

**SOAH DOCKET NO. 582-20-1895  
TCEQ DOCKET NO. 2019-1156-IWD**

**IN THE MATTER OF THE  
APPLICATION OF PORT OF  
CORPUS CHRISTI AUTHORITY OF  
NUECES COUNTY FOR TPDES  
PERMIT NO. WQ0005253000**

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**BEFORE THE STATE OFFICE  
  
OF  
  
ADMINISTRATIVE HEARINGS**

**EXHIBIT PAC-44R**

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REMAND PREFILED TESTIMONY

OF

BARNEY AUSTIN

ON BEHALF OF

PORT ARANSAS CONSERVANCY

SUBMITTED ON FEBRUARY 2, 2022

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**REMAND PREFILED TESTIMONY OF BARNEY AUSTIN**

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**REMAND PREFILED TESTIMONY OF BARNEY AUSTIN**

**I. INTRODUCTION**

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**Q. PLEASE STATE YOUR NAME.**

**A.** Barney Austin.

**Q. PLEASE BRIEFLY DESCRIBE YOUR OCCUPATION.**

**A.** I am President and Chief Executive Officer of Aqua Strategies. Our small company of 12 employees offers engineering and water resources consulting services to clients in Texas, Oklahoma, and overseas.

**Q. PLEASE DESCRIBE YOUR EDUCATIONAL HISTORY, AS IT IS RELEVANT TO THE OPINIONS YOU HAVE DEVELOPED IN THIS MATTER.**

**A.** I graduated with a degree in Agricultural Engineering from McGill University in 1990. I graduated with a degree in Civil Engineering (Water Resources) from the University of Salford in 1995.

**Q. PLEASE DESCRIBE YOUR WORK HISTORY RELEVANT TO THE OPINIONS YOU HAVE DEVELOPED IN THIS MATTER.**

**A.** Following completion of my Ph.D., I worked for the Institute of Hydrology in the United Kingdom for three years, where I was primarily involved in water availability studies, but also supported a study on the viability of desalination plants for small islands in the Pacific Ocean. Later, I worked for Générale des Eaux (which was renamed Vivendi during my tenure, and later Veolia), as Team Leader of the Metering and Special Projects Group, focusing mainly on building statistical models for estimating customer water per capita consumption. In 1999, I joined the Texas Water Development Board (TWDB) where I was initially tasked with supporting the Instream Flow program as a hydrologist, conducting field work, and building hydraulic models, but a short time later became Team Leader of the Bays and Estuaries program, where I led and participated in field work, and helped conduct studies of the major and minor estuaries along the coast. In approximately 2002, I

1 was promoted to Chief of the Surface Water Availability Section, and later, in about 2004,  
2 I became Director of the Surface Water Resources Division, managing some 20 staff and 9  
3 programs, including the Coastal Hydrology, Oil Spill, and Bays and Estuaries programs.  
4 During my tenure at TWDB, I led and participated in many field trips to the coast, including  
5 a comprehensive synoptic survey of the Nueces Estuary and Corpus Christi Bay. I worked  
6 with Dr. Junji Matsumoto on a TxBLEND hydrodynamic model which was used to help  
7 develop estimates of freshwater inflow needs to the state's bays and estuaries, fate of  
8 chemical spills, and impacts of ship channel deepening and widening in both Corpus  
9 Christi Bay and Sabine Lake. While at the Texas Water Development Board, I became  
10 familiar with the CORMIX software and encouraged the state to fund the development of  
11 code improvements that would allow CORMIX to simulate the discharge of negatively  
12 buoyant fluids such as brine from desalination plants. I left the Texas Water Development  
13 Board in 2009 and joined INTERA where I led the surface water division. In this capacity,  
14 I had business development responsibilities across the United States and worked on  
15 hydrology and hydraulics projects in Florida, California, Oklahoma, and Texas. Some of  
16 these projects were in the coastal zone. In 2014, I started my own company – Aqua  
17 Strategies – focused initially on water availability and water supply planning projects, but  
18 rapidly expanding into water quality, environmental flows, and flood mitigation. Many of  
19 our projects are in the coastal zone, dealing with salinity, dissolved oxygen, and sediment  
20 transport or erosion issues.

21 **Q. PLEASE IDENTIFY EXHIBIT PAC-44R BA-1.**

22 **A.** Exhibit PAC-44R BA-1 is a copy of my current Curriculum Vitae.

23 *PAC offers Exhibit PAC-44R BA-1.*

1 **II. SUMMARY OF OPINIONS**

2 **Q. HAVE YOU DEVELOPED OPINIONS RELATING TO THE JUNE 24, 2021 FIELD**  
3 **SAMPLING TECHNICAL MEMORANDUM, WHICH HAS BEEN DESIGNATED**  
4 **AS EXHIBIT APP-RP-3-R IN THIS MATTER?**

5 **A.** Yes.

6 **Q. DO THOSE OPINIONS RELATE TO THE CHARACTERIZATION OF CURRENT**  
7 **VELOCITY WITHIN THAT MEMORANDUM?**

8 **A.** Yes.

9 **Q. PLEASE SUMMARIZE YOUR OPINIONS RELATED TO THE**  
10 **CHARACTERIZATION OF CURRENT VELOCITY PRESENTED IN THAT**  
11 **MEMORANDUM.**

12 **A.** In my opinion, the analysis presented in the Memorandum provides an over-simplified and  
13 inaccurate characterization of the movement of water in the vicinity of the proposed  
14 discharge point. The flow near the discharge point is not as uniform as the Memorandum  
15 suggests, where only plots of the velocity magnitude are presented, together with total flow  
16 in the channel. The only velocity direction information presented in the Memorandum is  
17 averaged for the entire channel in a way that does not reveal variations in flow direction  
18 near the north shore. Furthermore, the presence of a hole in the channel near the discharge  
19 point, two significant groins on the shoreline nearby, and likely submerged infrastructure  
20 from dismantled and discarded loading/unloading facilities point to the hydrodynamics of  
21 the region being fairly complex, significantly slower than in the main channel, and not  
22 uniform at all.

23 **Q. HAVE YOU DEVELOPED OPINIONS RELATED TO THE PRESENCE OR**  
24 **ABSENCE OF AN EDDY IN THE VICINITY OF THE DISCHARGE POINT?**

25 **A.** Yes. The Port contends that there is no eddy in the hole near the discharge point, but the  
26 data gathered by the Port itself indicates that there is circular movement of water near the  
27 discharge point. This is consistent with the visible presence of an eddy in a prior aerial  
28 photograph of the area.

