Chapter 11 – Environmental Assessment

11.1 The Project

The Government of Panamá (GOP) through the Coordinating Unit (CU) for the Sanitation of Panamá City and Panamá Bay of the Ministerio de Salud (MINSA) has been developing the implementation program for the wastewater collection and treatment works to serve the City of Panamá. The program consists of the following elements;

A. Collection facilities consisting of gravity sewers, lift stations and pressured transmission mains to convey wastewater generated in individual drainage or service areas to central collection locations along the Pacific Ocean coast.

B. Transport facilities consist of principal pump stations and transmission mains which intercept wastewater flows delivered by the collection works. The intercepted flows are conveyed through large transmission mains running parallel to the coast to the regional wastewater treatment works.

C. Treatment works consist of a major 4.5 m^3/s activated sludge wastewater treatment plant located at the Rio Juan Diaz site and a small biological plant know as the Veracruz WWTP. Raw wastewater will be pretreated via screening and grit removal. Biological treatment of the liquid stream will be by the activated sludge process. Treated effluent will be discharged into the Pacific Ocean through short marine outfalls. Effluent quality will conform to the Republic of Panamá Water Quality Standards. Biosolids will be stabilized. In the initial years of operation, stabilized solids will be landfilled at the Rio Juan Diaz site. The long term goal is to land apply stabilized biosolids. In order to implement the long term biosolids land application program, a pretreatment treatment program must be undertaken to identify and minimize pollutants in the wastewater stream and insure high quality biosolids. Land application sites must be identified and site owners encouraged to accept and utilize the stabilized biosolids.

The principal long term impacts are associated with the siting and operation of the two wastewater plants. Short term impacts associated with the construction of collection, transmission and treatment works will impact the residents of the City. Installation of utility infrastructures in a metropolitan area will cause unavoidable short term adverse impacts. Locating these facilities in less congested areas and scheduling work activities can minimize these short term impacts.

This Environmental Assessment focuses on the impacts associated with the two proposed wastewater treatment plants. The major impacts will be focused on the 85 HA Rio Juan Diaz site and wastewater treatment plant. The Veracruz Plant will be placed on a 3.5 HA site.

11.2 Wastewater Treatment Plants

11.2.1 Background

Current plans for wastewater treatment in the Panamá City metropolitan area include the construction and operation of two wastewater treatment plants: one at the mouth of the Rio Juan Diaz and the other in the Veracruz area. The Juan Diaz Wastewater Treatment plant (JDWWTP) will receive sewage generated within 20,931 hectares of the most densely populated areas in the Panamá City metropolitan area. The Veracruz Wastewater Treatment Plant (VWWTP) will serve approximately 1,408 hectares west of the Panamá Canal Zone. According to the year 2020 projections, the design population for the JDWWTP and VWWTP is 1,074,703 and 19,163 inhabitants, respectively.

The projected year 2020 wastewater flow for the JDWWTP is 102 million gallons per day (mgd). The design flow for the VWWTP is 1.9 mgd.

The maximum month organic loading for the JDWWTP and VWWTP is 177 mg/liter of BOD_5 and TSS, respectively. The wastewater facilities will be designed to meet current effluent regulatory requirements which are, 35 mg/liter of BOD_5 and TSS, 10 mg/liter TN and 1 mg/liter of NH_3.

11.2.2 Juan Diaz Wastewater Treatment Plant System

A full description of the wastewater treatment process proposed for the JDWWTP is presented in Chapter 7 of this report. Figure 11-1 presents the proposed layout. The basic process units for the liquid and solid streams include the following units:

Liquid Stream Preliminary Treatment

- Headworks will include chemical odor control system for treatment of Hydrogen Sulfide (H_2S) and other gaseous emissions.
- Mechanical Screens
- Vortex Grit chamber with sand removal

The mechanical screens, and grit removal units are part of the preliminary treatment process. These unit processes involve the physical removal of pollutants through screening and gravity settling. Raw wastewater flows through mechanical bar screens that remove large objects such as cans, rocks, sticks, and rags. Clear openings in the bar screens range from 1/8-inch to ¼-inch depending upon the screen selected. After screening, the wastewater is sent to vortex grit chambers, which slow the velocity of the wastewater and allow heavy material such as sand and grit to settle out. This treated pretreated raw wastewater stream is then routed to the secondary treatment process.

Liquid Stream Secondary Treatment

- Anoxic denitrification
- Biological activated sludge process

- Effluent disinfection with chlorine
- Marine Diffuser the Pacific Ocean

Whereas preliminary treatment relies on mechanical screens and gravity settling to remove coarse material, secondary biological treatment uses aerobic bacteria to digest the fine organic material in solution. The bacteria are called "aerobic" because they need oxygen to survive. Under the secondary treatment proposed for the JDWWTP, raw wastewater is directed to anoxic tanks where nitrate nitrogen is converted biologically to nitrogen in the absence of oxygen. Following the anoxic treatment are large aeration tanks where oxygen is bubbled through the water to stimulate the growth of bacteria that consume and digest biodegradable pollutants in the wastewater. After time, the combination of digested material along with the bacteria, called mixed liquor, flows into large tanks called secondary clarifiers. Here, the mixed liquor is detained for 4 to 8 hours to allow the bacteria and other fine material to settle out, producing a clarified secondary effluent. The effluent is then disinfected with chlorine to kill pathogens. Finally, effluent is piped to a marine diffuser (short marine outfall) for discharge into Panamá Bay. The diffuser allows dispersion of the treated effluent in an environmentally sound manner.

Solids Stream

- Sludge conditioning system will include odor and harmful gas control system
- Filter press thickening of liquid waste activated sludge from the secondary clarifier
- Anaerobic digestion
- Dewatering of stabilized sludge with centrifuges.
- Hauling stabilized solids via truck to land application at JDWWTP sludge landfill.

Solid material separated from the wastewater during secondary treatment is conveyed to filter press units and large above-ground digesters. Here, the organic material is digested by anaerobic bacteria that can tolerate oxygen-free conditions. After a period of 3 to 4 weeks, the digested solids are removed, dewatered by centrifugation (a dewatering process) to 25% solids consistency (by weight). The dewatered solids are referred to as biosolids cake. Stabilized biosolids are then hauled by trucks to the onsite sludge landfill and disposed of in accordance with Panamanian regulations.

Biosolids Cake Transportation and Sludge Landfill Operation

- Biosolids transport vehicles (leakproof and easy to unload trucks)
- HDPE lined sludge landfill (state of the art leakproof technology)
- Leachate collection and pumping works to return captured liquid streams to treatment works

Water Quality Laboratory

The JDWWTP will operate a water quality laboratory for process control and effluent compliance with GOP water quality standards. The laboratory will provide all related services including sampling program design, sample collection, analytical method development, analyses, and reporting of water quality monitoring results.

11.2.3 Veracruz Wastewater Treatment Plant System

A full description of the wastewater treatment process is presented in Chapter 9. The basic process units for the liquid and solid streams include the following facilities:

Liquid Stream Preliminary Treatment

- Headworks will include odor control system for treating Hydrogen Sulfide (H2S) and other gas emissions.
- Screening
- Vortex Grit chamber

The screening and grit chamber units are part of the preliminary treatment process. These involve the physical removal of pollutants through screening and settling. Raw wastewater flows through either two (2) conventional Plastic Flight (1/8-inch opening) screens or two (2) step screens (1/8-inch opening) which remove debris. After screening, the wastewater is sent to vortex grit chambers, where by gravity and vortex force heavier grit particles settle into a bottom chamber. This raw wastewater stream is then routed to the secondary treatment process.

Liquid Stream Secondary Treatment

- Sequencing Batch Reactors
- Effluent disinfection with chlorine
- Outfall to the Pacific Ocean

The SBR is a fill and draw activated sludge treatment process. Sequencing batch reactors can achieve combined carbon and nitrogen oxidation, nitrogen removal, and phosphorous removal. The SBR process involves a single, complete-mix reactor in which all steps of treatment occur, eliminating the need for both secondary clarifiers and a sludge recycle system. The SBR reactor is filled during a discrete period of time and then operated in a batch treatment mode. MLSS remains in the reactor during the treatment cycle, thereby eliminating the need for a separate clarifier.

Each SBR tank carries out the functions of equalization, aeration, denitrification, and sedimentation in a time sequence, rather than in the conventional space sequence of continuous flow systems where these functions are carried out in separate tanks.

Treated effluent is disinfected with chlorine to kill pathogens. Finally, effluent is piped to an outfall at Panamá Bay. The outfall depth and distance from shore allows dispersion of the

remaining pollutants so that public health and the environment are protected. Maximum coliform levels at the Veracruz beach will be 100 coli/100 MPN or less.

Solids Stream

- Odor control works to collect and treat gas emissions from the aerobic digesters
- Rotary press thickening of dilute biological solids
- Aerobic digestion
- Hauling liquid stabilized solids via tanker truck to JDWWTP

The recommendation is not to install sludge drying beds at the Veracruz WWTP site due to the close proximity of residences and public facilities. Stabilized liquid biosolids would be hauled by tanker truck to the Juan Diaz WWTP and discharged to the treatment works. At buildout the quantity of biosolids would be 6,000 gallon per day which can be handled by one tanker truck.

Stabilized liquid solids can also be delivered to land application sites within economical haul distance from the plant site.

11.3 Treatment Plant Siting

11.3.1 Juan Diaz WWTP Siting Procedure

Following the adoption of the current wastewater management program by the GOP, the CU began a process to site the JDWWTP. The CU identified a potential land area adjacent to the Corredor Sur highway and just south of the Entronque Embarcadero that might be suitable for a treatment plant. As part of the siting process, Hazen and Sawyer gathered preliminary information on the referenced land and identified the five alternative sites.

Siting information gathered was then used to analyze a broad set of engineering and environmental factors and constraints which would impact the construction or operation of a wastewater facility.

Biologists visited potential sites and prepared a survey which established a value ranking of existing vegetation. These observations are presented in Chapter 5 – Environmental Setting of Juan Diaz Area. Hazen and Sawyer prepared a separate report on the Juan Diaz Site Evaluation and summarized the siting process in Chapter 6 – Juan Diaz WWTP Site Selection. To help evaluate how well each site met the adopted site screening criteria, the team developed a set of detailed decision issues that permitted the objectively assessment of measurable site characteristics. Information used for the evaluation of each site came from site reconnaissance, aerial photographs, local plans, published environmental and geotechnical data and initial screening reports. The results of the sites evaluation process is summarized in Table 11-1.

