DOUBLE BAYOU WATERSHED PARTNERSHIP
Stakeholder Meeting 8

November 18, 2014
5:30 – 7:30 PM
Double Bayou Community Building

MEETING SUMMARY

Stakeholders: David Boyd, Linda Broach, Clay Dean, Tom Douglas, Alice Durst, Keith Durst, Leroy Ezer, Becky Fancher, Clint Fancher, Guy Robert Jackson, Brandt Mannchen, David Manthei, Lisa Marshall, Tom McNeely, Bob Scherer, Jerry Shadden, Matt Singer, Rex Tunze, Blake Turner, Otho Turner, Kay Willcox, Pudge Willcox

Team Members: Ryan Bare (HARC), Abby Ficklin (Shead), Stephanie Glenn (HARC), Brian Koch (TSSWCB), Brandie Minchew, Linda Shead (Shead)

1. Welcome, Introductions, and Agenda Review

Linda introduced Matt Singer of the Galveston Bay Foundation (GBF) and noted that GBF sponsored the refreshments for the meeting.

Mr. Singer introduced himself and the Galveston Bay Foundation, which is a nonprofit organization based in Webster, Texas, operating out of four counties surrounding the Galveston Bay system: Brazoria, Harris, Chambers, and Galveston counties. He stated that GBF's mission is to preserve, protect, and enhance the natural resources of Galveston Bay. He lauded stakeholders for coming together to work proactively toward a solution to potential impacts in the Double Bayou watershed. He noted that he would be available for questions on GBF or on how GBF could help property owners, and he then reminded everyone that refreshments were available.

Linda thanked Mr. Singer and reviewed the agenda: presentations on the highlights of the feral hog workshop; a short review of bacteria results presented at the last meeting; and new data and sampling results on dissolved oxygen and nutrients. Linda then started the self-introductions of meeting attendees.

2. Key Lessons from the Chambers County/Double Bayou Watershed Feral Hog Management Workshop

Linda introduced three folks who attended the feral hog workshop in June and would present on key lessons from that workshop: Pudge Willcox, David Boyd, and David Manthei.

Pudge Willcox presented first on feral hog traps, because traps interested him most at the workshop, and because it was suggested that traps could be the first line of defense as a control. Mr. Willcox focused on box traps and corral traps for his presentation.

Box traps, sized 4 feet by 8 feet, 3-4 feet tall, are easy to transport and to set up, and can be bought ready-made. It is recommended to place a top on box traps, because, if several hogs are trapped at one time, they may crawl out of the top of the trap. If the trap is constructed with both a top and a bottom, the trapper can then move the hog without removing it from the trap. Mr. Willcox noted that box traps have the disadvantages of catching only a small number of hogs and that the presence of the traps can cause feral hogs to become trap-shy and relocate to another area. Other disadvantages include the possibility of trapping other animals, including domestic pets. A box trap requires a t-post to anchor it.

A corral trap is usually constructed with livestock panels and t-posts and is best for serious trapping needs. It allows for the trapping of entire sounders (groups of feral hogs) and reduces the number of non-targeted catches. A corral trap is not inexpensive to construct, since they use cattle panels, since cattle panels. The corral traps are highly adaptable to various types of terrain. A disadvantage is that they do require a significant amount of labor to put them together, and they are difficult to relocate once built. Materials noted for construction were: lifting head/rooter gate, 13 T-posts (6-ft), 4 utility panels, 16 feet long by 52 inches tall, roll of tie wire (bailing wire), T-post driver, lineman's pliers or fencing tool, 4-foot long 2x4, and hook and eye latch (4-inch).

Mr. Willcox noted the damage feral hogs can cause to an environment and how they can negatively impact water quality in a watershed. Feral hogs can tear up yards and landscaping, damage crops, and impact livestock and wildlife.

Mr. Willcox referenced the AgriLife Extension websites, where he obtained information for his presentation:

- http://www.extension.org/category/feral_hog_traps
- http://feralhogs.tamu.edu/

He described the baiting process of the traps, which is required to be effective, but is also both expensive and time consuming. Pre-baiting involves placing bait inside the trap and allowing hogs to get used to entering and exiting the trap. At a later time, the trap is set so that it will close after a hog has entered to get the bait.

