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February 12, 2007

MEMORANDUM TO: Al Garza
Director of Public Works
City of Pensacola
2757 N. Palafox St.
Pensacola, FL 32501-1439

SUBJECT: Pensacola Small Boat Harbor Channel Investigation

1. In response to your request I have made a preliminary investigation of the entrance channel to the Pensacola Small Boat Harbor (PSBH), located at the foot of "A" Street, Pensacola, FL. The channel is currently shallower and narrower than the design cross section and requires maintenance dredging. I performed a qualitative assessment of the coastal processes in the vicinity of the channel. The purpose of my investigation was to determine if the shoaling in the entrance channel was a direct result of Hurricane Ivan. The discussion and conclusions are contained in the following paragraphs, but the succinct summary is that a significant portion, and in all likelihood the majority, of the sediment deposited in the channel was a direct consequence of Hurricane Ivan.
2. The PSBH is located on the northwest shoreline of Pensacola Bay (Figure 1), approximately halfway between the Port of Pensacola and Bayou Chico (Figure 2). The entrance channel is well protected by a rubble mound jetty on the west end and a revetment-faced mole to the east. The dominant sediment feature in the vicinity of the harbor is a broad, shallow sand flat at a depth of 3- 6 ft below MLLW. The sand flats to the west of the harbor do not extend close enough to the end of the jetty to be a source of sediment to the harbor. There are other sand flats immediately to the east and inside the harbor that could be a source of sediment for deposition into the channel.
3. These sand flats are typical of the Pensacola Bay shoreline. They are relatively stable, long-term features of the that are not significantly transported under typical (non hurricane) conditions. Figure 3a is a false-color aerial photograph of the harbor and vicinity taken in 1999; Figure 3b is the same area taken in March 2004. There is no discernible difference in the size or shape of the sand flats (at this scale) over the five year interval. Because there are no there are no sources of easily mobilized sand adjacent to or inside the harbor, the sedimentation rate of the channel by wind waves is not significant during typical and normal (non hurricane) storm conditions. Figure 3c is an aerial photograph taken immediately after Hurricane Ivan. There has been little change in the size or shape of the sand flat to the west of the harbor. The sand flats on the western side of the harbor appear to have been lowered, though this visual effect may be partially due to reduced water clarity. The sand flats on the eastern side of the harbor have definitely gotten larger and shallower, and the interior harbor shore protection structures have suffered major damage.
4. The majority of sediment transport along the Pensacola Bay shoreline occurs during hurricanes. The

general trend is a flattening of both the onshore and offshore profile; steep shorefaces are eroded and the sand is both pushed landward and pulled seaward. If the duration of the storm is sufficient, the resulting profile is nearly planar from offshore to well beyond the normal waterline. Another general trend is that suspended sediment tends to settle in holes, channels, and inlets. This trend is sustained over a broad range of scales. The US Navy is in the process of instituting an emergency dredging plan to remove 8 M CY of sand from Pensacola Pass (see Figure 1), much of it deposited by Hurricane Ivan. The entrance to Hawkshaw Lagoon, (a small, artificial waterway a few miles east of the PSBH; see Figure 2) remained open without maintenance for years. It was completely filled in by Hurricane Ivan overnight (Figure 4). The orientation of the entrance PSBH placed its opening squarely into the incoming waves during the most intense intervals period Hurricane Ivan. All of the Bay shorelines exposed to these conditions experienced significant erosion. There is every reason to assume that the eroded sediment inside PSBH harbor would likewise tend to settle in the channel.

5. Figure 5a is an aerial photograph of the PSBH and channel taken in the first week of February 2003, and Figure 5b is the same area taken on December 17 2004, three months after hurricane Ivan. The impacts to the shoreline are obvious and dramatic: the revetment inside the harbor has been destroyed and sediment from the uplands has been deposited on the formerly submerged sand flats, bringing their elevation to above the waterline. Figure 5c is a composite overlay of the two images to better illustrate the changes. The area of newly deposited subaerial sand is shown crosshatched in Figure 5d with the approximate location of the dredged channel. It is reasonable to assume that a similarly significant amount of eroded sand was also deposited in deeper adjacent water of the channel (beyond the limit of visibility in these photos) by the same processes.

6. Conclusions:

A) Under normal conditions, the PSBH channel was subject to relatively small amounts of sedimentation because there is no source of easily mobilized sediment in the immediate vicinity.

B) During Hurricane Ivan both the upland shore and the submerged sand flats inside the PSBH basin were mobilized and showed signs of redistribution.