Of the five sites evaluated, site 2A obtained the maximum scoring. Site 2A is located adjacent to the Corredor Sur, approximately 11 kilometers west of downtown Panamá City and is bounded by Calle 115 Este to the west, and the Corredor Sur to the north, the Juan Diaz River to the east, and an industrial complex to the south. The site is roughly 85 Hectares fitting all components of

the proposed treatment facility. The site covers a wide area and the treatment plant can be located in several locations within the Site. Based on the results of the evaluation documented in Chapter 6, the remaining sections of the chapter provide an environmental assessment of site 2A for the JDWWTP.

11.3.2 Veracruz WWTP Site Selection

The Veracruz site was identified as a viable and logical site for the treatment works. The Veracruz WWTP is a small facility with a hydraulic capacity of 1.9 MGD. Open land encompassing 3.5 HA was available for current and future works. The site is adjacent to the Pacific Ocean. Land availability was the most important criteria.

The plant will be located on a 3.5 HA site situated between the Pacific Ocean and the main road of Veracruz (Calle Principal de Veracruz). A cemetery borders the plant on the east. The west boundary follows a drainage ditch discharging into the Pacific Ocean.

The cemetery provides a 50 meter buffer to residential homes located east of the plant. Road traffic will be adjacent to the plant's north boundary. Residential homes will be adjacent (now or in the future) to the west boundary.

Due to the close proximity of residential homes and the location of Pacific Ocean, the following minimum requirements for use of this site are as follows.

Odors: The operating units in the headworks structure (screens and grit works) and the aerobic digesters will be either enclosed or covered. Gases or other odorous emissions at these two facilities will be collected and treated prior to discharge to the atmosphere.

Chlorine: Chlorine will be delivered to the plant in 150 pound or 1 ton containers and used to disinfect the final effluent. All containers will be placed in a enclosed building. In the event of an accidental chlorine leak, a gas collection will be activated and chlorine gas will be treated in chemical scrubbers to minimize any potential risk of hazardous gas release to the surrounding community. An alternate means of disinfecting the liquid effluent (UV) may be installed in lieu of chlorine.

Solids Dewatering: It is recommended that sludge drying beds not be installed on the site due to potential odors. Only a small drying bed for 14-days of solids to be used only in emergencies is recommended.

Effluent Discharge: Treated effluent will be discharged through a short ocean outfall to ensure a total 10:1 dilution of effluent and seawater at low tide at the shoreline. Bathing or water contact coliform standards will be met at the shoreline (100 Coli / 100 ml).

Beach Access: A small park with resident access will be constructed along the shoreline (260 meters). Several covered outdoor shelters will be installed for public use.

The goal of these proposed works and facilities is to minimize any potential adverse impacts associated with the treatment plant on the surrounding community. Development of park facilities along the shoreline will allow the local residents to maximize the recreational and scenic benefits of the marine shoreline.

Table 11-1
Site Ranking Results

Major Category	Driving Force	Considered Issues	Weighing Factor	Score									
				Site 1		Site 2A		Site 2B		Site 3A		Site 3B	
				S	**WS**	S	**WS**	S	**WS**	S	**WS**	S	**WS**
Size Requirements	▪ Area of site ▪ Space for expansion ▪ Shape of land parcel		All sites meet this criteria.										
Environmental Issues	▪ Land use	▪ Compatibility w/surrounding land uses	5	5	**25**	5	**25**	5	**25**	4	**20**	4	**20**
	▪ Impact to Residential Areas	▪ Noise ▪ Odor ▪ Chlorine gas release	5	4	**20**	4	**20**	5	**25**	3	**15**	3	**15**
	▪ Impact on local Traffic	▪ Construction	1	4	**4**	5	**5**	4	**4**	4	**4**	4	**4**
		▪ Operational	2	4	**8**	5	**10**	5	**10**	5	**10**	5	**10**
	▪ Ecological issues	▪ Effect on habitat ▪ Wetland	10	4	**40**	5	**50**	2	**20**	3	**30**	1	**10**
	▪ Natural resources	▪ Loss of agricultural, pastures, fisheries	2	4	**8**	4	**8**	5	**10**	4	**8**	5	**10**
Technical Issues	▪ Site access/ Convenience of location	▪ Proximity to major highways ▪ Highway restrictions	2	4	**8**	5	**10**	5	**10**	5	**10**	5	**10**
	▪ Utility service availability	▪ Power source ▪ Existing water ▪ Capacity of existing service	2	5	**10**	5	**10**	4	**8**	5	**10**	4	**8**
	▪ Disposal of residuals	▪ Access to sludge operations ▪ Proximity to residential areas	4	4	**16**	4	**16**	5	**20**	3	**11**	3	**11**
Topographical and Soils Conditions	▪ Site Topography	▪ Slope constraints ▪ Grading of roads	2	5	**10**	4	**8**	5	**10**	4	**8**	5	**10**
	▪ Sub surface conditions	▪ Difficulty of excavation ▪ Load bearing capacity ▪ Foundation site preparation	10	4	**40**	5	**50**	3	**30**	3	**50**	3	**30**
	▪ Site drainage considerations	▪ Susceptibility to flooding ▪ Effect on surface water quality ▪ Effect on groundwater quality	5	5	**25**	5	**25**	4	**20**	3	**25**	4	**20**
Institutional Issues	▪ Land availability	▪ Existing land ownership ▪ Willing Seller ▪ Easement acquisition	10	4	**40**	5	**50**	4	**40**	4	**40**	4	**40**
	▪ Regulatory issues	▪ Environmental issues ▪ Agency goals	10	4	**40**	5	**50**	5	**50**	4	**40**	4	**40**
Score: 5= Best, 1 = Worst *S: Score / WS: Weighed Score*		**Total Weighted Score**			**294**		**337**		**282**		**282**		**229**

11.4 Earth And Groundwater

This section addresses the environmental setting, impacts to the environment, mitigation measures, and significant unavoidable adverse impacts related to earth and groundwater for the JDWWTP and the VWWTP.

The regulatory environment for earth includes local regulations of the GOP relating to geologic hazards as well as regulations pertaining to seismic design, earthwork construction safety, and soil and groundwater contamination.

This section describes the existing geologic conditions (topography, soil, groundwater, and erosion, landslide, and seismic hazards) that may affect or be affected by the proposed treatment plants including outfalls. The known presence of, or potential for encountering groundwater during construction is also considered in this chapter.

Data used in this evaluation were obtained from published reports on the earth environment, field explorations and laboratory testing conducted by Hazen and Sawyer and its subconsultants as part of the siting study.

11.4.1 Location

JDWWTP

The project area is located in the central portion of the Bay of Panamá (see Figure 11-3). The site of the JDWWTP is located along the Corredor Sur approximately 11 kilometers east of downtown Panamá City. The site is accessed by the Embarcadero Entronque exit at Calle 115 Este. The site is bounded by a residential community Costa del Este to the west, the Corredor Sur to the north, the Río Juan Díaz to the east, and the Bahía de Panamá to the south. The site consists of a relatively flat terrain subject to seasonal periods of inundation.

VWWTP

The site proposed for the VWWTP is located along the Calle Principal de Veracruz on the site shown on Figure 11-4.

11.4.2 Geology

JDWWTP

The uppermost soil present over the site appears to be fine clayed material. This stratum ranges in thickness from about 2 to several meters. Near the ground surface, the soil has been reported to consist primarily of clay with traces of sand.

11.4.3 Regional Seismicity

Seismic hazard areas are generally defined as those areas subject to severe risk of earthquake damage due to seismically induced settlement, soil liquefaction, ground rupture, lateral spreading, or slope instability. One indicator of potential for future earthquake damage is a record of past earthquake damage. The Panamá Bay region, including the area of the JDWWTP and VWWTP is an area of low seismic activity. Consequently, low levels of shaking should be anticipated during the life of the project.

11.4.4 Local Groundwater Regime

Groundwater regime throughout both the Juan Diaz and the Veracruz sites is considered to be influenced by tide.

In general, at the Juan Diaz site groundwater reaches the ground surface during different periods of the year. Based on field observations groundwater flow is generally upward and downward. Groundwater is often perched in the fine grained stratum at the ground surface. No water supply wells are located within a 1-kilometer radius of the proposed Juan Diaz site.

11.5 Impacts

Potential impacts identified at the sites of both the JDWWTP and the VWWTP include inundation, erosion, landslide, seismic hazards and groundwater and soil disturbance. Impacts could occur both during the construction phase and during the operation of the facility.

11.5.1 Inundation

JDWWTP

The site is part of the Juan Diaz River floodplain and it is also influenced by tide.

VWWTP

The proposed site is located between the Pacific Ocean and the main road of Veracruz. The west boundary follows a drainage ditch discharging into the Pacific Ocean. The area along the shoreline that is tide-influenced.

11.5.2 Erosion Hazards

At both the JDWWTP site and the VWWTP site, erosion hazards are restricted primarily to the slope between the upper and lower elevations of fill materials. Erosion hazard would be higher in areas of exposed soil, where vegetation is not well established, and where stormwater runoff is poorly controlled.

11.5.3 Seismic Hazards

The sites are located within an area of low seismic risk. Therefore, the seismic hazard potential for both sites are relatively low. Soil at both sites presents a low potential liquefaction hazard.

11.5.4 Groundwater

JDWWTP

Groundwater conditions at the site of the JDWWTP are typical of an area at sea level subject to seasonal periods of inundation. The low permeability nature of the upper soil strata creates conditions for a layer of perched groundwater at the surface ground level. The surface perched groundwater has been reported to vary from one foot or more feet over the ground level to several feet below ground surface and to fluctuate several feet in depth from season to season. Development of the JDWWTP at the site will require modification to the perched groundwater system. Consequently, development of the JDWWTP will involve disturbance of existing soil and groundwater conditions and related short-term potential impacts due to construction and long-term potential operational impacts are anticipated.

11.6 Potential Impacts During Construction

Several potential construction impacts commonly encountered are:

- Erosion
- Groundwater control and dewatering
- Excavated soil management
- Excavation safety and stability
- Contaminated soil and groundwater
- Outfall construction

Each of these potential construction impacts is discussed below.

