 57 cases) during 1991–2002, before implementation, to 0 (range, 0–2; total 4 cases) during 2003–2010, after implementation of the 2003 regulation.”).

²⁰⁷ *Id.*

cases.²⁰⁸ The survey did not, however, reflect a significant change in the number of people consuming raw oysters that were available in the state.²⁰⁹ The success of this California legislation was used as an example by officials proposing a similar federal ban in 2009.²¹⁰ According to a California public health official, “[a] similar regulation to restrict the sale of raw summer-harvested Gulf Coast oysters to those treated by postharvest processing, if implemented in Florida, would likely decrease *V. vulnificus* illnesses and deaths due to eating unprocessed raw oysters.”²¹¹

V. PROPOSAL TO ENHANCE THE HEALTH SAFETY OF BEACHGOERS AND RAW OYSTER CONSUMERS

With sea temperatures on the rise and Vibrio vulnificus on the prowl, the state of Florida faces increased risks of the bacteria along its Gulf Coast as these warm, clear waters are heavily used by the public for swimming and recreational purposes and raw oysters are still a popular food item in many restaurants. This risk is not isolated to the Gulf coast, but stretches to all of Florida’s coastlines, as the bacteria crops up in new locales and infects many along the Atlantic coastline of Florida as well. And with over one thousand miles of coastline²¹² and a profitable oyster industry,²¹³ Florida’s pull on tourists and residents alike creates a large potential for Vibrio vulnificus outbreaks and a great need for heightened public awareness of the bacteria.

²⁰⁸ *Id.* (“The data strongly suggest that the dramatic and sustained drop in reported raw oyster-associated *V. vulnificus* illnesses and deaths in California was related to the 2003 California regulation that restricts the sale of raw oysters harvested from the Gulf Coast during the 7 warmest months to oysters treated with postharvest processing.”).

²⁰⁹ *Id.*

²¹⁰ Lyndsey Layton, *Industry, FDA at Odds on Raw Oysters*, WASH. POST (Nov. 10, 2009), <http://www.washingtonpost.com/wp-dyn/content/article/2009/11/09/AR2009110903339.html>.

²¹¹ *Id.* (according to the chief of the Infectious Diseases Branch at the California Department of Public Health).

²¹² Florida has nearly 1,350 miles of coastline. U.S. CENSUS BUREAU, STATISTICAL ABSTRACT OF THE UNITED STATES: 2012 225 (2012).

²¹³ “Apalachicola Bay produces 90% of Florida’s oysters and 10% of the nationwide supply. Over 2.6 million pounds of oyster meat is harvested annually.” *Apalachicola’s Fresh Local Seafood*, APALACHICOLA BAY, <http://www.apalachicolabay.org/index.cfm/pageid/101/fuseaction/chamber.categorydisplay> (last visited Apr. 17, 2015).

The legal framework discussed above, while not directly addressing the looming problem of *Vibrio vulnificus* along Florida's coasts and nestled in the state's oyster beds, is a foundational step in the right direction to address the health and safety concerns that the bacteria poses to the public. The federally mandated bacteria testing, as applied by the state, can be tweaked to address the concerns of environmental bacteria as it affects coastal water quality. There can be more stringent enforcement of oyster bed closings in peak *Vibrio vulnificus* months to reduce the risk of contaminated shellfish reaching the dinner plates of the unaware or risk-taking consumer. More importantly, the public can be made more aware, and the state can take further steps in educating and notifying the public, as to the dangers of *Vibrio vulnificus* and the times at which they are most likely to come into contact with the illness.

*A. Addition of *Vibrio Vulnificus* to Bacteria Criteria for Water Quality and Subsequent Testing*

Federal and state laws already provide a framework for the regulation of water quality, but these criteria focus solely on pollutants found in coastal waters. Bacteria criteria are leveled at enteric bacteria²¹⁴ that are found in waters due to sources of pollution like run-off, discharge, or waste that finds its way into coastal waters. The previously mentioned deficiency in the current bacteria water quality standards is that state regulations do not require the monitoring of coastal waters for environmental bacteria, such as the naturally occurring *Vibrio* bacteria. This flaw could be remedied by a requirement that the elevated presence of environmental bacteria be considered by the SDS and listed as a criteria for water quality and for subsequent testing. This addition would require little change to the current laws, as the general framework is already provided and water quality already regulated to protect the health of those who partake in the recreational opportunities along Florida's miles of coasts.

²¹⁴ The federal and state governments mandate testing only for fecal bacteria, like coliform and enterococci bacteria, as a sign that waters are bacterially impaired. FLA. DEP'T OF ENVTL. PROTECTION, *supra* note 124, at 13.

Should legislation be too time consuming or cumbersome to pass, it is also possible to amend the FHPB's protocol to include testing for *Vibrio vulnificus*. The FHPB's explanation for not testing for the presence of *Vibrio vulnificus* in recreational coastal waters is that the process is too "difficult and costly."²¹⁵ However, new methods to test for *Vibrio vulnificus* are being studied that make distinguishing between *Vibrio* and other naturally present environmental bacteria more affordable and accessible.²¹⁶ Recently, methods have been studied to test for *Vibrio* in both coastal waters and oysters that would be "rapid, reliable, and cost-effective."²¹⁷ This method uses a fluorescent dye that has worked well for other bacteria to achieve test results in under eight hours for both water and oyster samples, a marked improvement from former processes that took three to four days to produce results for *Vibrio vulnificus* tests.²¹⁸ This process has so enhanced the testing procedures for *Vibrio vulnificus* that commercial tests for the bacteria are now available and can produce results within twenty-four hours.²¹⁹

Further, since the peak seasons for *Vibrio vulnificus* are widely known, testing weekly or bi-weekly the whole year round, as the FHPB currently requires for fecal bacteria found in the coast via pollutants, would not be necessary. "Rapid detection of [Vibrio vulnificus] in consumable oysters and in coastal water, especially in and around approved oyster-harvesting sites . . . would help reduce the incidence of illness and fatality that result from ingestion of raw shellfish or from exposure to coastal water."²²⁰ This proposed testing would provide the state of Florida advance warning of *Vibrio vulnificus* both in its popular coastal waters and oyster harvesting regions, thus enabling the state to

²¹⁵ Bibler, *supra* note 173, at 9.

²¹⁶ Several decades ago, the process of isolating *Vibrio vulnificus* from other naturally occurring flora and bacteria in the ocean incorporated Colistin-Polymyxin B-Cellobiose agar (CPC agar), a form of antibiotics. James D. Oliver et al., *Use of Colistin-Polymyxin B-Cellobiose Agar for Isolation of Vibrio vulnificus from the Environment*, 58 APPLIED & ENVIRONMENTAL MICROBIOLOGY 737, 738 (1992).

²¹⁷ Panicker, Myers & Bej, *supra* note 194, at 506.

²¹⁸ *Id.*

²¹⁹ *Vibrio sp. Detection and Identification in Foods*, RAPIDMICROBIOLOGY, <http://www.rapidmicrobiology.com/test-method/detection-and-identification-of-vibrio-species-in-food/> (last visited Apr. 17, 2015) ("An example of a commercially available PCR-based method for pathogenic *Vibrio* detection is the BAX® System Real-Time PCR Assay . . . [which is] able to detect the three most important species, *V. cholerae*, *V. parahaemolyticus* and *V. vulnificus* . . .").

²²⁰ *Id.*

prevent illness by detecting contaminated batches of oysters before they hit the hands of consumers.

*B. Restricting the Sale of Raw Oysters During Peak *Vibrio Vulnificus* Seasons – Applying the California Model*

Florida's battle with *Vibrio vulnificus* appears to be intensifying, with more reported cases each year. California implemented its strict raw oyster legislation after battling sixteen cases and ten deaths resulting from *Vibrio vulnificus* outbreaks in a span of two years,²²¹ but these numbers closely resemble the statistics for one year of reported cases of the bacteria and resulting illnesses in Florida.²²² As the oceans warm and bacteria populations grow, the state of Florida should consider maximizing the protection of public health by enacting stronger oyster protection legislation pursuant to the precautionary principle discussed previously. With some laws already in place, Florida could easily amend this legislation or enact new regulations, possibly following the California model that has markedly reduced reported cases of infection and death at the hands of *Vibrio vulnificus*. While the NSSP guidelines are the primary source and inspiration for Florida's shellfish regulation, the guidelines are meant to establish only the minimum necessary requirements for the protection of consumers.²²³

Florida has already established the Shellfish Harvesting Program to monitor water quality in and around oyster beds, but the program currently uses fecal bacteria as indicators for dangerous pathogens.²²⁴ Florida should consider adding *Vibrio vulnificus* bacteria as a criteria for water quality, which would trigger testing for its presence in harvesting areas, in order to prevent potential illnesses before the oysters even leave the bays. Advancements in testing protocols²²⁵ for *Vibrio vulnificus* appear to have made it easier to isolate the bacteria from others that naturally occur in coastal waters, and the quick turn-

²²¹ Panicker, Myers & Bej, *supra* note 194, at 506.

²²² In 2008, Florida reported fifteen cases of infection and five deaths; in 2009, these values rose to twenty-four cases and seven deaths. In 2011, fatalities in Florida were at an all-time high, with thirty-five reported infections and thirteen deaths. *Information on Vibrio Vulnificus*, *supra* note 24.

²²³ NAT'L SHELLFISH SANITATION PROGRAM, *supra* note 137, at 10-11.

²²⁴ FLA. DEP'T OF ENVTL. PROTECTION, *supra* note 124, at 7.

²²⁵ Panicker, Myers & Bej, *supra* note 194, at 498.

around time for results would allow harvesting areas to be quickly classified as restricted or closed to prevent contaminated shellfish from reaching consumers. Mandating and implementing testing for *Vibrio vulnificus* specifically, and responding quickly to change the status of these harvesting areas would also allow Florida to more expediently and efficiently comply with, or even render unnecessary, NSSP's requirement that harvesting areas be closed, states warned, and recalls orchestrated after two or more cases of *Vibrio vulnificus*-associated illnesses have been discovered.²²⁶

Like California, Florida already regulates the seasons during which oysters can be harvested from certain areas. Unlike California, however, which requires the treatment or refusal of oysters from the Gulf of Mexico from April until the end of October,²²⁷ Florida only closes or conditionally allows harvesting from areas it considers at high risk for *Vibrio vulnificus* from July to the end of September.²²⁸ The CDC has noted that over eighty-five percent of *Vibrio vulnificus* cases are reported in the months between May and October.²²⁹ Florida's seasonal restrictions thus fail to include three months in which *Vibrio vulnificus* cases are known to peak, leaving a gap in the protection of consumer health. Adopting similar seasonal restriction months as California, perhaps from May to the end of October, to close or conditionally approve harvesting areas where populations of *Vibrio vulnificus* are known to peak, coupled with testing for the bacteria, would allow Florida to combat oyster-associated illness rates.²³⁰ Reported cases of the bacteria associated with the consumption of raw oysters in Florida could be dramatically reduced, if not eliminated, as shown in California.

Should Florida fail to be persuaded in extending seasonal restrictions to cover the full peak season of the bacteria, the state could also consider requiring post-harvest treatment of oysters pulled from at-risk areas. Like California, Florida could require FDA-approved post harvest treatments, including low-

²²⁶ NAT'L SHELLFISH SANITATION PROGRAM, *supra* note 137, at 23.

²²⁷ CAL. CODE REGS. tit. 17, § 13675(c)(5).

²²⁸ FLA. ADMIN. CODE ANN. 68B-27.019.

²²⁹ *Vibrio Vulnificus*, *supra* note 12.

²³⁰ Restricting or closely regulating oyster harvesting during the known peak seasons from May to October would be less restrictive than the eight-month total ban the FDA suggested placing on Gulf oysters in 2009. Press Release, *supra* note 161.

temperature pasteurization, and high-pressure processing.²³¹ These methods are accredited with reducing, if not eliminating entirely, the risk of the bacteria in oysters.²³² Post-harvest treatment would avoid the industry harm that has been associated with harvesting bans during extended seasonal periods.²³³ There are several paths Florida could take, following the example of California, in saving the lives and limbs of oyster consumers.

C. *Requiring Public Notification and Warnings During Peak Vibrio Vulnificus Seasons*

Important in implementing each of the aforementioned proposed courses of action is how Florida uses these methods to notify the public of the presence of *Vibrio vulnificus* in coastal waters and warn individuals of the risks associated with exposing open wounds to or ingesting the bacteria. Regulation coupled with public notification is key to successfully tackling the challenge that *Vibrio vulnificus* presents to the state. Adapting the legislation already in place to fit the demands of the *Vibrio* bacteria would allow Florida to make strides in the direction of increasing awareness and vigilance within the public realm to reduce illness.

1. Coast Posts – Tailoring Beach Advisories to *Vibrio Vulnificus*

The BEACH Act already requires,²³⁴ and Florida has in place,²³⁵ an existing procedure for public notification of bacteria levels in recreational coastal waters that exceed mandated water criteria standards. The current system, which involves notifying the media, posting the results of water samplings on county health department websites, and posting advisory signs on the beach where failing

²³¹ Daniels, *supra* note 59, at 791.

²³² *Id.*

²³³ Kevin Begos et. al., U.S. FDA BAN ON RAW OYSTERS WILL PUT THOUSANDS OF GULF COAST MEN AND WOMEN OUT OF WORK, AND THREATEN OTHER REGIONS 1 (Oct. 22, 2009), available at http://www.ecsga.org/Pages/Issues/Human_Health/FDA_OysterBanPressRelease10-09.pdf (fearing loss of jobs and harmful industry impacts stemming from a federal ban on all Gulf coast oysters for eight months each year).

²³⁴ 33 U.S.C. § 1346(a)(1)(B).

²³⁵ Bibler, *supra* note 173, at 9.

samples were obtained, hinges on fecal bacteria to indicate the presence of dangerous pathogens.²³⁶ This system could easily be tweaked to apply to *Vibrio vulnificus* bacteria. At the root of all possible solutions for addressing the concern spawned by this bacteria is a testing procedure for *Vibrio vulnificus* that isolates this natural pathogen from others that float along the coasts. If the state were to mandate testing specifically for the bacteria, the FHPB could then conduct these tests as part of their bi-weekly sampling program²³⁷ and post the results accordingly. Testing the coast for the bacteria would provide advance warning of the bacteria, allowing the media to be notified before tragedy falls upon any uninformed victim, thus provoking education and discussion of the bacteria's presence as opposed to panic that evolves from news stories of horrific injuries and loss of life.

An equally potent source of public notification exists in the sign postings along the shore and beach access points where *Vibrio vulnificus* may be discovered prowling along the surf. The current advisories that are posted for elevated levels of fecal bacteria are a solid foundation,²³⁸ requiring only minor changes to make them suitable for apprising the public of risks associated with diving into waves speckled with *Vibrio* bacteria. The FHPB should consider, however, employing the methodology California uses in its consumer advisories—that is, tailoring the general beach warnings to those individuals that face a higher chance of contracting an illness from interacting with the bacteria in the surf and identifying them in the text of the warning.²³⁹ By targeting the advisory to those at risk, Florida would promote awareness in those that face heightened levels of danger while leaving those healthy individuals to enjoy their time on the state's coasts with more knowledge of the bacteria, but less baseless fear. Creating an advance warning system for *Vibrio vulnificus* would allow the public to make better health decisions in their recreational activities and reduce the rate of infection.

²³⁶ *Id.*

²³⁷ *Id.* at 3.

²³⁸ See *supra* text accompanying notes 171-74.

²³⁹ See *supra* text accompanying note 201.

Should testing for the specific bacteria be deemed impractical, the state may consider a mandated warning and notification system employing these same methods during the known peak season of *Vibrio vulnificus*. While actually testing the water prior to generating public awareness is preferable, both to avoid speculation and unnecessary avoidance of coastal recreation when the bacteria may not even be at issue, the old adage does say that it is better to be safe than sorry. If the state's health departments were to generate media buzz about *Vibrio* season and the risks that the bacteria poses to certain individuals, people may be inspired to do their own research and avoid the water until there was no risk, or take proper precautions to protect themselves from wound exposure to saltwater.²⁴⁰ Posting signs along the coast based on the possibility that the bacteria may be lurking within the waves may give individuals the opportunity to consider the consequences of wound exposure if they believe themselves to be at risk. Although this form of notification involves speculation, it would be effective in getting the word out about a bacteria that few know poses any threat.²⁴¹

2. Raw Oyster Warnings – Tailoring Advisories to Those Most at Risk Pursuant to the California Model

Paramount in Florida's efforts to educate consumers of the risks associated with consuming raw oysters that may be contaminated with *Vibrio vulnificus* is the consumer advisory that the state requires on containers and displayed in restaurants with raw oysters on the menu.²⁴² While it is safe to say that this system of warning is effective in providing some awareness of the risk this menu item may pose, small changes to the existing advisory could significantly increase awareness for those individuals that should abstain from the food altogether. Here again, amending Florida's current warning system to reflect the California advisory²⁴³ would allow the state to more directly warn at-risk consumers away from the perilous entrée. It would be beneficial to add to the existing advisory individuals with diabetes, as this condition has been widely accepted as one that

²⁴⁰ The Florida Department of Health recommends individuals to “[a]void exposure of open wounds or broken skin to warm salt or brackish water, or to raw shellfish harvested from such waters.” *Information on Vibrio Vulnificus*, *supra* note 24.

²⁴¹ See *supra* note 85 and accompanying text.

²⁴² FLA. ADMIN. CODE ANN. § 61C-4.010.

²⁴³ See *supra* text accompanying note 201.

puts individuals at a higher risk for contracting an illness after exposure to the bacteria.²⁴⁴ The state should also consider more stringent regulations of the sign, including size and coloring, to make the advisory as prominent as possible, as practiced by California.²⁴⁵

Florida should also consider, along the lines of the California regulation, mandating a warning at locations that sell raw oysters over the counter.²⁴⁶ Not all raw oysters are consumed within the confines of a restaurant, and those individuals that take the shellfish home for consumption may not read or notice a label affixed to the container in which the product is packed. Posting a noticeable warning at the point of sale would give consumers an extra chance to take heed and protect themselves from possible illness. For those consuming the dish in restaurants, Florida should consider requiring more than the consumer warning be visible in a viable location,²⁴⁷ but consider mandating that the warning be either on the menu or on tent cards on the table, as required by California's 2003 legislation.²⁴⁸

VI. CONCLUSION

Vibrio vulnificus-associated illnesses are not isolated to the state of Florida. As the oceans warm, the populations of Vibrio vulnificus thrive and spread to areas that have previously not had to worry about the lurking dangers of the pathogens.²⁴⁹ However, Florida is particularly vulnerable to the risks of the bacteria, as the state's coasts draw millions of visitors each year²⁵⁰ and its oyster

²⁴⁴ See *supra* text accompanying notes 74, 100.

²⁴⁵ See *supra* text accompanying note 203.

²⁴⁶ CAL. CODE REGS. tit. 17, § 13675(b)(2).

²⁴⁷ *Id.* § 61C-4.010.

²⁴⁸ *Id.* § 13675(b)(3).

²⁴⁹ Jessica Forres, *Vibrio Bacteria a Bigger Threat to Swimmers than Sharks as Northern Waters Warm*, NATURAL RES. NEWS SERVICE (May 22, 2007), <http://www.debureau.org/20070522711/natural-resources-news-service/vibrio-bacteria-a-bigger-threat-to-swimmers-than-sharks-as-northern-waters-warm.html> ("For example, Vibrio wound infections have increased from one victim reported to Maryland public health authorities in 2000 to 13 reported [in 2006] in that state.").