C) Settling of suspended sediments into deeper channels is the universally observed coastal process. Both larger and smaller channels on either side of the PSBH channel experienced significant shoaling directly attributable to Hurricane Ivan.

D) It is certain that a significant amount of sediment was deposited into the PSBH channel from adjacent sand flats and uplands as a direct result of Hurricane Ivan.

E) The rate of sedimentation during a hurricane is very much larger than the rate transported under typical conditions. In all likelihood, the sediment deposited during and after Hurricane Ivan accounts for the majority of sediment deposited in the channel over the last several years.

Sincerely,



David D. McGehee, P.E.M.Oc.E.



Figure 1. Pensacola Small Boat Harbor (PSBH) Vicinity Map



Figure 2. PSBH Site Map



Figure 3 - a) Aerial Photo from November 27, 1999 (top) and b) from March 17, 2004 (bottom)



Figure 3 – c) Post-Ivan Aerial Photograph taken September, 2004



Figure 4. Posy-Ivan Aerial Photograph of Hawkshaw Lagoon with Entrance (enlarged), taken September, 2004



Figure 5 - a) Aerial Photograph of PSBH taken February 2003

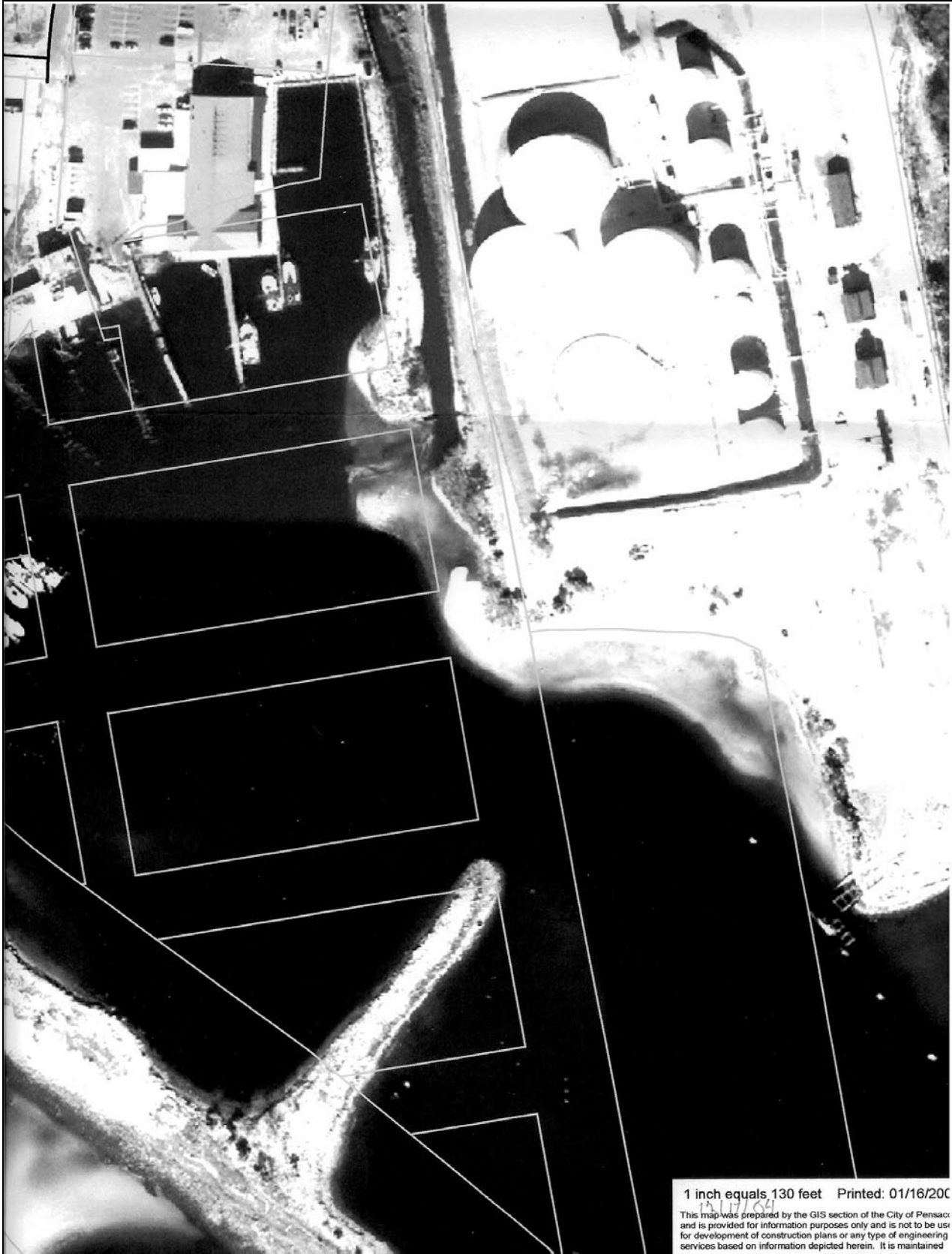


Figure 5 – b) Aerial Photograph of PSBH taken December 2004

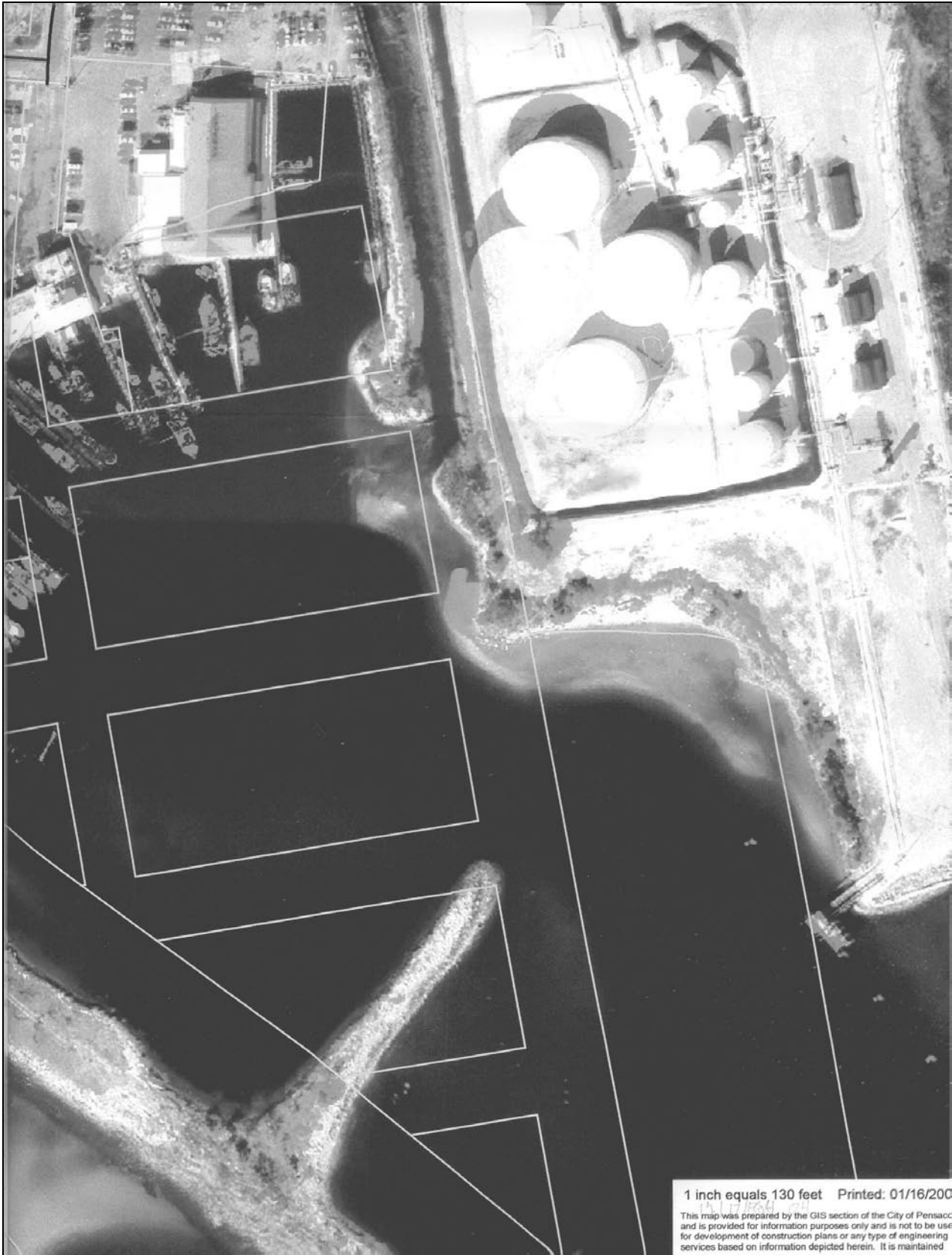


Figure 5 – c) Composite of Pre and Post Ivan Aerial Photographs of PSBH



Figure 5-d) Aerial Photograph of PSBH with Location of Cannel and Post Ivan Subaerial Deposition (crosshatched)