Erosion

If uncontrolled, stormwater runoff during the construction phase of the treatment plants could result in sediment-laden surface water from erosion of disturbed, stockpiled, or unvegetated soil areas. Within the work zone, construction would expose soil and remove vegetative cover, leaving the area vulnerable to erosion during runoff events. If sediment reaches adjacent surface water resources, increases in turbidity, suspended and settable solids, and nutrients could occur, possibly to the detriment of fish and other aquatic organisms.

Groundwater Control and Dewatering

Construction of some treatment plant structures could take place below the groundwater table, necessitating groundwater control during construction. Depending on the soil characteristics and construction methods, groundwater control may consist of pumping groundwater at volumes ranging from a few gallons per minute (gpm) to several thousand gpm. Disposal of large volumes of dewatering discharge in areas of loose or soft soil may cause localized settlement; if located sufficiently close, nearby utilities or structures may be adversely impacted.

Excavated Soil Management

Soil may need to be hauled away for offsite disposal. Additional earth would be excavated for creation of the JDWWTP sludge disposal cells. Soil from excavations could be used to create berms and grading in the vicinity of the sludge fill and may not need to be trucked offsite. Hauling and disposing of soil offsite will increase truck traffic to and from the sites of the treatment plants during construction.

Excavation Safety and Stability

During construction of underground features of the wastewater treatment plants, required excavations could change or reduce the existing stability of the ground. Excavations must be safe and stable to enable construction of below-grade portions of the project.

Contaminated Soil and Groundwater

Construction activity may result in potential contamination of soil and groundwater if chemical spills (such as fuel and lubricants) occur. The potential for the contaminants to impact the soil and groundwater will depend on the nature and quantity of the spill, time between the spill and the mitigation response.

11.7 Outfalls Construction

JDWWTP

Construction activity related to the outfalls would result in short-term impacts to earth and groundwater resources. The outfall would be constructed using both in-water and on-land open-cut methods. The pipeline would extend to the near shore area and the diffuser located below the low tide elevation.

Under trench construction methods, conventional land-based equipment including an excavator, front-end loader, crane, vibratory compactor, bulldozer, and dump trucks would be used to excavate a trench and install pipeline up to the shoreline. Trench excavation and pipeline installation extending through the shallow groundwater will generate turbid groundwater and mud due to dewatering and other related construction activities. Temporary impacts will be experienced during construction.

VWWTP

The marine outfall consist of 16-inch ductile iron pipe extending 200 meters from the low tide shoreline. The pipe will have concrete weights and will be placed on the ocean floor. No excavation will be required.

11.8 Potential Impacts during Operation

Several earth-related potential operational impacts at the JDWWTP and the VWWTP are:

- Erosion
- High groundwater levels
- Soil and groundwater contamination

Each of these potential operational impacts is discussed below.

Erosion

Sediment erosion into surface water can occur during the operational life of the proposed wastewater treatment plants if stormwater runoff is not controlled. Long-duration rain storms, coupled with inadequate surface water control, can cause slopes to become unstable by saturating thin clay deposits within the slope and causing the slope to lose strength and slide downward.

Erosion potential would be reduced by maintaining vegetation and providing adequate runoff controls. The facilities will be designed to incorporate all required measures to control and treat stormwater runoff.

High Groundwater Levels

The presence of high groundwater elevations in relation to the depth of the treatment plant structures will result in upward hydrostatic pressures on the base of the structures. If these upward water forces are not adequately resisted by downward forces of the structure's weight, the structures could develop cracks and pathways for groundwater to leak into the building. Groundwater can also leak into the structure through the joints of concrete pours unless mitigated by specific design and construction techniques. Approaches to resist hydrostatic uplift pressures and to prevent leakage into structures will be part of the design features of the project.

Soil and Groundwater Contamination

Impacts to groundwater quality or quantity after construction will be limited to potential contamination in the unlikely event of a broken treatment plant pipeline or tank. Large scale breakage of a pressurized pipeline could result in discharge of wastewater into the soil and groundwater. The likelihood of pipeline breaking and leaking appears minimal, but could result from movement on an unknown fault or large catastrophic events.

11.9 Mitigation Measures

11.9.1 Mitigation Measures during Construction

Erosion

Best Management Practices (BMPs) will be required by the construction contractor during earthwork activities. Monitoring programs will be required to ensure compliance with local regulatory constraints.

Groundwater Control and Dewatering

Standard excavation dewatering procedures will be required to lower the groundwater level to a safe level below the base of any excavation. Standard methods would likely include sumps/pumps, well points, and dewatering wells, depending on the excavation size and depth, groundwater flow rate, and amount of drawdown needed.

Excavated Soil Management

The physical properties of the excavated soil will influence the amount of excavated soil that can remain onsite for structural backfill and general site fill; excess excavated soil will need to be hauled offsite for disposal. To the greatest extent possible this excavated earth will be used to create berms and grading in the vicinity of the sludge cells and will not be trucked offsite.

Optimized plant site layouts will provide an acceptable cost-benefit outcome between the layout configuration and offsite disposal quantities. The construction contractor will reuse as much excavated material as possible and thus reduce offsite haul trips.

Excavation Safety and Stability

Excavations must be safe and stable to enable construction of below-ground portions of the projects. All excavation sloping and shoring will be designed by a experienced professional engineer in accordance with GOP or U.S. Occupational Safety and Health Act (OSHA) standards.

Contaminated Soil
JDWWTP and VWWTP construction specifications will include provisions for monitoring soil during excavation activities, for handling and disposing of contaminated soil if encountered, and for required upgrades to worker personal protection equipment as appropriate. There are currently no existing data that indicate that soil beneath the site is contaminated; however, if contaminated soil is encountered, increased construction costs will result for handling and disposal and for additional health and safety measures for workers.

Contaminated Groundwater
No existing data indicate that groundwater beneath the site is contaminated. However, pre-construction warrant site investigations during the design phase are warranted. If contaminated groundwater is encountered, increased construction costs would result for handling and disposal and for additional worker health and safety measures.

Outfalls Construction
The JDWWTP outfall pipe will be installed in a rock trench.

11.9.2 Mitigation Measures during Operation

Long-Term Erosion potential
Vegetation must be maintained and adequate surface water runoff controls provided.

High groundwater elevations
High groundwater levels exert uplift pressures at the base of facilities, which must be resisted by downward forces such that the structure does not "float" or incur adverse cracking or other damage. Structures must be designed and constructed to resist the buoyancy (uplift) pressures, typically by structural dead weight. If additional downward force is required, lateral footing or concrete mat extensions and allowances for frictional resistance of the soil against exterior walls can also be considered. For structures located below the water table, water-stops will be necessary to eliminate groundwater leakage into the structure through joints in concrete pours.

11.9.3 Unavoidable Impacts

Design and construction of both the JDWWTP and VWWTP treatment, conveyance, and outfall facilities will incorporate measures to avoid or minimize geologic hazards and to minimize construction and operational impacts on soil, sediment, and groundwater to the maximum extent practicable. No significant unavoidable adverse impacts to earth and groundwater resources are expected to result from construction or operation of both the JDWWTP and the VWWTP.

11.10 Air and Odor

This section addresses the environmental setting, impacts to the environment, mitigation measures, and significant unavoidable adverse impacts related to air and odor for the JDWWTP and VWWTP. It describes the existing air environment that may affect, or be affected by, the proposed treatment plants. The air environment includes climate, air quality, odor and prevailing wind conditions. These factors are important in determining the potential for air emissions and odor impacts, and play an important role in wastewater facility design and operation.

11.10.1 Climate Conditions

Climatological data collected at the Tocumen International Airport weather station is used for this report. The Tocumen International Airport is located approximately 7 kilometers to the east of the JDWWTP.

The average annual temperature for Panamá City is 26.5 degrees Centigrade (° C). Average monthly temperatures range from 26° C in December to 27.6 during April. The highest average daily maximum temperature is 34.1° C in March and the lowest is 22.2 in January. Average rainfall is approximately 1,797.2 mm. Precipitation is fairly well distributed from May to November, with the heaviest amounts occurring in October and November.

Thunderstorms are a common occurrence year round and almost daily during the wet months. The maximum monthly occurrence of thunderstorms is associated with the months of October and November. The hurricane season coincides with the latter part of the wet season from July to the end of October.

In the Panamá City, area wind direction is predominantly fluctuates between the northeast and southeast direction. However, wind can change in direction throughout the year as a result of tropical depressions. The annual average wind speed is 1.9 meter per second with monthly averages ranging from 2.4 meter per second in February and March to 1.6 meter per second throughout the wet season.

11.10.1.1 Air Quality Standards

Panamá has developed its own air quality standards that are regulated by the Autoridad Nacional del Ambiente (ANAM). Air quality standards generally apply for source or type of pollutant. Odor is an air quality indicator not specifically addressed under air quality regulations, other than by public nuisance requirements, but is covered in this chapter as a potential impact of the proposed project.

Both the JDWWTP and VWWTP are not a major source of Hazardous Air Pollutants (HAP) emissions. If turbines or reciprocating standby diesel engines will be used in the final design of the treatment plants, the combustion technology used may need to comply with the new EPA MACT related standards, as deemed applicable by the GOP.

11.10.1.2 Odor

While the GOP regulations set standards for criteria air pollutants, they do not set standards for odors. Odors are commonly addressed as air emissions that may be a detriment to a person or property. Thus, it is generally accepted as unlawful for any person to cause or allow the emission of any air contaminant in sufficient quantities and of such characteristics and duration as is, or is likely to be, injurious to human health, plant or animal life, or property, or which unreasonably interferes with enjoyment of life and property.

11.10.1.3 Potential Air Emissions and Odor Sources

JDWWTP

The JDWWTP would have a number of potential air emission and odor sources, including influent portals, pump stations, grit chambers, and potentially at the chlorination chamber, sludge management processes and sludge disposal operation. Based on current information, these emission sources appear to fall into the category of sources exempt from air quality permitting according to GOP regulations

The JDWWTP site is located on a flat terrain and its topography does not have the potential to create challenges to good air dispersion. However, the treatment plant would have limited distance between the Corredor Sur and the property line. Therefore, the distance between a potential emission source at the facility and the property line would not allow emissions to disperse to acceptable levels before they reach potential receptors traveling on the Corredor Sur. There are not stationary sensitive receptors of air emissions within approximately 600 meters of the site.

However, odor control facilities will be provided at the pretreatment building and the solids thickening and dewatering building. These structures are major odor producing operations and will be designed completely enclosed.