1 **Q. HAVE YOU DEVELOPED OPINIONS RELATED TO THE PORT'S**  
2 **CHARACTERIZATION OF THE HOLE IN THE VICINITY OF THE**  
3 **DISCHARGE POINT?**

4 **A.** Yes.

5 **Q. PLEASE SUMMARIZE THOSE OPINIONS?**

6 **A.** The Port has asserted that the hole is the product of rapid water movement in the area, and  
7 that the water within the hole is frequently flushed. In my opinion, the Port has not provided  
8 any evidence on the history or origin of the hole and has not demonstrated that the hole  
9 likely flushes out every tidal cycle. The Port's conclusions do not account for the possibility  
10 that the hole could have formed during an extreme flood or storm surge event a long time  
11 ago rather from the daily flood and ebb tides. In fact, in several of the figures in the Parsons  
12 Field Sampling Technical Memorandum, velocity magnitude in the bottom of the hole is  
13 significantly less than in the surrounding areas. In my opinion, the available information  
14 does not support the conclusion that the hole is frequently flushed.

15 **III. OPINIONS RELATED TO NON-UNIFORM FLOW IN VICINITY OF**  
16 **DISCHARGE**

17 **Q. IN EVALUATING THE PORT'S CHARACTERIZATION OF CURRENTS AND**  
18 **FLOW IN THE VICINITY OF THE DISCHARGE POINT, DID YOUR**  
19 **EXAMINATION FOCUS UPON ANY PARTICULAR DATA COLLECTION AND**  
20 **ANALYSIS PERFORMED FOR THE PORT?**

21 **A.** Yes. In considering the Port's characterization of current flow, I evaluated the ADCP data  
22 that was gathered on behalf of the Port June 7, 2021, through June 10, 2021. I also used the  
23 Port's HYPACK navigation software output for georeferencing the ADCP data, using the  
24 time stamp in the respective data files.

25 **Q. WHAT IS AN ACOUSTIC DOPPLER CURRENT PROFILER (ADCP)?**

26 **A.** An ADCP works similarly to the radars used by police to detect the speed of vehicles.  
27 However, instead of electromagnetic waves that radars use, ADCPs send high frequency



1 acoustic signals (sound waves) into a water body and process the return signal. Each  
2 acoustic signal is referred to as a “ping.” By measuring the characteristics of the return  
3 signal from each ping, the instrument is used to estimate how quickly particles suspended  
4 in water are moving with respect to the instrument, and how far away they are. The  
5 component that produces and receives the pings is called a “transducer.” Four transducers  
6 are typically used on a boat mounted ADCP to characterize the velocity in three dimensions  
7 in the water column below the instrument. The return signals are also used to track the  
8 bottom of the water body to get water velocity with respect to the earth. This is important  
9 when the instrument is mounted on a moving data collection platform, such as a boat. When  
10 deployed across an entire channel cross-section, the readings can be integrated to determine  
11 the total flow.

12 **Q. WHAT IS HYPACK NAVIGATION SOFTWARE?**

13 **A.** HYPACK is a software program used to help plan and collect data in the marine  
14 environment. The software can be used to pre-plot desired locations or transects for data  
15 collection and then to aid navigation while the vessel is actually collecting data. Computers  
16 using the HYPACK software are typically connected to a GPS instrument, for logging  
17 horizontal position, and other instruments such as depth sounders, water quality sensors,  
18 or ADCPs.

19 **Q. DID THE PORT GATHER ADCP DATA ALONG DIFFERENT TRANSECTS?**

20 **A.** Yes. The boat operated by the Port gathered data along several different paths, referred to  
21 as “transects.” Transect T1 was the boat path nearest to the proposed discharge point.

22 **Q. DID THE PORT ALSO GATHER FIXED ADCP DATA?**

23 **A.** Yes. ADCPs are sometimes fixed in place for continuous logging of velocity and magnitude  
24 of water in the vicinity of the instrument. Although they are sometimes deployed such that

1 they are “looking” vertically, fixed ADCPs are typically fixed near the shore and pointing  
2 across the channel for estimating total flow. The Port deployed an ADCP on the north shore  
3 of Aransas Pass pointing towards the middle of the channel.

4 **Q. DID THE DATA GATHERED BY THE PORT ALONG TRANSECT T1 ALWAYS**  
5 **INCLUDE DATA IN THE CHANNEL THAT EXTENDED TO THE LOCATION OF**  
6 **THE PROPOSED DISCHARGE POINT?**

7 **A.** No. The only transect to go all the way to the proposed discharge point while collecting  
8 positional data was that gathered along Transect T1 starting at 8:34 a.m. on June 8. The  
9 data file for that transect contains points that go a little beyond the proposed discharge  
10 point, but all others either do not have associated positional data or stop short.

11 **Q. PLEASE IDENTIFY EXHIBIT PAC-44R BA-2.**

12 **A.** Exhibit PAC-44R BA-2 is a table I have assembled as Table 1 to this testimony. That table  
13 shows the recording and availability of location data for each of the times that the Port  
14 indicated it was collecting ADCP data along Transect T1.

15 *PAC offers Exhibit PAC-44R BA-2.*

16 **Q. WHAT IS IMPORTANT TO NOTE IN THIS TABLE?**

17 **A.** This table shows that the Port did not collect any location data for seven of the thirteen  
18 trips along Transect T1. For five of the thirteen trips, the Port only collected partial location  
19 data. In these cases, the collection of location data was not started until up to a minute after  
20 the collection of ADCP data was started. The first trip along Transect T1 is the only trip  
21 where the Port collected location data for almost the entire period when ADCP data was  
22 being collected.

23 **Q. WHAT STEPS DID YOU TAKE TO EVALUATE THE PORT’S ANALYSIS OF THE**  
24 **ADCP DATA PRESENTED WITHIN THE TECHNICAL MEMO?**

25 **A.** I reviewed the horizontal (fixed) ADCP data using Teledyne’s WinADCP software. I  
26 reviewed the boat mounted ADCP data using Teledyne’s WinRiver software. In addition to

1 viewing the vertical profiles of velocity magnitude, like the figures presented in the Parsons  
2 Memorandum, I also viewed the velocity direction for the T1 files, for which we were able  
3 to obtain horizontal positional data.

4 **Q. WHAT DO YOU MEAN BY A “VERTICAL PROFILE” OF VELOCITY**  
5 **MAGNITUDE?**

6 **A.** To describe its movement of water, it is important to know both the direction it is traveling  
7 in and how fast. The boat mounted ADCP collects data below the boat, between the water  
8 surface and the bottom of the channel, in vertical “bins” as the boat follows a transect  
9 across the channel. The ADCP software reports both the direction and speed of water in  
10 each of these bins. The ADCP plots presented in the Parsons Memorandum show velocity  
11 magnitude from surface to the bottom of the channel for each transect.