Mr. Wilcox described factors in selecting the location for traps. Traps should be placed near the bayou, ponds, or other water locations, particularly if rooting and bedding activity is noticed in the area. Other effective trap locations are in brushy areas or along hog trails. Mr. Wilcox noted the suggestion to use wildlife cameras to determine hog behavior in an area, along with the ideal placement location for a trap. He stated a quote from the workshop that, "Trapping feral hogs is a process, not an event." He described a personal experience with using a trap on his property noting that no hogs were caught, but the hogs never returned to the property.

Linda said that the slides from Mr. Willcox's presentation would be posted on the website. She then introduced David Boyd to speak next on the feral hog workshop highlights.

Mr. Boyd reported that the information from the workshop that most interested him was the impact of feral hogs on wildlife refuges, national parks, nature parks, etc. He stated that he and Brandt had seen a great deal of damage from feral hog activity, and that, in addition to impacting

the general environment, there were specific impacts on plants and trees. Feral hogs eat acorns, which reduces trees' ability to repopulate, which in turn affects riparian ecosystems.

Mr. Boyd shared that he found most alarming the population models which showed that, in order to keep a feral hog population from increasing, 66% of the hog population would have to be removed. This removal would not decrease the population and would merely keep it from increasing.

Mr. Boyd next shared information that he learned from a ranger at Guadalupe National Park in West Texas. The ranger stated that feral hogs had not yet impacted the park, but that ranchers had noted feral hog activity in the desert environment and that they seemed to be moving from stock tank to stock tank. The feral hogs have been spreading across Texas and neighboring states.

Another alarming issue to Mr. Boyd was the evidence of feral hogs seen in the lawns of his and his neighbors' properties. He also noted the tendency of hogs to stick to waterways and to push sediment and other droppings into the waterways as they rooted and traveled from place to place. He noted that he had once seen 18 hogs feeding in broad daylight.

Mr. Boyd concluded that removing 66% of a hog population would be difficult and would require trapping, shooting, or other measures. He noted that Texas A&M was studying the problem and had presented solutions such as the use of sodium nitrite and the use of genetic engineering.

Linda thanked Mr. Boyd and invited David Manthei to speak next and answer some questions.

The first question Mr. Manthei addressed was on fecundity. Sounders can contain anywhere from 2-50 hogs. Female hogs sexually mature at 6-10 months of age and can have up to 2 litters of 8 piglets per year.

The next question was on the reason that hogs need to be around water. Feral hogs don't have sweat glands, so they need water to regulate their body temperature.

On the question of what food they eat, Mr. Manthei stated that feral hogs will eat anything. They primarily eat vegetation, and the season will drive their diet.

Next, Mr. Manthei addressed hunting and licensing. If feral hogs are on a person's property, and they are degrading a crop, that person does not need a permit to shoot the hogs. Under any other circumstances, however, a license is required.

Regarding any laws regarding putting diesel or motor oil on the corn, it was not discussed at the workshop, but there was talk of poisoning hogs as a solution. The problem in that case is finding a poison that affects hogs but not other wildlife or livestock. It was noted that diesel and motor oil attracted hogs, and that deer would not eat corn coated in motor oil or diesel, but feral hogs would. Mr. Manthei concluded that this seemed to fall under "baiting," which is legal.

One comment was that if there would be money to fund this project, then some should be used to put a bounty on feral hogs. Brian Koch stated that other watersheds have used a bounty system to reduce hog populations. Mr. Koch stated that it would be a good idea to convince the County to offer a bounty, which would interest people in shooting hogs. It might not be watershed-specific but would still have a positive impact.

3. Summary of New Bacteria Modeling in Double Bayou

Linda presented a review of bacteria in Double Bayou to give context to Stephanie Glenn's presentation to follow. Bacteria can be indicators of disease-causing pathogens, and the two indicators used by TCEQ are: *Escherichia coli* from freshwater samples, and Enterococcus in saltwater samples. Linda noted that Stephanie stated previously that bacteria are counted in two

different units: Colony Forming Units or CFUs in the SELECT model, and the Most Probable Number in culture tests done in lab sampling. For CFUs, the bacteria are grown on a solid medium. Each colony formed is started from a bacterium, and the colonies are then counted. This helps to estimate the number of bacteria that were originally in the water. In order to calculate the Most Probable Number, a liquid medium is used, the bacteria are observed under a light, and statistical methods are applied to determine the likely number of bacteria that were present at the start.

