

# Joint Interim Committee to Study a Coastal Barrier System

Report to the 85th Texas Legislature

December 15, 2016



Co-Chairmen:  
Senator Larry Taylor  
Representative Joe Deshotel

Clerk:  
Nicole Sunstrum



December 15, 2016

The Honorable Dan Patrick  
Lieutenant Governor of Texas  
P.O. Box 12068  
Austin, Texas 78711

The Honorable Joe Straus  
Speaker, Texas House of Representatives  
P.O. Box 2910  
Austin, Texas 78768

Dear Lieutenant Governor Patrick and Speaker Straus:

Senate Bill 695, passed by the 84<sup>th</sup> Legislature during the regular session, established the Joint Interim Committee to Study a Coastal Barrier System. The Committee submits this report in accordance to SB 695.

The Committee has carefully considered all the testimony received on this issue and looks forward to continued discussions during the 85<sup>th</sup> legislative session.

Respectfully submitted,

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Co-Chair Senator Larry Taylor

Handwritten signature of Brian Birdwell in cursive script.

Senator Brian Birdwell

Handwritten signature of Craig Estes in cursive script.

Senator Craig Estes

Handwritten signature of Joe Deshotel in cursive script.

Co-Chair Representative Joe Deshotel

Handwritten signature of Cecil Bell in cursive script.

Representative Cecil Bell

Handwritten signature of John Cyrier in cursive script.

Representative John Cyrier

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Senator Troy Fraser



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Representative Wayne Faircloth

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Senator Bob Hall



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Representative Matt Krause



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Senator Kelly Hancock



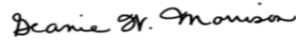
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Representative Eddie Lucio III



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Senator Juan "Chuy" Hinojosa



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Representative Geanie Morrison



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Senator Lois Kolkhorst



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Representative Scott Sanford



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Senator Eddie Lucio, Jr.



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Representative Ed Thompson



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Senator Robert Nichols

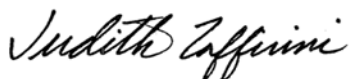


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Senator Kel Seliger

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Senator Carlos Uresti



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Senator Judith Zaffirini

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## Executive Summary <sup>1</sup>

Texas' diverse natural landscape includes 367 miles of coast, the Texas Gulf Coast, and 3,300 miles of bay front.<sup>2</sup> The size and location of this feature brings both fortune and risk to the state. Hurricanes and other damaging weather events have a long history of putting our citizens, economy, and environment in jeopardy. Since the 83<sup>rd</sup> Legislative Session, the Texas Legislature has made efforts to assess and consider coastal protection solutions.

House Bill (HB) 3459 by Representative Craig Eiland and Senator Larry Taylor in the 83<sup>rd</sup> Legislative Session permitted the Land Commissioner to issue an order to suspend line of vegetation determinations for a period of up to three years after a storm. The bill also instructed the legislature to establish a Joint Committee to study the desirability and feasibility of constructing a coastal barrier protection system.<sup>3</sup> Senate Bill (SB) 695 in the 84<sup>th</sup> Legislative Session by Representative Wayne Faircloth and Senator Larry Taylor renewed the Committee through the 2016 interim.

Following the passage of SB 695, the Joint Interim Committee to Study a Coastal Barrier System met on April 11, 2016, in Galveston, Texas and on October 5, 2016 in Austin, Texas. These meetings provided a forum to discuss this complex issue and gather information for the upcoming 85<sup>th</sup> legislative session. More information about the creation of the Joint Committee can be found below in the Committee Composition and Proceedings section.