²⁵⁰ Approximately seventy-five million people visit Florida per year. David G. Hallstrom, Sr., *Florida Travel and Tourist Information*, VISIT FLORIDA, http://www.visitfloridaonline.com/article_visit.htm (last visited Apr. 17, 2015).

production is a significant source of revenue,²⁵¹ both of which are avenues of infection for *Vibrio vulnificus*. On average, between 2008 and 2014, approximately thirty people have suffered from *Vibrio vulnificus* infections and illnesses in the state of Florida each year, and an average of nine individuals have succumbed to these bacterial illnesses.²⁵² Strikingly, despite the rate of infection and illness caused by the bacteria and the fact that these cases have been under a system of national surveillance since 2007,²⁵³ many individuals remain unaware of the risks associated with wading out into coastal waters or slurping back a raw oyster. This lack of awareness creates a system where individuals put themselves at risk without intention because they are not aware of the dangers against which they need to guard themselves. This lack of awareness is especially problematic in the case of immunocompromised individuals, as these individuals are regarded as eighty times more likely to become a *Vibrio* victim.²⁵⁴

There is little direct regulation regarding the risk of *Vibrio vulnificus* in Florida. While water quality is monitored per federal and state legislation, the resulting system of testing and reporting fails to isolate environmental bacteria like *Vibrio*. The FDA and ISSC, however, do require direct regulation of *Vibrio* bacteria in shellfish, especially those hailing from the Gulf of Mexico. And while Florida has enacted the required minimum legislation as proposed by the NSSP guidelines, individuals are still contracting *Vibrio*-related illnesses via consumption of shellfish from the Gulf, not just in Florida, but in regions that receive importations of Gulf oysters. At the root of the problem is the lack of notification, as no advance warning system for *Vibrio* exists to notify those who should think twice before diving into the coast or, aside from vague consumer advisories, ordering a plate of raw oysters.

California has taken the NSSP guidelines a step further than what is strictly required in regulating Gulf oysters. The state has placed an embargo of sorts on raw oysters during peak *Vibrio vulnificus* seasons, requiring either the

²⁵¹ *Shellfish*, *supra* note 136.

²⁵² These calculations are based on the figures distributed by the Florida Department of Health. See *Information on Vibrio Vulnificus*, *supra* note 24.

²⁵³ *Id.*

²⁵⁴ *Id.*

treatment of raw oysters before consumption or the refusal to accept the shellfish.²⁵⁵ California also ensures the notification of at-risk individuals as to the dangers of consuming raw oysters, directing their advisories to these individuals in particular.²⁵⁶ These regulations, while seemingly harsh, have dramatically reduced the incidence rate of reported cases of Vibrio in the state.

The proposals discussed in this article, like mandating testing of recreational waters and oyster harvesting areas for *Vibrio vulnificus* and applying the California model of raw oyster regulation during the bacteria's peak seasons, could reduce the number of individuals who fall prey to *Vibrio vulnificus* in Florida each year. Instituting these measures would necessarily address the root of the problem—the lack of an advance warning system. Testing waters and preventing the consumption and sale of contaminated shellfish during peak Vibrio seasons would pave the way to the creation of a public warning system, as state officials would have specific knowledge of the presence of the bacteria without the unnecessary tragedies of illness and infection that once gave rise to such information. Directing warnings to at-risk individuals, as California requires in their consumer advisories, would also work to enhance public knowledge of the dangers of the bacteria and allow those individuals to make informed decisions that could directly impact their health, taking some of the mystery out of the bacteria and lifting some of the burden of researching it from the shoulders of the public.

When asked about dangers hidden within the depths of Florida's coasts, many individuals' minds will spring to sharks, the ultimate marine predator. Few individuals, if any, will consider the bacteria that lurk, quite as naturally as sharks, within the crests of the waves they enjoy. However, sharks only killed three people worldwide in 2014,²⁵⁷ whereas *Vibrio vulnificus* killed seven people in Florida alone.²⁵⁸ The loss of life and limb that *Vibrio vulnificus* causes can be reduced or eliminated, if the California model is any example, and the state of

²⁵⁵ See generally CAL. CODE REGS. tit. 17, § 13675.

²⁵⁶ See *supra* text accompanying note 201.

²⁵⁷ George H. Burgess, *ISAF 2014 Worldwide Shark Attack Summary*, INT'L SHARK ATTACK FILE, <https://www.flmnh.ufl.edu/fish/sharks/isaf/2014Summary.html> (last visited Apr. 17, 2015).

²⁵⁸ Information on *Vibrio Vulnificus*, *supra* note 24.

Florida should consider taking the aforementioned steps to protect the public from the unseen danger that the bacteria presents.

HOW PLANNING FOR SEA LEVEL RISE CREATES FLOOD INSURANCE REDUCTIONS: THE GEORGIA CONTEXT

Hunter Jones¹

I. INTRODUCTION

Flood insurance rates are rising for homeowners. One way local governments can create insurance discounts for their constituents is to participate in the National Flood Insurance Program's (NFIP or Program) Community Rating System (CRS) and earn CRS credits for flood control measures and community outreach. The CRS is a voluntary incentive program that encourages local governments to enact enhanced floodplain management and improve local resilience to flooding in exchange for reductions in flood insurance premiums across their communities. The CRS provides an opportunity for communities to derive substantial benefits from activities that increase their resilience to flooding hazards. In Georgia, 542 cities and counties are eligible to participate in the CRS. According to a 2014 Federal Emergency Management Agency report, 42 communities participate in the CRS, saving Georgia policyholders approximately \$6.6 million.²

¹ J.D., University of Georgia, 2015; Spring 2015 Georgia Sea Grant Legal Fellow. The Georgia Sea Grant Legal Program is a new partnership between Georgia Sea Grant and the Carl Vinson Institute of Government at the University of Georgia. The program solicits legal and policy questions from Georgia coastal communities, regional organizations, state agencies and others to address critical environmental, economic and social concerns affecting coastal Georgia. In providing objective analysis for coastal decision makers, the Georgia Sea Grant Legal Program strives to support informed and effective management of coastal resources, in order to improve hazard resilience, encourage sustainable development and promote healthy coastal ecosystems. The program also provides training in environmental law and policy to students at the University of Georgia School of Law through the highly competitive Georgia Sea Grant Legal Fellowship. Research for this article was supported in part by an Institutional Grant (NA14OAR4170084) to the Georgia Sea Grant College Program from the National Sea Grant Office, National Oceanic and Atmospheric Administration, U.S. Department of Commerce. All views, opinions, findings, conclusions, and recommendations expressed in this material are those of the author and do not necessarily reflect the opinions of the Georgia Sea Grant College Program or the National Oceanic and Atmospheric Administration.

² *CRS State Profile: Georgia* (Jan. 2014), THE NATIONAL FLOOD INSURANCE PROGRAM, available at http://crsresources.org/files/200/state-profiles/ga-state_profile.pdf.

This article provides an overview of the CRS, analyzes how CRS credits are awarded through new sea level rise measures that were added to the CRS in 2013, and outlines existing Georgia law that may further protect Georgia's coast. The most important implications of the new sea level rise measures for Georgia communities for flood insurance reduction purposes include:

Future Flooding Due to Sea Level Rise. The CRS Manual awards up to 20 credits to communities that provide information not shown on communities' Flood Insurance Rate Maps (FIRMs) for areas that are predicted to be susceptible to future flooding due to sea level rise. To be eligible for credits for this activity, a community's mapping information service must be able to locate a property based on a street address and provide an opportunity for a community member to communicate with a staff person. Communities could build off of information provided in the Coastal Resource Division's Coastal Hazards Portal or the National Oceanic and Atmospheric Administration's Sea Level Rise Viewer to earn credits for this activity.

Real Estate Agent Disclosure. The CRS Manual awards up to 8 credits to communities that require real estate agents disclose to prospective buyers a property's hazards in areas specifically subject to increased flooding due to sea level rise. While Georgia law requires disclosure about flood hazards generally, it does not require disclosure about areas specifically subject to flooding due to sea level rise. Although disclosure about areas specifically subject to flooding due to sea level rise is not legally mandated, a community can still be eligible to receive CRS credits for implementing this measure for the real estate agents working within its own community. In other words, a community can receive CRS credits for implementing this measure if it can document disclosure at the local level.

Minimizing Increases in Future Flooding. The CRS Manual awards credits to communities that adopt programs that minimize increases in future flooding, as well as to communities that use regulatory flood elevations in the V and coastal A zones that reflect future conditions, such as sea level rise. These two measures are likely only relevant for the most engaged CRS communities in Georgia. For example, the measure requiring that a community demonstrate that it has programs which minimize increases in future flooding represents a prerequisite

for a community to become a Class 4 or better community. Very few, if any, communities in Georgia are close to being a Class 4 community. However, these credits may be of particular interest to a number of communities on Georgia's coast that are making strides toward achieving these lower CRS classes.

Stormwater Management Measures. The CRS Manual awards up to 380 credits to communities that require new development to prevent or reduce increased stormwater runoff from a 10-year storm or larger (e.g., 50- or 100-year storms). While Georgia's Coastal Stormwater Supplement (Supplement) recommends that new development reduce runoff, it does not base its recommendations to reduce stormwater runoff on a 10-year storm or larger. However, local governments are not limited to the recommendations set forth in the Supplement. Communities may adopt measures to reduce stormwater runoff that meet the CRS criteria required to receive credits under the Manual's sea level rise measure.

II. OVERVIEW OF NFIP'S COMMUNITY RATING SYSTEM

In 1968, Congress created the NFIP to provide flood insurance to homeowners, renters, and business owners in communities that participate in the Program.³ Prior to the NFIP's inception, national response to flood disasters was limited to constructing flood control structures and providing disaster relief for flood victims.⁴ There were no measures to reduce losses, and insurance companies were unable to provide affordable flood insurance coverage due to the high risk and seasonal nature of flood disasters.⁵ To combat increasing flood losses, Congress passed the National Flood Insurance Act, thus establishing the NFIP. The Program strives to not only provide property owners with flood insurance, but also to save taxpayers' money and encourage communities to

³ *About the National Flood Insurance Program: Overview*, THE NATIONAL FLOOD INSURANCE PROGRAM, https://www.floodsmart.gov/floodsmart/pages/about/nfip_overview.jsp.

⁴ *Answers to Questions about the NFIP*, FEDERAL EMERGENCY MANAGEMENT AGENCY 1 (Mar. 2011), available at http://www.fema.gov/media-library-data/20130726-1438-20490-1905/f084_atq_11aug11.pdf.

⁵ *Id.*

engage in flood loss reduction activities.⁶ Between 1978 and October 2013, the NFIP paid out over two million losses, totaling over \$50 billion.⁷ To participate in the Program, a community must agree to adopt and enforce ordinances which meet or exceed requirements set forth by the Federal Emergency Management Agency (FEMA) to reduce the risk of flooding in the community.⁸

In 1990, FEMA established the CRS to acknowledge and reward communities that engage in activities that exceed the minimum measures required by the NFIP to reduce flood damage to property owners and implement comprehensive floodplain management.⁹ The CRS encourages communities to exceed NFIP's minimum standards by providing flood insurance premium rate reductions to policyholders.¹⁰ The CRS Coordinator's Manual, which is the guidebook for the CRS, sets forth nineteen creditable local government activities and assigns credit points for each activity based upon the degree to which it advances the goals of the CRS.¹¹ A community receives one of ten possible CRS classifications based upon the total number of credits it receives for these activities.¹²

Communities enter the CRS as a Class 10. As they receive credits for adopting creditable activities, their CRS class improves and they receive an additional five percent reduction in flood insurance premiums for all local policies affecting structures located inside FEMA's floodplain. For local policies affecting structures located outside FEMA's floodplain, Class 9, 8, and 7 communities receive a five percent reduction in flood insurance premiums, while Class 6 through 1 communities receive a ten percent reduction. This paper focuses on the

⁶ *CRS Coordinator's Manual*, FEDERAL EMERGENCY MANAGEMENT AGENCY 110-1 (2013), available at http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15_NFIP-Coordinators-Manual_2014.pdf.

⁷ *Id.*

⁸ *About the National Flood Insurance Program: Overview*, THE NATIONAL FLOOD INSURANCE PROGRAM, https://www.floodsmart.gov/floodsmart/pages/about/nfip_overview.jsp.

⁹ *CRS Coordinator's Manual*, *supra* note 6, at 110-1.

¹⁰ *Id.* at 110-2.

¹¹ *Id.* at 110-4.

¹² *Id.* at 110-3.

creditable activities that the CRS acknowledged in its 2013 Coordinator's Manual as addressing rising sea levels and other factors attributable to climate change.¹³

III. SEA LEVEL RISE MITIGATION PROVISIONS IN THE CRS MANUAL

The 2013 CRS Coordinator's Manual (Manual) divides all of the activities that create credits under the program into the following: (1) Series 300 - Public Information Activities; (2) Series 400 - Mapping and Regulations; (3) Series 500 - Flood Damage Reduction Activities; and (4) Series 600 - Warning and Response. The activities that generate credit within these categories are varied and include building public support for floodplain management, preserving open space, maintaining flood data, and acquiring properties that flood regularly, known as "repetitive loss properties."

In addition to these traditional floodplain management activities, the 2013 Manual acknowledged, for the first time, measures by which communities can earn CRS credits for their efforts to anticipate future risks of flooding due to climate change or sea level rise.¹⁴ Each of these measures are distributed throughout the Manual among the following categories: Public Information Activities (Series 300); Mapping and Regulations (Series 400); and Flood Damage Reduction Activities (Series 500). They are discussed in more detail as part of each category below. The specific measures that communities may receive credit for include:

- (1) providing information not included in the FIRM about areas susceptible to flooding in the future due to climate change or sea level rise;
- (2) demonstrating that the community itself has programs that minimize increases in future flooding;
- (3) using regulatory flood elevations in the V and coastal A zones that reflect future conditions, including sea level rise;
- (4) ensuring that prospective property buyers are advised of the potential for flooding due to climate change and sea level rise;

¹³ *Id.* at 110-15.

¹⁴ *Id.*

- (5) basing the community's regulatory map on future-conditions hydrology, including sea level rise;
- (6) regulating runoff from future development through the community's stormwater program;
- (7) managing future peak flows through the community's watershed master plan so that flows do not exceed present values; and
- (8) incorporating flood hazard assessments and problem analyses for areas likely to flood and potential increased flood problems due to changes in floodplain development and demographics, development in the watershed, and climate change or sea level rise.¹⁵

A. Series 300- Public Information Activities

Series 300 of the Manual addresses credits available to communities for implementing local activities that advise community members about flood hazards, insurance, and protection measures.¹⁶ Communities can direct these activities toward floodplain residents, property owners, insurance agents, real estate agents, or other sectors in the local community.¹⁷ The sea level rise measures in the Public Information Activities Series are discussed below.

1. Provide Information about Areas Predicted to be Susceptible to Future Flooding due to Sea Level Rise

Section 322.c of the Manual awards credits when communities provide information (not shown on the community's FIRM) about areas that are predicted to be susceptible to flooding in the future because of climate change or sea level rise.¹⁸ The maximum credit for this measure is 20 points.¹⁹ To receive the maximum credits, a community must provide information regarding flood hazards that are not shown on the community's FIRM.²⁰ The information provided should be located on a map or geographic information system (GIS) layer so that a

¹⁵ *Id.* at 110-15, 110-16.

¹⁶ *Id.* at 300-1.

¹⁷ *Id.*

¹⁸ *Id.* at 320-11.

¹⁹ *Id.*

²⁰ *Id.*

person responding to the inquiries has an accurate source of information.²¹ A community has the option to provide the information via phone, written or e-mailed inquiry, or website.²²

The criteria required for this measure suggest that the Georgia Coastal Resources Division's (GCRD) Coastal Hazards Portal would make Georgia's coastal communities eligible for these CRS credits. However, the measure requires that the mapping information service be able to locate a property based on a street address.²³ In addition, the measure requires that the mapping service provide an opportunity for a community member to contact a "staff person," which affords the community member the opportunity to obtain additional information, such as a permit requirement.²⁴ As of now, GCRD's Coastal Hazards Portal does not possess all of these characteristics, and thus, a community would need to supplement the portal data with street addresses and staff contacts. A community could potentially meet the street address requirements by adding data from the National Oceanic and Atmospheric Administration's (NOAA) Sea Level Rise Viewer to their existing GIS platform.

2. Advise Prospective Buyers of Property's Potential for Flooding due to Sea Level Rise

The Hazards Disclosure Section of Section 300 seeks to disclose to prospective buyers a property's potential flood hazard before the lender notifies the prospective buyers of the need for flood insurance.²⁵ Section 342.d provides credits related to real estate agents advising prospective buyers of the potential for flooding due to climate change or sea level rise. The maximum credit for this measure is 8 points.²⁶

To receive credit for this measure, real estate agents need to advise potential property buyers of hazards that have been identified for areas subject to

²¹ *Id.* at 320-3.

²² *Id.*

²³ *Id.* at 320-3, 320-4.

²⁴ *Id.* at 320-4.

²⁵ *Id.* at 340-2.

²⁶ *Id.* at 340-10.

increased flooding due to climate change or sea level rise.²⁷ In order to receive these credits, the Manual requires communities to provide specific documentation to ensure that the community's real estate agents are, in fact, disclosing the appropriate information. For example, the Manual requires that a community present at least one copy of a disclosure notice from at least five real estate agencies that serve the community.²⁸ The required documentation can include copies of notations on property summary sheets, offer-to-purchase forms, MLS forms, or other media.²⁹

Georgia law requires real estate agents to disclose to prospective buyers a property's flood hazards. For a community to earn the eight additional points for the Manual's sea level rise measure, however, hazards must be identified for areas specifically subject to increased flooding as a result of sea level rise.³⁰ Although Georgia does not have a law that requires real estate agents to disclose flood hazards identified as a result of sea level rise, a community can adopt such a measure for the real estate agents working within its own community. In other words, a community can receive CRS credits for adopting this measure if it can document that the required disclosures are occurring at the local level.

B. *Series 400- Mapping and Regulations*

Series 400 of the Manual addresses credits that communities can receive for enacting and enforcing regulations which exceed NFIP's minimum standards and provide greater flood protection for new and existing development.³¹ This Series of the Manual allows communities to receive credit for the following five sea level rise-related activities, each of which will be discussed below: (1) demonstrating that the community has programs that minimize increases in future flooding; (2) using regulatory flood elevations in the V and coastal A zones that reflect future conditions, including sea level rise; (3) basing the community's

²⁷ *Id.*

²⁸ *Id.* at 340-5.

²⁹ *Id.*

³⁰ *The Georgia Brokerage Relationships in Real Estate Transactions Act*, GEORGIA REAL ESTATE COMMISSION,

<https://www.grec.state.ga.us/infobase/table%20of%20contents%20pdf/Chapter%209.pdf>.

³¹ *CRS Coordinator's Manual*, *supra* note 6, at 400-1.

regulatory map on future-conditions hydrology, including sea level rise; (4) regulating runoff from future development through the community’s stormwater program; and (5) managing future peak flows through the community’s watershed master plan so that the flows do not exceed present values.

1. Demonstrate that the Community has Programs that Minimize Increases in Future Flooding

The first mitigation measure for sea level rise in Series 400 provides potential credits for communities that demonstrate they have programs to minimize increases in future flooding.³² To demonstrate that a community has minimized increases in future flooding, it must: (1) show that it enforces higher regulatory standards to manage new development in the floodplain; (2) receive credits for its watershed management plan under Section 451.b; and (3) have adopted and be implementing a floodplain management plan that receives at least 50% of the maximum credit for Floodplain Management Planning.³³ This mitigation measure is a prerequisite for a community to become a Class 4 or better community.

2. Use Regulatory Flood Elevations in the V and Coastal A zones that Reflect Future Conditions, including Sea Level Rise

The second mitigation measure for sea level rise in Series 400 allows communities to receive credit for using regulatory flood elevations in the V and coastal A zones that reflect future conditions, including sea level rise. The term “V zone” refers to the Special Flood Hazard Area that is subject to coastal high hazard flooding.³⁴ The term “coastal A zone” refers to those parts of the community’s coastal floodplain, inland from the mapped V zone, that are subject to the damaging effects of waves, velocity flows, erosion, scour, or combinations

³² *Id.* at 210-4.

³³ *Id.* at 210-4, 210-5.

³⁴ *Id.* at 120-10.

of these forces.³⁵ This mitigation measure is a prerequisite for a community to become a Class 1 community.³⁶

A community must meet the following prerequisites in order to become a Class 1 community: (1) meet all the Class 4 prerequisites; (2) meet the minimum standards of the NFIP as determined by a Community Assistance Visit conducted by FEMA within the previous 12 months; (3) promote flood insurance as a vital way to protect residents and businesses from the financial impacts of a flood; and (4) demonstrate that it has a “no adverse impact” approach to floodplain management.³⁷ Of these prerequisites, a community’s demonstration that it has a “no adverse impact” approach to floodplain management is most relevant to addressing future risks of flooding due to sea level rise. To demonstrate that it has met this prerequisite in its coastal floodplains, a community must show that it is receiving credit for using regulatory flood elevations in the V and coastal A zones that reflect future conditions, including sea level rise.³⁸ A community can illustrate that it is receiving credits for using these flood elevations by using future-conditions hydrology under the higher study standards measure in Section 412.d, discussed below.³⁹

3. Basing its Regulatory Map on Future-Conditions Hydrology, including Sea Level Rise

Section 412.d provides the third mitigation measure for sea level rise that is addressed in Series 400 and allows a community to receive up to 160 credits if its regulatory maps are based on higher study standards than those required by FEMA.⁴⁰ To be eligible for credit under this measure, a community must implement at least one of the following higher study standards: (1) using a factor of safety when calculating the 100-year discharge; (2) using better topographic data; (3) using future-conditions hydrology (including sea level rise); and (4)

³⁵ *Id.* at 120-2.

