# CHAPTER 1

# INTRODUCTION

## 1.1 NEED FOR STUDY

Galveston Bay is the most important estuary on the Texas coast. It harbors the largest seaport, houses the largest industrial complex, and produces the largest shellfish catch on the Texas coast at 38 percent of the state's total. Thousands of weekend fishermen and boaters use the bay. However, Galveston Bay also receives the largest total amount of industrial and municipal effluent of all the Texas estuaries, both directly from the Houston/Texas City areas and indirectly from the Dallas/Ft. Worth area via the Trinity River (EPA, 1980).

Prior to the mid-seventies, the Houston Ship Channel, which empties into Galveston Bay, was listed as one of the 10 most polluted bodies of water in the United States by the U.S. Environmental Protection Agency (EPA). A Ralph Nader Task Force Report (EPA, 1980) stated, "The Houston Ship Channel is the most poisoned and potentially the most explosive body of water in the United States." In 1969, state water quality specialists determined that this water quality degradation caused frequent and massive fish kills in the upper portion of Galveston Bay (EPA, 1980).

In recognition of the magnitude of the threat to Galveston Bay, the Texas Department of Health (TDH), the Texas Water Quality Board (TWQB) (later the Texas Water Commission, TWC, and now the Texas Natural Resources Conservation Commission, TNRCC), and the Federal Water Pollution Control Administration (FWPCA) (later the Federal Water Quality Administration and now the Environmental Protection Agency, USEPA) organized a series of studies providing a comprehensive study of the bay system. The studies spanned the years of 1966 to 1974. Following the studies, several corrective measures helped to reduce the impact of municipal and industrial waste on Galveston Bay. These included stricter and more vigorously enforced discharge permits and a monitoring program now operated by the Texas Water Commission (TWC). In 1971 the TWQB ordered all industries discharging to the Houston Ship Channel to conform to at least secondary treatment levels. Between 1973 and 1980, millions of dollars were awarded by the EPA to upgrade and expand municipal waste treatment facilities discharging to the Houston Ship Channel and Galveston Bay. In 1976 the EPA said that several Texas waterways were getting cleaner and singled out the Houston Ship Channel as “the most notable improvement, a truly remarkable feat” (EPA, 1980).

Point source loadings of many constituents have been characterized in some detail over at least the last three decades starting with the 1964 study by Gloyna and Malina, the 1970 compilation by Malina, the extensive compilations during the Galveston Bay Project (Beal, 1975; Armstrong and Hinson, 1973), and now by the TNRCC in the annual loadings summaries. For toxic materials in particular, two rather detailed loading analyses for permitted dischargers have been performed by

Neleigh (1974) and Goodman (1989) for point sources and for the Trinity and San Jacinto Rivers by Armstrong et al. (1977) and Goodman (1989).

The focus on these earlier studies was mainly on conventional pollutants as defined in the Clean Water Act: biochemical oxygen demand, fecal coliform, suspended solids, and pH. The effects of toxic material discharges to the bay have been documented in Copeland and Fruh (1970), Oppenheimer et al. (1973), Beal (1975), Armstrong et al. (1975), and Armstrong (1980), but these studies dealt primarily with toxic materials in the Bay rather than discharges to it. Until recently, there had been no studies of toxic material loadings to Galveston Bay. One such study was done by Neleigh (1974) based on information provided by industries complying with the 1899 Refuse Act as implemented by the EPA and the U.S. Army Corps of Engineers (USACE) in about 1970. Following passage of the Clean Water Act of 1972, significant changes were made in municipal wastewater treatment and regulatory implementation of industrial discharge permits as mentioned above. The amount of discharger documentation increased several-fold which made the accounting of toxic material discharges to the Bay potentially more realistic in accuracy and detail. Yet, little had been done to update the general picture of toxic material loadings to Galveston Bay after Neleigh's study. Was toxicity at this time still a problem? If it was, to what extent does it exist? Finally, what relationship could be established between toxicity emission rates and the levels of water quality in Galveston Bay? An investigative effort along this line required a close examination of the current waste discharge conditions in the Houston Ship Channel, Trinity River, and other bay waters, and that study was conducted by Goodman (1989) focusing on the 1985-87 period. Goodman's study had the benefit of a broader database than Neleigh's but was limited to the larger discharges to the Galveston Bay system. It should be noted that the phrase "toxic materials" as used to this point has been used in a broader sense than the phrase "toxic pollutants" in the Clean Water Act which refers (at least initially) to the priority pollutants. Some of the constituents included in Goodman's loading estimates would be classified as "non-conventional pollutants" as defined in the Clean Water Act as neither conventional nor toxic pollutants. This distinction is more closely followed in the balance of this report.