## Committee Composition and Proceedings

SB 695 instructed the Lieutenant Governor and Speaker of the House to appoint members to the Joint Committee consisting of the Senate Committee on Natural Resources, the House Committee on Land and Resource Management, and two additional coastal members from each chamber. Senator Larry Taylor and Representative Joe Deshotel were reappointed by Lieutenant Governor Patrick and Speaker Straus as Co-Chairs. In addition, Senator Lois Kolkhorst of Brenham, Representative Wayne Faircloth of Galveston, and Representative Geanie Morrison of Victoria were selected to serve on the Committee. Full membership is as follows:

### **Senate Members:**

Co-Chair Larry Taylor  
Brian Birdwell  
Craig Estes  
Troy Fraser  
Bob Hall  
Kelly Hancock  
Juan "Chuy" Hinojosa  
Lois Kolkhorst  
Eddie Lucio, Jr.  
Robert Nichols  
Kel Seliger  
Carlos Uresti  
Judith Zaffirini

### **House Members:**

Co-Chair Joe Deshotel  
Cecil Bell  
John Cyrier  
Wayne Faircloth  
Matt Krause  
Eddie Lucio III  
Geanie Morrison  
Scott Sanford  
Ed Thompson

The Committee held two hearings to gather information and public input. Academics, business leaders, local officials and coastal residents gave testimony on their experiences and updates on coastal barrier protection concepts.

## **Background and History**

According to FEMA, Texas is the number one state for disaster declarations in the US. The Texas Coast, especially Galveston, has long been susceptible to damage from storms and major weather events. Since 1980, at least 69 tropical or subtropical cyclones have affected Texas. According to David Roth of the Weather Prediction Center, "a tropical cyclone makes landfall along the coastline about three times every four years, and on any 50-mile (80 km) segment of the coastline a hurricane makes landfall about once every six years."<sup>4</sup> In addition to tropical storms, Texas experienced 12 major hurricanes between 1851 and 2005.<sup>5</sup> With such active weather patterns, the Gulf Coast remains vulnerable to natural disasters year after year.

In 2008, Hurricane Ike hit the Texas coast and caused severe and costly damage. Experts speculated that the destruction could have been catastrophic if the hurricane had hit further west. The Galveston Bay area was predicted to have a 25 foot storm surge before the storm hit. This could have caused upwards of \$100 billion in damage, killed hundreds of people, left thousands more homeless and jobless, and devastated the largest petrochemical complex in the nation.<sup>6</sup> Although the region has been spared from recent disasters, statistically, it is due.

### ***A matter of state importance***

As a state, disasters of all kind pose a constant threat to our wellbeing and economic health. This threat is particularly alarming in the Gulf Coast region which is home to one in four Texas residents and the largest petrochemical complex in the US, which generates over \$500 billion a year in economic activity.<sup>7</sup>

The Houston Ship Channel alone supports more than one million jobs in Texas. It also generates \$13 billion in payrolls for Texas companies, has \$178 billion in economic impact across the state, and contributes nearly \$5 billion annually in tax revenues. In addition, various lucrative industries are supported by the people and resources in this area. Those industries include: aerospace, chemical, oil and gas, healthcare, tourism, maritime activity, and education. Over the next five years there are \$35 billion in planned chemical plant expansions in the Bay Area/Houston Region.<sup>8</sup> There is also a large environmental interest in this environmentally sensitive area. Galveston Bay is home to the 7th largest estuary and produces the second largest amount of seafood in the United States. In addition, the Bay has active recreational boating and fishing communities.

Other locations along the Gulf Coast are significant contributors to the state's economy. Brazoria County boasts large industry and job contributions as well. Major employment sectors in the Brazosport area include petrochemical and mineral resources (oil and gas among others) and their support industries. Some companies located in Brazoria County include: Dow Chemical Company, Fluor Corporation, Zachry Group, Texas Department of Criminal Justice, the Infinity Group, and Phillips 66.<sup>9</sup> Port Freeport will soon be widened and deepened, allowing more access and capacity for future development.<sup>10</sup>

Similarly, Jefferson County is home to the Port of Beaumont and the Port of Port Arthur which handle a variety of cargo including military equipment and a variety of forest products, respectively. Each has an estimated \$120 million in annual economic impact to the state.<sup>11</sup>



### *A matter of national importance*

Beyond the statewide implications of an unprotected coast, the entire United States has a considerable stake in the economic health of the Texas Gulf Coast region. According to the Texas General Land Office, "Texas plays a key role in the economic and domestic energy security of the nation. Much of this activity takes place around Houston, home to 5,000 energy related companies and 15 of the 20 largest oil pipeline companies in the nation. Overall, the 27 Texas refineries represent 29% of the nation's total refining capacity."<sup>12</sup>