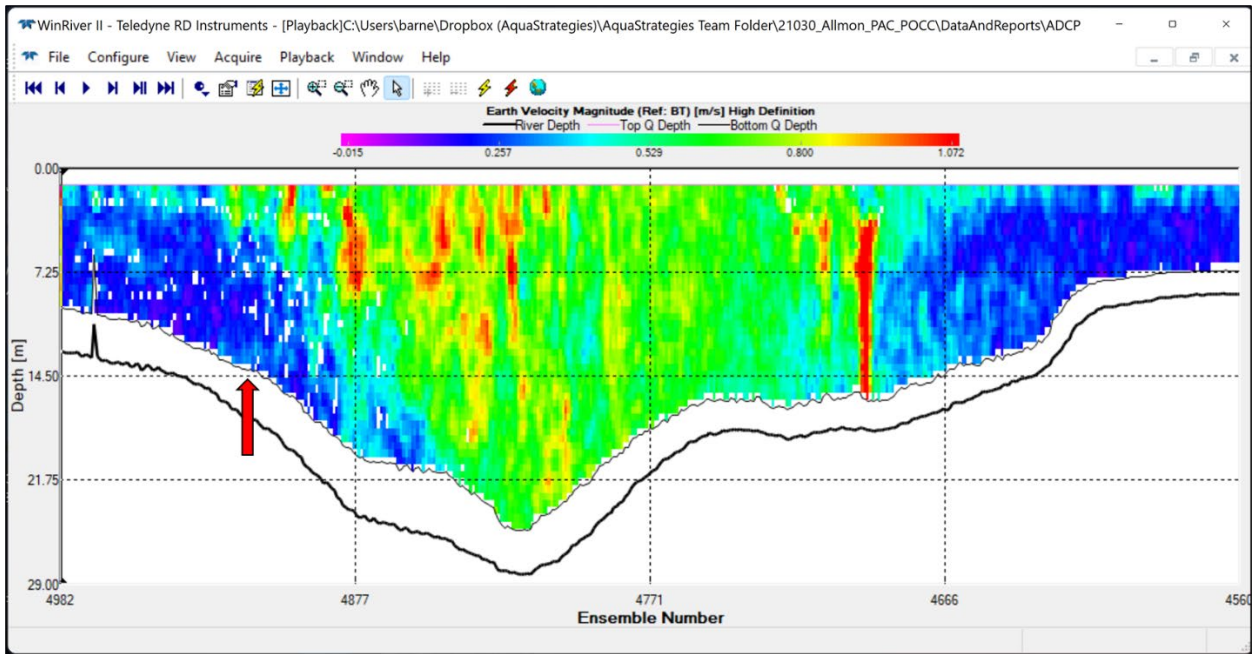
12 **Q. DID THE VELOCITY MAGNITUDE OF THE WATER IN THE CHANNEL VARY**  
13 **IN THE VICINITY OF THE DISCHARGE POINT, IN COMPARISON TO OTHER**  
14 **AREAS OF THE CHANNEL?**

15 **A.** Yes.

16 **Q. PLEASE EXPLAIN.**

17 **A.** The magnitude of the velocity of the water within the channel in the vicinity of the  
18 discharge point was typically slower than the velocity of the water in the central portion of  
19 the channel. This can be seen in Figure 1, below. As the scale for this figure shows, water  
20 in the vicinity of the proposed discharge point was moving at about 0.25 m/s, while water  
21 within the middle of the channel was moving closer to 0.5 m/s, with some areas of water  
22 within the channel moving as quickly as 1.0 m/s. Similar differences are observed between  
23 the bottom of the channel and the water surface in the vicinity of the discharge point. At  
24 the time of this transect, the current was flowing towards Corpus Christi Bay. The  
25 Memorandum describes this as a time with an average channel velocity of 0.502 m/s  
26 towards the Bay. As this figure shows, there was significant variation in velocity around

1 that average. The red arrow points towards the ensemble of ADCP data closest to the  
2 proposed discharge.



4 **Figure 1. Velocity profile (magnitude) of boat-mounted ADCP transect T1**  
5 **starting on June 8 at 8:34am.**  
6 **(Red arrow shows ADCP ensemble nearest the proposed discharge.)**  
7  
8

9 **Q. PLEASE IDENTIFY EXHIBIT PAC-44R BA-3.**

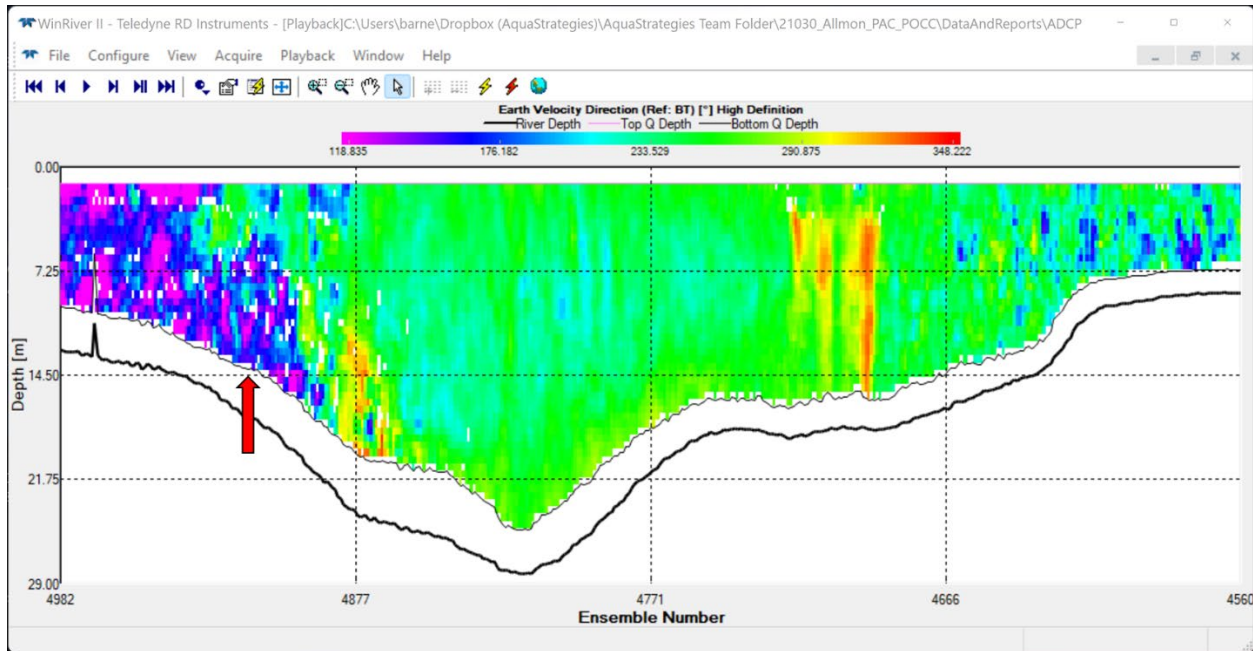
10 **A.** Exhibit PAC-44R BA-3 is a copy of Figure 1, discussed above. As noted, I developed this  
11 Figure using the WinRiver II software commonly used to view such data.