³⁶ *Id.* at 210-7.

³⁷ *Id.* at 210-6.

³⁸ *Id.* at 210-7.

³⁹ *Id.*

⁴⁰ *Id.* at 410-18.

showing 500-year flood elevations and the boundaries of the 500-year floodplain.⁴¹

The credits awarded for higher study standards are cumulative for up to three higher study standards, provided that the sum of the credits awarded does not exceed 160 points.⁴² Of the higher study standards listed under this measure, using future-conditions hydrology (including sea level rise) to develop a community's regulatory map is most relevant to addressing future risks of flooding due to sea level rise. To receive credits for using future-conditions hydrology, a community must use flood discharges associated with a fully developed watershed and create flood discharges without considering projected construction of flood detention structures or hydraulic modifications within a stream or other waterway.⁴³ Examples of flood detention structures or hydraulic modifications include bridge and culvert construction, fill, or excavation. If a community wants to receive credit for using future-conditions hydrology in coastal studies, the community must use an estimate of the sea level rise anticipated by the year 2100 or later.⁴⁴ The Manual requires that "the study used to determine the sea level rise estimate [be] developed by FEMA, the U.S. Army Corps of Engineers, the U.S. Geological Survey, NOAA, or through a regional study that produced higher base flood elevations."⁴⁵

To demonstrate that a community is eligible for credit under this measure, a community not only has to include these higher base flood elevations in its maps, but it also has to regulate to these higher levels by requiring that structures be built to meet the higher base flood elevation standards. This requirement is analogous to the criteria for receiving credit under the Higher Regulatory Standards Section (432.b) of the Manual. A community that enforces a 3-foot freeboard requirement to the elevation of the lowest floor of the building or to the elevation to which a non-residential building is dry floodproofed, and to all components of the building, is eligible to earn up to 500 credits.⁴⁶

⁴¹ *Id.*

⁴² *Id.* at 410-20.

⁴³ *Id.* at 410-18.

⁴⁴ *Id.* at 410-19.

⁴⁵ *Id.*

⁴⁶ *Id.* at 430-10, 430-11.

It would seem to make more sense, then, for a community to adopt the freeboard measure under Section 432.b as opposed to the future-conditions hydrology measure under Section 412.d because a community can earn more than three times the credit for adopting the freeboard measure. Further, the community can enforce the measure without encountering any controversial discussion of sea level rise.⁴⁷ For example, if a coastal community is predicted to experience three feet of sea level rise by the year 2100, the community can simply enforce a 3-foot freeboard and earn up to 500 credits as opposed to earning the maximum 160 credits under the higher study standards measure, all the while avoiding the extra cost, effort, and controversy of sea level rise mapping.⁴⁸ Insurance Services Office (ISO)/ CRS Specialists have recognized this potential issue and intend to review it for the next Manual update.⁴⁹

The criteria required for this measure suggest that some Georgia communities, which have used overlays from the Hazards Portal of NOAA's Sea Level Rise Viewer (Viewer), may be eligible for credits under this measure. According to NOAA, the maps used in the Viewer were derived from source elevation data that meet or exceed FEMA's mapping standards for the NFIP.⁵⁰ It seems to follow, then, that communities who have incorporated overlays from the Viewer into their FIRM, which were derived from data that exceeds FEMA's mapping standards, may be eligible to receive credits for using future-conditions hydrology. Communities working to improve their CRS rating should raise this possibility with the ISO/CRS Specialist reviewing their community.⁵¹ Notably, however, a community cannot receive credit for developing these maps unless the community also regulates the information provided on the maps.

⁴⁷ Telephone interview with Shannon Jarreau, Assistant Director, Wetlands Watch (Feb. 24, 2015).

⁴⁸ *Id.*

⁴⁹ *Id.*

⁵⁰ *Frequent Questions- Digital Coastal Sea Level Rise and Coastal Flooding Impacts Viewer*, NOAA COASTAL SERVICES CENTER 7 (Mar. 2014), http://coast.noaa.gov/digitalcoast/_/pdf/SLRViewerFAQ.pdf.

⁵¹ The Insurance Services Office, Inc. (ISO) serves as FEMA's CRS management contractor. ISO specialists review community activities when they seek to join the CRS program as well as conduct "cycle verification visits" to review existing programs. *CRS Coordinator's Manual*, *supra* note 6, at 110-8.

4. Community's Stormwater Program Regulates Runoff from Future Development

The fourth mitigation measure for sea level rise that is recognized in Series 400 of the Manual, in which the community's stormwater program regulates runoff from future development, falls within the Stormwater Management Section (452.a). The Stormwater Management Section seeks to prevent future development from increasing flood hazards to existing development and maintain and improve water quality.⁵² The maximum credit for this measure is 380 points.⁵³ A community can receive credit for this measure if it requires new development to prevent or reduce increases in runoff caused by urbanization.⁵⁴ Additionally, credit is only provided for regulating runoff from a 10-year storm or larger.⁵⁵ It is important to note that a community can only receive CRS credit for this activity if the community's regulations are legally enforceable. For instance, mere policies or guidelines may not be acceptable.⁵⁶

Georgia's Coastal Stormwater Supplement (Supplement) provides post-construction stormwater management recommendations, such as reducing stormwater runoff, for certain new development.⁵⁷ For example, the Supplement recommends that new development sites reduce the volume of stormwater runoff volume generated by a 1.2-inch rainfall event, which represents the majority (85th percentile) of storm events in Georgia.⁵⁸ Additionally, the Supplement recommends that new development sites reduce the volume of stormwater runoff generated by the "first flush," or the first 1.2 inches, of all larger rainfall events.⁵⁹ Although the Supplement recommends that new development reduce runoff, it does not base its recommendations on a 10-year storm or larger. Thus, it does not

⁵² *Id.* at 450-2.

⁵³ *Id.* at 450-4.

⁵⁴ *Id.*

⁵⁵ *Id.*

⁵⁶ *Id.* at 450-13.

⁵⁷ *Georgia Coastal Stormwater Supplement*, CENTER FOR WATERSHED PROTECTION 4-13 (Apr. 2009), https://epd.georgia.gov/sites/epd.georgia.gov/files/related_files/site_page/Georgia_Coastal_Stormwater_Supplement_2009.pdf.

⁵⁸ *Id.*

⁵⁹ *Id.*

appear that the Supplement has provisions to meet the criteria required to receive credits for this measure. Moreover, the Supplement's guidelines are merely recommendations and, thus, are not legally enforceable in Georgia communities unless they adopt its guidance by local ordinance.⁶⁰

However, notably, local governments are not limited to the recommendations set forth in the Supplement. Communities may exceed existing minimum standards and adopt requirements to reduce stormwater runoff that meet the criteria required to receive credits under the Manual's sea level rise measure.

5. Community's Watershed Master Plan Manages Future Peak Flows so that They do not Exceed Present Values

Alongside the fourth mitigation measure, the fifth mitigation measure for sea level rise that is addressed in Series 400 of the Manual, in which the community's watershed master plan manages future peak flows so that they do not exceed present values, falls within the Stormwater Management Section (452.b).⁶¹ The maximum credit for this measure is 315 points.⁶² To receive CRS credit for this activity, a community's watershed master plan must address the regulatory standards for new development and identify the natural drainage system and constructed channels of the watersheds that drain into the community.⁶³

The Georgia Supplement does not address the management of a community's future peak flows. Nor does the Supplement mention community watershed plans directly, although arguably some of its recommendations could be considered a community watershed plan if adopted.⁶⁴ Despite the fact that the Supplement does not address community watershed plans, communities may still develop such a plan. Nothing prevents communities from using the Supplement as a guide and developing a community watershed plan that incorporates provisions

⁶⁰ *Id.* at 1-5.

⁶¹ *CRS Coordinator's Manual*, *supra* note 6, at 450-14.

⁶² *Id.*

⁶³ *Id.*

⁶⁴ *Georgia Coastal Stormwater Supplement*, *supra* note 57.

into the plan that monitor future peak flows in order to receive CRS credits under this measure.

C. *Series 500- Flood Damage Reduction Activities*

Series 500 of the Manual focuses on reducing flood damage to existing buildings.⁶⁵ As such, it recognizes the following types of damage reduction measures: acquiring, relocating or retrofitting existing buildings; maintaining and improving drainageways and retention basins; and planning for the best ways to implement these and other loss prevention and reduction activities.⁶⁶ Series 500 of the Manual provides for the following mitigation measure for sea level rise: conduct a flood hazard assessment and problem analysis to address areas likely to flood and flood problems that are likely to get worse in the future.

This mitigation measure for sea level rise falls under the Floodplain Management Planning Section (512.a), which seeks to credit the production of an overall strategy of programs, projects, and measures that will reduce the adverse impact of the hazard on the community and help meet other community needs.⁶⁷ The measure is specifically addressed in Steps 4 and 5 of Section 512.a.⁶⁸ Communities that meet this measure can receive a maximum of 35 credits for Step 4 and 52 credits for Step 5.⁶⁹ Step 4 provides for reviewing and analyzing data from existing flood studies to assess the sources, frequency, extent, and causes of flooding.⁷⁰ To receive CRS credit for Step 4, a community hazard assessment must describe the local flood hazard as opposed to a generic discussion of flooding.⁷¹ Furthermore, the assessment must discuss how often flooding occurs, the locations of areas that flood, flooding depths, and sources or causes of the flooding.⁷²

⁶⁵ *CRS Coordinator's Manual*, supra note 6.

⁶⁶ *Id.*

⁶⁷ *Id.* at 510-2.

⁶⁸ *Id.* at 110-16.

⁶⁹ *Id.* at 510-14, 510-16.

⁷⁰ *Id.* at 510-13.

⁷¹ *Id.* at 510-14.

⁷² *Id.*

While Step 4 addresses the hazards faced by a community, Step 5 requires community planners to collect and summarize data on what is at risk in the community.⁷³ To receive CRS credit for Step 5, a community must, among other things, assess all relevant flood-related hazards identified in Step 4.⁷⁴ In order to be eligible to receive credit under this section, a community must not skip more than two steps discussed in the Manual; if more steps are skipped, no credit will be awarded.⁷⁵

IV. CONNECTING GEORGIA LAW WITH THE CRS

Various statutes in Georgia indirectly address sea level rise issues, such as by regulating land-disturbing activity that can cause erosion and administering a coastal management program that protects Georgia's coastal marshlands and beaches. Although they do not specifically reference "sea level rise" in their provisions, the following statutes contain provisions that are particularly relevant to sea level rise issues: (1) Georgia Coastal Marshlands Protection Act; (2) Georgia Erosion and Sedimentation Act; (3) Georgia Shore Protection Act; and (4) Georgia Coastal Management Act.⁷⁶

A. *Georgia Coastal Marshlands Protection Act*

Georgia's Coastal Marshlands Protection Act (CMPA) was enacted in 1970 to protect the state's coastal marshlands that help with flood control and provide habitat for wildlife.⁷⁷ The CMPA specifically states that a property owner cannot fill, drain, dredge, or otherwise alter marshlands along the Georgia coast unless the Coastal Marshlands Protection Agency of the Department of Natural

⁷³ *Id.* at 510-16.

⁷⁴ *Id.*

⁷⁵ *Id.* at 510-4.

⁷⁶ *Key Coastal Management Policies Relevant to Sea-Level Rise in Georgia*, RIVER BASIN CENTER AT THE UNIVERSITY OF GEORGIA, http://www.rivercenter.uga.edu/education/practicum/documents/coastal_management_policies_fed_state_local.pdf.

⁷⁷ Teresa Concannon, Mushtaq Hussain, Daniel Hudgens & James G. Titus. *The Likelihood of Shore Protection: Georgia*, U.S. ENVIRONMENTAL PROTECTION AGENCY, 267 (Feb. 2010), <http://risingsea.net/ERL/shore-protection-retreat-sea-level-rise-Georgia.pdf>.

Resources issues a permit to the property owner for such activity.⁷⁸ With respect to sea level rise concerns, the CMPA contains provisions that may be able to address the following impacts of sea level rise: (1) increased coastal flooding and inundation; (2) increased shore erosion and land loss; (3) threats to aquatic and marine ecosystems; (4) saltwater intrusion into coastal freshwater and estuarine ecosystems; and (5) potential wetlands loss.⁷⁹

While the CMPA has no direct connection to the sea level rise measures mentioned in the previous section of this article, the CMPA does address the concept of open space preservation, which is discussed in Section 420 of the Manual.⁸⁰ Like the CMPA seeks to protect coastal marshlands that help with flood control, the open space preservation measure in the Manual seeks to prevent or minimize development in the floodplain that would adversely affect floodplain functions.⁸¹ The open space preservation measure in Series 400 awards up to 1,450 points for communities that preserve open space in the floodplain and prohibit future development, fill, and materials storage on these parcels.⁸² Communities can earn up to 120 points for shoreline protection programs that protect or restore channels and shorelines to their natural state.⁸³ The credit is based either on shoreline protection practices put in place by property owners or on protection requirements embodied in local regulations.⁸⁴

A community that adheres solely to the regulations set forth in the CMPA is unlikely to meet the criteria required under the Manual's open space preservation measure, though. Simply requiring property owners to obtain a permit is insufficient to obtain the available credits; the sea level rise measure in the Manual requires a community to actually prohibit structural shoreline protection. However, a community may be eligible to earn credits for this measure if the community enforces prohibition of structural shoreline protection at the

⁷⁸ *Key Coastal Management Policies Relevant to Sea-Level Rise in Georgia*, *supra* note 76.

⁷⁹ *Id.*

⁸⁰ *CRS Coordinator's Manual*, *supra* note 6, at 420-1.

⁸¹ *Id.* at 420-3.

⁸² *Id.*

⁸³ *Id.* at 410-1

⁸⁴ *Id.* at 420-3.

local level or makes it a dedicated practice to not issue permits for structural shoreline protection.

B. *Georgia Erosion and Sedimentation Act*

Georgia's Erosion and Sedimentation Act (GESA), enacted in 1975, regulates land-disturbing activity that may result in erosion, such as the clearing, dredging, grading, excavating, transporting, and filling of land.⁸⁵ Specifically, the GESA requires counties and municipalities to adopt ordinances that establish measures for controlling such land-disturbing activities.⁸⁶ Additionally, the GESA mandates that permit applicants adopt best management practices that avoid soil erosion caused by stormwater runoff.⁸⁷ A 25-foot stream buffer for state waters adjacent to wrested vegetation is also required.⁸⁸ In 2015, the Georgia General Assembly passed Senate Bill 101, which established a 25-foot buffer along coastal marshlands, as measured horizontally from the coastal marshland-upland interface,⁸⁹ also known as the "marsh jurisdictional line" established by CRD under the CMPA. With respect to sea-level rise concerns, the GESA contains provisions that may be able to address the following impacts of sea level rise: (1) increased coastal flooding and inundation; and (2) increased shore erosion and land loss.⁹⁰

Although there is no direct connection between the provisions set forth under the GESA and the sea level rise measures mentioned in the prior section, there is potential for the GESA's requirements to integrate with some of the measures found in Series 400. For example, a community's adherence to state-mandated regulation standards may qualify for bonus credit under Series 400.⁹¹

⁸⁵ *Key Coastal Management Policies Relevant to Sea-Level Rise in Georgia*, *supra* note 76.

⁸⁶ Teresa Concannon, Mushtaq Hussain, Daniel Hudgens & James G. Titus, *supra* note 77.

⁸⁷ *Key Coastal Management Policies Relevant to Sea-Level Rise in Georgia*, *supra* note 76.

⁸⁸ *Turner v. Georgia River Network*, 297 Ga. 306, 307 (2015).

⁸⁹ See S.B. 101 (2015), Georgia General Assembly, available at <http://www.legis.ga.gov/Legislation/en-US/display/20152016/SB/101>. At the time of publication, the Environmental Protection Division was conducting stakeholder meetings to discuss proposed changes to the Rules for Erosion and Sedimentation Control, as mandated by S.B. 101. The rules were to be issued by December 31, 2015.

⁹⁰ *Id.*

⁹¹ *CRS Coordinator's Manual*, *supra* note 6, at 430-38.

Additionally, a community may qualify for credits for erosion and sedimentation control regulations under Section 450, which includes a maximum of 40 credits for erosion and sedimentation control regulations under Section 452.c.⁹² However, a community is only eligible for this additional credit if the state mandate exceeds the requirements for a National Pollutant Discharge Elimination System (NPDES) permit.⁹³

C. *Georgia Shore Protection Act*

In 1992, Georgia enacted the Shore Protection Act (SPA) to protect sand dunes and beaches along the Georgia coast.⁹⁴ The SPA requires property owners to obtain a permit for certain activities and structures on the beach,⁹⁵ such as construction of a structure that will alter the natural shoreline's topography and vegetation.⁹⁶ With respect to sea-level rise issues, the SPA contains provisions that may be able to address the following impacts of sea level rise: (1) increased coastal flooding and inundation; (2) increased shore erosion and land loss; and (3) threats to aquatic and marine ecosystems.⁹⁷

Although the SPA has no direct connection to the sea level rise measures discussed in this article, it does contain provisions that relate to the natural shoreline protection measures discussed in Section 422.g of the Manual under Mapping and Regulations.⁹⁸ Like the SPA recognizes the importance of protecting Georgia's shoreline features including sand dunes, beaches, sandbars, and shoals, the natural shoreline protection measure in the Manual recognizes the importance of preserving the natural state of channels and shorelines.⁹⁹ The natural shoreline protection measure under Series 400 credits up to 120 points for communities that allow natural channels and shorelines to follow their natural processes and to encourage natural shorelines that provide water quality benefits

⁹² *Id.* at 450-18.

⁹³ *Id.* at 430-39.

⁹⁴ Teresa Concannon, Mushtaq Hussain, Daniel Hudgens & James G. Titus, *supra* note 77.

⁹⁵ *Key Coastal Management Policies Relevant to Sea-Level Rise in Georgia*, *supra* note 76.

⁹⁶ Teresa Concannon, Mushtaq Hussain, Daniel Hudgens & James G. Titus, *supra* note 77.

⁹⁷ *Key Coastal Management Policies Relevant to Sea-Level Rise in Georgia*, *supra* note 76.

⁹⁸ *CRS Coordinator's Manual*, *supra* note 6, at 420-1.

⁹⁹ *Id.* at 420-28.

for runoff.¹⁰⁰ While communities following SPA regulations are unlikely to be credited for this natural shoreline protection measure under current regulations, a community that adopts stricter regulations or that makes it a dedicated practice to refrain from issuing any permits that affect natural shoreline protection may be eligible for credits under this measure.

D. Georgia Coastal Management Act

The Georgia General Assembly enacted the Georgia Coastal Management Act (GCMA) in 1997.¹⁰¹ The GCMA authorizes the state of Georgia to prepare and administer a coastal management program.¹⁰² Additionally, the GCMA establishes requirements for the Department of Natural Resources to develop and implement a program that addresses sustainable development and protection of coastal resources.¹⁰³ With respect to sea level rise issues, the GCMA contains provisions that may be able to address the following impacts of sea level rise: (1) increased coastal flooding and inundation; (2) increased shore erosion and land loss; and (3) threats to aquatic and marine ecosystems.¹⁰⁴

The GCMA has indirect connections to some of the sea level rise measures discussed in the previous section of this article, particularly the development of a master watershed plan and the incorporation of a mapping system. Although the GCMA does not require watershed planning, Georgia's coastal management program is structured in a way that could likely incorporate a watershed planning component similar to the master watershed plan discussed above and found in Section 452.b of the Manual.¹⁰⁵ In addition to adopting a master watershed plan, a community could likely incorporate a mapping system, in which a community provides information (not mapped on the FIRM) about areas that are predicted to be susceptible to flooding in the future because of climate change or sea level rise. Credit is awarded for this measure based on the

¹⁰⁰ *Id.*

¹⁰¹ *About Coastal Management*, Coastal Resources Division of the Department of Natural Resources, available at <http://coastalgadnr.org/cm/about>.