Texas ports play a significant role in the U.S. cargo industry. The Port of Houston is first in U.S. foreign waterborne tonnage, imports tonnage, exports tonnage, and second in total tonnage. In addition, the Port of Houston handles 65% of all major U.S. project cargo.<sup>13</sup> Three ports in Texas are designated as strategic military ports and part of the US port readiness system (Corpus Christi, Beaumont, and Port Arthur). These ports serve as places of deployment during defense emergencies.<sup>14</sup> In addition to military cargo, "the Texas coast delivers a larger volume of energy products, such as jet and diesel fuel, to the US military than any other state."<sup>15</sup>

Among economic and security benefits, the Johnson Space Center (JSC) in south Houston is an important contributor to the space industry. The JSC leads NASA's efforts in human space exploration. It is the premier NASA center for human space flight and related scientific and medical research efforts. JSC plays a pivotal role in the success of NASA's mission by managing the development, testing, training, and operation of all U.S. human spacecraft missions. JSC is also home to Mission Control and the Astronaut Corps.<sup>16</sup>

### ***Coastal Barrier Protection***

Since Hurricane Ike, various options have been studied about how to protect the Texas coast. Texas A&M University at Galveston, the Severe Storm Prediction, Education, and Evacuation from Disasters Center at Rice University, the Gulf Coast Community Protection and Recovery District, the Texas General Land Office, and the US Army Corps of Engineers have continued to study storm surge suppression alternatives. Each agency's design concepts and studies were presented and discussed at the April 11, 2016 and October 5, 2016 Joint Interim Committee hearings.

## **Issues and Findings**

The Committee was tasked with studying the desirability and feasibility of constructing a coastal barrier system. To this end, the Committee held public hearings in April at Texas A&M University at Galveston and in October at the Texas State Capitol.

Invited testimony was provided by agencies and organizations involved in coastal barrier projects: the Texas General Land Office (GLO), the Gulf Coast Community Protection and Recovery District (GCCPRD), US Army Corps of Engineers (USACE), Texas A&M University at Galveston (TAMUG), and Severe Storm Prediction, Education, and Evacuation from Disasters (SSPEED) Center at Rice. Other invited testimony included the Galveston Bay Foundation, Bay Area Houston Economic Partnership (BAHEP), Texas Chemical Council, East Harris County Manufactures Association (ECHMA) and AECOM.

Public testimony was also taken at each meeting and included comments from private citizens, interest groups, and representatives from interested cities and counties. The hearing revealed different roles and interests of the agencies, academic institutions and interested parties.

### ***Texas General Land Office***

The Texas General Land Office (GLO) is the oldest state agency. The agency was created to manage the public domain by collecting and keeping records, providing maps and surveys, and issuing titles. In addition to its modern-day mission focused on maximizing and diversifying revenue sources for the Permanent School Fund, it also plays an important role in coastal management.<sup>17</sup> In this capacity, the GLO conducts studies and partners with other entities studying coastal plans in Texas to fulfill this roll.

GLO's coastal protection and community development and revitalization studies include ongoing work with the GCCPRD. More information on this three-phase study can be found in the GCCPRD section below. The GLO is also working with the USACE on two ongoing studies: the Sabine Pass to Galveston Bay Study, focusing on northern coastal barrier planning, and the Coastal Texas Protection and Restoration Feasibility Study, focusing on long term, large scale project feasibility.<sup>18</sup> Finally, the GLO recently completed the Texas Coastal Resiliency Study which created a list of comprehensive infrastructure projects. The Texas Coastal Resiliency Master Plan which will study storm surge suppression and ecological preservation is scheduled to be completed by the end of 2016.<sup>19</sup>