12 *PAC offers Exhibit PAC-44R BA-3.*

13 **Q. DID THE DIRECTION OF THE WATER IN THE CHANNEL VARY IN THE**  
14 **VICINITY OF THE DISCHARGE POINT, IN COMPARISON TO OTHER AREAS**  
15 **OF THE CHANNEL?**

16 **A.** Yes. I was also able to obtain the horizontal positional data for the ADCP data for the  
17 transect path starting on June 8 at 8:34 a.m. That enabled me to view the direction of flow.

18 I have captured that view in Figure 2, below.



2  
3 **Figure 2. Velocity profile (direction) of boat-mounted ADCP transect T1**  
4 **starting on June 8 at 8:34am.**  
5 **(Red arrow shows ensemble nearest the proposed discharge.)**

6 Rather than showing the magnitude of the velocity of the water, Figure 2 shows the  
7 direction of water in degrees as related to compass directions. According to those compass  
8 directions, zero would represent flow directly to the north, 90 degrees would represent flow  
9 to the west, 180 degrees would be flow to the south, 270 degrees would be flow to the east,  
10 and numbers approaching 360 would be flow towards the north and slightly east.

11 The lowest angle of flow detected was 118 degrees (depicted by pink in Figure 2). That  
12 represents water moving in approximately a westerly direction. Most of the water was  
13 flowing at compass angles of approximately 230 degrees (depicted in green). That  
14 represents water moving in approximately a southwesterly direction and represents the  
15 primary flow of water into Corpus Christi Bay through the channel. However, portions of  
16 water in the channel were observed to be flowing at a compass angles approaching 350  
17 degrees (depicted by red in Figure 2). That represents water moving almost due north. As

1 this shows, the data gathered did not indicate water flowing in a uniform direction and is  
2 particularly non-uniform near the north shore of Transect 1 and the proposed discharge  
3 point.

4 **Q. PLEASE IDENTIFY EXHIBIT PAC-44R BA-4?**

5 Exhibit PAC-44R BA-4 is a copy of Figure 2, discussed above.

6 *PAC offers Exhibit PAC-44R BA-4.*

7 **Q. DID YOU PERFORM OTHER ANALYSIS OF THE ADCP DATA TO DISPLAY**  
8 **THE DIRECTION OF FLOW IN THE AREA OF THE DISCHARGE LOCATION?**

9 **A.** Yes. It can be hard to visualize flow through the type of cross-sectional view shown in  
10 Figure 2, so I decided to develop a way to depict the data as vectors.

11 **Q. PLEASE EXPLAIN.**

12 **A.** I developed computer code to process the ADCP data and display it in the form of velocity  
13 vectors. In developing those displays, I averaged the data over a shorter time frame than  
14 the Port had done in its processing of the data. This enabled a more detailed examination  
15 of the data. That visualization, reflecting the average recorded direction for each second,  
16 averaged for the entire water column, is shown in Figure 3, below. Each vector represents  
17 approximately two ensembles of data points.



2 **Figure 3. Depth-averaged velocity vectors from ADCP transect T1 starting on June 8 at**  
 3 **8:34am, with data averaged in the horizontal at one per second (approximately two**  
 4 **ensembles).**

1 As Figure 3 illustrates, the velocity vectors near the north shore on the ADCP transect point  
2 in directions that are different to the velocity vectors in the main channel. These vectors  
3 are depth-averaged and averaged in the horizontal too, at one vector per second.

4 **Q. PLEASE IDENTIFY EXHIBIT PAC-44R BA-5.**

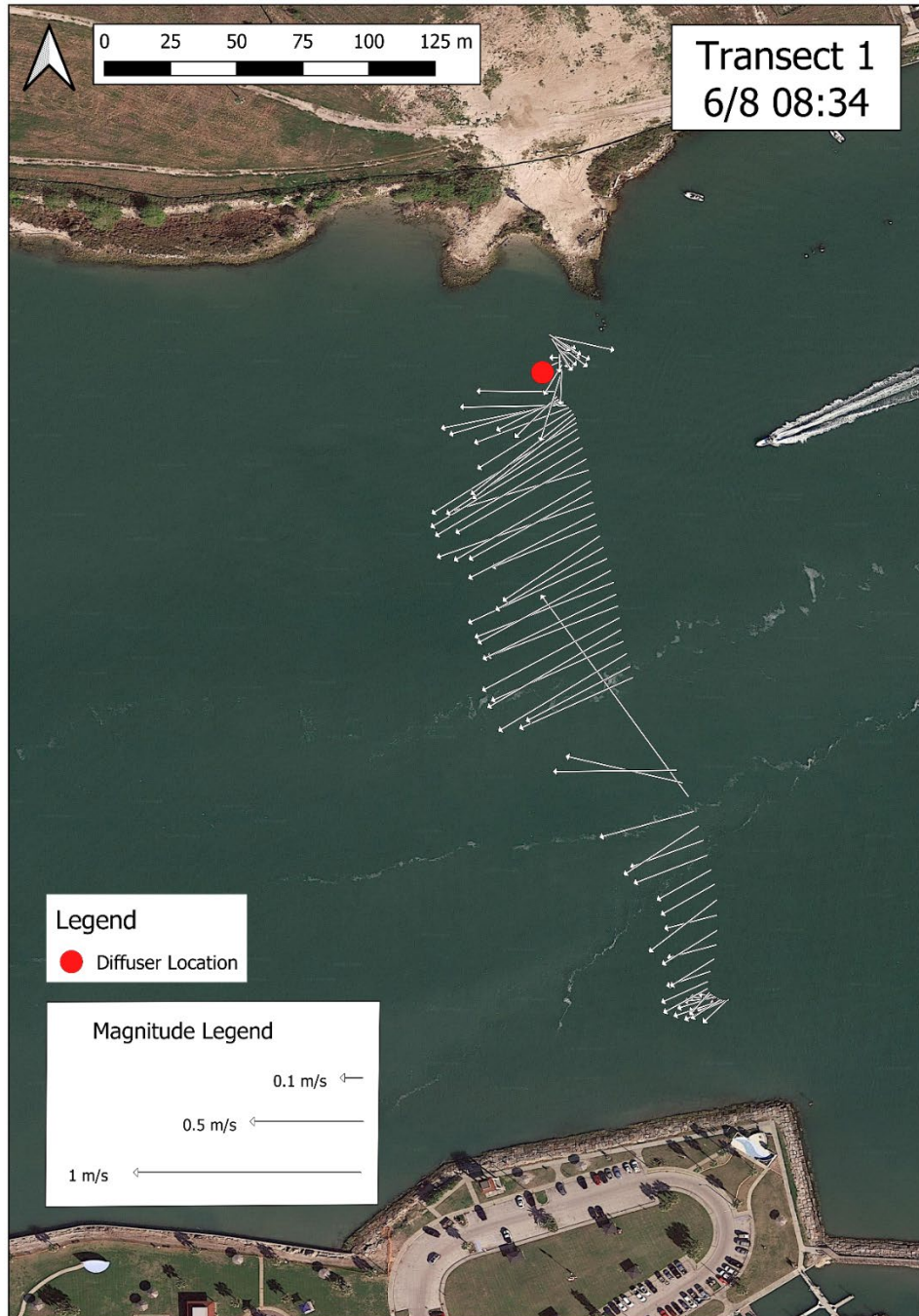
5 **A.** Exhibit PAC-44R BA-5 is a copy of Figure 3 discussed above.