The sampling period began in October 2013, and the data has been quality-assured through August 12, 2014, providing nearly a full year of data. Two types of sampling were conducted: Routine sampling and targeted rain event sampling. Routine sampling is scheduled ahead of time and does not correlate with weather conditions. Routine samples are currently planned for twice per month. Targeted rain event sampling is unscheduled sampling that takes place during a rain event. This kind of sampling will typically give worst-case bacteria level scenarios and may help identify sources of bacteria not seen during dry weather sampling.

Linda reviewed the locations of the five sampling stations and that routine sampling occurred 17 times, and 4 targeted rain events were sampled during the sampling period, which is ongoing. Reporting on the results is based on the sampling data that have been checked and quality-assured.

Linda presented a map showing how many out of the 17 routine samples at each station were over the benchmark level. The benchmark level has been set as a guideline, and if a sample has bacteria levels above the benchmark, this may point to a problem. The benchmark is not regulatory; it is meant to help identify problems in water quality. The most samples which exceeded the benchmark level occurred in the Upper West Fork; the second most occurred in the Lower East Fork; third most occurred in the Lower West Fork; and the 4th most instances of samples exceeding the benchmark level were in the Upper East Fork. The wastewater treatment plant had the lowest number of routine samples that exceeded the benchmark.

Targeted rain samples are more difficult to show and explain. Each bar at each location is one day of a targeted rain sample. All samples exceeded the benchmark for that location. The third event at the wastewater treatment plant far exceeded the benchmark, and that same rain event resulted in a very high level at the Lower East Fork station, although not as high as at the treatment plant.

Linda presented a table showing the levels of bacteria and how much is above the benchmark according to the season. For the fall season, 65% of routine samples were above the benchmark, whereas in winter and spring, it was 27%-28%, and in summer, it was 36%. During rainfall events, 100%, 100%, and 90% exceeded the benchmark. Thus, we have both seasonal differences and rainfall differences.

The geomeans are an average that emphasizes the middle, taking the middle more into consideration than high values. That is, high values are not permitted to skew the average. TCEQ uses geomeans for indicator criteria for bacteria and water quality. Of the 17 routine samples the geomean was not exceeding the geomean criterion of the Upper East Fork. The Lower East Fork, the West Fork Upper, and the West Fork Lower, which are tidal, have a different standard, because they count Enterococcus rather than *E. coli*. Every tidal sampling station is over the criterion for bacteria, indicating a problem.

TCEQ has already decided, based on past sampling, that the West Fork is not meeting the geomean. The East Fork is borderline in terms of meeting the geomean. In routine sampling, the wastewater treatment plant has not exceeded the geomean. High geomeans at the tidal stations are above the state's criterion for routine sampling, which is done primarily in dry weather.

Rainfall patterns affect targeted rain event sampling. A rainfall event depends not only on how much rain has fallen, but also on how recently the last rain fell. If rain fell the day before a sample was taken, it might have washed out the bacteria, so that the sample might not indicate levels that are as high. If rain has not fallen in some time, a sample might show higher levels of bacteria.

Linda then went over the structure of the graphs: the x-axis, the y-axis, the units, the reference line (screening level or benchmark), the legend, and the data point symbols.

Linda introduced Guy Robert Jackson, 2nd Vice-Chair and a Chambers County representative on the Galveston Bay Foundation board, whose arrival had been delayed by business matters. Mr. Jackson welcomed and thanked everyone for being at the meeting.

4. Results of New Dissolved Oxygen Sampling

Stephanie Glenn introduced the topic of the cycle of dissolved oxygen and nutrients and why this cycle is important. Nutrients can be regarded as food for the system (bacteria, plants, animals, and humans). Chlorophyll-a given off by plants can be an indicator of how much photosynthesis is going on in the system. Excess nutrients can increase bacteria and plant growth, which can lead to an increase in chlorophyll-a. Dissolved oxygen (D.O.) decreases as more of it is consumed by the bacteria growth. Cycles can change over the course of a day or over long-term cycles. Depending on the nutrients being input into the system, the cycle can shift. Small changes in nutrients can cause a big impact on the cycle.