### ***Gulf Coast Community Protection and Recovery District***

The GCCPRD was created via executive order by Governor Rick Perry in the aftermath of Hurricane Ike. The GCCPRD's purpose is to "investigate the feasibility of reducing the vulnerability of the upper Texas coast to hurricane surge and flood damages through the study of an integrated flood protection system that relies on...non-structural and structural interventions."<sup>20</sup>

The GCCPRD originally set out to conduct a three phase Storm Surge Suppression Study. The study specifically investigated storm surge suppression alternatives in three regions: the North Region-Orange and Jefferson counties; the Central Region- Galveston, Chambers, and Harris counties; and the South Region- Brazoria and Galveston counties. Phase III of the study was completed in June of 2016 and presented the recommended actions for the entire study. The results "clearly illustrate the need for a storm surge protection system in the six-county region to mitigate current and future risks to the public, the economy, and the environment."<sup>21</sup> The

recommendations also establish a framework for a plan and "serve as a call to action for local, state, and federally elected officials to become advocates for coastal protection."<sup>22</sup>

The study concluded that a storm surge protection system would have significant impact across all three regions. This alternative includes a coastal spine and has a 3.22 (5.09 with GDP impact) benefit-cost ratio.<sup>23</sup> At an estimated cost of \$11.6 billion, the recommend plan will include each of the three regions and protect over 6 million people and an economy that "generates 31% of Texas' \$1.4 trillion GDP."<sup>24</sup> Of the three regions, the Central Region shows the most significant surge reduction.

After the final report was presented, it was determined there would be a Phase IV of the study to expand on the work of the prior phases. GCCPRD will focus on the environmental implications of the alternatives in Phase IV. This phase is scheduled to be completed and made available to the public in the summer of 2017.<sup>25</sup>

### ***US Army Corps of Engineers***

The USACE also plays a role in the state's coastal protection. Sharing Texas' vision for a protected and resilient coast, they work with state and local partners to maintain and improve navigation infrastructure, reduce storm surge risk, and increase coastal resiliency.<sup>26</sup>

USACE is involved with two studies to directly address the issue of storm surge in Texas; the Sabine Pass to Galveston Bay Study and the Coastal Texas Protection and Restoration Study. Both studies are being conducted with the collaboration with GLO, and the two entities are 50/50 cost-sharing.

The Sabine Pass to Galveston Bay Study existed before Hurricane Ike, but after the hurricane the study was restructured to better assess coastal needs. In partnership with the GLO, the study will assess potential coastal storm risk management and environmental projects within

six counties of the upper Texas coast (Orange, Jefferson, Chambers, Harris, Galveston, and Brazoria counties). The study, however, will focus on Orange, Jefferson, and Brazoria counties and is scheduled to be completed in July 2017.<sup>27</sup>

The Coastal Texas Protection and Restoration Study is a much larger scale study. Also done in partnership with GLO, the study aims to develop a comprehensive plan for the Texas coastal zone's flood risk management, coastal storm surge risk management, and ecosystem restoration. The study will identify projects for Congressional authorization. It will also determine the feasibility of coastal barrier alternatives based on engineering, economic, and environmental analyses. The USACE and GLO will identify tentatively selected alternatives by May of 2018 and the entire project will be completed in 2021.<sup>28</sup>

### ***Texas A&M University Galveston***

The Ike Dike, or coastal spine, is a coastal barrier protection concept conceived by Dr. Bill Merrell of TAMUG in response to the extensive surge damage caused by Hurricane Ike in September of 2008.<sup>29</sup> According to Dr. Merrell, the spine is primarily designed to "stop the surge at the coast... and not let it get in the inland waters."<sup>30</sup> Upon its completion, this concept would protect the Houston-Galveston region from hurricane storm surge.

Specifically, the coastal spine would enhance the existing coastal protection provided by the Galveston Seawall. It would extend "along the rest of Galveston Island and along the Bolivar Peninsula, with a 17ft high revetment near the beach or by raising the coastal highways."<sup>31</sup> There would also be flood gate components at Bolivar Roads, the entrance to the Houston, Texas City, and Galveston Ship Channels, and at San Luis pass that would create a barrier against Gulf surges into the Bay.<sup>32</sup> TAMUG has worked extensively with Delft University in the Netherlands

to study how their successful Delta Works Project could be applied along the Texas coast. This ongoing relationship has yielded extensive collaboration between the two universities and sharing of ideas and information.