VWWTP

Similarly at the VWWTP, odor control facilities will be provided at the pretreatment building and the solids thickening and dewatering building. These structures are major odor producing operations and will be designed completely enclosed.

11.11.2 Impacts

This section describes the impacts on the air environment that may result from the construction and operation of the proposed wastewater facilities.

11.11.2.1 Potential Air Emission during Construction

Construction-related activities would result in short-term impacts to ambient air quality. Dust emissions from heavy construction operations could temporarily elevate levels of particulate matter in the ambient air. These impacts typically are related to fugitive dust emissions in and around the sites. The potential for impacts would be short term, occurring only while construction work is in progress. No significant long-term adverse impacts on local or regional air quality are anticipated.

Fugitive dust emissions typically occur during ground clearing, excavation, site preparation, grading stockpiling of materials, onsite movement of equipment, and transportation of material. In the case of the JDWWTP, additional dust would be created during excavation of the sludge cells; however, much of this earth will be reused onsite. Fugitive dust emissions are greatest during dry periods, periods of intense construction activity, and periods of high-wind conditions.

Construction odors (such as odors from painting a building or laying asphalt) might temporarily be noticeable in the project areas. Any such odors likely would be intermittent and diluted at increasing distances from the source.

Decreased roadway capacity due to construction vehicles and emissions from construction vehicles has the potential to degrade air quality in the surrounding areas. Traffic disruptions would be greatest at intersections, such as the Entronque-Embarcadero exit, and a the entrance of the Veracruz site leading to increased queuing and air quality emissions.

11.11.3 Potential Air Emissions during Operation

Odor emissions from the headwork of both the JDWWTP and the VWWTP and from the solids management processes at the JDWWTP have the potential to occur based on experience at other similar facilities. Wastewater treatment plants may generate odors when odorous compounds in the wastewater are released into the atmosphere. This can occur at various locations in the treatment plant, especially where there is turbulence (inlet drops, flumes, mixing boxes, screens and grit chambers). Odors at wastewater treatment plants are typically from hydrogen sulfide (H_2S) as well as ammonia, amines, and mercaptan-based compounds. These odor-producing compounds are generated from anaerobic decomposition of organic matter containing sulfur and nitrogen.

Odor emissions from the treatment plant's liquid processes due to volatilization of H_2S and other volatile organic compounds (VOC) and biodegradation are plant-specific and difficult to analyze.

The emission rates from the solids processes are generally estimated based on actual odor sampling data from other similar plants. VOC and other emissions from the solids treatment processes consist of emissions from three processes: gravity belt thickeners (GBTs), digesters, and dewatering centrifuges.

11.11.3.1 Mitigation Measures during Construction

During the construction phase of both facilities fugitive dust emissions from construction would be reduced by implementing a watering program at the construction sites. In addition, the speed of onsite construction vehicles would be limited to prevent the generation of dust. The cleaning of vehicles and/or wheel washing prior to the vehicle leaving the site would minimize dust or mud generated by vehicles as they leave the site.

Combustion sources at the construction site such as vehicles and stationary gasoline or diesel powered engines will be required to use emission control equipment at least as stringent as required by applicable GOP regulations.

11.11.3.2 Odor Control during Operation

The goal for odor control at both the JDWWTP and the VWWTP is to prevent offsite nuisance odors from occurring by using a combination of design, operational, and maintenance practices and procedures. The odor control system at both facilities will have the highest degree of odor control equipment and proven strategies currently available for municipal wastewater plants in

the United States. This combination approach of prevention plus high control has been proven to meet public concerns regarding offsite odors and reliable control at many similar facilities both in the United States and abroad. To achieve this goal, the proposed odor control system will be designed to remove 99.9 percent hydrogen sulfide that is present in the process air. Any residual hydrogen sulfide emissions after treatment will be non-detectable to most senses of smell. The other odorous compounds noted above (ammonia, amines, and mercaptan-based compounds) will also be removed to prevent offsite nuisance odors and will also be non-detectable to most senses of smell.

Odor Control System
JDWWTP

Odor prevention and control have been incorporated into the liquids and solids treatment processes of the JDWWTP and VWWTP. The objective of the odor control system is to capture and treat process air to remove the odorous compounds before discharging the air to the atmosphere. For this purpose, the odor control system will involve covering the headwork structures (influent pump station wet well, screening and grit chamber). The odor control system would also include enclosed sludge management facilities.

Hydrogen sulfide generation is more prevalent in the influent pump station, headworks, including bar rack and grit chamber than in downstream process units. Aeration basins are typically not significant sources of hydrogen sulfide or ammonia odor due to the biological activity taking place within the basin. The aeration basins do have a distinct earthy or musty odor, but the odor typically does not have the intensity of hydrogen sulfide. Secondary clarifiers and disinfection processes typically are not large odor sources at wastewater treatment plants and are commonly uncovered.

All process air from the headworks treatment units including the influent pump station, bar racks and grit chambers will be enclosed or covered areas at the JDWWTP, air collected from this area will be conveyed to an odor treatment system, where it would be scrubbed using a treatment system that would include a combination of multi-stage (sodium hypochlorite, sodium hydroxide, and/or sulfuric acid) chemical scrubbers followed by activated carbon or biofilters for polishing. The exhaust air from the scrubbers would be discharged from the scrubber stacks or from the biofilter surface.

Sludge handling facilities are usually producers of odor due to the high organic content of solids under common anaerobic conditions. Many odorous compounds are represented in the solids processes, including hydrogen sulfide, ammonia, reduced sulfur compounds, amines, and organic acids. All sludge handling facilities at the JDWWTP and VWWTP will be enclosed to avoid odor emissions.

11.11.4 Unavoidable Impacts

There are no significant unavoidable adverse impacts to air quality associated with this project since the main sources of odor emission will be enclosed and odor generating substances treated prior to their release to the atmosphere.

11.12 Surface Water

The JDWWTP project area is located in an 85 hectares parcel adjacent to the Rio Juan Diaz (see Figure 11-3). The treated effluent from the JDWWTP will discharge into the Panamá Bay at a location to be determined during the final design phase of the project.

The VWWTP is located on a 3.5 hectares site situated between the Pacific Ocean and the main road of Veracruz. The west boundary follows a drainage ditch discharging into the Pacific Ocean (see Figure 11-4). The area along the shoreline is tide-influenced.

This section describes the surface water environment within the project area of influence. After presenting a summary of applicable laws and regulations, the text describes surface water features at the JDWWTP and the VWWTP and in the outfall areas.

11.12.1 Regulatory Framework

Water quality is regulated by the "Autoridad Nacional del Ambiente (ANAM)." ANAM was enacted by Law 41 of June 1, 1998, which establishes the environmental regulatory framework in the Republic of Panamá. The interested reader is referred to ANAM website at www.anam.gob.pa/portada.htm for details on the Panamanian environmental regulatory framework.

Water quality regulations do not detail water quality standards for surface water. Environmental regulations with regard to the discharge of treated wastewater and sludge are provided in the following regulations:

1. REGLAMENTO TÉCNICO DGNTI-COPANIT 24-99 REUTILIZACION DE LAS AGUAS RESIDUALES TRATADAS

2. REGLAMENTO TÉCNICO DGNTI-COPANIT 35 - 2000 AGUA.DESCARGAS DE EFLUENTES LÍQUIDOS DIRECTAMENTE A CUERPOS Y MASAS DE AGUA SUPERFICIALES Y SUBTERRANEAS.

3. REGLAMENTO TÉCNICO DGNTI-COPANIT 39-2000 AGUA. DESCARGAS DE EFLUENTES LÍQUIDOS DIRECTAMENTE A SISTEMAS DE RECOLECCIÓN DE AGUAS RESIDUALES.

4. REGLAMENTO TÉCNICO DGNTI-COPANIT 47-2000 AGUA, NORMA DE USOS Y DISPOSICION FINAL DE LODOS.

5. CARACTERIZACIÓN Y ADECUACIÓN A LOS REGLAMENTOS TÉCNICOS PARA DESCARGAS DE AGUAS RESIDUALES DGNTI-COPANIT 35-2000 Y DGNTI-COPANIT 39-2000 Resolución 002/2002

For the purpose of this report, water quality standards required for treated wastewater discharge are considered the water quality standards for surface water. Table 11-2 summarizes water quality requirements for treated wastewater to be discharged by the JDWWTP and VWWTP.

Table 11-2
Maximum Effluent Discharge Limits to Receiving Water Bodies

Parameter	Unit	Symbol	Limit
Grease and Oils	mg/l	A y G	20
Aluminum	mg/l	Al	5
Arsenic	mg/l	As	0,50
Boron	mg/l	B	0,75
Cadmium	mg/l	Cd	0,01
Calcium	mg/l	Ca	1 000
Cyanide	mg/l	CN	0,2
Residual Chlorine	mg/l	Cl	1,5
Chlorides	mg/l	Cl_2	400
Copper	mg/l	Cu	1
Total Coliforms	NMP/100 ml	Coli/100ml	1 000
Phenolic Compounds	mg/l	Fenoles	0,5
Hexavalent Chromium	mg/l	Cr^{6+}	0,05
Total Chromium	mg/l	Crt	5
Biochemical Oxygen Demand	Mg O_2/l	BOD_5	35
Chemical Oxygen Demand	mg/l	COD	100
Detergents	mg/l		1
Detergent foam	Mm	PE	7
Fluoride	Mg/l	F-	1,5
Total Phosphorous	mg/l	P	5
Total Hydrocarbons	mg/l		5
Total Iron	mg/l	Fe	5
Manganese	mg/l	Mn	0,3
Mercapatans	mg/l		0,02
Mercury	mg/l	Hg	0,001
Molybdenum	mg/l	Mo	2,5
Nickel	mg/l	Ni	0,2
Nitrates	mg/l	NO_3	6
Total Organic Nitrogen	mg/l	N	10
Ammonium Nitrogen	mg/l	NH_3-N	3

Table 11-2 (continued)
Maximum Effluent Discharge Limits to Receiving Water Bodies

Parameter	Unit	Symbol	Limit
Odor			No perceptible
Organochlorides	mg/l		1,5
Pentaclorophenol	mg/l	C_6OHCl_5	0,009
pH	Unidad	pH	5,5 - 9,0
Lead	mg/l	Pb	0,050
Selenium	mg/l	Se	0,01
Sodium	%	% Na	35
Settleable Solids	mg/l	S.SED.	15
Suspended Solids	mg/l	SS	35
Total Dissolved Solids	mg/l	TDS	500
Sulfates	mg/l	SO_4^{-2}	1 000
Sulfur	mg/l	S^{-2}	1
Temperature	ºC		± 3°C de la T. N
Toluene	mg/l	$C_6H_5CH_3$	0,7
Tricloroethane	mg/l	HC_2Cl_3	0,04
Tricloromethane	mg/l	$CHCl_3$	0,02
Turbidity	NTU	NTU	30
Xylene	mg/l	$C_6H_4C_2H_6$	0,05
Zinc	mg/l	Zn	3

NOTE:
Color: The discharged effluent should not add color to the receiving water body
All concentrations refer to total values.
T.N: Normal site temperature.