¹⁰² *Key Coastal Management Policies Relevant to Sea-Level Rise in Georgia*, *supra* note 76.

¹⁰³ *Id.*

¹⁰⁴ *Id.*

¹⁰⁵ *CRS Coordinator's Manual*, *supra* note 6, at 450-14.

criteria set forth in Section 322.c of the Manual, as discussed in Section II of this article.¹⁰⁶

In addition to the statutes discussed in this section, the Executive Order signed by Governor Nathan Deal on January 14, 2013 has the ability to address sea level rise concerns in Georgia. In his Order, Governor Deal directed the Department of Natural Resources' CRD and other state agencies to develop the Georgia Disaster Recovery and Redevelopment Plan (GDRRP).¹⁰⁷ CRD is two years into a five-year strategy to produce a model post-disaster redevelopment plan to evaluate state and local policies and procedures for use in a post-disaster environment.¹⁰⁸ In developing the GDRRP, if CRD and other relevant state agencies require communities to implement the sea level rise measure addressed in Section 512.a of the Manual, which requires a community to assess local flooding hazard data including how often it floods, the locations of areas that flood, the depth of flooding, and the source or cause of flooding, communities could earn CRS credit in this area.

V. CONCLUSION

Including sea level rise measures as part of the CRS Manual has been an important way to acknowledge local efforts to plan for increased flooding caused by rising sea levels. Several areas exist where Georgia communities can take advantage of these opportunities and create greater discounts for their communities. Because coastal floodplains - and the policies that protect properties in these areas - are projected to expand, it is likely that the next version of the CRS Manual will include even more provisions. As Georgia communities work to protect private property from increased flood risks, a strong potential exists that even more CRS credits – and savings – will be available in the future.

¹⁰⁶ *Id.* at 320-11.

¹⁰⁷ *Executive Order signed by Georgia Governor Nathan Deal* (Jan. 14, 2013), available at http://gov.georgia.gov/sites/gov.georgia.gov/files/related_files/document/01.14.13.02.pdf.

¹⁰⁸ *Coastal Hazards*, COASTAL RESOURCES DIVISION OF THE DEPARTMENT OF NATURAL RESOURCES, <http://coastalgadnr.org/cm/hazard>.

APPENDIX: Summary of CRS Sea Level Rise Measures		
Category	Measure	Maximum CRS credits available
Series 300: Public Information Activities	Map Information Service: community must provide inquirers with information (not shown on the community's FIRM) about areas that are predicted to be susceptible to flooding in the future due to sea level rise	20
	Hazard Disclosure: local real estate agents must disclose to prospective buyers a property's potential for flooding due to sea level rise	8
Series 400: Mapping and Regulation	Program Prerequisite: community must demonstrate that it has programs which minimize increases in future flooding	Prerequisite to become a Class 4 or better community
	Program Prerequisite: community must be using regulatory flood elevations in the V and coastal A zones that reflect future conditions, including sea level rise	Prerequisite to become a Class 1 or better community
	Floodplain Mapping: community's regulatory map must be based on future-conditions hydrology, which means that discharges associated with a fully developed watershed must be used and must be created without consideration of projected construction of flood detention structures or hydraulic modifications within a stream or other waterway	160
	Stormwater Management: community's stormwater program must regulate runoff from future development	380
	Stormwater Management: community's watershed master plan must manage future peak flows so that they do not exceed present values	315
Series 500: Flood Damage Reduction Activities	Floodplain Management Planning: community must conduct a flood hazard assessment and problem analysis to address areas likely to flood and flood problems that are likely to get worse in the future <u>Step 4</u> (assess the hazard): community planners must review, analyze, and summarize data from existing flood studies to assess the sources, frequency, extent, and causes of flooding <u>Step 5</u> (assess the problem): community planners must assess the impact of the flood-related hazards identified in Step 4 on the community	Step 4: 35 Step 5: 52
		Total credits available: 970

CLAM BAYOU RESTORATION PROJECT: A CASE STUDY IN WETLAND RESTORATION

Lauren Eliopoulos¹

I. INTRODUCTION

“When we try to pick out anything by itself, we find it hitched to everything else in the universe.”²

In today’s modern, fast-paced world it is easy to forget about the innate interconnectedness of our natural surroundings and the benefits they provide us. For many years, wetlands, for example, were characterized as cesspools for malaria and disease. It was not until scientists brought to light the multivariate benefits of wetlands—such as biodiversity, water purification, storm surge protection, and the fact that wetlands are key areas for wildlife to breed and grow—did destruction begin to slow.³ To date, over half of the wetlands in the United States have been destroyed,⁴ and Florida alone has lost over 9.3 million acres of wetlands.⁵ Clam Bayou, a tributary wetland of Boca Ciega Bay, located in Gulfport, Florida, presents a case study of this destruction. Thankfully, Clam Bayou also provides an example of successful restoration.

Estuaries are the cradle of life for coastal environments.⁶ Coastal environments depend on tidal creeks to balance salinity levels through the timing

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² John Muir, *Welcome*, <http://discoverjohnmuir.com/> (last visited Nov. 18, 2014). This quote has personal meaning for me. The first time I read it, I was in Muir Woods National Park just outside of San Francisco, California—the same place that Mr. Muir spent many of his days.

³ Mary E. Kentula, *Restoration, Creation and Recovery of Wetlands*, United States Geological Survey Water Supply Paper 2425 (1996).

⁴ Thomas E. Dahl & Gregory J. Allord, *Technical Aspects of Wetlands: History of Wetlands in the Conterminous United States*, National Water Summary—Wetland Resources 19 (1996).

⁵ *Florida Wetlands: Wetlands Threats and Loss*, UNIVERSITY OF FLORIDA (August 2015), <https://soils.ifas.ufl.edu/wetlandextension/threats.htm>.

⁶ Dahl & Gregory, *supra* note 4, at 20.

and distribution of freshwater flows and creeks. They also provide an essential nursery habitat for a variety of sport fish and the forage they consume.⁷ This essential function of Clam Bayou had been eliminated, and the bayou's restoration sought to rejuvenate it.

This article examines Clam Bayou's restoration and argues that the interdisciplinary approach used by the Florida Department of Environmental Protection (DEP), Southwest Florida Water Management District (SWFWMD), and private ecological groups, coupled with the support of local government and citizens to achieve this restoration, present a framework that could be adopted on a national scale. While SWFWMD largely spearheaded the restoration, many community partners and levels of government made this project possible. Part II looks at the history of Clam Bayou, including its ecological character, water, wetlands, wildlife, and functions. Additionally, Part II will focus on both the importance and value of Clam Bayou within the greater community. Part III examines the extensive Clam Bayou Restoration Project. Next, Part IV discusses the results of the restoration, the response from the local community, continued government involvement, and litigation. Finally, this article concludes with recommendations for the future and suggests how elements of the Clam Bayou Restoration Project could be applied to similar restoration efforts.

II. THE HISTORY OF CLAM BAYOU

In the early 1900s Clam Bayou was a small, but well-functioning, estuarine wetland. However, due to development in the 1920s and 1930s, Clam Bayou became a dumping ground for St. Petersburg, Seminole, Gulfport, and North St. Petersburg. As SWFWMD reports, “[u]ntil the 1920s, Clam Bayou was relatively untouched by human alteration.”⁸ But soon, untreated sewage, stormwater, trash, and urban refuse from the surrounding 2,600 acres began to funnel through the stormwater system directly into the wetland. Aerial

⁷ *Id.*

⁸ SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, 21ST ANNUAL FUTURE OF THE REGION AWARDS PROJECT DESCRIPTION AND SUPPLEMENTAL INFORMATION, CLAM BAYOU PHASE 3 ECOSYSTEM RESTORATION AND STORMWATER TREATMENT PROJECT 3 (2013) (copy of report on file with author).

photographs document how urban development around the Bayou drastically altered the habitat and hydrology. Clam Bayou originally included a shallow, low-energy U-shaped embayment that harbored an undulating shoreline, at least five tidal creeks, small mangrove islands, sand flats, seagrass beds, coastal pine flatwoods, various avian and marine species, and scattered hammocks.⁹ At the time, little thought was given to how the vast amounts of pollution would impact Clam Bayou, let alone the greater water system of Tampa Bay and the Gulf of Mexico.

As one might expect, Clam Bayou became severely degraded—the wetland simply could not support the amount of pollution flowing through it. As District Senior Professional Engineer Janie Hagberg commented to SWFWMD, “most of Clam Bayou watershed was developed prior to the state’s implementation of stormwater regulations requiring treatment.”¹⁰ Further, in the 1940s a natural stream was converted into a channel at the end of 26th Avenue in Gulfport to accommodate overflow and stormwater from the surrounding 800 acres.¹¹ When the channel was created, the bed of the existing stream was dredged and widened.¹² This process removed natural vegetation and changed the natural flow of the water. Essentially, it lessened the amount of time water spent in the stream, meaning fewer pollutants could be filtered out—resulting in more pollution into the greater water system.¹³ The toxicity of the water killed many native marine species, and the Bayou became overrun with nonnative species, such as Brazilian pepper, Australian pine trees, and Guinea grass, causing many of the native plant species to die.¹⁴

Fortunately, things began to change in the 1990s when the Florida DEP and SWFWMD paired with a private wetland restoration firm, Scheda Ecological

⁹ *Id.* at 3.

¹⁰ *Id.*

¹¹ *Id.*

¹² *Id.*

¹³ *Id.*

¹⁴ *Final Clam Bayou Restoration Phase Under Way*, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT (Oct. 2010), available at <https://www.swfwmd.state.fl.us/documents/publications/watertmatters/sep-oct2010/1.html> [hereinafter Final Clam Bayou Restoration Phase Under Way].

Associates,¹⁵ to restore Clam Bayou. The Bayou's restoration officially began in 1995 with wide support from the local community, who had witnessed the Bayou's destruction.

Before it could be implemented, the restoration project had to go through multiple permit processes. First, the restoration was classified as storm water restoration under the Army Corps of Engineers' Nationwide Permit (NWP) 27.¹⁶ SWFWMD, which provided the majority of the restoration's funding, had to have the project approved through the DEP permit process.¹⁷ Pinellas County, however, exempted the project through the Inland Navigation District, which states that anything that comes into contact with mangrove, a protected species, can be restored without a permit.¹⁸

SWFWMD began the restoration process by dividing the Bayou's 170 acres into seven restoration areas, which would be restored in three phases. The Phase I project, initiated by the Florida DEP, the City of Gulfport, and SWIM, focused on the 10-acre area now known as Clam Bayou Nature Park.¹⁹ Phase I included restoring coastal uplands, creating an open water lagoon, marshes, coves, and a tidal channel, and stabilizing the southern shoreline.²⁰ Phase II began in 2000 and focused on restoring ten additional acres of estuarine channels, lagoons, and marshes.²¹ During this phase, SWIM also had a \$1,721,600 budget for the 1999, 2000, and 2001 fiscal years²² to create two new areas for improved

¹⁵ Interview with Thomas Ries, Executive Vice President & Principal Scientist, Scheda Ecological Associates, in Tampa, Florida (Oct. 28, 2014) [*hereinafter* Ries Interview]. As the lead scientist on the Channel Area Restoration Project, Ries worked with the DEP and SWFWMD to complete the survey, renderings, and restoration. Ries was also involved with the North Pond Restoration and the Spoil Mound Restoration while working for SWIM.

¹⁶ 33 C.F.R. § 320.4.

¹⁷ SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, *supra* note 8, at 3.

¹⁸ *Id.*

¹⁹ See generally *Final Clam Bayou Restoration Phase Under Way*, *supra* note 14.

²⁰ *Id.*

²¹ *Surface Water Improvement and Management (SWIM) Plan: Tampa Bay*, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT 25 (Feb. 8, 1999), available at http://www.swfwmd.state.fl.us/files/database/site_file_sets/34/tampabay.pdf; *Final Clam Bayou Restoration Phase Under Way*, *supra* note 14.

²² SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, *supra* note 8, at 25.

stormwater treatment.²³ Phase III spanned forty-four acres, including twenty-four acres of restored habitat and twenty acres of improved stormwater treatment.²⁴

The Clam Bayou restoration was completed in October 2012 and dedicated on October 27, 2012.²⁵ The seven restored areas became known as the North Stormwater Pond, Central Stormwater Pond, South Stormwater Pond, Spoil Mound Restoration (String-of-Pearls), Channel Restoration Area, Central Restoration Area, and Southern Restoration Area Projects.²⁶ These individual projects covered approximately 200 acres of landform change and were completed from 1995–2012.²⁷

Since the restoration's completion, local community groups continue to support the state's efforts through cleanups and local awareness campaigns.²⁸ However, more work still needs to be done to protect the Bayou. For instance, in 2008, local Brownie Troop 906 collected forty-two pounds of garbage in the Nature Park, including everything from styrofoam cups and beer bottles to cigarette lighters, lipstick, Burger King wrappers, and plastic forks.²⁹ Further, due to record amounts of rain and the shutting down of a stormwater treatment plant in the summer of 2015, over fifteen million gallons of raw untreated sewage flowed through Clam Bayou in August 2015.³⁰ The amount of trash in the Bayou

²³ *Id.*

²⁴ *Id.*

²⁵ Press Release, City of St. Petersburg, Clam Bayou Nature Preserve Restoration Dedication and Skyway Trail Ribbon Cutting Ceremony (Oct. 23, 2012).

²⁶ *Overview of Clam Bayou Habitat Restoration and Stormwater Treatment Project*, SOUTH WEST FLORIDA WATER MANAGEMENT DISTRICT, <http://www.swfwmd.state.fl.us/projects/clambayou/ClamBayouRestorationStormwaterProjectSitesSummary.pdf> (last visited Nov. 18, 2014).

²⁷ Ries Interview, *supra* note 15.

²⁸ Stephen Nohlgren, *Little Hands do Big Job Cleaning Clam Bayou*, ST. PETE TIMES (Oct. 18, 2008), <http://www.tampabay.com/news/environment/water/little-hands-do-big-job-cleaning-clam-bayou/861285>.

²⁹ *Id.*

³⁰ Jacqueline Ingles, *15 Million Gallons of Raw Sewage Dumped into Clam Bayou by City of St. Pete is costing Businesses*, ABC ACTION NEWS (Sept. 3, 2015), <http://www.abcactionnews.com/news/region-pinellas/15-million-gallons-of-raw-sewage-dumped-into-clam-bayou-by-city-of-st-pete-is-costing-businesses>); Zachary T. Sampson, *Sewage pumped into Clam Bayou place St. Petersburg and Eckerd College at odds, again, over Wastewater*,

today and the risk of raw sewage being dumped into the Bayou again demonstrates that additional work still needs to be completed to protect this wetland.

III. THE RESTORATION PROJECT

As discussed above, Clam Bayou's restoration involved seven different restoration projects. This article analyzes the three largest projects that resulted in the greatest impact: the North Stormwater Pond Restoration, Channel Restoration Area Project, and Spoil Mound Restoration.³¹

A. *The North Stormwater Pond*

Clam Bayou's restoration began in 1995 with the North Stormwater Pond Restoration with SWIM and Thomas Ries leading the project.³² North Pond covers 5.81 acres and receives runoff from 630 acres of surrounding lands.³³ The pond is located between a public golf course on its north end and Clam Bayou on its southwestern end.³⁴

The project focused on a retrofit of a retention pond to allow untreated stormwater to settle in the pond, filter out debris and nutrients, prevent trash and floatable material from entering the upper reaches of Boca Ciega Bay, and improve stormwater runoff through wet detention.³⁵ For this project, stormwater runoff enters the systems from the Clam Bayou Canal through a 10-foot by 8-foot box culvert.³⁶ Further, “[a] diversion weir was installed in the canal immediately downstream from the culvert to directly flow into the North Pond.”³⁷ Installed in

³¹ TAPMA BAY TIMES (Aug. 6, 2015), <http://www.tampabay.com/news/localgovernment/raw-sewage-pumped-into-clam-bayou-places-eckerd-college-and-city-at-odds/2240328>.

³² Thomas Ries, *Clam Bayou Tract Phase 3: Habitat Restoration Project*, C1–C10 (Mar. 2009).

³³ *Id.*

³⁴ VANASSE HANGEN BRUSTLIN, INC., CLAM BAYOU STORMWATER TREATMENT PROJECT PERFORMANCE EFFICIENCY EVALUATION PINELLAS COUNTY, FLORIDA 4, 28 (Oct. 2013) (copy of report on file with author) [*hereinafter Vanasse*].

³⁵ Ries Interview, *supra* note 15.

³⁶ Vanasse, *supra* note 33, at 1.

³⁷ *Id.*

the pond are a number of turbidity barriers and nets that help catch trash and other debris and keep it from flowing through the pond and entering Clam Bayou.³⁸

The pond's restoration did not disturb the pond's existing mangroves or the adjacent wetlands along the east side of the pond. A variety of saline tolerant plants were integrated into the pond area, such as smooth cordgrass (*spartina alterniflora*), seashore paspalum (*paspalum vaginatum*), and Walter's viburnum (*viburnum obovatum*).³⁹ The addition of such plants aimed to help filter and clean the water that enters North Pond.⁴⁰

Due to the restoration, the upper portion of North Pond now has a barrier to prevent water from immediately running into Clam Bayou. Currently, water stays in North Pond for approximately fourteen days, which allows for pollutants and nutrients to drop into the sediment of the pond instead of flowing into Boca Ciega Bay.⁴¹ In addition, stormwater is now diverted and moved through a spillway and filter system in order to collect large pieces of trash and debris.⁴²

According to Ries, the most important factor of the stormwater retrofit is the addition of the vegetation.⁴³ In his opinion, because it had such a profound effect on the surrounding watershed, the North Pond restoration was the model for the rest of the restoration projects to follow.⁴⁴ Furthermore, due to the intensity of the chemicals and fertilizers running off from the golf course, creating a retention pond to collect and filter the pollutants was paramount to the restoration and cleanup of Clam Bayou.

³⁸ Ries Interview, *supra* note 15.

³⁹ *Id.*

⁴⁰ *Id.*

⁴¹ *Id.*

⁴² *Id.*

⁴³ *Id.*

⁴⁴ *Id.*

B. *The Channel Restoration Area Project*

The Channel Restoration Area Project began in 2012, with construction lasting twelve months.⁴⁵ The project's focus was to restore the natural flow and vegetation that had been removed from the channel during the 1940s and 50s.⁴⁶ Before the restoration, a drainage ditch bisected the Bayou and was bordered by a spoil berm inundated with nonnative species.⁴⁷ By reconfiguring the ditch and berm to create a meandering tidal channel, the project provided more coastal habitat and increased the channel's natural flow and turbidity. Water now moves more slowly through the habitats, allowing more dirt and pollution to be filtered out before it enters the Bayou and Tampa Bay.⁴⁸

As Ries notes, restoration projects like this should "design around existing features in the area, be it an oak tree, uplands, marshes, and tidal areas."⁴⁹ This concept of "adaptive management" allows for changes in the initial plans to better reflect the actual landscape of the areas being restored.⁵⁰ Specifically, in the Channel Restoration Area Project, the parties wanted to ensure that oak trees and mangroves were preserved during the restoration.⁵¹ In addition, large limestone rocks that were on site were re-deposited in the channel to act as critical habitat for juvenile recruits of several game fish species native to the area, such as snook, tarpon, and redfish.⁵² Furthermore, only certain areas were smoothed, and ruts were increased in other areas, to create a more natural flow in the water.⁵³

In addition, contour lines were added to increase the natural flow of water, a silt fence was inserted along the sides and at the end of the channel, a rock-filled ditch area was created at the beginning of the channel to catch trash from stormwater, and floating turbidity barriers were installed.⁵⁴ Each of these elements

⁴⁵ Ries, *supra* note 31, at C2.

⁴⁶ *Id.*

⁴⁷ See generally Southwest Florida Water Management District, *supra* note 8.

⁴⁸ *Id.*

⁴⁹ Ries Interview, *supra* note 15.

⁵⁰ *Id.*

⁵¹ Ries, *supra* note 31, at C2.