Testimony from TAMUG at the October 5<sup>th</sup> hearing shared estimated avoided losses with use of the coastal spine. Their model projects residential and industrial losses with and without a coastal spine. If instituted, the coastal spine could have prevented over 95% of residential damages caused by Hurricane Ike. Residential losses avoided through this type of coastal protection are reduced by 70% in a 100-year storm and 71% in a 500-year storm.<sup>33</sup>

For the industrial sector, the estimated losses from plant shutdowns are between \$4-\$9 billion, depending on the stoppage time and the intensity of the storm. The total direct economic impact, including both residential and industrial losses, was estimated between \$1.3-\$12 billion. Significant loss avoidance for both residential and manufacturing sectors can be attributed to coastal protection; “86%-91% of total output losses can be avoided under a 500-year storm scenario, 79%-84% for the 100-year storm, and 100% of all losses could be mitigated under 10-year and Ike-type storm surge scenarios. Overall benefits in terms of damage avoidance due to coastal protection correspond to 81%-85% of total economic loss avoidance.”<sup>34</sup>

Current cost estimates for the Ike Dike are projected at around \$11 billion. Even with the cost, this large-scale infrastructure project has generated significant local support. As of December 1, 2016, 28 resolutions have been passed by surrounding cities and 20 local organizations (economic, chambers, nonprofits, etc.) in favor of the Ike Dike.

### ***SSPEED Center at Rice University***

The SSPEED Center at Rice University was formed in 2007 as a resource for research and education related to protection strategies for severe storms and hurricanes. SSPEED has been an active participant in researching structural and non-structural coastal storm surge protection options for the region known as the Houston-Galveston Area Protection System or, H-GAPS. SPEED is working to promote multiple lines of defense in reducing storm surge impacts in the Gulf Coast region focusing on the Houston Ship Channel, City of Galveston and the west side of Galveston Bay.

The multiple lines of defense referenced in the H-GAPS plan are a combination of structural and non-structural options and consist of gates, levees, raised roadways, berms, oyster reef restoration, and other ecosystem enhancements. The plan is composed of a coastal spine similar to the Ike Dike developed by TAMUG, but the plan locates the coastal spine in a different spot and will incorporate different features than the Ike Dike. Importantly, the H-GAPS design can be implemented in stages. The more complicated spine component will follow the implementation of a mid-bay gate, Galveston levee, and dunes during the first phase. The cost estimate for this system is estimated to be between \$6.8 and \$8.3 billion.

### ***Other Testimony***

Other testimony at the Joint Committee's hearings included the Galveston Bay Foundation, Bay Area Houston Economic Partnership (BAHEP), Texas Chemical Council, East Harris County Manufacturers Association (EHCMA) and AECOM. Public testimony was also received from residents, businesses, and organizations with opinions on coastal barrier systems



Scott Jones of the Galveston Bay Foundation testified on the organization's behalf. He emphasized the Foundation's commitment to preserving, protecting, and enhancing the resources of Galveston Bay. Mr. Jones testified that a storm surge could cause devastating environmental damage to the Bay through release of oil and petrochemicals that are abundant in the region. However, they caution against possible unintended consequences of gate, levee, or other structural options on habitats, water circulation, and salinity in the area.<sup>35</sup>

The president of BAHEP, Bob Mitchell, testified that BAHEP “engages approximately 270 investor companies, business professionals, local governments, and educational institutions to bring about prosperity and a high quality of life to its service area of southeast Texas.”<sup>36</sup> BAHEP testified that because it recognizes the large population and the immense economic responsibility the region has, BAHEP is an active coastal spine supporter. At both the April and October Joint Committee hearings, Mr. Mitchell stressed the extent of the damage caused by Hurricane Ike “even though it wasn't a direct hit.” He pointed out a protection system has not been implemented since Ike, and meanwhile other US cities with similar coastal vulnerabilities have received federal assistance for such a project.<sup>37</sup>