More reporting of toxic materials is being required now than during the period Goodman (1989) used to estimate toxic material loading to the Bay (i.e., 1985-87) and there are more dischargers now releasing a variety of conventional, nonconventional, and toxic pollutants to the Galveston Bay system. Thus, there is a need to update all of the loading estimates for constituents reaching Galveston Bay. As the goals of the Galveston Bay National Estuary Program are to protect and improve water quality and to enhance living resources within the Galveston Bay Estuary and the approach to achieving these goals includes linking the problems identified in the Bay with their causes, the determination of point source loading is a major step in characterizing one of the causes.

## 1.2 OBJECTIVES

The overall objective of this study, as stated in the Galveston Bay National

Estuarine Program (GBNEP) Contract Scope of Services, was to provide an inventory and analysis of pollutant loading data to determine current status and trends of these parameters (i.e., constituents discharged) and their potential effect on water and sediment quality in the Galveston Bay system, and to examine loadings for previous years for this assessment. The main objective of this study was to characterize the current status and spatial and temporal trends in permitted and nonpermitted point source loadings of constituents into the Galveston Bay system. Nonpermitted point sources were considered to be major tributaries.

The overall and main objectives were accomplished through the following specific objectives:

1. Research and compile long-term point source loadings data;
2. Determine data gaps and the reliability of loading data sets;
3. Describe existing permitted point source loading and historical (temporal trends);
4. Determine spatial loading trends;
5. Determine cumulative loadings and identify potential problem areas; and
6. Prepare a final report.

## 1.3 SCOPE

To estimate loadings from point sources (and nonpoint sources), one must have information on both flow and constituent concentration as their product yields load. For permitted point sources into the Galveston Bay System, good estimates of loading could be calculated because of the regularity of sampling of flow and constituent concentration on the same days and consecutive days. These data were available from the self-reporting data in the files of the TNRCC. Compiling that information, calculating loads as necessary, and aggregating and presenting the loads by water quality segment accomplished the objective of estimating actual permitted point source loads.

Other point source loads such as major tributaries (including reservoir discharges) were determined again by multiplying flow and concentration. However, while flow data were often available on a daily basis from U.S. Geological Survey (USGS) records, constituent concentrations were not, and various statistical techniques had to be employed to overcome this irregularity of data collection. These techniques include using concentration vs. flow relationships and load vs. flow relationships developed from flow and constituent concentration data taken on the same day and extrapolating those relationships to days for which flow data were available but concentration data were not.

Brine discharge data were obtained from the Texas Railroad Commission and reported essentially as presented in the original data. Flows were converted from barrels per day to MG per year for compatibility with other discharge data presented herein.

The project included examination of data reliability (Quality Assurance/Quality Control), identification of data gaps (spatial and temporal), and evaluation of monitoring methodology changes needed, as well as other reviews of the data to discern limitations to the utility of the data. Where possible, per capita (for municipal wastes) and per product or other measure (for industrial wastes) generation rates were calculated so that estimates of future loadings were made as possible.

This study provides an analysis of the present levels of conventional, nonconventional, and toxic pollutant loadings (as data permitted) to the Galveston Bay and the sources of the important contaminants in an effort to answer these questions.

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