D.O. is needed by aquatic life for survival. A D.O. of less than 3 can cause aquatic life to die off. Levels of 4-5 are considered a stressor. Numbers above 6 are considered good.

The levels of D.O. depend on several factors. For example, plants do not produce oxygen during the night, but oxygen is still being used by aquatic life for respiration. It is usually the case that D.O. concentrations will be lowest during the morning in a water body. But D.O. is also temperature dependent; colder water has greater capacity to hold oxygen. Salinity of the water is also a factor. As salinity increases, the water's ability to hold D.O. decreases. The West Fork Lower is the most saline of the tidal stations. An increase in D.O. can be observed right after a rainfall. As rainwater is flushed into the system, it brings in fresh D.O. However, during periods of infrequent rainfall, a rain event can result in excess bacteria getting flushed into the system, which then takes in the dissolved oxygen, so that D.O. levels dip.

There are two methods of sampling D.O.: grab sampling, which is taking a scoop of water once during the day; and 24-hour sampling that captures the events of an entire day and the impacts of those events on the levels of D.O. TCEQ uses 24-hour data for D.O. criteria assessment, if those data are available. If the 24-hour data are not available, grab samples are used for screening parameters. 24-hour data were available on the West Fork for the last screening assessment. Grab sampling is still important, because 24-hour sampling ("soaks") cannot be done every day due to the expense. Grab sampling also shows the course of a year and changes that might be happening in D.O. levels over time.

In the D.O. grab samples for Double Bayou, higher D.O. levels were observed in January, while lower D.O. levels were observed in July and August. This correlates to changes in water temperature. At the Anahuac Wastewater Treatment Plant, though, not much change or cycling was observed in D.O. levels. The WWTP does not have the same stream movement that other bayou samples do, so it tends not to show the same cycles as the other samples.

On the correlation graph, with D.O. on the y-axis and water temperature on the x-axis, non-tidal sample areas have a much higher correlation between water temperature and D.O. than the tidal

samples. (That is, the sample values are hugging the correlation line more tightly.) This shows the effects of salinity at tidal stations on D.O. levels.

A seasonal table (not including the WWTP) was presented, looking for seasonal patterns that could help with discussions of Best Management Practices (BMPs) to implement for the watershed protection plan. During the summer, 4 out of 20 samples fell below the screening levels. Overall, for the grab samples, the number of routine samples that fell below the screening level was not that many.

The 24-hour sampling tells a different story. Two 24-hour samplings have been done on the non-tidal East Fork Upper so far. The criteria for 24-hour sampling for tidal and non-tidal differ slightly, because salinity must be taken into account. The 24-hour average D.O. non-tidal criterion is 5.0; for tidal, it is 4.0, and for both, the minimum is 3.0. During a 24-hour soak, the sampling instrument is left in the water, and every fifteen minutes, it records D.O., salinity, and temperature. From that data, an average is taken, as well as the absolute minimum. The 24-hour sample gives an idea of what is happening over an entire day, which is why it is preferred over a grab sample.

For East Fork Upper in August, the minimum D.O. level was about 1.8; September was about 0.5; and October was about 1.2. On the West Fork Upper, the minimum D.O. level was slightly under 3 for August and September, and it was better for the October date. On the East Fork Upper, none of the averages met the criterion, and none of the minimums met the criterion. On the West Fork Upper, 2 out of 3 averages did not meet the criterion. It is important to keep in mind that the first two samples were taken during warmer months, which is when it is expected to see the lowest lows, in terms of D.O. levels.

Q: Was the water flowing in October, too?

A: Yes, and that makes a difference, too. On all of these, we do take a flow sample, so we will be able to chart those, as well, against this.

Stephanie also noted that soaks were being done on the two lower stations, and that they want to get two soaks at the lower stations in August 2015, if possible, so that the data would be available for comparison.