6 *PAC offers Exhibit PAC-44R BA-5.*

7 **Q. DID YOU PERFORM AVERAGING FOR ANY OTHER TIME INTERVALS, OR**  
8 **DEPTHS?**

9 **A.** Yes. I developed Figure 4, below, for which data are averaged on three second intervals,  
10 instead of one second as shown in the previous figures. Figure 4 shows approximately six  
11 data ensembles averaged per vector. Figure 4 displays the flow direction observed for the  
12 entirety of that particular transect, depth-averaged in the vertical and three-second averages  
13 in the horizontal.





2 **Figure 4. Depth-averaged velocity vectors from ADCP transect T1 starting on June 8 at**  
 3 **8:34am, with data averaged in the horizontal at 3-second intervals (approximately 6**  
 4 **ensembles per vector).**

5 This averaging of the ADCP data clearly shows the flow in the vicinity of the proposed  
 6 discharge point to be not uniform at all.

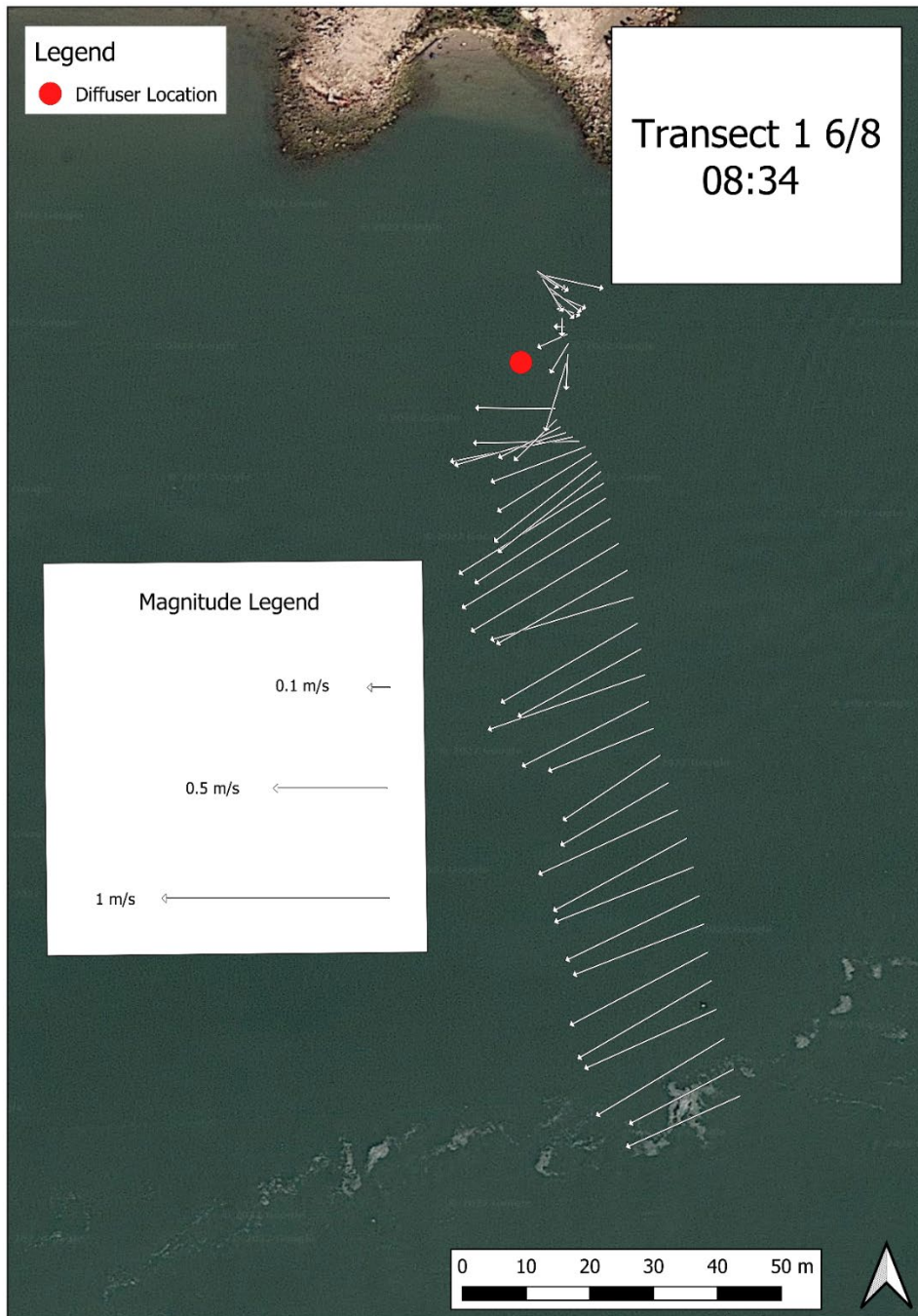
1 **Q. PLEASE IDENTIFY EXHIBIT PAC-44R BA-6.**

2 **A.** Exhibit PAC-44R BA-6 is a copy of Figure 4 discussed above.