⁵² *Id.*

⁵³ *Id.*

⁵⁴ *Id.*

of the restoration allowed for the channel to better filter water, essentially creating a habitat mosaic, in which each element of the channel—from the bed, to the flow of the water, to the tree and mangrove preserves—make this a more natural habitat.⁵⁵ In the channel today, the water is approximately fifty percent stormwater and fifty percent natural flowing water from the watershed.⁵⁶

C. *The Spoil Mound Restoration*

The Spoil Mound Restoration, commonly referred to as the “String of Pearls,” is located in a mangrove forest. Before it was restored, the area contained mosquito ditches and spoil piles dominated by nonnative, invasive vegetation, such as Brazilian pepper.⁵⁷ The String of Pearls project features open water lagoons as the “pearls” and tidal channels as the “strings.”⁵⁸ The project aimed at creating a series of small tidal channels and lagoons by excavating spoil piles and restoring critical open-water and fishery habitats in Clam Bayou.⁵⁹

The City of St. Petersburg constructed a temporary road that extended the length of the spoil mounds, beginning with the mound closest to the water and moving inward toward 26th Avenue.⁶⁰ As each spoil mound was eliminated, the road was slowly removed and the land returned to its natural state.⁶¹ Here, the most difficult aspect of the restoration, as the SWFWMD’s Chief Environmental Scientist Brandt Henningsen noted, was the fact that the original creeks of the Bayou could not be restored ““because there ha[d] been so much alteration of the watershed and development as an urban landscape.””⁶² As a result, SWIM worked to create a tidal creek that would flow naturally, but that would be filled with

⁵⁵ Ries Interview, *supra* note 15.

⁵⁶ *Id.*

⁵⁷ SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, *supra* note 8.

⁵⁸ *Id.* at 7.

⁵⁹ *Id.*

⁶⁰ Ries, *supra* note 31, at C1.

⁶¹ Ries Interview, *supra* note 15.

⁶² David Brown, *Making Pearls on Tampa Bay*, FLORIDA SPORTSMAN (Aug. 12, 2013), <http://www.floridasportsman.com/2013/08/12/making-pears-on-tampa-bay/> (quoting Brandt Henningsen).

stormwater rather than pristine waters. This would allow some of the habitat benefits and functions of a natural creek to be present.⁶³

IV. RESULTS OF THE RESTORATION

The construction and restoration, completed in 2012, vastly improved the water quality in Clam Bayou as a whole.⁶⁴ However, there has been backlash from local community members regarding the speed and thoroughness of the restoration.⁶⁵

Throughout the restoration project and during the initial months afterwards, the FWCC and private ecological groups performed various water quality tests. Vanasse Hangen Brustlin, Inc. (Vanasse), an environmental and ecological services company, released a report in October 2013 that demonstrated the water quality of Clam Bayou post-restoration.⁶⁶ In July 2012, SWFWMD created and submitted their Quality Assurance Project Plan (QAPP) for the Clam Bayou project.⁶⁷ The Vanasse study then used the QAPP to create the parameters for their subsequent study.⁶⁸ Vanasse followed an eighty-five-day evaluation period from August 17 to November 9, 2012, and took data and samples from North Pond, Central Pond, and South Pond to determine the efficacy of the restoration in these sites. The purpose of the study was to review the concentrations of nutrients, sediment, and floating trash in the pond based off reports from the permanent field data monitoring equipment, and then develop

⁶³ *Id.*

⁶⁴ SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, *supra* note 8, at 3.

⁶⁵ Telephone Interview with Tom W. Reese, Attorney (Oct. 18, 2014).

⁶⁶ It is important to note that all of the pre- and post-restoration water quality studies are permitted under Clean Water Act § 319 Nonpoint Source Management Program through the EPA and Florida DEP. Through the § 319 program the EPA is required to help fund the project in return for performance monitoring of the site once restoration is completed. The Clam Bayou Restoration Project in total cost \$5,094,495, and approximately 17.6% or \$898,800 was provided by the EPA. Vanasse, *supra* note 33, at i.

⁶⁷ § 319(h) Project Summary FY2005 Section 319 Grant, FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION 23, http://www.dep.state.fl.us/water/nonpoint/docs/319h/FY05-319h_Project_Summary.pdf.

⁶⁸ Vanasse, *supra* note 33, at 5.

removal efficiencies and create a total maximum daily load (TMLD) as required by the Clean Water Act.⁶⁹

During Vanasse's experiment, three different types of testing were performed: stormwater flow, baseflow, and *in situ*.⁷⁰ The site modules were calibrated to begin testing during two different periods: (1) when there was any rainfall greater than 0.2 inches to measure the stormwater runoff; and (2) in times of baseflow.⁷¹ Benchmark EnviroAnalytical, Inc. analyzed each sample from the modules for ammonia, nitrogen, nitrite and nitrate nitrogen, total kjeldahl nitrogen, total nitrogen, orthophosphorus, total phosphorus, total suspended solids, turbidity, total cadmium, total chromium, total cooper, and total zinc.⁷² The *in situ* data referenced temperature, pH, dissolved oxygen, conductivity, and salinity.⁷³

During the eighty-five days, North Pond received the most rainfall overall, including 2.2 inches on October 5, 2012. According to Vanasse, the increased runoff volumes from these larger rain events "serve to shorten the residence time within the stormwater treatment ponds, which in turn reduces their efficiency."⁷⁴ As a result, in the summer months and during the rainy season when rainfall is greater in the Tampa Bay area, the efficiency of the restoration project decreases simply because the amount and volume of water flowing through the ponds and restoration sites is so great. The efficiency of the Bayou restoration is also impacted during the summer due to increases in tidal flows associated with the position of the sun and moon and their respective gravitational forces.

However, these periods of lower efficacy do not mean that the North Pond Restoration has not been successful; rather it demonstrates that a larger area of land to hold water would be able to better treat stormwater and tidal flow pollution. In fact, Environmental Research & Design, Inc. found that for an "average annual rainfall year based on a 50-year period of record, the North Pond

⁶⁹ *Id.*

⁷⁰ *Id.* at 4.

⁷¹ *Id.* at 9.

⁷² *Id.* at 10.

⁷³ *Id.* at 20.

⁷⁴ *Id.* at 15.

and Central Pond would treat 87.3% and 90% of the estimated annual runoff volume.”⁷⁵

In total, the Vanasse study completed fourteen sampling events: ten storm-related and four baseflow.⁷⁶ Of those samplings, seven storm events and three baseflow events were measured at North Pond. In the pond the “average removal efficiencies for total nitrogen were 37.0% and 32.6% for storm events and baseflow events respectively, with an overall removal efficiency of 36.9%.”⁷⁷ The average removal efficiency for total phosphorus was 14.8 percent, with similar removal efficiencies for total suspended solids.⁷⁸ While these percentages may seem small or disproportionate to the money spent on the Bayou’s restoration, it must be considered that prior to the project there were no removal efficiencies, and that the removal efficiencies will improve over time generally and during periods with lower rainfalls.

According to SWFWMD, the North Pond alone has accounted for a “33 percent annual load reduction for total nitrogen and greater than 80 percent annual load reduction for total suspended solids,” both of which are the primary contributors to habitat degradation.⁷⁹ First, nitrogen inputs accelerate the growth of algae, negatively affecting water quality and light availability for other native species to grow and thrive. Second, total suspended solids alter the turbidity and sediment in the Clam Bayou ecosystem. As the amount of total suspended solids enter the water, they change the clarity and density of the water and eventually settle to the bottom of the wetland ecosystem, which changes the depth and natural flow of the water moving through the area. By installing the box culvert and reconstructing the pond, the restoration has resulted in an “estimated reduction of 576 kilograms or 1,267 pounds of total nitrogen per year and an

⁷⁵ ENVIRONMENTAL RESEARCH & DESIGN, INC., SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, CLAM BAYOU STORMWATER TREATMENT PROJECT FEASIBILITY STUDY RESULTS (2004); ENVIRONMENTAL RESEARCH & DESIGN, INC., SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, CLAM BAYOU STORMWATER TREATMENT PROJECT HYDROLOGIC MODELING REPORT (2008).

⁷⁶ Vanasse, *supra* note 33, at 21.

⁷⁷ *Id.* at 24.

⁷⁸ *Id.*

⁷⁹ SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, *supra* note 8, at 6.

estimated reduction of 6,483 kilograms or 14,263 pounds of total suspended solids per year.”⁸⁰

The String of Pearls restoration was also pivotal to restoring habitat and ensuring the potential growth of mangrove pockets. In the String of Pearls, the mangrove roots act as the ideal place for juvenile fish to mature by protecting them from larger predators that cannot navigate through the mangroves. The Spoil Mound Restoration has brought back some of the original tidal creeks, and as a result, the rejuvenated Clam Bayou is a better representation of the natural wetland before the development and alterations that occurred throughout the mid-1900s.⁸¹ Due to the String of Pearls restoration, Clam Bayou can now more efficiently function as a wetland and provide enhanced ecosystem benefits, such as cleaner water, fisheries habitats, and species diversity.

In addition, the String of Pearls receives treated stormwater from the adjacent North Stormwater Pond. The flow of freshwater from the pond through the new series of lagoons and channels helps to establish salinity gradients, including low salinity habitats, which are critical for fisheries.⁸² In addition to purifying water, the wetland complex is now further cleansing stormwater as a result of the restoration, which SWFWMD refers to as “stormwater polishing.”⁸³ This additional layer of purification prior to discharge to the open waters of Clam Bayou allows for cleaner water to eventually enter Boca Ciega Bay.⁸⁴

SWFWMD also contends that the entire seven-site restoration project has restored some of the original hydrology and landscape of Clam Bayou. As Henningsen noted, “as with the string-of-pearls design, not only have some of the original open water habitats been restored, but the restored hydrology of tidal and freshwater flows is helping drive salinity gradients important for fisheries productivity as well as promote some additional stormwater polishing.”⁸⁵ In

⁸⁰ *Id.*

⁸¹ *Id.* at 10.

⁸² *Id.* at 7.

⁸³ *Id.*

⁸⁴ *Id.*

⁸⁵ *Id.* at 8.

addition, this sinusoidal tidal creek complex helps offset the loss of the original four tidal creeks that historically drained to this corner of the Bayou.

While the cooperation between Florida DEP, SWFWMD, environmental groups, the City of St. Petersburg, and Gulfport have been largely praised for the work completed at Clam Bayou, some feel that it is not enough. In 2008, Alfred and Cynthia Davis, local residents of Gulfport, Florida, filed suit against the U.S. Environmental Protection Agency (EPA) claiming that the EPA had not done enough with the Clam Bayou restoration project.⁸⁶ In their initial letter, the Davises claimed the EPA and state of Florida failed to establish ambient water quality in Clam Bayou as is required by the Clean Water Act (CWA).⁸⁷ The Davises felt that the restoration project should have restored the Bayou's water quality to 1975 levels.

The Davis' main point of contention was the amount of sediment in the Bayou, rendering much of it non-navigable.⁸⁸ In the first case, the focus of litigation was interpretation of CWA § 303,⁸⁹ regarding DEP's obligation to designate, protect, and clean the waters of Clam Bayou. The DEP dismissed the petition.⁹⁰ Next, the Davises sued the EPA, which led to the parties reaching a settlement.⁹¹ As of September 2014, the Davises planned to file a third phase of litigation in light of FWCC studies on fish flesh in the Bayou, such as striped mullet, snook, and sheepshead, which showed degradation from pollutant contamination.⁹²

In addition, as of January 21, 2014, the Gulfport City Council felt additional review of the water quality was warranted, indicating that the community wanted more to be done to restore Clam Bayou. As reported in the St. Petersburg Times, "City Council told the staff [of Clam Bayou] to retain an

⁸⁶ Austin Bogues, *The Battle for Clam Bayou*, ST. PETERSBURG TIMES, Dec. 13, 2008, <http://www.tampabay.com/news/environment/water/the-battle-for-clam-bayou/936245>.

⁸⁷ *Id.*

⁸⁸ *Id.*

⁸⁹ 33 U.S.C. §1313; Ries Interview, *supra* note 15.

⁹⁰ See generally Bogues, *supra* note 86.

⁹¹ Telephone Interview with Tom W. Reese, Attorney (Oct. 18, 2014).

⁹² *Id.*

outside firm to review and compile all existing data as the first step in developing plans for the estuary.”⁹³

V. CONCLUSION

The restoration of Clam Bayou provided opportunities for community members, members of the local and federal government, agencies, and environmental groups to unite and create a functioning wetland ecosystem that provides services to both local habitat and community members who enjoy the area. A large group of stakeholders came together to restore this wetland, including the Native Plant Society, Audubon Society, the local units of Boy Scouts and Girls Scouts, Keep Pinellas Beautiful, SWFWMD, Florida DEP, over 500 volunteers, and five environmental consulting groups.

SWIM worked in conjunction with Tampa Bay Watch to organize and implement a series of volunteer marsh plantings, installing tens of thousands of marsh grasses throughout various project intertidal marsh platforms.⁹⁴ The marsh plugs themselves were, in part, grown by the Fish and Wildlife Conservation Commission (FWCC) in ponds associated with filtering effluent water from the FWCC’s Port Manatee Fish Hatchery. Inmates from the Manatee County Correctional Facility or public volunteers then harvested the marsh plugs.⁹⁵

It is evident that the restoration of Clam Bayou is due to this unique interplay between all of these actors that continue to work toward a better habitat and ecosystem for Clam Bayou. As Ries notes, “I can write you the best possible sketches and hire the very best contractor to put into place those designs, but the difference comes in when we are on site, working together with volunteers and community members to best invigorate the habitat already there.”⁹⁶ At Clam Bayou, all of these groups were able to take a synergistic approach to the restoration, which allowed for ongoing revisions to the project plans, which

⁹³ Diane Craig, *Community News: City Council Orders Clam Bayou Review*, ST. PETE TIMES, Jan. 21, 2014, <http://www.tampabay.com/news/humaninterest/gulfport-community-news-city-council-orders-clam-bayou-review/2162029>.

⁹⁴ *Id.*

⁹⁵ *Id.*

⁹⁶ Ries Interview, *supra* note 15.

resulted in the best possible restoration given the landscape, stormwater concerns, and development surrounding the wetland.

The Clam Bayou Restoration project is an example of mutual reinforcement—the community advocated the project and now maintains it through cleanups. SWFWMD estimates that daily volunteer efforts, coupled with several well-organized group efforts, have retrieved an estimated 200,000 pounds (100 tons) of trash from the Bayou.⁹⁷ It is the collaborative and interdisciplinary cooperation that has made the Clam Bayou restoration successful. And while the restoration does not prevent untreated stormwater releases, it has allowed a valuable natural resource to rebuild in a local ecosystem. The stormwater system and management still need to be improved, but the restoration of Clam Bayou represents a step in the right direction.

⁹⁷ Southwest Florida Water Management District, *supra* note 8, at 9.

**METHODOLOGY FOR IDENTIFYING AND EVALUATING SHELLFISH
MARICULTURE SITE DEVELOPMENT IN CALIFORNIA**

Mike Wilson, P.E.¹ and Annalisa Batanides, Esq.²

I. INTRODUCTION

Shellfish mariculture is an increasing area of interest for Californians, as project proponents up and down the state pursue permits and approvals for beginning or expanding shellfish mariculture operations. Coastal areas in Northern California are primarily being pursued for oyster farming, while offshore areas in Southern California are, for the most part, being considered for mussel farming. It is important to note that although “shellfish” includes a range of species such as crabs, lobsters, and shrimp, California shellfish mariculture is primarily limited to oyster, mussel, and clam cultivation. Thus, oysters, mussels, and clams are the most pertinent species to consider for California shellfish mariculture, and are the species primarily considered in this article.

After a long and entrenched history, shellfish mariculture in California experienced a steep decline at the turn of the Industrial Revolution. The renewed interest in developing shellfish mariculture is due in part to a recognition of our seafood deficit. In addition, state and federal guidelines have pushed for increased

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domestic shellfish production. The economic benefits to coastal communities and relatively limited environmental effects of shellfish farming on marine ecosystems have also renewed interest in the industry. Each of these will be described in greater detail below.

One of the greatest hurdles in pursuing new or expanded areas for shellfish mariculture in California is where decision-makers start in analyzing an area's suitability for production. Decision-makers must analyze an area's physical ability to grow shellfish in any particular site, or the site's physical feasibility. Decision-makers must also analyze the proximity of these areas to known environmentally sensitive, culturally significant, and economically important regions in deciding whether a chosen site is suitable for initiating or expanding shellfish mariculture operations. As will be discussed in further detail below, there are numerous laws and policies that govern the determination of site suitability based on the aforementioned factors. Decision-makers may in good faith attempt to conform with these laws and policies, and pursue environmentally and economically sound shellfish mariculture operations by choosing an appropriate site based on its physical and environmental constraints. However, this is made difficult by the myriad of possible factors for analysis related to physical feasibility, environmental constraints, cultural and economic considerations. The result can be overwhelming and confusing, and lead to uncertainty for decision-makers as far as where to initiate an analysis for site suitability.

This article provides decision-makers with the tools to undertake an initial review of physical and environmental constraints. An initial review may determine if an area is deemed physically suitable for shellfish mariculture activities, and may take the form of a pre-feasibility study similar to the Humboldt Bay Pre-Feasibility Study, which will be described in greater detail below.

II. SHELLFISH AQUACULTURE IN CALIFORNIA

“Aquaculture” is defined as the propagation and rearing of aquatic organisms for any commercial, recreational, or public purpose.³ This definition covers all production of finfish, shellfish, plants, algae, and other marine organisms for: 1) food and other commercial products; 2) wild stock replenishment for commercial and recreational fisheries; 3) rebuilding populations of threatened or endangered species under species recovery and conservation plans; and 4) restoration and conservation of marine and Great Lakes habitat.⁴ “Mariculture” generally refers to aquaculture operations that take place in the marine environment, typically bays and estuaries, but also offshore in the open ocean.⁵ Shellfish mariculture is also often referred to as “shellfish farming.”

California has a long and substantial history of shellfish culture, and its oyster industry can be traced back to the 1850s. Settlers associated with the Gold Rush acquired a taste for naturally occurring Olympia oysters from California’s coastline, and thus provided a commercial market for oysters.⁶ Unfortunately, the naturally occurring populations of oysters declined rapidly because of intensive harvesting, pollution, and increased coastal development.⁷ This resulted in the first attempts at oyster mariculture on the West Coast, in which Olympia oysters were transported from Shoalwater Bay, Washington (Willapa Bay), and later from other bays in the Pacific Northwest and Mexico, to San Francisco.⁸ The

³ *Shellfish Aquaculture – Frequently Asked Questions*, NAT’L OCEANIC AND ATMOSPHERIC ADMIN. FISHERIES, http://www.nmfs.noaa.gov/aquaculture/shellfish_portal/shellfish_faqs.html (last visited April 11, 2016).

⁴ *What Is Aquaculture*, NAT’L OCEANIC AND ATMOSPHERIC ADMIN. FISHERIES, http://www.nmfs.noaa.gov/aquaculture/what_is_aquaculture.html (last visited April 11, 2016).

⁵ MONTEREY BAY NATIONAL MARINE SANCTUARY SITE CHARACTERISTICS, NAT’L OCEAN SERVICE, NAT’L OCEANIC AND ATMOSPHERIC ADMIN. (March 5, 2014), <http://montereybay.noaa.gov/sitechar/soci4.html>.

⁶ *Shellfish Research and Information Services for the U.S. West Coast*, PAC. SHELLFISH INST., <http://www.pacshell.org/california.asp> (last visited June 1, 2015).

⁷ *Id.*

⁸ Fred S. Conte, *California Aquaculture: California Oyster Culture*, UNIV. OF CAL. DAVIS DEP’T OF ANIMAL SCI. 1, <https://www.extension.org/sites/default/files/California%20Oyster%20Culture.pdf> (last visited September 9, 2015).