11.12.2 River and Marine Water Quality

The limited water quality program conducted as part of the CESOC master plan, involved a limited number of sampling stations. Water quality information for the Juan Diaz River in the area of the proposed site is not available. However, a visual inspection of its course upstream from the Entroque-Embarcadero revealed that this watercourse receives contaminated runoff from surrounding residential and industrial developments, including likely untreated discharges from a diverse type of land uses and potential hazardous substances from auto wrecking yards and auto repair shops and a variety of industrial and commercial facilities.

According to information provided in the CESOC Master Plan and reported in the October 2001 CMP, water quality information for the marine environment showed great variation, water quality in the proximity of the Casco Viejo River shows greater urban pollution impact. Analytical data for the proposed location of the VWWTP is not available. Our visual inspection

of the shoreline in the Veracruz area near the Venado River Bridge did not reveal water quality pollution sources that could be impacting the marine environment.

11.12.3 Impacts

Impacts to surface water are possible both during the construction phase and routine operation of the JDWWTP and VWWTP. Both are discussed in this section.

11.12.3.1 Potential Impacts during Construction

The potential for surface water impacts due to construction are considered localized, short-term impacts to the Juan Diaz River and in the vicinity of the outfall location. Potential construction impacts could be expected for the duration of the construction phase. These may include erosion related impacts, dewatering, leaks and spills from construction equipment, construction waste, and changes in surface runoff patterns due to soil compaction.

Erosion and Sediments Disturbance

Stormwater runoff could deliver sediment to surface water resources from the erosion of disturbed or stockpiled soils during construction. Compaction of soils and absence of vegetative cover in construction zones would exacerbate the potential problems, as would the release of excavated soil and fill material outside the work zone. Sediment routed to the Juan Diaz River and Panamá Bay, and Pacific Ocean could increase turbidity, settleable solids, nutrients, and other pollutants, resulting in water quality degradation and reduced habitat values.

Localized water quality impacts would occur during construction of the short outfalls. During placement of the outfall pipe soil disturbances would occur, creating localized increases in turbidity. Increased turbidity would occur in the vicinity of the construction zone throughout the duration of in-water construction. Construction of the marine outfall is expected to minimally impact the waters of Panamá Bay, with all impacts of short duration. Increases in water turbidity may be expected predominantly during the near shore construction of the outfall. Trenching activities during outfall construction will disturb and re-suspend bottom sediments, temporarily increasing turbidity in the immediate vicinity of the trench.

Dewatering

During the construction of the plants, groundwater would need to be removed from the work zone to enable below-grade construction. The amount of groundwater requiring removal would vary depending on the depth of excavation and the hydraulic and water yielding properties of the aquifer beneath the site. In lowering groundwater elevations, dewatering could temporarily divert water to the Juan Diaz River. Potential water quality impact such as increase in turbidity, particularly during low-flow conditions may occur.

Spills and Leaks

Oil, grease, other petroleum hydrocarbons, and other substances could leak or spill from construction equipment or storage facilities. If an uncontrolled spill occurred, these substances could reach the Juan Diaz River and Panamá Bay. Uncontrolled large volume spills of petroleum products could be toxic to aquatic organisms. The severity of the impact would

depend upon the volume of spill or leak, type of material spilled, and the volume of water available to dilute or disperse pollutants in the receiving water.

11.12.3.2 Potential Impacts during Operation

Impacts to surface waters from the operation of both the JDWWTP and VWWTP could occur due the discharge of contaminants to the receiving body of water. Other impacts may originate from increased stormwater runoff or through spills and leaks at the wastewater treatment plants caused by operational or maintenance malfunctions or extreme emergency conditions.

Treated Wastewater Discharge

The function of the outfall is to discharge treated wastewater into Panamá Bay meeting the Panamanian effluent standards. Thus, there is a potential for chemical or biological contaminants to enter the marine environment. The JDWWTP and VWWTP outfalls will be designed to achieve GOP water quality standards and other related water quality objectives. The expected concentrations of chemical and biological pollution indicators to be discharged are below the GOP water quality criteria. The addition of effluent to the marine environment is also not expected to impact normal currents or circulation of the water. Therefore, operation of the outfall is expected to meet all GOP water quality criteria.

Floods

JDWWTP

The JDWWTP lies adjacent to the Juan Diaz River and within 1.5 kilometers of the Panamá Bay shoreline. Ground surface elevation at the JDWWTP site ranges from about 7 meters above sea water level during ebb tides to approximately 2 meters above sea water level at high tides. Due to the its proximity to the Juan Diaz River and the effect of backwater trapped at high tides, the site could be subject to flooding under catastrophic events. Thus, engineering measures to avoid floodwaters from reaching the treatment plant site should be contemplated in the final design.

VWWTP

The potential impact under catastrophic events of the drainage ditch that lies parallel to the west side of the VDWWTP will be assessed during the final design phase of the project. The engineering measures to avoid floodwaters from reaching the treatment plant site should be contemplated in the final design.

Runoff

Stormwater runoff from wastewater treatment plants could collect sediments and petroleum products which in turn would be discharged to the Juan Diaz River and Panamá Bay decreasing water quality and habitat value in these water resources.

Spills and Leaks

Operation of the JDWWTP and VWWTP includes the potential for a spill or leak. Such an event could occur as an accident (e.g., if a pipe within the system ruptures), through leaks from vehicles, or through an emergency event (such as an extreme storm, power outage, or other natural catastrophe). Such leaks or spills could include untreated wastewater or other liquid such

as fuel or treatment chemicals. Potential impacts to receiving waters would depend on the volume and character of the spill, and could include temporary increases in turbidity and suspended solids, reductions in dissolved oxygen levels, and increased bacteria levels.

Emergency Overflows

Emergency overflows would not occur at JDWWTP or the VWWTP. However under catastrophic emergency conditions such as a complete loss of the influent or effluent pump stations a gravity conveyance system could convey emergency flows to the nearby receiving bodies of water. Potential impacts to these water bodies are those associated with the temporary discharge of raw sewage.

11.12.4 Mitigation Measures

The following section identifies measures to mitigate potential impacts to surface water resources due to construction and operation of the JDWWTP and VWWTP. The general approach to mitigation for surface water resources is to avoid impacts through careful site design, planning, construction techniques, and strict adherence to Best Management Practices (BMPs). If impacts are unavoidable, measures will be taken to minimize the effects through appropriate mitigation.

The operation of both treatment plants will incorporate a number of measures to minimize the potential for impacts to surface waters. These include onsite containment of spill-prone areas, regular monitoring of equipment performance and efficiency, state of the art equipment maintenance, and extensive staff training and certification. These measures will ensure that the facility will operate as designed, which will significantly reduce the potential for spills, leaks, or other releases of untreated materials to the environment.

11.12.4.1 Mitigation Measures during Construction

To avoid impacts to surface water resources, the project would implement BMPs to control construction runoff and to prevent sediment, petroleum products, and construction waste from entering surface water resources. The Contractor will be required to develop of a stormwater pollution prevention plan specifying measures to control erosion and sedimentation during construction with the intent of mitigating potential impacts to surface and ground water resources. Construction would be managed to minimize potential erosion and maximize the effectiveness of structural erosion and sediment control BMPs. Management measures include timing and staging of construction activities to minimize erosion potential, routine inspection and maintenance of structural BMPs, and effective BMP removal and site restoration.

Erosion Control Measures

Erosion and sediment control BMPs would be implemented to prevent and reduce the export of soils from the site. In general, the extent of BMPs required would depend on the amount of land area disturbed by construction, including excavation areas, work zones, and equipment and material staging areas. Erosion and sediment control BMPs to be implemented during construction will be developed by the Contractor prior to the start of the project.

Minimizing Land Disturbance

Construction activities would require clearing of vegetation and other existing material from areas to be used as work zones, staging areas, and access routes. To prevent unnecessary land disturbance and protect critical or sensitive areas and their buffer zones, the size of areas to be cleared for construction activities would be limited. In addition, the number of access points to the site would be minimized to reduce the tracking of soils onto adjacent roadways by construction vehicles. Access roads and parking/staging areas in unpaved locations would be stabilized with quarry spalls, crushed gravel, or temporary paving. Wheels of construction vehicles would be washed with water prior to leaving the construction site, with the wash water collected and discharged to temporary settling ponds.

Dust Control and Soil Stabilization

Soils and soil stockpiles exposed during clearing and grading would be stabilized to prevent erosion. BMPs for exposed soils and soil stockpiles include seeding; sodding; mulching; installing plastic covering, erosion control blankets, or matting; and applying soil binders such as magnesium chloride.

Exposed slopes would be managed, designed, and constructed to minimize water flow velocity on the slope face. The Contractor will implement runoff control measures to minimize runoff velocities, these measures could include diverting flow in mid-slope channels, reducing slope steepness, installing pipe slope drains and subsurface drains, and roughening the slope surface. In addition, slope faces would be stabilized as indicated above.

Drainage Channels Stabilization

Drainage channels would be constructed to prevent erosion from estimated peak discharge from a 2-year 24 hour storm event. Conveyance channels could be stabilized by grass, riprap, or erosion control blankets/turf reinforcing mats. Check dams would be installed in steeper channels to reduce flow velocities.

Sediment Trapping and Flow Rates Control

Straw-bale and brush barriers, straw wattles, vegetated strips, or silt fences may be applied to treat sheet flow runoff. Concentrated runoff from exposed soil surfaces in construction areas would be treated and controlled before discharge to waterways (Juan Diaz River or Panamá Bay). Discharge rates would be controlled by detention, storage, and onsite sediment traps or ponds.