3 *PAC offers Exhibit PAC-44R BA-6.*

4 **Q. DID YOU DEVELOP A VIEW OF THIS DIRECTIONAL INFORMATION THAT**  
5 **IS MORE FOCUSED ON THE AREA OF THE PROPOSED DISCHARGE?**

6 **A.** Yes. Figure 5, below, depicts the same averaging approach shown in Figure 4, above, but  
7 zoomed in to allow examination particularly of the direction of the flow in the area near  
8 the proposed discharge point.



2 **Figure 5. Depth-averaged velocity vectors from ADCP transect T1 on June 8 at 8:34am,**  
 3 **with data horizontally averaged on 3-second intervals (approximately 6 ensembles per**  
 4 **vector). Zoomed in.**

1 **Q. PLEASE IDENTIFY EXHIBIT PAC-44R BA-7.**

2 **A.** Exhibit PAC-44R BA-7 is a copy of Figure 5 discussed above.

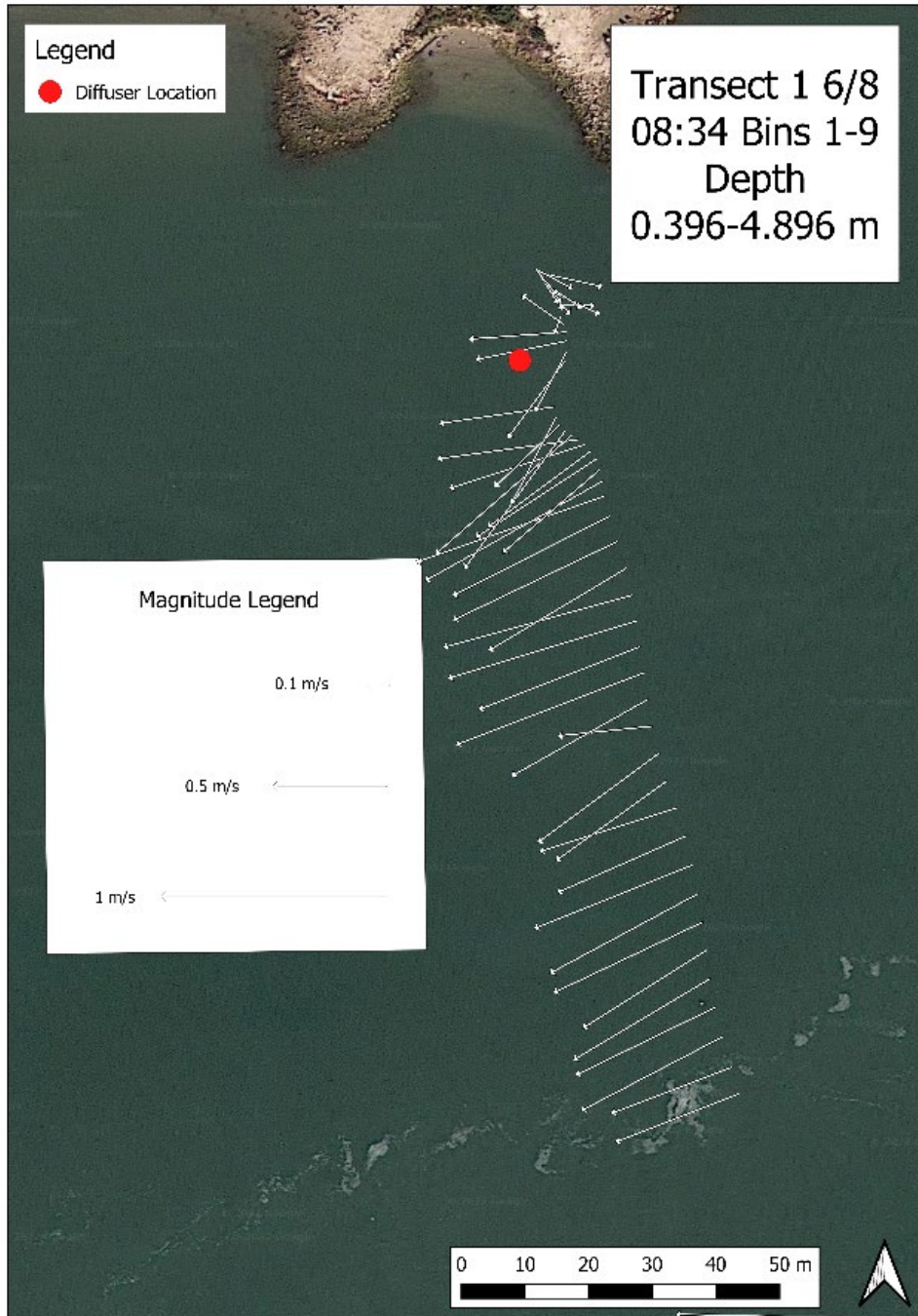
3 *PAC offers Exhibit PAC-44R BA-7.*

4 **Q. DOES THE ADCP DATA GATHERED BY THE PORT REFLECT THIS NON-**  
5 **UNIFORM DIRECTION OF FLOW THROUGH A SIGNIFICANT PORTION OF**  
6 **THE WATER COLUMN?**

7 **A.** Yes.