Shoalwater Bay trade of Olympia oysters dominated the California market from 1850 through 1869.⁹

In 1875, Eastern oyster seed from the Atlantic states was planted and cultured in San Francisco Bay, an operation made possible by the completion of the transcontinental railroad.¹⁰ The Bay reached maximum production in 1899 with an estimated 2.5 million pounds of oyster meat produced.¹¹ However, by 1908, Eastern oyster production fell by fifty percent in San Francisco Bay, mostly due to degraded water quality and other human-caused stressors. Although oysters are filter feeders and thus can greatly improve water quality, oyster growth is limited in waters that are extremely degraded due to human activity. Thus, “degrading water quality is both a cause and an effect of oyster decline.”¹² This is because human stressors cause changing ocean conditions like higher water temperature, changed salinity, low dissolved oxygen, and incoming silt.¹³ These stressors make it more difficult for oysters to reproduce, increase disease, and increase predation.¹⁴ This decreases the amount of oysters in the water, which in turn lowers the amount that filtering oysters can provide to the water quality, which further limits oyster growth. By 1939, the last of the San Francisco Bay oysters were commercially harvested.¹⁵

In 1929, the California Department of Fish and Game (now the California Department of Fish and Wildlife) and commercial companies conducted experimental plantings of Pacific oysters in Tomales Bay just north of San Francisco and Elkhorn Slough in Monterey County.¹⁶ These were the first known

⁹ *Id.*

¹⁰ *Id.*

¹¹ *Id.*

¹² *Oyster Reefs*, NAT'L OCEAN SERVICE, CHESAPEAKE BAY OFFICE, NAT'L OCEANIC AND ATMOSPHERIC ADMIN., <http://chesapeakebay.noaa.gov/oysters/oyster-reefs> (last visited January 24, 2016).

¹³ *Id.*

¹⁴ *Id.*

¹⁵ Conte, *supra* note 8 at 2.

¹⁶ *Id.* (note, some sources disagree and cite this first experimental planting as taking place in 1928. See Elinore M. Barrett, *The California Oyster Industry*, RES. AGENCY OF CAL. DEP'T OF FISH & GAME 49 (1963), http://content.cdlib.org/view?docId=kt629004n3&brand=calisphere&doc.view=entire_text (last visited July 1, 2015)).

experimental plantings of the Pacific oyster in California, although such plantings had been occurring in Washington for decades.¹⁷ In the 1930s, experimental plantings continued in a number of bays, including Drakes Estero, Bodega Lagoon, and San Francisco Bay in northern California; Morro Bay in central California; and Newport Bay in southern California. Several Pacific oyster plantings proved successful, demonstrating that imported Pacific oyster seed (juvenile oysters about two millimeters in length brought from other water bodies) could be grown commercially in California.¹⁸

Although Pacific oysters can be grown successfully in California, they have failed to effectively reproduce in California waters.¹⁹ To reproduce, female oysters discharge several millions eggs repeatedly during one spawning period. A small number of these eggs are fertilized by sperm discharged by male oysters into the water. An even smaller number of fertilized eggs, or larvae, survive water hazards in order to attach to a surface and grow out into oyster seed, or very small juvenile oysters.²⁰ Pacific oysters have failed to effectively reproduce in California coastal waters due to a variety of environmental factors, chiefly water temperature. California oyster growing areas typically are not warm enough for oyster spawning. Occasionally, when water temperatures in California do reach that required for oyster spawning, the larvae do not survive, and “whether they perish because of temperature, salinity, or lack of food is unknown.”²¹ As such, the oyster industry has turned to the importation of oyster seed. Pacific oyster seed originated from Japan, and thus this importation was disrupted for a time during World War II.²² Today, most of the oysters grown in California are Pacific oysters produced from seed hatcheries in Washington and Oregon, and from several smaller specialty hatcheries within the state.²³

¹⁷ Elinore M. Barrett, *The California Oyster Industry*, RES. AGENCY OF CAL. DEP’T OF FISH & GAME, 48-89 (1963), http://content.cdlib.org/view?docId=kt629004n3&brand=calisphere&doc.view=entire_text (last visited July 1, 2015).

¹⁸ Conte, *supra* note 8, at 1.

¹⁹ Barrett, *supra* note 17, at 50.

²⁰ *Id.* at 14-16.

²¹ *Id.* at 15.

²² *Id.* at 56-57, 67.

²³ *Id.* at 50-51.

The California Department of Fish and Wildlife initially excluded Humboldt Bay from Pacific oyster plantings, as they were trying to re-establish natural populations of native oysters.²⁴ Efforts to raise Pacific oyster seed in Humboldt Bay began in 1953, in the northern part of the bay also known as Arcata Bay.²⁵ The planting was effective, and Coast Oyster Company initiated large-scale plantings in Arcata Bay in 1955.²⁶ Over the next thirty years, the California industry grew rapidly, centered in Humboldt Bay, Drakes Estero, Tomales Bay, Elkhorn Slough, and Morro Bay.²⁷

In addition to oysters, the California coast is home to a number of clam species including the gaper clam, Pacific razor clam, Pismo clam, butter clam, native littleneck, Manila clam, and geoduck clam.²⁸ The Manila clam, also known as the Japanese littleneck clam, was introduced with imports of Japanese oyster seed in the 1930s.²⁹ It has since become an important species to the aquaculture industry in California.

The life cycle of a manila clam, and thus the manila clam mariculture operation, begins at hatcheries, where “broodstock animals,” or adult clams are conditioned with heated water and food to stimulate the natural breeding season.³⁰ This can take six to nine weeks, but once desirable conditions are reached, the broodstock animals release eggs and sperm, and thus begin the spawning process.³¹ This process is also known as “rearing.” California does not have any facilities that rear Manila clam larvae. Instead, California imports Manila clam larvae from Oregon, Washington, and Hawaii, and grows the larvae to clam “seed,” or small juvenile clams.

²⁴ Conte, *supra* note 8, at 1.

²⁵ Barrett, *supra* note 17, at 70; Conte, *supra* note 8, at 55.

²⁶ Barrett, *supra* note 17 at 69.

²⁷ Conte, *supra* note 8, at 1.

²⁸ PAC. SHELLFISH INST., *supra* note 6.

²⁹ Kathryn Johnson, *California's Living Marine Resources – A Status Report: Culture of Clams*, CAL. DEP'T OF FISH AND WILDLIFE 19-1 (2008), <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=34426&inline=true>.

³⁰ *Id.* at 19-1.

³¹ *Id.*

California mariculture operations specializing in Manilla clams obtain larvae from out of state and culture the larvae in floating upweller systems, otherwise known as “FLUPSYs.” These FLUPSYs are “suspended trays covered in mesh netting,” and the larvae grow within these trays “until they are between 0.08-0.39 inches (0.2-1.0 centimeters); it is at this point in development that they become clam seed.”³² California shellfish farmers typically do not grow out the clam seed to mature clam size, but supply the seed to other farmers who do so. Although not a large producer compared to Canada and Washington, California is the leading supplier of clam seed worldwide.³³

Mussels are also a popular and important shellfish source in California. Since the early 1900s, mussels have maintained their commercial and recreational importance as food and fish bait.³⁴ Despite their popularity, the mariculture industry for mussels did not develop until the late 1970s and 1980s, which brought successful experiments in culturing wild seed stock and in developing hatchery grow out methods.³⁵

In 1979, researchers tested the feasibility of harvesting and marketing naturally set Mediterranean mussels from oil platforms in the Santa Barbara Channel.³⁶ This practice proved feasible, and the harvest of mussels from oil platforms in the Santa Barbara Channel reached its peak in the 1980s. In the fall of 1997, El Nino seawater conditions brought strong storms and warm water, and mussel production fell nearly fifty percent by 1998.³⁷ In 1999-2000, colder waters improved the growing conditions for mussels, and thus harvest rates increased and mussel production reached a new record high in 2002. From 2002-2009, offshore oil platform harvest reduced by about thirty-three percent, largely due to a major cultivation company ceasing operations.³⁸

³² *Id.* at 19-2.

³³ *Id.* at 19-1.

³⁴ Thomas Moore et al., *California’s Living Marine Resources – A Status Report: Culture of Mussels*, CAL. DEP’T OF FISH AND WILDLIFE 20-1, (2008) <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=34439&inline=true>.

³⁵ *Id.* at 20-1.

³⁶ *Id.* at 20-2.

³⁷ *Id.* at 20-4.

³⁸ *Id.*

In 1983, in Aqua Hedionda Lagoon near Carlsbad, a shellfish company began experimental mussel cultivation, which turned to commercial cultivation in 1985. The mussel culture followed Italian longline techniques, where mussel seed (or small juvenile mussels) is “placed in a tubular net ‘stocking’ designed specifically for mussel growing.”³⁹ The stockings are suspended from longlines and supported by small buoys to keep the stockings off the bottom of the ocean. Mussel production in the Carlsbad area peaked in 1989, but production in the area ceased from 1990 to 1992 due to rising coliform counts in the lagoon.

In the mid-1980s, Tomales Bay also began to culture mussels on longlines, and it was common for oyster growers in the Bay to diversify into mussel production.⁴⁰ However, most of these Tomales growers ceased all but minimal production of mussels in the mid-1990s to focus mariculture operations on oyster culture. This was mostly due to cheaper, foreign mussel competition.

In 1992, an oyster farmer in Mad River Slough, a tributary to Humboldt Bay, began mussel culture using a floating raft culture method, where seed is “attached to a line inside flexible plastic mesh netting . . . [and] suspended from the raft during grow out.”⁴¹ One other operation experimented with mussel grow out in Humboldt Bay in 2001. However, as of 2008, no shellfish farmers in Humboldt Bay were raising mussels.⁴²

Recent declines in mussel culture are due to a variety of factors, but the most prominent limiting factor noted by farmers is foreign competition. California growers face strong competition from imported mussels due to low cost air transport and new flash freezing methods of transporting mussels.⁴³ In other words, local small mussel operations feel they are unlikely to prevail over large, foreign operations providing a cheaper product to consumers. However, a few producers are able to successfully market mussels as locally produced seafood in specialty restaurants and markets.

³⁹ *Id.* at 20-3.

⁴⁰ *Id.*

⁴¹ *Id.*

⁴² *Id.*

⁴³ *Id.* at 20-4.

Today, a small operation in Tomales Bay supplies mussels to local restaurants, an operator in Santa Barbara provides mussels to local restaurants and markets, and mussels are cultivated from offshore platforms in the Santa Barbara Channel.⁴⁴ Growth of mussel mariculture in California that specializes in local markets is likely to continue to develop in the near future, located in offshore waters using the longline technique. This prediction is based on the recent efforts of shellfish producers seeking permits for offshore mussel mariculture operations in Southern California.⁴⁵

Today, the commercial culturing of marine species in California is limited primarily to the production of shellfish such as clams, mussels, and oysters.⁴⁶ While the global aquaculture industry is quite large (likely over a \$100 billion enterprise), California's \$23 million commercial shellfish industry is relatively small.⁴⁷ Statewide demand exceeds production, which is constrained by several challenges facing farmers as further described in the following sections.⁴⁸

State and federal governments have recently created several policies to encourage shellfish mariculture in California due to the potential ecosystem benefits, nutritional value of shellfish, and industry's potential to support working waterfronts. However, the expansion of commercial shellfish production has been

⁴⁴ *Id.* at 20-3, 20-4.

⁴⁵ Catalina Sea Ranch was recently permitted off the coast of southern California, but has not yet been built. For more information, see *About Catalina Sea Ranch*, CATALINA SEA RANCH, http://catalinasearanch.com/Catalinasearanch.com/About_1.html; Santa Barbara Mariculture is seeking to amend permits to continue to cultivate mussels in the Santa Barbara Channel. For more information, see *Santa Barbara Mariculture*, SANTA BARBARA MARICULTURE, <http://www.sbmiculture.com/>.

⁴⁶ CAL. DEP'T OF FISH & GAME, STATUS OF THE FISHERIES REPORT: AN UPDATE THROUGH 2008 17-1 (Traci Larinto ed., 2010).

⁴⁷ The National Oceanic and Atmospheric Adminstration states that the industry is \$100 billion (see *Basic Questions About Aquaculture*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN. FISHERIES, http://www.nmfs.noaa.gov/aquaculture/faqs/faq_aq_101.html); The Food and Agricultural Organization of the United Nations states states that the industry is valued at \$144.4 billion (see FOOD AND AGRICULTURAL ORG. OF THE UNITED NATIONS STATES, THE STATE OF WORLD FISHERIES AND AQUACULTURE (2014), available at <http://www.fao.org/3/a-i3720e.pdf>).

⁴⁸ CAL. DEP'T OF FISH AND WILDLIFE: *Culture of Clams*, *supra* note 29, at 19-3; CAL. DEP'T OF FISH AND WILDLIFE: *Culture of Mussels*, *supra* note 34, at 20-5; CAL. DEP'T OF FISH & GAME, *supra* note 46, at 17-1.

stunted by a lengthy, complex, and costly regulatory process. To overcome this challenge, entities in some coastal communities with potential for commercial shellfish production growth are turning to innovative permitting approaches.

One such approach is the Humboldt Bay pre-permitting project. Here, the Humboldt Bay Harbor, Recreation and Conservation District (the District), a public agency charged with managing and regulating tidelands in the bay, is seeking to obtain programmatic permits to lease pre-identified tidelands in Humboldt Bay for shellfish mariculture. The District would subsequently lease those pre-permitted tidelands to individual farmers, thus easing the otherwise prohibitively time consuming and expensive permitting process that individual bay farmers would face on their own. (This project will be discussed in more detail in Part V.)

Before pursuing similar permitting or pre-permitting mariculture projects in any additional California coastal water bodies, community and industry leaders should consider conducting pre-feasibility studies at the proposed locations. A pre-feasibility study generally consists of analyzing an area's physical opportunities and constraints for shellfish mariculture. A pre-feasibility study is highly valuable in that it can help to determine if investment in a more extensive review and permitting process is warranted. However, undertaking such an analysis can be daunting, as there are numerous potential physical opportunities and constraints to be studied. This article provides a blueprint and suggests guidelines for developing such a pre-feasibility study.

III. AQUACULTURE EXPANSION: A NATIONAL AND STATEWIDE PRIORITY

The Marine Aquaculture Policy and National Shellfish Initiative's stated reasons for encouraging marine aquaculture development are to provide domestic jobs and healthy, safe, and sustainable seafood products, while protecting marine ecosystems.⁴⁹ The Department of Commerce and the National Oceanic and

⁴⁹ *National Shellfish Initiative*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN. FISHERIES, http://www.nmfs.noaa.gov/aquaculture/docs/policy/natl_shellfish_init_factsheet_summer_2013.pdf (last visited June 1, 2015).

Atmospheric Administration (NOAA) also encourage marine aquaculture growth in order to support increased U.S. exports of domestically produced marine aquaculture products in response to global demand.⁵⁰ These policies encourage sustainable aquaculture innovation and the advancement of improved aquaculture technologies; collaboration between state, local, regional, academic, and business partners; and the exchange of science and insights with other nations to support cooperative research.⁵¹ Lastly, the policies seek to advance public understanding of the environmental, social, and economic benefits and challenges of sustainable marine aquaculture.⁵²

Capture fisheries⁵³ have basically plateaued since the mid-1980s.⁵⁴ As such, many regulators and shellfish farmers see mariculture as a viable option to serve growing demand.⁵⁵ Commercial fisheries are determined to have plateaued worldwide based on expert assessments from the Marine Fisheries Advisory Committee (MAFAC).⁵⁶ In the 2007 MAFAC Final Report, *Vision 2020: The Future of U.S. Marine Fisheries*, experts concluded that:

Most assessments on the world-wide status of marine fisheries indicate that on a species by species level, most species considered have reached or are near maximum sustainable exploitation levels. Thus, wild marine fisheries harvest which has peaked, at

⁵⁰ *Id.*

⁵¹ *Id.*

⁵² *Id.*

⁵³ “Wild capture fisheries” refer to seafood obtained from harvesting or catching naturally occurring species of fish or shellfish (*See What is a Fishery*, NAT’L OCEANIC AND ATMOSPHERIC ADMIN. FISHWATCH, http://www.fishwatch.gov/wild_seafood/what_is_a_fishery.html, last visited July 15, 2015).

⁵⁴ *A Milestone for U.S. Aquaculture: 25th Anniversary of the National Aquaculture Act*, NAT’L OCEANIC AND ATMOSPHERIC ADMIN. (September 21, 2015), http://www.fisheries.noaa.gov/aquaculture/homepage_stories/18_35th_anniversary.html.

⁵⁵ FOOD AND AGRICULTURAL ORG. OF THE UNITED NATIONS, WORLD REVIEW OF FISHERIES AND AQUACULTURE 83-86 (2010), available at <http://www.fao.org/docrep/013/i1820e/i1820e01.pdf>.

⁵⁶ MAFAC, FINAL REPORT OF THE MARINE FISHERIES ADVISORY COMMITTEE, VISION 2020: THE FUTURE OF U.S. MARINE FISHERIES, available at http://www.nmfs.noaa.gov/ocs/documents/Vision_2020_FINAL-1.pdf, December 2007.

approximately 93 million tons per year on a worldwide basis, should not be expected to grow significantly.⁵⁷

The maximum sustainable exploitation level or “maximum sustainable yield,” is defined as the “largest, long-term average catch that can be taken under existing conditions.”⁵⁸ In other words, it is the largest amount of fish and shellfish that can be taken from the ocean without causing long-term deleterious impacts to the population in question. Thus, the MAFAC assessment that fisheries have reached this level worldwide is quite significant. It reveals that we cannot increase the amount of seafood we commercially harvest from the ocean without causing serious adverse impacts to the ocean ecosystem.

In the same report, MAFAC experts determined that on a per capita basis, seafood consumption in the United States is steadily increasing, and is expected to continue growing as the health benefits of seafood are increasingly recognized.⁵⁹ Coupled with a growing domestic population and longer average life expectancy, this increase in per capita demand translates into a large overall rise in seafood demand nationwide. Global seafood demand is expected to increase by up to 27 million metric tons by 2030.⁶⁰ This predicted increase in demand and the inability to meet such demand from commercially fishing wild stocks is largely the impetus for regulations supporting mariculture development in the United States.

The United States Department of Agriculture (USDA) 2015 Dietary Guidelines Advisory Committee advises moderate intake of seafood to benefit individual health as well as environmental sustainability.⁶¹ The Dietary Guidelines Advisory Committee noted in their report that the collapse of some fisheries due to overfishing in the past decade has raised supply concerns, and that

⁵⁷ *Id.* at 2.

⁵⁸ *Annual Catch Limits: Setting an Annual Catch Limit*, NAT’L OCEANIC AND ATMOSPHERIC ADMIN., http://www.nmfs.noaa.gov/sfa/management/acls_ams/setting_acl.html (last visited March 21, 2016).

⁵⁹ MAFAC, *supra* note 56, at 2.

⁶⁰ See *What is a Fishery*, *supra* note 53, at 69.

⁶¹ U.S. DEP’T OF AGRICULTURE, SCIENTIFIC REPORT OF THE 2015 DIETARY GUIDELINES ADVISORY COMMITTEE 4-8 (Feb. 2015), available at <http://www.health.gov/dietaryguidelines/2015-scientific-report/PDFs/Scientific-Report-of-the-2015-Dietary-Guidelines-Advisory-Committee.pdf>.

“to supply enough seafood to support meeting dietary recommendations, both farm-raised and wild caught seafood will be needed.”⁶² Thus, the USDA, in addition to the Department of Commerce and NOAA, has national policies encouraging domestic shellfish mariculture growth in the face of ever increasing demand.

While seafood demand in the United States is predicted to increase, current demand already exceeds domestic production. The commercial production of most cultured shellfish in the United States has remained about the same or declined in recent years.⁶³ To meet consumer demand, the United States imports more than ninety percent of all seafood consumed, as measured by edible weight.⁶⁴

Opponents of domestic shellfish operations cite the seemingly counterintuitive practice of importing ninety percent of American seafood, while exporting the majority of what is caught or cultivated in the United States.⁶⁵ Certain fish stocks from the United States are more valuable overseas and thus are immediately exported abroad, while other fish stocks are transported overseas for inexpensive processing, and then brought back into the United States for consumption. In fact, 90% of seafood exported by the United States to China is either reprocessed and exported by China to other countries or sent back to the United States.⁶⁶

U.S. exports of fish and seafood products are led by lobster, Alaskan Pollock, salmon, surimi, and fish roe.⁶⁷ Shellfish exports (including lobster and crab) made up thirty-one percent of U.S. fish and seafood exports in FY 2014, and

⁶² *Id.* at 8.

⁶³ *National Aquaculture Sector Overview: United States of America*, FOOD AND AGRICULTURAL ORG. OF THE UNITED NATIONS, 1 (February 1, 2011), http://www.fao.org/fishery/countrysector/naso_usa/en.