Avoiding Impacts to Adjacent Public Properties

Unpaved access roads and onsite traffic areas would be sprayed with water or other dust control materials to reduce windborne movement of soils. When necessary, wheels of construction vehicles would be washed before leaving the site, with the wash water collected and discharged to installed sediments trapping structures or devices. Adjacent streets would be swept as necessary to remove soils tracked offsite by construction vehicles.

Dewatering
Groundwater may need to be removed from the work zone. To prevent impacts to adjacent surface waters, pumped water could be discharged to onsite infiltration basins, or treated prior to discharge into the Juan Diaz River or Panamá Bay. Dewatering discharge directed to surface waters should be required to meet GOP water quality standards.

Petroleum Products
Oil, grease, and other petroleum hydrocarbons may leak or spill from construction equipment or storage facilities. Because uncontrolled, spilled petroleum products could reach surface water resources adjacent to the work zone, the construction contracts will require prevention of possible petroleum impacts to area surface waters. As a minimum practice, all petroleum spills will be contained within the construction area. The Contractors will be required to prepare and implement a detailed emergency spill response plan. As a routine procedure, Contractors would be required to steam-clean all construction equipment to be used near bodies of water. Contractors would also be required to use nontoxic and biodegradable hydraulic fluid.

Construction Waste
Solid wastes discarded during construction would be collected and appropriately disposed of offsite. Waste materials could be recycled or landfilled as deemed acceptable under local regulations. Slurry from exposed aggregate washing would be contained and collected. Concrete pumping vehicles would not discharge concrete, slurry, or rinse water into the adjacent water resources or drainage ditches. A washout area would be provided for cleaning of application and mixing equipment. All accumulated aggregate chunks and other solids will be collected with a shovel or other mechanism for off-site final disposal at the end of each day.

11.12.4.2 Mitigation Measures during Operation

Treated Wastewater Discharge
The JDWWTP and VWWTP are projected to discharge in Year 2020 102 mgd and 1.9 mgd, respectively, of treated effluent into Panamá Bay. This input is very small relative to the total volume of Panamá Bay, and is not expected to impact circulation. With tidal current speeds generally at 1 ft/sec the discharged effluent will be quickly entrained into the tidal currents and diluted. Most importantly, the water quality of the discharges meet GOP water quality standards. Therefore, mitigation for the operation of the outfall would not be necessary unless specific oceanographic information with regard to the level of dilution at the mixing zone provides questions with regard to the long-term effects to marine biota.

The marine outfall will likely discharge small amounts of microbiological and chemical contaminants into the marine environment. Therefore, water quality monitoring is recommended for the receiving body of water. The monitoring program should aim at confirming that concentrations of constituents are below water quality criteria for the protection of wildlife and human health. The monitoring program should assess the nutrients assimilation capacity of the receiving body of water, as the discharge of the effluent from both wastewater treatment plants will introduce nutrients in the form of nitrogen. These nutrients could stimulate the overproduction and growth of microscopic algae, inhabiting the water column particularly in

areas of poor water circulation. This could result in unsightly water conditions and depleted oxygen levels in the water, which can harm fish and shellfish. Nutrients are also sometimes suggested as possible contributors to harmful algal blooms commonly referred to as "red tides."

Floods

The JDWWTP would be located immediately adjacent to the Juan Diaz River and as such will be potentially subject to flooding. The VWWTP would be located adjacent to Pacific Ocean. The JDWWTP and VWWTP will be designed taking into consideration guidelines for reducing flood impacts. The JDWWTP will be designed to withstand floods that could reasonably be projected to occur within its design lifetime. The design for example would protect the treatment plant facility against damage due to a 100-year flood; however, they would not ensure protection against catastrophic events that are larger than the 100-year event.

Runoff

To avoid or minimize impacts to surface water resources, the project would implement BMPs for sediment and erosion control. Because runoff from both the JDWWTP and VWWTP would be treated within the stormwater treatment facilities prior to discharge to surface waters; concentrations of contaminants in runoff from the sites are expected to be substantially reduced and would likely compare in quality to the current condition.

Spills and Leaks

Measures, minimizing or preventing spills and their potential for impacts to surface waters will be contained in the hazardous substance emergency management plan to be prepared for both wastewater treatment plants. A variety of liquids would be used and stored on the treatment plant site for use in treatment plant operations. These liquids, include corrosive and flammable chemicals. All chemicals would be stored and used in accordance with permit requirements of the United States Uniform Fire Code or similar Panamanian standard, which include requirements for onsite spill containment. Loading and unloading of potentially hazardous materials would be subject to spill prevention and containment requirements. As a result, there is a very low potential for any material spilled onsite to be transported into a surface water body.

All areas used for loading/unloading materials would include spill containment systems. Stormwater collected from areas of the treatment plant where there is risk of chemical spills or wastewater contact, such as drainage from the process units, chemical storage areas, and chemical loading/unloading areas, would be routed back to the wastewater treatment plant headworks to ensure that spills do not impact receiving waters. This would also prevent washdown water or any other contamination from untreated wastewater from entering the stormwater treatment system.

Emergency Overflows

The duration of these events would depend on the volume of the emergency spill. Impacts could be of greater concern if the spill or leak occurred during the dry season when stream flows and potential dilution are lowest. However, the likelihood of a significant emergency overflows from the treatment plants is very low because influent must be pumped up into the treatment plants,

and any failures at the sites of the treatment plants would result in implementation of the emergency flow management procedures. Both plant designs will also include emergency flow management measures to minimize the potential for spills or leaks. The treatment plants will include provisions to contain any potential spill that could occur and the contaminants would be rerouted to the treatment plant, as described under Mitigation for spills and leaks.

11.12.5 Unavoidable Impacts

Significant unavoidable adverse impacts to surface water resources are not anticipated because of construction or operation of a treatment plant. Some unavoidable adverse impacts to surface water resources may occur during construction if mitigation measures are not consistently applied or maintained, however, they are not anticipated to be significant.

While all efforts will be made to avoid emergency overflows, such events could occur on very rare occasions. Temporary violations of water quality standards could occur. The impact of emergency overflows onto Panamá Bay would resemble the impact of current discharge of raw sewage into Panamá Bay.

During operations, the outfalls will discharge 102 mgd and 1.9 mgd of treated wastewater into Panamá Bay and small amounts of microbiological and chemical contaminants would be discharged into the marine environment. However, the concentrations of contaminants in the water discharge are anticipated to be below water quality criteria for the protection of wildlife and human health.

11.13 Plants and Wetlands

This chapter addresses the environmental setting, impacts to the environment, mitigation measures, and significant unavoidable adverse impacts related to the proposed JDWWTP and VWWTP. This chapter addresses terrestrial habitats and wetlands on the JDWWTP only.

Information sources used in the preparation of this Chapter include the Habitat Assessment for a Potential Waste Water Treatment Plant Site near the Juan Diaz River by CZR Incorporated.

11.13.1 Environmental Setting

11.13.2 Habitat Description

According to the CZR, Inc. report, the entire site is part of a large, tidally influenced mangrove area on the Panamá Bay. A berm and canal system running parallel to the shoreline approximately 15 meters inside the tree line at the shore prevents all but extremely high storm tides from reaching inland. More recently, a large portion of the site has been used for rice cultivation and cattle grazing. Currently, portions of the site along the shoreline are being used for a variety of industrial types such as solid waste disposal, a commercial marina and maintenance facility, and the land based operations of a sand dredge facility with associated storage and loading areas.

CZR, Inc. biologists performed a site evaluation using the Wetland Rapid Assessment Procedure (WRAP) developed by the South Florida Water Management District (1997) to evaluate wetlands and wetland mitigation measures. The WRAP methodology has been adopted by the U.S. Army Corps of Engineers. The interested reader is referred to the CZR, Inc. report for further details on the WRAP methodology. According to the WRAP methodology, wetlands with a rating above 0.66 are considered to high quality wetlands; those with scores between 0.33 and 0.66 are rated medium quality; and those with a score below 0.32 are considered of low quality.

According to the CZR, Inc. report, the site contains upland habitats (managed grass areas and tropical forests) and wetland habitats (seasonally wet prairie and mangrove forests). The site has been separated into the thirteen distinct habitat areas summarized in Table 11-3.

Mangroves forests dominate the general area proposed for the JDWWTP. Areas C, E, G and I are high quality matured forested wetlands. Areas A, B, L and M are low quality wetlands dominated by herbaceous species. Areas D, F and H are low quality upland habitats dominated by shrubby species and thick grasses. Areas J and K were probably wetlands in the past and currently exhibit only few wetlands characteristics and are not qualified as wetlands.

Table 11-3 Habitat Description

Wetland	Approximate Size (Hectares)	Habitat Type	WRAP Score	Observed Vegetation	Soil Characteristics	Hydrologic Characteristics
A	8.451	Wetland – Seasonally Wet Prairie	0.42	Wet Grass, Panicum sp.	Clay	Floodplain
B	2.701	Wetland – Seasonally Wet Prairie	0.48	Wetland Grasses, Spartina sp.	Clay	Floodplain
C	11.151	Wetland – Forested Mangrove	0.42	Forested Mangrove	Clay	Floodplain
D	11.805	Upland - Rangeland	Not a Wetland	Upland Grasses, Panicum sp.	Sand and Clay	No Evidence of Seasonal Inundation
E	83.2	Wetland – Forested Mangrove	0.69	Forested Mangrove	Clay	Evidence of Seasonal Inundation
F	5.75	Upland – Mixed Rangeland	Not a Wetland	Upland Grass, Panicum sp.	Sand and Clay	No Evidence of Seasonal Inundation
G	96.05	Wetland – Forested Mangrove	0.75	Forested Mangrove	Clay	Strong Evidence of Seasonal Inundation
H	13.983	Upland – Mixed Rangeland	Not a Wetland	Mixed Upland, Panicum sp.	Sand and Clay	Seasonally inundated
I	11.981	Wetland – Forested Mangrove	0.55	Forested Mangrove	Clay	Strong Evidence of Seasonal Inundation
J	25.744	Upland – Improved Pasture	Not a Wetland	Historically part of a rice plantation, pastureland	Clay	Evidence of Seasonal Inundation
K	49.179	Upland – Improved Pasture	Not a Wetland	Historically part of a rice plantation, pastureland	Clay	Seasonally inundated
L	10.149	Wetland – Shrubby Mangrove / Seasonally Wet Prairie	0.39	Shrubby Mangrove, Panicum sp.	Clay	No Evidence of Seasonal Inundation
M	24.306	Wetland – Seasonally Wet Prairie	0.73	Grass Prairie, Panicum sp.	Clay	Strong Evidence of Seasonal Inundation

11.13.2 Regulatory Framework

Resolution JD-09-94 of the GOP created "el Sistema Nacional de Áreas Silvestres Protegidas" as an administrative entity of the "Instituto Nacional de Recursos Naturales Renovables (INRENARE)" with the objective to preserve and protect naturals resources. The text of Resolution JD-09-94. Provision 10 , Article 3 of Resolution JD-09-94 covers "Humedales de Importancia International" (Wetlands of International Importance). Articles 4 and 5 establish INRENARE as the GOP agencies responsible for the administrative duties of the law with regard to all provisions of Resolution JD-09-94 including the approval of land use in protected areas.