On the two upper stations, D.O. levels for the 24-hour samples suggested that fluctuations throughout the day show levels that could be problematic for aquatic life. Five to six sampling periods had minimums below the criterion, and five to six had averages below the criterion. Grab samples showed a seasonal pattern: 5% below screening level during the summer. This is expected, due to water temperature. East Fork Upper shows samples below screening levels in July through October.

Linda asked stakeholders if there was anything that was a surprise, or stood out, that wasn't expected, or they didn't know was going to happen? Mr. Fancher indicated that this material is not surprising. He spoke of "black water," when the bayou turns the color of tea, and the resultant fish kills.

5. Results of New Nutrient Sampling

Next, Stephanie discussed the results of nutrient sampling. During photosynthesis, plants absorb sunlight and convert it to sugar, using the nutrients phosphorous and nitrogen. The results for ammonia, nitrate, phosphorous, and chlorophyll-a will be discussed. High levels of nutrients often indicate poor water quality and low oxygen levels. Stephanie reminded everyone to keep in mind the overall cycle – that there is variation throughout the day and across space, and that the long-term persistence of elevated levels can be problematic.

Measurement of chlorophyll-a and nutrients was done through grab samples. 24-hour samples were only for measuring D.O. levels. For *ammonia* measurements, all of the sampling stations exhibit the same pattern. Once again, two screening levels are given: one for tidal, at 0.46 for ammonia, and one for non-tidal, at 0.33 for ammonia. All sampling stations (not including the WWTP) had good ammonia levels generally over all months. During May and June, a rise in exceedances was observed, which needs to be a focus during discussion of BMPs, to determine what is occurring during May and June to cause this spike. The highest mark on the graph for the bayou sampling stations was 1.5 mg/L for ammonia. At the WWTP, the spike in May went up to about 21 or 22 mg/L.

Everything on the seasonal tables is grouped together, except the WWTP, to see if there is a seasonal pattern. Routine samples showed higher exceedances in the summer and during targeted rain events. The highest percentage level exceedance for ammonia was in the summer, and the highest highs were at the WWTP. On the seasonal ammonia table for the WWTP, it had a higher percentage of exceedances during the summer, at 60%, with 3 of 5 samples being over the screening levels. There was also suggested impact for rain events.

For *nitrate*, all four stations showed a similar pattern except for West Fork Upper, which showed more exceedances and higher numbers, though not too bad overall. On the East Fork Upper, a rise was observed in May, but remained below the screening level. Highest highs were 6-7 mg/L for nitrate. For the WWTP, the nitrate highs were at about 41 mg/L, and all of the nitrate samples (routine and targeted) except for two were over the screening level.

In the seasonal pattern, the numbers were lower for nitrate in the summer and higher in fall, winter, and spring for routine sampling. For rain event sampling, the pattern was different, with higher numbers observed for nitrates in the spring, but not in the fall or winter. For the WWTP, only two samples did not go above the screening level.

Nitrate and ammonia are both forms of nitrogen, which is one nutrient input for plants and bacteria. Phosphorus is another nutrient. It is important to look at both phosphorus and nitrogen, and what they are doing in the stream. Some samples fell above the tidal screening level. Tidal screening level is 0.66 mg/L, while non-tidal screening level is 0.69 mg/L. Only the West Fork Upper sampling station went over the screening levels, at 0.76 mg/L. Everything else was below screening levels and exhibited the same steady pattern throughout sampling. At the WWTP, all phosphorus levels were above the screening level and went up to about 7 with no particular pattern in terms of seasonality.

The seasonal phosphorus table (not including the WWTP) saw 1 out of 4 rain event samples in the fall that were above the screening level, but nothing that suggested a seasonal pattern. The WWTP seasonal table showed all samples being above the screening level for targeted and rain events.

Chlorophyll-a might be growing because it is consuming some of the excess nutrients. The highest high (140 µg/L) is in the West Fork Upper. The West Fork Lower also had three samples above the tidal screening level, and the East Fork Upper had a couple of samples above the non-tidal screening level. The WWTP had low numbers in chlorophyll-a, which is expected, as the WWTP is putting nutrients into the bayou, that are then moving downstream, where the plant growth cycle will then happen.