⁶⁴ *Global Wild Fisheries*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN. FISHWATCH, <http://www.fishwatch.gov/sustainable-seafood/the-global-picture> (last visited March 21, 2016).

⁶⁵ See PAUL GREENBERG, AMERICAN CATCH: THE FIGHT FOR OUR LOCAL SEAFOOD (2014).

⁶⁶ Pramod, Nakamura, Pitcher and Delagran, *Estimates of illegal and unreported fish in seafood imports to the USA*, 48 MARINE POL'Y 102-113 (2014).

⁶⁷ *U.S. Fish and Seafood Exports Reach Record Levels*, UNITED STATES DEP'T OF AGRICULTURE (Jan. 13, 2015), <http://www.fas.usda.gov/data/us-fish-and-seafood-exports-reach-record-levels>.

the large majority of these exports consisted of lobster and crab.⁶⁸ Many may cite this “seafood swap” as an argument against the need for additional domestic shellfish production, because presumably, any additional shellfish grown domestically will be necessarily exported overseas. However, the vast majority of growing U.S. seafood exports are limited to certain high value products such as lobster, Pacific salmon, and crab sent to China.⁶⁹ Contrastingly, shellfish mariculture operations in California are mainly limited to the aforementioned categories of oysters, clams, and mussels.

It is true that as China’s population continues to grow, so too will U.S. exports of high value seafood products. Additionally, domestic seafood producers will likely continue to take advantage of inexpensive Chinese labor and process seafood abroad, only to re-import it back to the United States. However, California shellfish mariculture facilities have historically been marketed primarily to local California consumers. This may be due in part to the relatively small size of the California mariculture industry, coupled with the large local demand for oysters, clams, and mussels.

In addition to promoting shellfish mariculture in California to reduce the trade deficit and provide local seafood to consumers, some decision-makers promote California shellfish mariculture for its water quality benefits. Shellfish mariculture can provide vital ecosystem benefits to the marine environment, and this potential is increasingly being recognized by many regulators and scientists who monitor marine and estuarine habitat.⁷⁰ Shellfish farms can “improve water quality by filtering out nutrients, suspended sediment, and chlorophyll.”⁷¹ Shellfish have the potential to remove phytoplankton, detritus, and particulate material through filtration, thus improving water quality. This can, in turn, improve certain areas of fish habitat in high-turbidity systems. In fact, the

⁶⁸ *Id.*

⁶⁹ *Id.*

⁷⁰ *Aquaculture and Eutrophication in Long Island Sound and Great Bay – Piscataqua Estuary*, NAT'L CTRS. FOR COASTAL OCEAN SCI., <http://coastalscience.noaa.gov/projects/detail?key=32> (last visited June 1, 2015).

⁷¹ *Id.*

National Center for Coastal Ocean Science (NCCOS) is currently studying and quantifying the water filtration benefits from shellfish farms.⁷²

Additionally, many coastal community leaders and policy makers encourage shellfish mariculture expansion to reinvigorate and support working waterfront economies. Fishing limitations, due to many factors including decreased wild stocks, have led to lost employment and revenues for many coastal communities. Shellfish farming would allow these communities to use existing skills, boats, and infrastructure to boost their income and economies while maintaining traditions of working on the water.⁷³ Shellfish mariculture operations in these coastal communities can provide jobs for unemployed and underemployed fishermen, as well as unskilled and semi-skilled workers at new seafood processing facilities. The industry even has the potential to generate increased tourism.⁷⁴

According to a 2013 economic report prepared by the Pacific Shellfish Institute, in 2010 California shellfish farmers were responsible for approximately 200 direct jobs and generated an additional 80 jobs through “indirect and induced activity.”⁷⁵ These shellfish mariculture operations paid approximately \$5.4 million in wages and generated additional labor income of \$4.6 million, for a total of \$10 million in labor income in California. For every dollar spent by the California shellfish mariculture industry, \$1.97 worth of economic activity and \$0.85 in wages are generated.⁷⁶ Because of these potential benefits to working waterfront communities and economies, local governments across the California coast have recently initiated the process of pursuing shellfish mariculture development permits.

⁷² *Id.*

⁷³ *Shellfish Aquaculture Supports Working Waterfronts—Growing Mussels in Gloucester*, NAT’L OCEANIC AND ATMOSPHERIC ADMIN. FISHERIES (August 6, 2012), http://www.nmfs.noaa.gov/stories/2012/08/08_06_12gloucester_mussels.html.

⁷⁴ *Id.*

⁷⁵ NORTHERN ECONOMICS, INC., PACIFIC SHELLFISH INSTITUTE, THE ECONOMIC IMPACT OF SHELLFISH AQUACULTURE IN WASHINGTON, OREGON AND CALIFORNIA 29 (2013).

⁷⁶ *Id.*

Because of the need to reduce the seafood trade deficit and the potential benefit to coastal communities and ecosystems, state and federal governments have established policies in the past few decades to support shellfish mariculture development. The California Aquaculture Development Act (1983) declared that the growth of aquaculture is in the interest of the people of the state of California in order to augment food supplies, expand employment, promote economic activity, increase native fish stocks, enhance commercial and recreational fishing, and protect and better use the land and water resources of the state.⁷⁷

Additionally, the U.S. Department of Commerce and NOAA, consistent with the National Aquaculture Act of 1980, released a new Marine Aquaculture Policy and a National Shellfish Initiative in June 2011. These policies encourage the growth of a business climate and technological base to foster development of sustainable marine aquaculture in the United States.⁷⁸ The goal of the National Shellfish Initiative is to “increase populations of bivalve shellfish in our nation’s coastal waters . . . through commercial production and conservation activities.”⁷⁹

Inspired by the National Shellfish Initiative, the Pacific Coast Shellfish Growers Association (PCSGA) approached numerous agencies in Washington along with the Washington governor’s office to create the Washington Shellfish Initiative (WSI). It met great success, leading PCSGA to also approach the National Marine Fisheries Service (NMFS), California Department of Fish and Wildlife (CDFW), California Coastal Commission (CCC), and other state and federal agencies in California to develop the California Shellfish Initiative (CSI). To date, the CSI Working Group has held five meetings and developed a working vision, which includes expanding sustainable and legal commercial and restoration shellfish mariculture in California.

⁷⁷ CAL. PUB. RES. CODE § 826-828.

⁷⁸ U.S. DEP’T OF COMMERCE, AQUACULTURE POLICY (June 2011), available at http://www.nmfs.noaa.gov/aquaculture/docs/policy/doc_aquaculture_policy_2011.pdf.

⁷⁹ *National Shellfish Initiative*, NAT’L OCEANIC AND ATMOSPHERIC ADMIN. FISHERIES, http://www.nmfs.noaa.gov/aquaculture/docs/policy/natl_shellfish_init_factsheet_summer_2013.pdf (last visited June 1, 2015).

IV. CONSTRAINTS TO SHELLFISH MARICULTURE EXPANSION

Despite the federal and state policies promoting the growth of the industry, the shellfish mariculture industry in California is not growing. Shellfish farmers, local officials in coastal regions, and other stakeholders contend that the industry's primary constraint is the regulatory permitting process and associated costs that shellfish farmers must pay to obtain mariculture permits.⁸⁰

Shellfish mariculture generally takes place on public lands and in waters held in trust by the state of California. Shellfish farmers must, therefore, obtain leases to grow within these lands, unless the culture is to take place in federal waters.⁸¹ In addition to leases, local shellfish farmers must obtain regulatory approvals. Depending on culture methods and extent, multiple approvals and permits may be required from the U.S. Army Corps of Engineers (USACE) under the Clean Water Act and Rivers and Harbors Act, the CCC under the Coastal Zone Management Act and California Coastal Act, Regional Water Quality Control Boards, the State Department of Health, and local agencies. Further, when a California agency issues a permit or approval, it must comply with the California Environmental Quality Act (CEQA), while federal agencies must follow the National Environmental Policy Act (NEPA).

In turn, permits and approvals usually trigger additional consultation requirements. Consultation, for example, may be required with the CDFW and the National Marine Fisheries Service (NMFS) to ensure compliance with the Endangered Species Act (ESA), California Endangered Species Act (CESA),

⁸⁰ See PACIFIC COAST SHELLFISH GROWERS ASSOCIATION (PCSGA), CALIFORNIA SHELLFISH INITIATIVE POSITION PAPER 5-6 (2013), available at <http://pcsga.org/wprs/wp-content/uploads/2013/08/CA-Shellfish-Initiative-Position-Paper-Aug-2013-.pdf>.

⁸¹ See THE NATURAL RES. AGENCY OF CALIFORNIA, DEP'T OF FISH AND WILDLIFE, INFORMATION LEAFLET REGULATIONS GOVERNING LEASING OF STATE WATER BOTTOMS FOR AQUACULTURE, available at <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=27450> (describing the general lease application process for aquaculture farmers in California, including the most common process of leasing state water bottoms or the water column from the California Fish and Game Commission).

Marine Mammal Protection Act (MMPA), Magnuson-Stevens Act (MSA), and other laws.⁸²

This permitting and review process can take shellfish farmers years and cost tens or hundreds of thousands of dollars to complete. One memorandum recently presented to the CSI Working Group compares the aquaculture project review process in California to that of Maine, New Hampshire, Rhode Island, Connecticut, Maryland, Florida, and Washington. It found that, on average, the permitting process takes four to twelve months and costs \$10,000. In comparison, in California it takes two to five years and costs between \$75,000 and \$200,000, with some reviews costing much more and taking significantly longer.⁸³ For example, Coast Seafoods Company spent more than \$1 million on permits and environmental reviews over a 10-year period for a California shellfish mariculture project.⁸⁴ As the largest oyster farmer in California, Coast Seafoods was able to absorb the expense, but the regulatory process and associated costs can be prohibitive barriers for smaller farmers and potential new farmers.⁸⁵

California's environmental laws and regulatory structure are responsible for the increased cost and time for shellfish permitting in California relative to other states. This includes the CEQA, which imposes statutorily mandated guidelines and timelines for environmental review and public participation.⁸⁶ Additionally, the CCC is the state agency charged with implementing the Coastal Zone Management Act (CZMA) in California. The CCC has a separate review and approval process for shellfish mariculture projects than that of the State lessor in California (usually the California Fish & Game Commission). This adds a significant layer to the approval process and differs greatly from most states, which either exempt shellfish projects from CZMA review (such as Washington

⁸² Reducing Regulatory Risks for Shellfish Growers in Humboldt Bay, Case Study 2 (2009-ongoing).

⁸³ Robert M. Smith, Plauche & Carr, *Memorandum Re. Shellfish Aquaculture Permitting Comparison 2* (March 27, 2015).

⁸⁴ Reducing Regulatory Risks for Shellfish Growers, *supra* note 82 at 2.

⁸⁵ *Id.*

⁸⁶ *Id.* at 5.

and Maryland), or combine the CZMA consultation process with the state leasing process with no separate approval (such as Rhode Island and Florida).⁸⁷

Another significant barrier to shellfish mariculture development in California is uncertainty as to the extent of environmental effects and the lack of site-specific data. In response to relative uncertainty, many advocate for strict employment of the “precautionary principal,” or in other words, prohibit any action if the effects are not known and predictable. Others support an “adaptive management” approach, with strict monitoring of shellfish mariculture sites and the flexibility to respond to environmental impacts that may arise. Extensive environmental review of shellfish mariculture projects is vitally important. Shellfish mariculture expansion has the potential to impact eelgrass and other habitats; marine species that use these habitats; and recreational uses such as kayaking, fishing, and hunting. Given the cumulative impacts of historic and current uses of estuaries and bays, the ecological carrying capacities of water bodies proposed for shellfish expansion must be assessed (see Other Issues for Evaluation below).⁸⁸

V. HUMBOLDT BAY’S “PRE-PERMITTING” APPROACH

Many sites suitable for shellfish mariculture in California are not being used because of the aforementioned regulatory, financial, and environmental hurdles facing shellfish farmers. Despite the State Legislature designating Humboldt Bay as the Oyster Capitol of California in 2009, only a small fraction of tidelands with the potential for shellfish mariculture are being farmed.⁸⁹

In 2010, the Humboldt Bay Harbor, Recreation and Conservation District (District) reached out to local shellfish farmers and environmental groups to explore the idea of increasing sustainable commercial shellfish mariculture activities in Humboldt Bay. The District devised an innovative “pre-permitting” approach, in which it would obtain the necessary permits, and then lease the pre-

⁸⁷ *Id.*

⁸⁸ *Id.* at 2.

⁸⁹ *Id.* at 1.

permitted tidelands to interested farmers through a public bidding process.⁹⁰ The District is currently seeking permits and approvals from federal and state regulatory agencies to implement its plan.

The District will incur the costs associated with obtaining permits and regulatory approvals as a one-time expense. They will also incur the risk of investing significant amounts of time and money into the permitting process, with no guarantee of approval. The District decided to pursue this project regardless of these associated costs and risks, based on a pre-feasibility study done by Humboldt State University's Natural Resource Planning Team.⁹¹ This pre-feasibility study determined that some amount of shellfish mariculture expansion and associated economic development in the bay is generally highly feasible.

By seeking all permits and approvals itself, the District will transfer the cost and regulatory risk from individual farmers to the District, and provide a more affordable and overall less risky investment for new farmers. In addition to eliminating high costs faced by individual farmers, the pre-permitting approach could ensure greater environmental compliance and sustainable management than project-by-project reviews, by analyzing all potential sites in a comprehensive environmental review.

The Humboldt Bay Pre-permitting approach is still in the process of development, but its innovative solution to shellfish mariculture development barriers has inspired others in California to look to similar solutions. For example, the Ventura Port District is currently exploring the possibility of a similar venture in offshore waters in southern California. However, before similar projects can be developed in additional California coastal areas, pre-feasibility studies should be completed to assess whether geographic areas under consideration possess the necessary attributes for successful shellfish culturing.

⁹⁰ *Id.*

⁹¹ YVONNE EVERETT WITH CARRIE CARTER-GRIFFIN ET AL., A PRE-FEASIBILITY STUDY EXAMINING OYSTER MARICULTURE EXPANSION IN HUMBOLDT BAY, CA 18 (Humboldt State University 2010).

VI. METHODS TO QUANTIFY PRE-FEASIBILITY OF SHELLFISH MARICULTURE IN CALIFORNIA COASTAL WATER BODIES

Pre-feasibility studies could be conducted for additional California water bodies following the model established by “A Pre-Feasibility Study Examining Oyster Mariculture Expansion in Humboldt Bay, California, 2010.” A Humboldt State University Natural Resources Planning Practicum team under the direction of Professor Yvonne Everett performed this pre-feasibility study for the District in order to analyze the area’s geographic opportunities and constraints for shellfish mariculture development, and evaluate if moving forward in the permitting process is warranted.

A. Methodology

The parameters to determine the feasibility of permitting new shellfish mariculture facilities in coastal water bodies of California include: preliminary evaluation factors; physical boundaries; natural resources; land use; property ownership; and proximity to sensitive natural, cultural, and recreational resources. Decision makers, like the District, may use these parameters for initial screening to determine if a full feasibility assessment is warranted.

In the case of Humboldt Bay, geographic information system (GIS) and light detection and ranging (LIDAR, for bathymetry) data showing existing elevations, property boundaries, land use, and natural resource data was collected from the County of Humboldt and the District. Interviews were conducted with local scientists and shellfish industry experts to identify key physical and resource based constraints on shellfish mariculture sites in Humboldt Bay.

The most essential parameters to review are those related to areas where culture is physically possible based on current and anticipated culture methods. For the Humboldt Bay Pre-feasibility Study, the parameters were depth (based on acceptable depths for cultivation), Humboldt Bay ownership and leases, and sensitive habitats—in this case, existing eelgrass beds and seal haul-outs. These spatial parameters were then digitally mapped and analyzed in GIS to identify areas where expanded shellfish culture would be appropriate.

In all cases, working with, acquiring, and confirming information from existing shellfish farmers was essential. In order for commercial shellfish mariculture operations to have prevailed in this environment, they had to be resourceful, creative, and collaborative. Thus, their knowledge and experience was indispensable for this study—and will be for other pre-feasibility studies in additional coastal areas of the state.

B. Preliminary Evaluation Factors

The initial evaluative factor relates to existing shellfish mariculture activities in the water body being examined. Quantifying and reviewing an area's existing mariculture practices and most recent permitting processes will be useful in predicting the outcome of any new shellfish culture activities or expansion of existing operations. It is assumed that if there are currently shellfish culture operations in a given location, additional culture of the same species and methods may be more practical than initiating culture in an entirely new area or with a novel species or method. However, this assumption could be challenged by identifying new areas, shellfish species, and improved culture methods (depending on the analysis of the physical and environmental parameters).

Physical boundaries must also be evaluated to determine if shellfish mariculture operations may be initiated or expanded in any coastal water body. If the proposed activities are based on expansion of existing mariculture locations and methods, the most practical way to define parameters is to review the physical constraints determining the boundaries of the existing culture. In general, the physical boundaries for culture (depending on method) are primarily: (1) elevation (relative to tide); (2) water quality; and (3) proximity to sensitive natural, cultural, and recreational resources. *FLUPSY* culture is further limited to subtidal areas (typically in channels) where floating infrastructure can be adequately secured and maintained and is not a navigational hazard.

Suitable intertidal growing depths are determined by several factors, including sediment build-up, shelter from harsh wave action, and depth of

structures to determine ease of servicing.⁹² Targeted species in certain areas will only grow at a specified range of elevations.

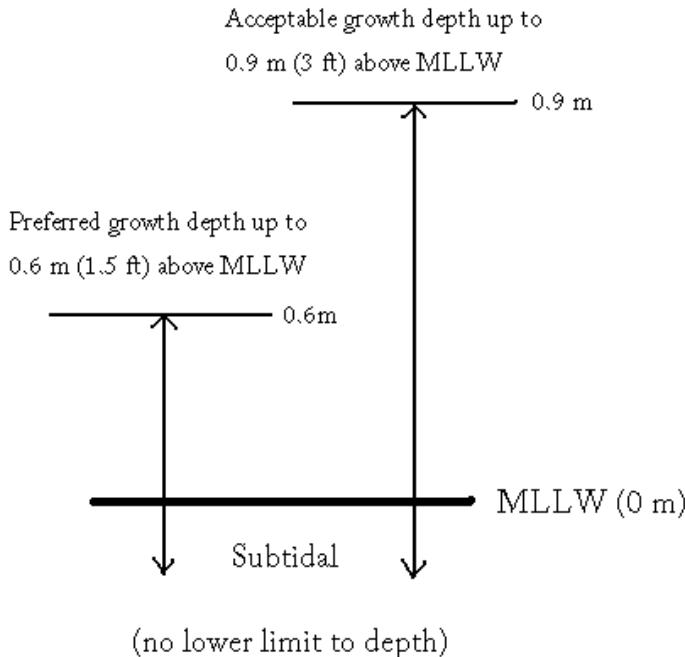
Figure 1 is an example from the Humboldt Bay study, which focused on the cultch-on-longline method of producing Pacific and Kumamoto oysters. The study established that the typical elevation or depth for growing these oysters in Humboldt Bay was intertidally at 1.5 feet (0.6 meters) Mean Lower Low Water (MLLW), but that oysters could be grown up to 3 feet (0.9 meters) MLLW.⁹³

Although Figure 1 is specific to oyster cultch-on-longline culture in intertidal areas of Humboldt Bay, similar studies can suggest preferred elevation parameters for other forms of shellfish culture in additional California water bodies.

⁹² *Id.* at 18.