República de Panamá
Instituto Nacional De Recursos Naturales Renovables
Resolución No. J D -09-94

Por medio de la cual se crea el Sistema Nacional de Áreas Silvestres Protegidas, ente administrativo del Instituto Nacional de Recursos Naturales Renovables, y se definen cada una de sus categorías de manejo.
La Junta Directiva del Instituto Nacional de Recursos Naturales Renovables en uso de sus facultades legales.

Considerando

Que a fin de. conservar y proteger parte importante de nuestros recursos naturales se han declarado como Áreas Silvestre Protegidas, por medio de Leyes, Decretos Leyes, Decretos y Resoluciones de Junta Directiva, más de un millón de hectáreas de del territorio nacional, constituyendo parques, reservas naturales refugios de vida silvestres y otras categorías reconocidas internacionalmente
Que al reconocer estas categorías y sitios de reconocimiento internacional, se hace necesario y de vital importancia para la Administración el contar con un instrumento técnico normativo el cual establezca los parámetros y defina cada una de estas categorías, y que además incluya aquellos elementos auxiliares que deban ser considerados como parte de este sistema.
Que aparte de las disposiciones diversas y heterogéneas establecidas en los instrumentos jurídicas que crean las categorías de manejo, no existen normas ni procedimientos uniformes para manejarlas ni tampoco una estructura institucional especifica del se encargue, con propiedad de su administración protección y vigilancia y desarrollo.
Que el articulo 50 de la Ley N^{0}21, de 16 de diciembre. de 16 de diciembre de 1986 asigna al lNRENARE la responsabilidad de definir, .planificar, organizar, coordinar regular y fomentar políticas y acciones aprovechamiento conservación desarrollo manejo y enriquecimiento, de parques nacionales y reservas equivalentes.
Que las áreas silvestres protegidas responden a la necesidad que tiene el estado en organizar para el desarrollo sostenido del país, una base de recursos naturales cónsona con las demandas de agua, energía, salud, ambiente y desarrollo de las generaciones presentes v futuras.

Resuelve

Artículo 1

Crear bajo la Dirección General del INRENARE, el Sistema Nacional de Áreas Silvestres Protegidas, orientado al logro de los objetivos siguientes:
1) Preservar los materiales genéticos como elementos de comunidades

naturales; evitar la perdida de especies de plantas o animales silvestres y mantener la diversidad biológica natural.

2) Conservar en su estado natural ejemplos de los diversos ecosistemas terrestres y marinos$_1$ paisajes naturales y formaciones geológicas esenciales y patrones naturales evolutivos como también restaurarlos y rehabilitar en los casos que sean necesarios para el beneficio de las generaciones presentes y futuras.
3) Proteger y manejar las fuentes de aguas dentro de las áreas silvestres protegidas a fin de mantener la calidad cantidad y flujo optimo, controlar y prevenir la erosi6n,sedimentación e inundaciones y proteger las inversiones que dependen del abastecimiento de agua tales como represas y proyectos de irrigación.
4) Promover los medios necesario para que, a través de las investigaciones científicas aumenten los conocimientos sobre la biodiversidad$_1$ para mejorar las opciones de la protección y aprovechamiento de este activo nacional.
5) Contribuir con el desarrollo sostenible en territorio de los grupos indígenas zonas rurales y el país en general mediante el aprovechamiento racional los recursos natura les renovables existentes en aquellos sitios claramente identificados en el plan de ordenamiento de cada área protegida, de acuerdo a su categoría de manejo.
6) Conservar y proteger los aspectos históricos culturales y arqueológicos dentro de las áreas silvestres protegidas$_1$ administradas por el sistema nacional
7) Proveer oportunidades para el desarrolla de actividades de Educación ambiental, turismo ecológica y recreación al aire libre
8) Apoyar las gestión de los grupos indígenas en la administración de los territorios que se le asignen para garantizar su mejor planeamiento y desarrollo.

Artículo 2

El Sistema Nacional de Áreas Silvestres Protegidas estará integrado por las siguientes categorías de manejo reserva científica, parque nacional, monumento natural refugio de vida silvestre, área de uso múltiple, paisaje protegido, área natural recreativa, reservas de los recursos, reserva forestal, reserva hidrológica, parque nacional marino, zona de amortiguamiento. además, se consideran las siguientes categorías de reconocimiento internacional: sitios de patrimonio mundial, reserva de la biósfera y los humedales de importancia internacional. También se considera como parte del Sistema Nacional de Áreas Silvestres Protegidas, los corredores biológicos y las áreas silvestres protegidas dentro de comarca o reserva indígena.

Artículo 3

Cada una de las categorías de manejo se definirá de las siguiente manera:

1) Reserva Científica: es un área con ecos sistemas sobresalientes especies de flora y fauna de importancia científica nacional. A menudo contiene ecosistemas frágiles posee áreas una diversidad biológica importante para la conservación de las recursos genéticos. El tamaño está determinada por el terreno requerido para asegurar la integridad del área a fin de alcanzar los objetivos del manejo científica y asegurar su protección.
2) Parque Nacional: es un área terrestres a acuática relativamente grandes (mas de cien hectáreas), que contiene muestras representativas

sobresalientes de las principales regiones, rasgos o escenarios de importancia nacional e internacional donde las especies de plantas y animales, sitios geográficas y habitats son de especial interés científico, educativo y recreativo. Contienen unos o varios ecosistemas completos que no han sido materialmente alterados por la explotación y ocupación humana.

3) Monumento Natural: Es un área que contiene uno o más rasgos sobresalientes únicos de importancia nacional, tales como las formaciones geológicas, sitios naturales especiales, habitats o especies de plantas a animales que debido a su singularidad, pueden estar amenazados y requieren de su protección. El tamaño esta determinado por el rasgo especifico y el área necesaria para asegurar su protección.
4) Refugio de vida Silvestre: Un refugio de vida silvestre provee la protección de o habitats específicos para la existencia o bienestar sostenido de las especies de flora y faunas migratorias o residentes de importancia nacional o global. El tamaño del área y el manejo especial requerido en ciertas circunstancias estaciónales dependerá de los requerimientos de habitats o características especificas de las especies; que serán protegidas En todo caso estas necesidades no requerirán zonas amplias podrían ser relativamente pequeñas: área de anidamiento pantanos lagos esteras bosques o pastizales
5) Paisaje protegido: El paisaje protegido, por lo general representan dos tipos de áreas: aquellos paisajes que poseen cualidades estéticas que especiales que son un resultado de la interacción armoniosa del hombre y la tierra, aquellos que son áreas naturales de un atractivo estético manejados por el hombre con fines recreativos y turísticos
6) Área natural Recreativa: Extensión relativamente amplia. Área natural escénica, con atractivos para uso recreativo, ya sean naturales o de fácil acceso artificiales, De fácil acceso o desde los centros importantes de población. Con potencial para el desarrollo de una Variedad de actividades recreativas al aire libre. Mantiene una alta calidad de paisajes y trata de evitar la degradación de los recursos naturales.
7) Sitio de Patrimonio Mundial: Área con rasgas naturales y culturales de significación internacional, que contiene muestras de los periodos evolutivos de la tierra, procesos geológicos significativos, rasgas o comunidades naturales singulares o en peligro, con gran valor artístico, científico, cultural, social o tecnológica, o de gran antigüedad.
8) Reserva de la Biosfera: Áreas que contiene muestras representativas de biomas importantes, rasgos naturales singulares, pautas armónicas y estables de uso de la tierra. También puede tratarse de ecosistema modificados susceptibles de investigación, especialmente para estudias de referencia, control ambiental y educación.
9) Áreas de Uso Múltiple: Son áreas terrestres Y marinas que además de contribuir a la protección de los recursos naturales y los sistemas ecológicos, contribuye en forma significativa a la economía social como fuente de otros recursos. La multiplicidad de funciones de estas tierras o aguas, representa una fuente importante de productos naturales (agua, madera, vida silvestre, pastos$_1$ tintes, etc) y de servicios permanentes, bajo un manejo integral sustentable.
10) Humedales de Importancia Internacional: Áreas designadas por la

"Convención Relativa a los Humedales de Importancia Internacional", especialmente como habitat de aves acuáticas que comprenden extensiones de marismas pantanos y turberas o superficies cubiertas de agua, sean éstas de régimen natural o artificial permanentes o naturales.

11)Corredor biológico: zonas naturales a en recuperación que conectan áreas protegidas con el objetivo de mantener el movimiento de especies de vida silvestre y así conservar la diversidad biológica.

11)Área Silvestre ubicada dentro de Comarca o Reserva Indígenas: Se trata de cualquier categoría de manejo definida por esta Resolución, ubicada dentro de las Comarcas y Reservas Indígenas legalmente establecidas**,** que haya sido declarada área silvestre protegida a través de los Congresos Generales de cada Comarca o Reserva de acuerdo a la regulación vigente para cada una de éstas.

13)Reserva de los Recursos: Categoría de manejo transitoria, generalmente consta de una zona extensa, inhabitada y de difícil acceso. El área se encuentra casi siempre con recursos naturales, todavía sin explotar ni desarrollar.

14)Reserva Forestal: Es un área de uso múltiple en donde el manejo adecuado conlleva el aprovechamiento racional programado de los recursos forestales contenidos.

15)Reserva Hidrológica: Área generalmente boscosa escarpada quebrada; cuyo valor primordial es conservar la producción hídrica en cantidad y calidad adecuada para las actividades humanas y productivas de la región.

16)Parque Nacional Marino: Área que posee una muestra representativa de los ecosistemas marinos costeros o insulares, también contribuye al reestablecimiento y mantenimiento de especies de fauna marinas, para su aprovechamiento sostenido.