Like Mr. Mitchell, Hector Rivero, President of the Texas Chemical Council, shared his concerns regarding Texas's coastal vulnerability at both hearings. Mr. Rivero's testimony focused on threats to industries in the region specifically. He also called attention to the protecting the families and homes of the industry's employees as well as the industries' real property. Mr. Rivero testified that if the wellbeing of the residents and employees in the region is not properly ensured and protected, the industry cannot operate.<sup>38</sup> Agreeing with Mr. Rivero, Craig Beskid, Executive Director of the East Harris County Manufactures Association

(EHCMA), stated he fully supports a coastal spine for protecting the people and industry of this region.

Finally, Christopher Toomey, Senior Vice President of Global Programs at AECOM, provided the Committee perspective from a Fortune 500 engineering firm, including his thoughts on “addressing a key challenge that obstructs successful implementation of the proposed coastal barrier system.”<sup>39</sup> He identified this challenge, the “ultimate challenge”, as the “financial considerations” associated with such a large-scale project. He noted how securing federal funding for this type of project is becoming more challenging and therefore the state must consider a “broader set of funding options that include a mix of local, State, and Federal funds.”<sup>40</sup> He also suggested a cost-share approach, utilizing the Economic Stabilization Fund (Rainy Day Fund), RESTORE Act dollars, and a special purpose district with taxing authority.<sup>41</sup>

## Recommendations

The Committee was also instructed to include recommendations in the report to the 85th Legislature. After information was presented and gathered, the Committee has made recommendations.

### *1. Coalesce around a singular coastal barrier protection option*

The legislature should encourage the previously mentioned entities to finalize plans and modeling for coastal protection methods. In addition to working together, these suggestions should include location, components of the plan, and consider environmental implications that will be outlined in the GCCPRD Phase IV Report and the USACE/GLO studies.

### *2. Designate a local partner*

The legislature should designate a local partner that will coordinate and work with the USACE on the chosen coastal barrier project. This entity should help solidify that final proposal and be involved in working with the Texas Congressional delegation to secure necessary funding and approvals needed to move forward.

### *3. Identify potential funding sources*

The coastal spine and other storm surge protection options will cost billions. Funding for such a large infrastructure project will likely need many levels of support. All sources of funding including federal, state and local should be considered, including grants, RESTORE Act funds, and a special purpose district.

### *4. Continue the Committee to Study a Coastal Barrier System*

The Joint Committee to Study a Coastal Barrier System has provided a public forum for discussion on this important issue. The Committee and the Gulf Coast community recognize that there is still important work to be done and many more crucial conversations to be had.

Continuing the Committee will be vital to keeping this issue in the forefront of state policymakers' minds over the next interim.