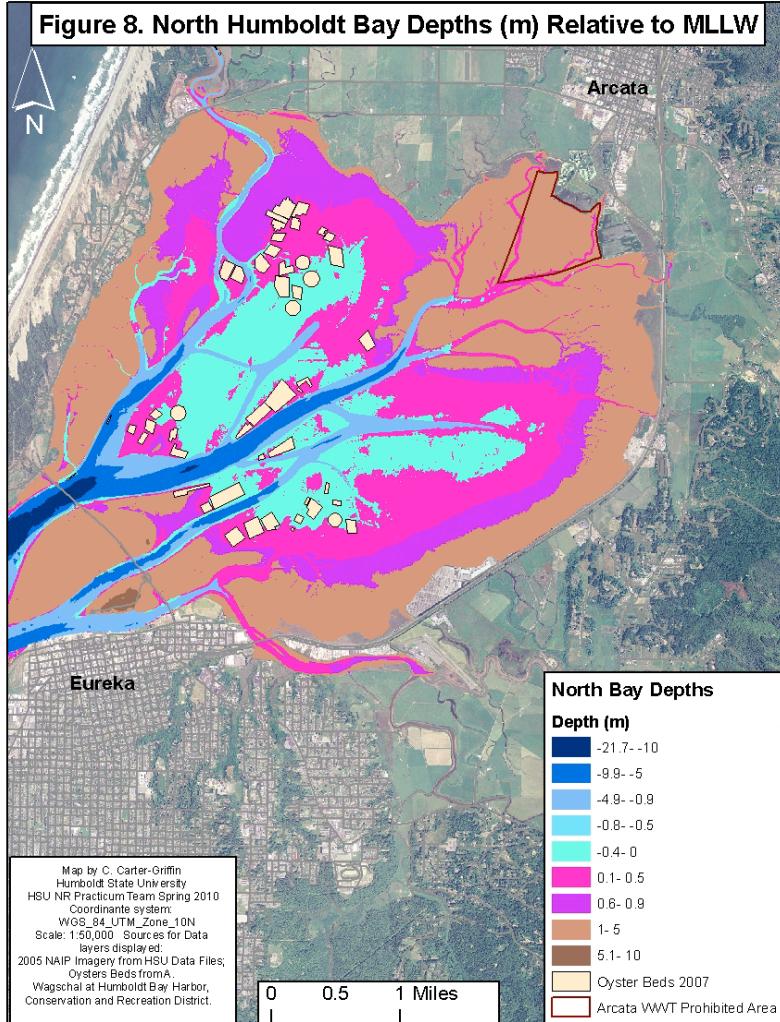
⁹³ *Id.* at 18. Mean Lower Low Water, or MLLW, is “the average of the lower low water height of each tidal day observed over the National Tidal Datum Epoch.” *Tidal Datums*, NAT’L OCEANIC AND ATMOSPHERIC ADMIN. (2009), https://tidesandcurrents.noaa.gov/datum_options.html.

Figure 4. Depth Ranges Suitable for Oyster Growth



Example of the elevation range for oyster culture for Humboldt Bay, from YVONNE EVERETT WITH CARRIE CARTER-GRIFFIN ET AL., A PRE-FEASIBILITY STUDY EXAMINING OYSTER MARICULTURE EXPANSION IN HUMBOLDT BAY, CA 18 (Humboldt State University 2010).

The Humboldt Bay study also mapped out areas of the Bay to show areas of depth relative to MLLW, as demonstrated in Figure 2. This, along with the figure demonstrating depth suitable for oyster growth in the Bay (Figure 1), helped decision-makers choose ideal areas for permitting, and thus cultivation in the Bay.



Example of the elevation range for oyster culture for Humboldt Bay, from YVONNE EVERETT WITH CARRIE CARTER-GRIFFIN ET AL., A PRE-FEASIBILITY STUDY EXAMINING OYSTER MARICULTURE EXPANSION IN HUMBOLDT BAY, CA 18 (Humboldt State University 2010).

In addressing whether or not existing water quality can successfully support new shellfish culture operations or shellfish expansion, the most important factors to address are: salinity, temperature, pollution (typically e-coli), and disease (relative to shellfish). Salinity and temperature are influenced by

parameters such as location within the water body, depth, tidal flux, freshwater inputs and seasonal changes. Water quality can also be negatively impacted from proximity to point source discharges such as industry and wastewater treatment plants, urban and agricultural runoff, failing septic systems, and other seasonal nonpoint sources. These can produce intermittent pulses of e-coli (an indicator of the presence of other pathogens) that can temporally, sometimes permanently, limit the ability to harvest shellfish from the water body. Also of importance is the potential for diseases that can impact shellfish culture in open water or for hatchery operations (i.e., oyster drills).

Substrate composition and stability is a major physical parameter to consider during the selection of a culture site suitable for shellfish growth, especially where benthic species or bottom culture may be pursued.⁹⁴ Substrate composition will determine the suitability of an area for a particular species.⁹⁵ This is not an issue for Humboldt Bay, however, where all intertidal shellfish culture is suspended off bottom on long lines or racks or in subtidal areas on rafts.

C. Natural Resources

In addition to physical boundaries, a pre-feasibility study using GIS should include mapped areas of known listed or significant natural resource areas such as current and potential essential fish habitat—including eelgrass—under the MSA. Habitat for listed threatened or endangered species under the ESA and habitat for listed species under the MMPA should also be included. Maps should also include the actual presence of any other federal and CESA listed species or significant natural resources. The presence of listed or sensitive species and habitat in areas would not necessarily preclude a project from consideration, but a detailed mapping of natural resources will help inform overall feasibility of shellfish mariculture projects. The Humboldt Bay study included GIS mapping of current and potential eelgrass beds found extensively throughout the Bay, and harbor seal haul out areas (areas where the seals rest on shore). Proximity to migratory bird feeding and gritting sites could have an impact on resources.

⁹⁴ Alessandro Lovatelli, *Site Selection for Mollusc Culture*, NETWORK OF AQUACULTURE CENTRES IN ASIA (Nov. 1988), <http://www.fao.org/docrep/field/003/AB722E/AB722E00.htm>.

⁹⁵ *Id.*

D. Land Use

A review of current zoning and land use ordinances is important. Many local coastal land use planning documents in California have provisions that address shellfish mariculture and identify it as a coastal dependent use. Designation as a coastal dependent use can give shellfish mariculture priority over certain other types of development, or could present challenges to mariculture operations, depending on the local plan. Potential conflicts with California Local Coastal Plans can create additional challenges to expansion, but these plans can be amended if it is determined by the applicable agency with land use authority that shellfish mariculture is desirable in these areas.

Determining which agency has public trust authority in the water body in question is essential for evaluating the feasibility of mariculture operations. All California tide and submerged lands are subject to the public trust doctrine, requiring that the State of California hold these lands in perpetuity and manage them for the benefit of all Californians for statewide purposes.⁹⁶ The California State Lands Commission (SLC) has leasing jurisdiction over much of California's tide and submerged lands, beds of naturally navigable rivers and lakes, and school or proprietary lands.⁹⁷ In some areas, permitting and leasing of sovereign state tide and submerged lands for mariculture purposes are under the primary jurisdiction of the California Fish and Game Commission. In some areas, SLC reviews all such permits and leases to ensure that the lands are not used in a way that would violate the public trust doctrine.

In areas such as Humboldt Bay, trust authority has been delegated to special districts and local agencies such as the District as well as the cities of Arcata and Eureka. All of these entities have the authority to lease state water bottoms or the water column to any person for mariculture, so long as they have determined the lease is in the public interest and the tideland is not privately

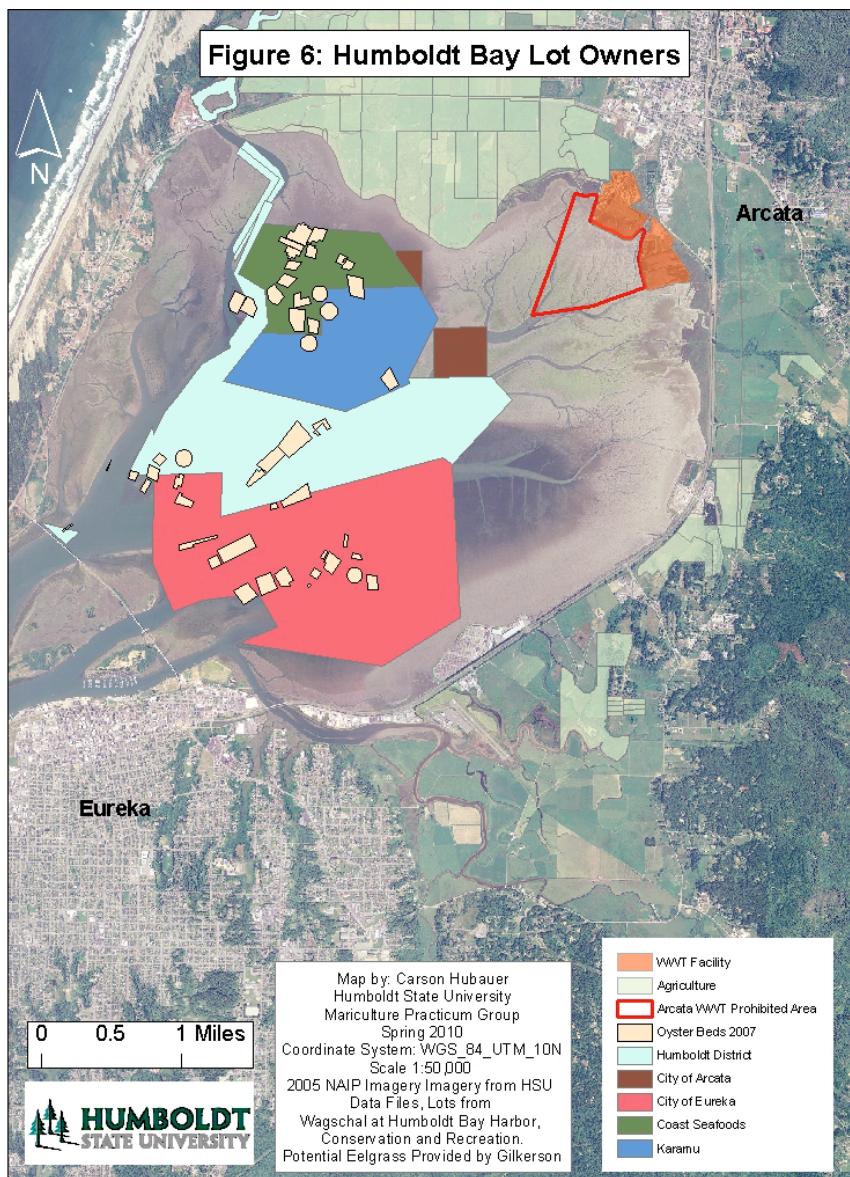
⁹⁶ *Illinois Central R.R. Co. v. Illinois* 146 U.S. 387, 452 (1892).

⁹⁷ *About the California State Lands Commission*, CAL. STATE LANDS COMM'N, <http://www.slc.ca.gov/About/About.html> (last visited May 13, 2016).

owned.⁹⁸ In order to simplify the action of pre-permitting, the number of permittees should be minimized. Ideally, only one permittee would be required.

In places like Humboldt Bay, there is a potential for private property holders to have claim over some tidelands. A review of what is public and privately owned is important, because in some cases, land owner participation may be needed. Figure 3 is an example of how a comprehensive map of public and privately owned areas can be helpful in pursuing a pre-feasibility study.

⁹⁸ CAL. FISH & GAME CODE §§ 15400-15415.



Example of Humboldt Bay lot owners from YVONNE EVERETT WITH CARRIE CARTER-GRIFFIN ET AL., A PRE-FEASIBILITY STUDY EXAMINING OYSTER MARICULTURE EXPANSION IN HUMBOLDT BAY, CA 18 (Humboldt State University 2010).

In addition, one should review whether there are any existing tideland trustees, trade cooperatives or associations, natural resource agencies, local government organizations (i.e., Harbor District, County, City, joint powers authority), or local NGOs (i.e., economic development corporation) that have interests in the area. If so, they should be contacted to identify concerns about shellfish mariculture expansion. Significant concerns can be addressed in the spatial analysis of specific areas for consideration.

Additional issues that may be of concern could include:

- *Carrying capacity:* In this context, carrying capacity is the level of shellfish culture that the region could ecologically sustain. It is important to analyze the carrying capacity of the geographic region proposed for shellfish mariculture to ensure that culture level does not surpass the region's ecological carrying capacity. For the Humboldt Bay study, environmental consultants analyzed the carrying capacity of shellfish culture in Humboldt Bay by quantifying the cumulative impact that shellfish mariculture expansion (including proposed projects other than the pre-permitting project) would have on the bay.
- *Existing Habitat Conservation Plan (HCP), Natural Community Conservation Plan (NCCP), or other resource plans:* An HCP is a requirement that may be issued under terms of an Incidental Take Permit pursuant to the ESA. An NCCP is a statewide program and applies to the CESA. Under either plan, land or habitat may be set aside to mitigate or minimize any adverse effects to listed species. It is important that any existing HCP, NCCP, or other resource plan be identified in a proposed area for culture. Such designation may, although not necessarily, preclude the area from development. If such an HCP, NCCP, or other resource plan exists, culture may still be possible so long as the applicant demonstrates that the activity is compatible with the protection of the species or resource.
- *Locations and infrastructure to support processing:* Existing infrastructure that would support shellfish processing near the proposed geographic area

could have significant impacts on project feasibility. If infrastructure support systems currently exist near the proposed geographic location, there may be little or no cost and associated ecological impact required to construct new infrastructure. Similarly, a close, convenient location can have fewer effects on the environment and lower costs than an inconvenient or distant location.

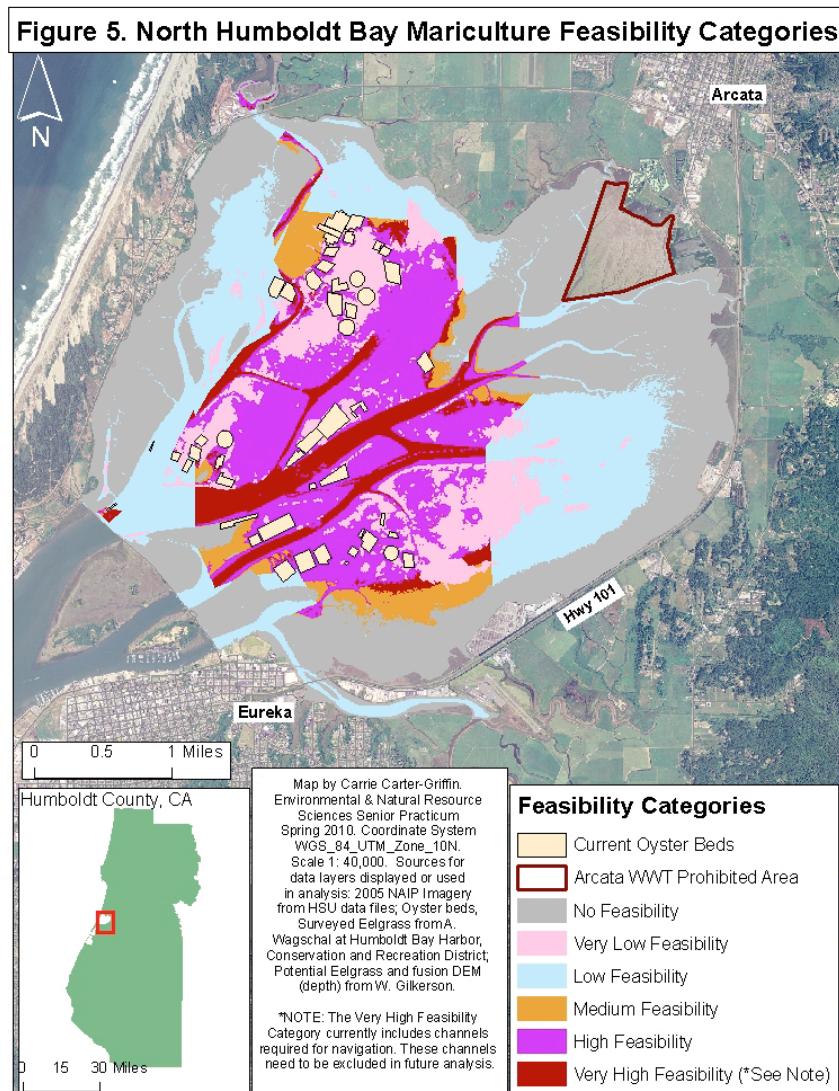
- *Aesthetic impacts:* Possible aesthetic impacts, or the impacts to the visual landscape of mariculture gear on a water body, are also important to evaluate. Possible negative aesthetic impacts on a coastal community should be addressed with community members. These could include impediments to viewing the natural and historical landscape adjacent to and within the bay.
- *Recreational and cultural uses:* Recreational uses such as hunting and boating as well as cultural gathering are possible sources of conflicts.

Using GIS, the aggregated data sets from the parameters described above can be evaluated to identify and quantify areas where expanded shellfish mariculture may be appropriate in various California coastal water bodies. Decision makers can then assess if there is sufficient potentially feasible geographic area to justify a more extensive review or permitting effort.

For example, the Humboldt Bay study addressed similar parameters in a GIS based capability and suitability planning exercise to determine the feasibility of mariculture expansion in the North Bay portion of Humboldt Bay (Figure 4). The study established feasibility categories for oyster culture expansion that ranged from “No Feasibility” to “Very High Feasibility,” and essentially laid the framework for the Humboldt Bay Pre-Permitting Project full-scale feasibility study for mariculture expansion.⁹⁹ In the case of Humboldt Bay, 2,700 acres were identified for culture. It was determined by the District that even if this was ten

⁹⁹ Everett et al., *supra* note 97, at 18.

percent accurate, 270 acres of expansion was worth pursuing with extensive study and permitting.¹⁰⁰



Example of Feasibility Areas from YVONNE EVERETT WITH CARRIE CARTER-GRIFFIN ET AL., A PRE-FEASIBILITY STUDY EXAMINING OYSTER MARICULTURE EXPANSION IN HUMBOLDT BAY, CA 18 (Humboldt State University 2010).

¹⁰⁰ *Id.*

Finally, no pre-feasibility cost estimation was done as part of this review. In the case of Humboldt Bay, the bulk of the work was completed by a group of Humboldt State University students with the guidance of their professor, local shellfish farmers, and the District staff and commissioners. Rough estimation of the work product, if done by consultants, would be in the range of \$30,000 to \$50,000.¹⁰¹

Funding is often a limiting factor for an applicant to move forward with necessary studies to obtain permits for shellfish culture. These preliminary reviews can demonstrate the potential for success and thus help to support funding requests for the permitting costs. In the case of Humboldt Bay, it is estimated the cost of permitting will be approximately \$400,000, including Humboldt Bay Harbor District staff time working on the project. These types of efforts can be eligible for economic development funding, especially with the current national and state focus on revitalizing working waterfronts.¹⁰² This can include grants from state and federal government programs, private grants, research grants, and other forms of applicable economic development funding.

VII. CONCLUSION

A spatial analysis-based approach to a pre-feasibility study, as discussed above, may be used to quantify a geographic area that would be potentially suitable for shellfish mariculture. This information can then be used to determine if an extensive review effort is worthwhile to expand or introduce shellfish mariculture in specific water bodies along the California coast.

Such a pre-feasibility study assumes that significant spatial data are already available for the study area and can be compiled. Most of the areas under potential consideration for new or expanded shellfish mariculture in California have had some amount of data collection already completed from existing and

¹⁰¹ This figure was provided by conversations officials from the Humboldt Bay Harbor, Recreation and Conservation District including Mike Wilson and author of the Humboldt Bay Pre-Feasibility Study, Yvonne Everett.

¹⁰² NAT'L WORKING WATERFRONT NETWORK, <http://www.wateraccessus.com/toolkit.html> (last visited April 12, 2016).

ongoing planning and research activities. Compilation of data related to parameters such as physical boundaries, natural resources, land use, and ownership for the specific potential location is recommended. Feasibility is greater in areas of suitable depth, water quality, and substrate for species to be cultured. It is also greater in areas that do not have projected or surveyed sensitive habitats; in areas that already have leases for shellfish mariculture operations; and in areas with no conflicting recreational, cultural, or land uses.

Specific water bodies in California with the potential for shellfish expansion include Tomales Bay, Morro Bay, and offshore of the Ventura Port District in southern California. Once pre-feasibility studies have been conducted, a pre-permitting approach, such as the Humboldt Bay pre-permitting process, could be considered as a method that is responsive to regulatory and financial challenges to shellfish mariculture development. This approach would also provide a holistic environmental review of a marine ecosystem, rather than a piecemeal approach to environmental permitting.

Californian shellfish mariculture developers (consisting of oyster, mussel, and clam cultivators) will be able to avoid some of the permitting challenges faced by other small shellfish farmers by implementing pre-permitting projects. Addressing regulatory challenges in this holistic way will enable the California shellfish mariculture industry to expand and meet domestic demand for oysters, clams, and mussels, both in California and nationally.