U.S. TRADE AND DEVELOPMENTAGENCY

North Lima Wastewater Treatment Plant

June 2000

U.S. Firm: Parsons Engineering Science International
Main Contact: Jorge Chaves S., Vice President Parsons Latin America
Current Phone: 619-687-0400
Current Fax: 619-687-0401

Project Sponsor: Sedapal
Main Contact: Marcel Marchand
Current Phone: 51-1-362-5149
Current Fax: 51-1-362-5148

Region: Latin America
Country: Peru
Sector: Water & Environment

TDA Activity Number: 1998-50028A
NTIS Number: PB2001103812

1 INTRODUCTION

1.1 Purpose and Scope

In 1996, Parsons Engineering Science International (Parsons) completed a Prefeasibility Study regarding wastewater treatment and disposal for the North Lima Metropolitan Area (References I through 5). The study included the following major tasks:

1. Projection of future wastewater flows for year 2024, for the northern portion of metropolitan Lima.
2. Performance of measurements for wastewater quality in order to determining constituent levels.
3. Conduct of oceanographic surveys to determine currents and ocean water quality parameter.
4. Development of a computerized model using the data developed from the field program to predict the fate of wastefield discharged from an ocean outfall.
5. Conduct of a prefeasibility-level design to determine the best location and level of treatment for a new wastewater treatment plant.
6. Determination of the location for an ocean and conduct of a prefeasibility-level design to determine size, length, and diffuser configuration.
7. Preparation of prefeasibility-level cost estimates for the wastewater treatment plant and ocean outfall.
8. Preparation of the Prefeasibility Report.

Following completion of the Prefeasibility Study, additional environmental studies were performed in 1997 (Reference 6) for the Oquendo and La Chira outfalls to determine the baseline oceanographic biological resources in the vicinity of the proposed outfall. The purpose of the environmental study was to provide the baseline conditions for the following biological resources: plankton, fish, benthic communities, intertidal communities, mariculture operations, and sea lion habitat areas.

This project represents the next phase in the implementation of wastewater treatment and discharge improvements for North Lima. The work has involved the conduct of preliminary engineering investigations focused on selection of the preferred treatment process and outfall length to achieve the recommended environmental standards. A series of technical memoranda (TMs), summarized in this final report, were prepared for the project on the following subjects:

Estimation of land requirements for the wastewater treatment plant and the configuration of wastewater collector connection points (TM No. 1.)

Characterization of the wastewater quality, including metals, and development of a wastewater monitoring system (TM No. 2.)

Evaluation of wastewater treatment alternatives based on environmental and cost criteria, and the identification of the recommended treatment system (TM No. 3.)

Using established computer modeling techniques, determination of the outfall length required to meet receiving water quality standards, (TM No. 4.)

Feasibility-level design of the selected treatment alternative, including the preparation of preliminary plans and cost estimate (TM No. 5.)

Feasibility-level design of the recommended ocean outfall, including the preparation of preliminary plans and cost estimate (TM No. 6.)

Upon completion of the feasibility level preliminary design and cost estimate, a financial plan was prepared to outline possible financing methods that SEDAPAL could employ to finance the project.

1.2 Authorization

SEDAPAL authorized Parsons in October 1998 to prepare this feasibility study. The study is funded by the Trade Development Agency (TDA) of the United Stated of America, under a grant to SEDAPAL. Under a separate authorization by the World Bank, Parsons prepared a preliminary marine geotechnical study for the North Lima outfall (Reference 7). These studies provide the necessary geotechnical and geophysical data to evaluate outfall alternatives and to prepare the preliminary design for the ocean outfall.

1.3 Previous Studies

The Prefeasibility Study determined that the plant should be designed to handle the projected 2024 average and peak flows of 14.9 and 22.4 *M3/s*, respectively. The system proposed in the Prefeasibility Study incorporated the following principal elements:

- Coarse screening using bar racks.
- Microscreening using approximately 40 cylindrical rotating screens, each with a capacity of approximately 0.6 m 3/s.
- Disposal to the ocean through an outfall.