## Endnotes

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- <sup>1</sup> Significant portions of this report represent updated information from the Joint Interim Committee to Study a Coastal Barrier System Report to the 84th Legislature, December 14, 2014. Full text can be found at: <http://www.senate.state.tx.us/75r/senate/commit/c840/downloads/c840.InterimReport84th.pdf>
- <sup>2</sup> Testimony of GLO to the Joint Interim Committee to Study a Coastal Barrier System, October 5, 2016
- <sup>3</sup> Joint Interim Committee to Study a Coastal Barrier System Report to the 84th Legislature, December 14, 2014
- <sup>4</sup> Joint Interim Committee to Study a Coastal Barrier System Report to the 84th Legislature, December 14, 2014
- <sup>5</sup> Joint Interim Committee to Study a Coastal Barrier System Report to the 84th Legislature, December 14, 2014
- <sup>6</sup> Joint Interim Committee to Study a Coastal Barrier System Report to the 84th Legislature, December 14, 2014
- <sup>7</sup> Testimony of TAMUG to the Joint Interim Committee to Study a Coastal Barrier System, October 5, 2016
- <sup>8</sup> See website: <http://www.allianceportregion.com/about/>
- <sup>9</sup> See website: <http://www.allianceportregion.com/about/>
- <sup>10</sup> See website: <https://www.brazosport.org/brazosport-is/industry/>
- <sup>11</sup> Senate Select Committee on Texas Ports Report to the Texas Senate, November 10, 2016
- <sup>12</sup> Testimony of GLO to the Joint Interim Committee to Study a Coastal Barrier System, October 5, 2016
- <sup>13</sup> See website: <http://www.allianceportregion.com/research>
- <sup>14</sup> Testimony of GLO to the Joint Interim Committee to Study a Coastal Barrier System, October 5, 2016
- <sup>15</sup> Testimony of GLO to the Joint Interim Committee to Study a Coastal Barrier System, October 5, 2016
- <sup>16</sup> See website: [http://www.bayareahouston.com/content/Regional\\_Profile/aerospace](http://www.bayareahouston.com/content/Regional_Profile/aerospace)
- <sup>17</sup> See website: <http://www.glo.texas.gov/the-glo/about/overview/index.html>
- <sup>18</sup> Testimony of GLO to the Joint Interim Committee to Study a Coastal Barrier System, April 11, 2016
- <sup>19</sup> Testimony of GLO to the Joint Interim Committee to Study a Coastal Barrier System, April 11, 2016 and October 5, 2016
- <sup>20</sup> Testimony of GCCPRD to the Joint Interim Committee to Study a Coastal Barrier System, April 11, 2016
- <sup>21</sup> Testimony of GCCPRD to the Joint Interim Committee to Study a Coastal Barrier System, April 11, 2016
- <sup>22</sup> See website: <http://gccprd.com/>
- <sup>23</sup> Testimony of GCCPRD to the Joint Interim Committee to Study a Coastal Barrier System, October 5, 2016
- <sup>24</sup> Testimony of GCCPRD to the Joint Interim Committee to Study a Coastal Barrier System, October 5, 2016
- <sup>25</sup> Testimony of GCCPRD to the Joint Interim Committee to Study a Coastal Barrier System, August 4, 2014
- <sup>26</sup> Testimony of USACE to the Joint Interim Committee to Study a Coastal Barrier System, April 11, 2016
- <sup>27</sup> Testimony of GLO to the Joint Interim Committee to Study a Coastal Barrier System, October 5, 2016
- <sup>28</sup> Testimony of GLO to the Joint Interim Committee to Study a Coastal Barrier System, October 5, 2016
- <sup>29</sup> Testimony of TAMUG to the Joint Interim Committee to Study a Coastal Barrier System, August 4, 2014
- <sup>30</sup> Testimony of TAMUG to the Joint Interim Committee to Study a Coastal Barrier System, October 5, 2016
- <sup>31</sup> Testimony of TAMUG to the Joint Interim Committee to Study a Coastal Barrier System, October 5, 2016
- <sup>32</sup> Testimony of TAMUG to the Joint Interim Committee to Study a Coastal Barrier System, October 5, 2016
- <sup>33</sup> Testimony of TAMUG to the Joint Interim Committee to Study a Coastal Barrier System, October 5, 2016
- <sup>34</sup> Testimony of TAMUG to the Joint Interim Committee to Study a Coastal Barrier System, October 5, 2016
- <sup>35</sup> Testimony of Galveston Bay Foundation to the Joint Interim Committee to Study a Coastal Barrier System, October 5, 2016
- <sup>36</sup> See website: <http://www.bayareahouston.com/>
- <sup>37</sup> Testimony of BAHEP to the Joint Interim Committee to Study a Coastal Barrier System, October 5, 2016
- <sup>38</sup> Testimony of Texas Chemical Council to the Joint Interim Committee to Study a Coastal Barrier System October 5, 2016
- <sup>39</sup> Testimony of AECOM to the Joint Interim Committee to Study a Coastal Barrier System October 5, 2016
- <sup>40</sup> Testimony of AECOM to the Joint Interim Committee to Study a Coastal Barrier System October 5, 2016
- <sup>41</sup> Testimony of AECOM to the Joint Interim Committee to Study a Coastal Barrier System October 5, 2016