8 **Q. PLEASE EXPLAIN.**

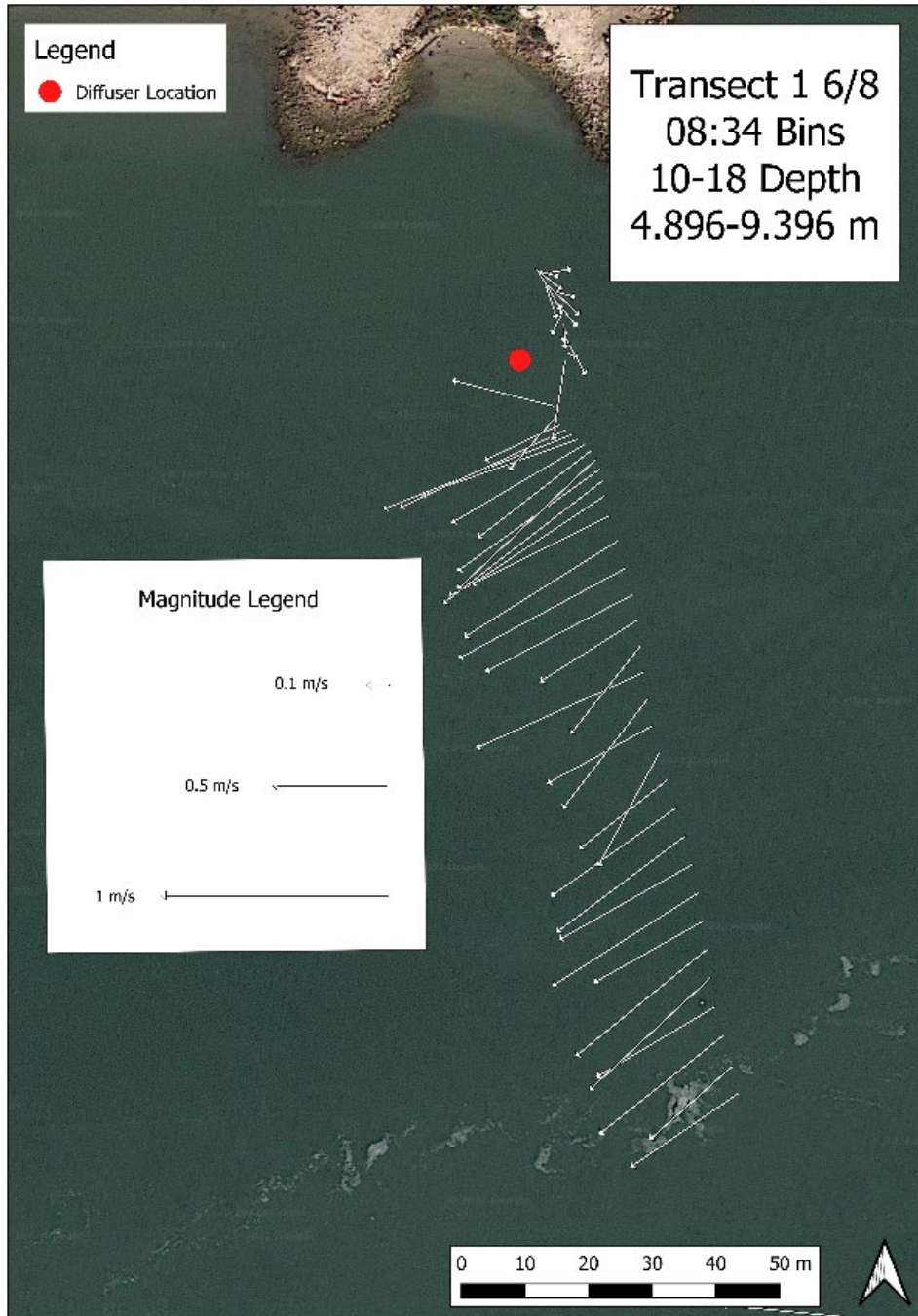
9 **A.** I also looked at the flow direction indicated by the data in the top five meters of the water  
10 column. A display of that data is reflected in Figure 6, below. For Figure 6, I used only  
11 Bins 1-9 to determine the directional velocity of flow in roughly the top 5 meters of the  
12 water column.



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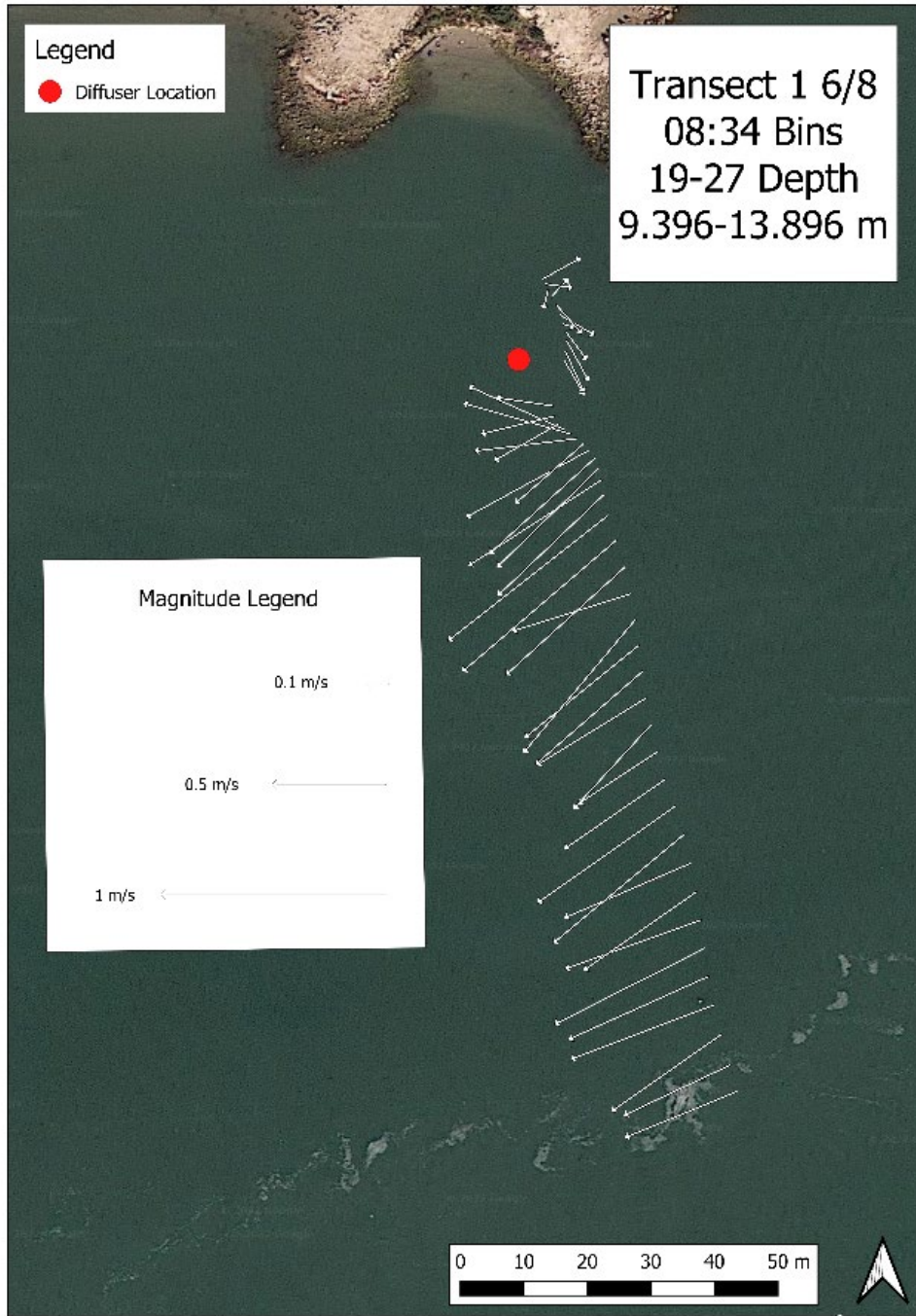
**Figure 6. Depth-averaged velocity vectors in Top Third of Water Column from ADCP transect T1 on June 8 at 8:34am.**

1 Then, I developed the depiction shown in Figure 7. For that depiction, I used data from  
2 Bins 10 – 18, representing the depths ranging from roughly 5 to 10 meters beneath the  
3 water surface.