Several sites for a wastewater treatment plant and outfall in the northern section of Lima were evaluated in the Prefeasibility Study. The criteria used to evaluate the alternative sites included land cost, cost and difficulty of intercepting the existing outfalls, and the environmental and social effects of locating and operating a wastewater treatment plant at each site. The selected site was by far the best from these evaluations. The SEDAPAL management agreed with the selection in 1995 and 1996. Following the Prefeasibility Study, SEDAPAL performed preliminary and final designs for the major interceptors which will convey wastewater into the site.

As part of the Prefeasibility Study, oceanographic current measurements were gathered during both summer and winter conditions. The results were used to develop a hydrodynamic model to predict the transport and dispersion of wastewater discharged through an ocean outfall. Modeling was based on a fecal coliform concentration in the untreated wastewater of 2 x 107 MPN/100ml. To evaluate the requirements for the ocean outfall, the principal criterion employed was the ability to eliminate fecal coliform contamination at the beaches and the ecologically-sensitive areas near Isla San Lorenzo. The model was operated using a fecal coliform decay rate (T90 value) of 24 hours.

Modeling results for the Prefeasibility Study indicated that an 8-km, 3.65-m diameter outfall, discharging at a depth of 45 m, would be sufficient to protect the beaches and the ecologically sensitive areas. The outfall would be equipped with a wye-type diffuser, with each leg of the wye having a length of approximately 970 m and incorporating some 200 to 300 discharge ports.

It was recognized in the Prefeasibility Study that the geotechnical conditions of the ocean bottom in the area of Oquendo would present a challenge for the construction of a large outfall. Over the course of geologic time, deposition of materials from the Rimac

River has created deep, fine sediments. Preliminary geotechnical studies indicated that the sediments have low density, high compressibility, and a high potential for consolidation (liquefaction) during a

seismic event. Such conditions could require special bedding design for the outfall, including possible pile foundations or special joints for a seabed outfall.

Also, there is heavy ship traffic in the area, as many large vessels dock at the Port of Callao, the largest port in Peru. The area proposed for the outfall. is a ship anchorage area, which creates the potential for damage to the outfall by ship anchors, this issue must be addressed in the final design for the outfall.

Two alternative construction methods may be adopted for large diameter ocean outfalls in areas of potential ocean floor instability, such as in Oquendo: trenching and tunneling. For the trenching method, a deep trench is excavated along the ocean floor and the trench typically extends from the beach to a point at which the natural ocean floor can support the weight of the outfall. The outfall pipe is placed along the bottom of the trench and is covered by protective armor rock. Protective rock usually extends I to 2 m above the top of the pipe, and the top of the rock is level with the adjacent natural ocean bottom.

With this method of construction, the potential for differential settlement during earthquakes is considerably reduced. Potential damage to the outfall from ship anchors is also mitigated, as are lateral forces caused by the accumulation of sediments on one side of the outfall. The principal disadvantages with this method are the high cost of construction associated with the long and deep trench excavation, and the large quantities of protective rock that are required.

An outfall may also be built by tunneling under the ocean floor. For tunnel construction, two diffuser options are available:

1. The tunnel is constructed to a point offshore at which the ocean floor can support the weight of the diffuser. At this point, a riser pipe is constructed to reach from the tunnel to the ocean bottom. The riser pipe connects to a wye diffuser on the seabed, identical to the diffuser for a conventional seabed outfall.

2.A series of vertical riser pipes are constructed from the tunnel, with each riser terminating above the seabed, and each riser equipped with a multi-nozzle diffuser turret.

1.4 Environmental Goals

The Prefeasibility Study recommended environmental standards to be used as a basis for the design of the North Lima Wastewater Treatment Plant and Ocean Outfall. Those standards were based on a review of existing standards from the following sources:

- Peru

- Other Latin America Countries
- United States
- European Union
- World Health Organization

These proposed standards were reviewed and accepted by PROMAR, SEDAPAL and an evaluation board comprised of international experts convened by the World Bank in Washington D.C. in May 1996. Goals were established for the following criteria:

- Settable solids
- Fecal coliform bacteria
- Dissolved oxygen and biochemical oxygen demand

- Floating materials
- Toxic materials

The specific standards are presented in Section 3.2 of this report.

1.5 Acknowledgements

During development of this study, a number of individuals and agencies provided information and assistance. Parsons wishes to acknowledge the support of SEDAPAL, the United States Trade Development Agency, and the World Bank for their valuable help for the completion of this study.