The seasonal table shows a seasonal pattern in terms of routine sampling. With more abundant sunlight in spring and summer, encouraging photosynthesis, this seasonal pattern is expected. Warmer water also contributes. Targeted rain events showed no exceedances during this time period.

Stephanie noted that there are a lower number of chlorophyll-a samples due to the fact that chlorophyll-a takes a long time to culture and get just right, so that it can be analyzed in the lab, resulting in the chlorophyll-a samples falling short by 3 or 4 from the targeted 17 samples, at this time.

Overall, a higher percentage of samples (not including the WWTP) was observed above the screening level for ammonia in the summer; for nitrate in the fall, winter and spring; and for chlorophyll-a in the spring and summer. By the bayou stations, overall exceedances were low, except for nitrate at West Fork Upper and chlorophyll-a at West Fork Lower (though lower number of chlorophyll-a samples). Phosphorus, nitrate, and ammonia had high exceedances across the board at the WWTP.

In terms of considering BMPs, some typical sources of nitrates are wastewater treatment plants, septic systems, fertilized lawns, crop land, and animal manure storage areas. One of the sources here is probably going to be the WWTP, and consideration needs to be given to what it is doing to the bayou downstream. High numbers for ammonia were also observed on the East Fork Lower, so that also needs to be taken into consideration when thinking about BMPs.

Overall, for nutrients and Chlorophyll-a, the bayou looks pretty good. More data on chlorophyll-a still need to be gathered.

Q: Do we know what percent of the flow from the WWTP gives to the Upper West Fork?

A: There isn't really a lot of flow contribution from WWTP in terms of pushing it out. It is typically low except during a rain event. Also, the monitoring station is tidal, so it is not easy to measure flow there.

Q: Are the nitrates and phosphorus from the WWTP, can you assume they are dominating the West Fork Upper numbers?

A: That is what we are going to try to find out, because the WWTP does have records of some of those nitrates and phosphorus. There are limits on how much they can discharge, so it will be a matter of where that discharge is and where it goes, from where they measure it into the ditch and from the ditch to the bayou.

Q: Is there any consideration of load, such as how much load of nitrate is going into the West Fork?

A: I don't think they have to report it by load. They report ammonia, and they don't always report it with the flow measure from that time.

Q: Can you say something about why we are talking about both nitrate and ammonia?

A: Ammonia is the kind of the nitrogen that is in waste, so that is what is coming into the WWTP. The treatment plant tries to break that down and add oxygen to it and get the hydrogens off, before it come out of the treatment plant. In the bayou, ammonium will use up oxygen and break itself down to nitrate, so ammonia is going to break down with treatment. Nitrate is washing in either because it's been out in the environment for a little while before being washed in or it could be in the fertilizer or other sources.

Q: So, ammonia can not only eventually cause a lot of nutrients in the bayou, it can also eventually kill off all the dissolved oxygen?

A: Yes.

Q: When we talk about fertilizer, are we talking about nitrates or ammonia, because we use both?

A: It depends on the fertilizer and on the use.

Linda S: One of the things that will happen over time is that connections will be made between the different things observed: What is the relationship between the bacteria level and D.O. levels? What is the relationship between nitrate levels and ammonia and D.O. levels?

Linda B: When measuring nutrients like nitrates, which are high in winter, with chlorophyll high in the summer, what's happening is that the chlorophyll is sucking up the nutrients. So, the nutrient being measured is what the chlorophyll hasn't used yet. That is, there is a balance, and the nutrient that is causing the growth is actually the one that is low at the time, instead of the one that is high.

Guy Robert Jackson pointed out that the Anahuac WWTP discharge is on average about 185,000 gallons a day.

5. Wrap-Up and Next Steps

Linda points out that there is more to this picture. The next steps are to start using this information to recommend BMPs and placement of BMPs. Some BMPs may focus on the watershed, or they may focus on things in the riparian areas. Other issues such as bacteria or nutrients may pertain to a particular sub-watershed. Other information is being collected about potential management measures. Workgroups will begin meeting after the first of the year to talk about what management practices to recommend, how much things will cost, and so forth. The next step will be looking at management measures and other water quality and modeling will come later as well.

Linda thanked everyone for attending, thanked GBF again for providing the refreshments, and adjourned the meeting.