5 **Figure 7. Depth-averaged velocity vectors in Middle Third of Water Column**  
6 **from ADCP transect T1 on June 8 at 8:34am.**

1 Finally, to develop Figure 8, I used data from Bins 19 – 27, representing the depths ranging  
2 from approximately 10 meters beneath the surface to the deepest depth for which data was  
3 collected at roughly 14 meters beneath the surface.



5 **Figure 8. Depth-averaged velocity vectors in Bottom Third of Water Column**  
6 **from ADCP transect T1 on June 8 at 8:34am.**

1 **Q. PLEASE IDENTIFY EXHIBIT PAC-44R BA-8.**

2 **A.** Exhibit PAC-44R BA-8 is a copy of Figure 6 discussed above.

3 **Q. PLEASE IDENTIFY EXHIBIT PAC-44R BA-9.**

4 **A.** Exhibit PAC-44R BA-9 is a copy of Figure 7 I have been discussing.

5 **Q. PLEASE IDENTIFY PAC-44R BA-10.**

6 **A.** Exhibit PAC-44R BA-10 is a copy of Figure 8 I have been discussing.

7 **Q. DO YOU HAVE AN OPINION AS TO WHAT MIGHT CAUSE THIS NON-**  
8 **UNIFORM DIRECTIONAL FLOW?**

9 **A.** Yes. The direction of flow is likely being influenced by the irregular bathymetry in the  
10 region.

11 **Q. PLEASE EXPLAIN.**

12 **A.** Although it is difficult to know without more detailed bathymetry, the double groin that is  
13 visible on the north side of the Aransas Pass near the proposed discharge point probably  
14 extends underwater into the channel. This feature causes flow along the north shore to  
15 deflect towards the channel, whether the bay is emptying or filling. The situation is further  
16 complicated by the deep hole, which may have been created by the irregular flow pattern  
17 and may even be influencing the circular motion seen in the boat mounted ADCP data.  
18 There may also be submerged infrastructure under the water's surface – you can see in  
19 older photographs that there were loading/unloading facilities along the shore. The  
20 bathymetry provided was single beam, single frequency so the detail needed to understand  
21 why the flow is not uniform in the area is not available.

22 **Q. IN YOUR OPINION, DOES AN EDDY OCCASIONALLY FORM IN THE**  
23 **VICINITY OF THE DISCHARGE POINT?**

24 **A.** Yes.

25 **Q. PLEASE EXPLAIN.**



1 A. Figures 3 through 8 show that there is indeed a circular movement of water (eddy) in the  
2 vicinity of the proposed discharge point. While flow in the main channel shows fairly  
3 uniform flow in the inland direction, the flow around the proposed discharge is in the  
4 direction of the Gulf of Mexico nearest the shore and towards the middle of the channel  
5 (south) next to the discharge point which indicates circular movement. As shown in Figures  
6 6 through 8, this pattern is observed in all parts of the water column too – the top third,  
7 middle, and bottom third. One would not expect the eddy to be present all the time, but it  
8 is present in the only ADCP transect made available by the Port that actually crosses the  
9 proposed discharge point.

10 Q. **IS THIS EXISTENCE OF AN EDDY CONSISTENT WITH PRIOR AERIAL**  
11 **PHOTOGRAPHY OF THE AREA?**

12 A. Yes. An aerial photograph of the area from 1956 clearly shows the existence of an eddy at  
13 this location. That photograph is shown in Figure 9, below.



15 **Figure 9. 1956 Aerial Imagery of Proposed Discharge Location**

1 There are a few different indications of the eddy in this photograph. First, you can see the  
2 disruption of the wave patterns of the wake created by the boat that is furthest to the right  
3 on the photograph. You can also see the light-colored water reflecting the presence of  
4 suspended sediment within the eddy.

5 **Q. HOW DID YOU OBTAIN THIS PHOTOGRAPH?**

6 **A.** Bruce Wiland initially called my attention to this photograph. It is accessible through  
7 Google Earth.

8 **Q. ARE GOOGLE EARTH IMAGES REGULARLY RELIED UPON BY EXPERTS IN**  
9 **YOUR FIELD?**

10 **A.** Yes. The base imagery for many of the depictions provided by the Port are Google Earth  
11 images.

12 **Q. PLEASE IDENTIFY EXHIBIT PAC-44R BA-11.**

13 **A.** Exhibit PAC-44R BA-11 is a copy of this 1956 aerial photograph.

14 *PAC offers Exhibit PAC-44R BA-11.*

15 **IV. CHARACTERIZATION OF NEARBY HOLE**

16 **Q. HAVE YOU REVIEWED TESTIMONY BY THE PORT REGARDING THE**  
17 **POTENTIAL FOR WATER TO BE FLUSHED OUT OF THE HOLE NEAR THE**  
18 **PROPOSED DISCHARGE POINT?**

19 **A.** Yes. I reviewed the testimony of Dr. Jordan Furnans, who asserts tidally driven forces are  
20 persistent within the hole.

21 **Q. IN YOUR OPINION, DOES THE INFORMATION PRESENTED BY THE PORT**  
22 **SUPPORT THAT CONCLUSION?**

23 **A.** No.

24 **Q. PLEASE EXPLAIN.**

25 **A.** I don't believe Dr. Furnans' statement is supported by the data. The ADCP data made  
26 available by the Port itself shows that velocities in the bottom of the hole are typically

1 lower than they are in the main channel. See figures on pages 22 to 52 in the Parsons report,  
2 which is Exhibit APP-RP-3-R.

3 **Q. ARE THERE STEPS THAT THE PORT COULD HAVE TAKEN TO TEST DR.**  
4 **FURNANS' THEORY AS TO WHETHER THE HOLE IS THE PRODUCT OF**  
5 **ONGOING SCOURING ACTION?**

6 **A.** Yes. The collection of core samples in this area would have been a simple step to undertake.

7 If the substrate at this location was very firm, then that would be an indication that  
8 persistent scouring action occurs in the hole. If the substrate is softer than in the main  
9 channel, then that would indicate that scouring action is not occurring within the hole on a  
10 regular basis. Furthermore, if a multi-frequency depth sounder had been used to gather the  
11 bathymetry data, it would have provided some insight into the density of the substrate in  
12 the hole compared to the main channel. Isotope analysis of the sediment might also provide  
13 insight into the age of the substrate, and dynamics of deposition and scour.

14 **V. CONCLUSION**

15 **Q. DOES THIS CONCLUDE YOUR TESTIMONY?**

16 **A.** Yes.