17)Zona de Amortiguamiento: Franja de tierra que rodea los recursos o habitats especiales, y que actúan como una barrera a las influencias externas. Esta franja debe ser lo suficiente ancha para absorber los disturbios químicos y físicas, tales como la contaminación del aire, suelo, agua fuego, caza furtiva y turismo incontrolado, y estará ubicada rodeando el perímetro del área protegida y proyectándose de los limites del área hacia su exterior.

Artículo 4:

Corresponderá al Instituto Nacional de Recursos Naturales Renovables (INRENARE), a través de la Dirección Nacional de Áreas Protegidas y Vida Silvestres, la administración, planificación, conservación, vigilancia, protección y control de los recursos naturales renovables existentes dentro de las unidades de manejo que integran el Sistema Nacional de Áreas Silvestres Protegidas del Estado, con fundamento en las disposiciones establecidas en esta Resolución.

Artículo 5:

En uso de las atribuciones indicadas en el párrafo anterior y basado en el artículo 50 de la Ley 21, del 16 de diciembre de 1986, el INRENÁRE esta facultado para celebrar toda clase de actos, convenios y contratos que tengan por objeto realizar actividades de investigación, planificación ejecución de obras y las prestación de todos los servicios que sean necesarios para el cumplimiento de

los objetivos de cada una de las unidades de manejo.

Artículo 6:
El INRENÁRE, previa informe técnico, aprobará a través de la Junta Directiva lo relativo al plan de ordenamiento los cambios de categorías de manejo y la creación de nuevas áreas silvestres protegidas.
Artículo 7:
Hasta tanto se elabore. el plan de ordenamiento de las unidades que integran el Sistema estas se regirán por las normas legales que crean para las respectivas áreas silvestres protegidas.
Artículo 8:

Los organismos administrativos estatales y particulares a nivel municipal provincial o nacional, no podrán crear nuevas áreas silvestres protegidas, sin asegurar recursos financieros y sin contar con la aprobación previa del INRENÁRE.

Artículo 8:
La Dirección General del INRENARE, emitirá y confeccionará los manuales necesarios de funciones y procedimientos que facilite el desarrollo administrativo del Sistema Nacional de Áreas Silvestres Protegidas. Estos manuales tomarán en cuenta los objetivos de cada una de las diferentes categorías de manejo. La Dirección General remitirá copias de los manuales aprobados a la Junta Directiva de INRENÁRE.
Fundamento Legal :

Ley 21 de 16 de diciembre de 1986.

Esta resolución entra en vigor a partir su promulgación en la Gaceta Oficial. Dado en la ciudad a los 26 días del mes de junio de 1994.

Lic.Julio Ramírez
Presidente a.i de la
Junta Directiva de INRENARE

Lic. Harry Diaz
Secretario de la Junta
Directiva de INRENARE

11.13.4 Impacts

This evaluation characterizes the potential impacts to plants and wetlands at the proposed JDWWTP site. Temporary impacts associated with construction are described followed by discussion of long-term impacts associated with operation of the wastewater treatment facility. Main impacts are those that include permanent loss of habitat, because the plant will located in these areas.

11.13.4.1 Potential Impacts during Construction

Vegetation Clearing and Grading

In order to construct the JDWWTP, clearing and grading will occur in an area characterized by wetlands. Construction activities would impact Wetlands A, B, C, D, F, L the northern part of Wetland E, and the buffers of fringe of Juan Diaz River.

Removal of wetland grasses, forested mangrove, shrubby mangrove habitats will result in displacement of wildlife species. Vegetation clearing and grading would result in a loss of potential nest sites for birds, burrows for ground-dwelling mammals and foraging and cover sites for amphibians, reptiles, birds, and mammals. Some areas will be permanently cleared for the facilities, whereas other areas will only be temporarily cleared during construction and then restored.

Generally, the loss of shrub and tree habitat during construction takes from one to three decades to restore, resulting in a long-term loss of habitat. While some displaced species will return to this habitat, most will be permanently displaced.

Wetland Removal and Sedimentation

The construction of JDWWTP and supporting infrastructure including access roads will require excavating, grading, stockpiling, and transporting soils in an area characterized by wetlands. Construction activities and related exposed soils may cause increased sedimentation to the adjacent Juan Diaz River, Panamá Bay and wetlands either by wind or water erosion. Plants and animals directly affected by these processes are closely tied to wetland habitats.

The addition of sediment could bury existing hydric soils and may disrupt the vertical stratification of microbes, insects, and plant species in the soil layers and the processes they support. Sedimentation can cause the mortality of wetland-dwelling species, loss of eggs or young, or a reduction in prey densities. Reduced prey densities in wetland habitats may also affect some animals found in upland habitats that forage on wetland and aquatic-related species.

Generally, small amounts of sedimentation in wetlands have little effect on wetland functions, but large amounts can alter hydrologic regimes and plants and animals communities within the wetland. The project can potentially reduce the water storage capacity of the wetland, leaving less water available for plants and animals. In addition, changes in water depth or effective rooting depth may alter the existing vegetation in the system by favoring invasive species tolerant of fluctuating hydrology. Changes in water depth may affect the suitability of a wetland for amphibian egg-laying and juvenile development.

Best Management Practices (BMPs), including site erosion control measures, should prevent large amounts of sediment from reaching sensitive habitats; however, small amounts of sediment may reach wetlands adjacent to construction areas.

Discharge of Pollutants

Use of construction equipment may result in the incidental, incremental, or accidental discharge of pollutants, such as fuel, oil, grease, and hydraulic fluid, and the unavoidable release of combustible exhaust. These pollutants may be discharged into adjacent wetlands and aquatic habitats during regular construction operations or in the event of machinery failure. Accidental spills of toxic substances could occur during construction activities and could be washed into the Juan Diaz River system and wetlands during rainstorms. Large, accidental releases of pollutants can cause direct mortality or impair the health of crustaceans, fish, amphibians, and other wetland and stream biota. Aquatic and plant life in wetland and stream systems can be adversely impacted by large petroleum discharges that eliminate gas exchange at the air/water interface and coat plant and animal species with toxic residues. Hydrocarbon pollutants within aquatic environments can lower dissolved oxygen levels causing impairment or mortality of aquatic species.

Implementation of BMPs will prevent or reduce the probability of accidental spills. The effects of the discharge depend on the volume, type of substance released, and the cleanup response. Employment of spill kit cleanup immediately after an accidental spill will reduce the effect of the spill on the surrounding environment. Petroleum hydrocarbons have a high potential for toxicity to resident flora and fauna and are likely to persist in wetlands and aquatic systems unless they are removed.

Removal and Discharge of Dewatering Water

Dewatering activities will be necessary during construction due to the presence of shallow groundwater tables at the site of the JDWWTP. It may be necessary to extract and transport groundwater offsite to enable construction activities. Dewatering could lower groundwater elevations and divert water that feeds wetlands; possibly lowering the water levels within these water bodies. Wetland habitats would be most susceptible to this potential impact, particularly during the dry season.

Lowering water levels within wetlands will temporarily affect the hydrologic regime and plants and animals in a wetland. Plant and biota stress or possible mortality in wetlands may result from temporary exposure to dry conditions, depending on the duration of low water levels.

On the other hand, if dewatering water is discharged directly into neighboring wetlands or Juan Diaz River, water levels in these systems may be altered. Dewatering could also result in temporary sedimentation of streams and wetlands due to discharge of sediment-laden waters. The sediment, nutrient, pH, and oxygen levels in the discharged water may also change conditions within the receiving aquatic systems. Therefore, dewatering impacts could affect wetlands and ground and surface waters in the areas surrounding the JDWWTP.

Inherent Impacts

During construction, vehicular and human traffic will increase within the proposed site and in the surrounding areas. Construction equipment and human activity would generate increased noise levels in the immediate surrounding area of the construction site. Noise levels associated with construction may affect wildlife using habitats in the vicinity of the construction area. For

example, birds may not be able to hear each other singing, which may disrupt territorial behavior and male frogs and toads may alter their breeding calls and space themselves differently near the site. Generally, construction activities in the proximity of wetlands and other sensitive habitats can disrupt the movements of amphibians, birds, and fish, negatively affecting predator-prey relationships.

11.13.4.2 Potential Impacts during Operation

JDWWTP operational activities and their effects on wetland habitats are related to the long-term fragmentation of current habitat conditions. Wetland plant communities would be permanently lost. In addition, other impacts could include noise, lighting and human activities.

Habitat Loss or Fragmentation

Construction of the JDWWTP would result in loss of habitat, mostly wetland grasses, forested mangroves and upland grasses. This would result in loss of wetland habitat elements including cover, nest sites, foraging areas, and corridors for wildlife movement.

Direct losses of wetland area at the JDWWTP are expected to be approximately 36 hectares. However, as a result of the direct loss of wetlands, vegetated buffer area surrounding wetlands and the Juan Diaz River could result in diminished functions of buffers and of wetlands that include flood control, microclimate maintenance, provision of woody debris, water quality improvement, erosion control, and foraging, water source, and refuge for wetland-dependent wildlife species.

Increased Stormwater Runoff

Increased impervious surfaces at the site could increase stormwater flow volumes and water level fluctuations within adjacent wetlands. This could foster growth of invasive, non-native plants that flourish in disturbance regimes. Animal species that forage on nonnative plant species and can survive within fluctuating water conditions will reside in the wetlands, while those that cannot adapt to these conditions may be lost or relocate to less disturbed wetlands. Successful relocation depends on the wildlife carrying capacity of the adjacent wetlands.

However, these impacts are not anticipated to occur because the JDWWTP will be designed with stormwater management systems that would minimize impacts to receiving waters as discussed in Chapter 5.

Increased Noise, Lighting, and Human Activity

Operational activities from the proposed JDWWTP would contribute to increased noise levels. Operational noise is likely to reduce the numbers of noise sensitive animals that currently use and inhabit the site.

Emergency Overflows

Overflows would not occur at JDWWTP unless a catastrophic emergency conditions occurs where flows are diverted into the Juan Díaz River and ultimately to Panamá Bay. Potential

impacts to these water bodies are those associated with the temporary discharge of raw sewage and would result in increased concentrations of bacteria, nutrients, and toxicants.

Emergency overflows would be discharged directly to the Juan Diaz River and no direct impacts to terrestrial species is expected to occur, except if contaminants wash up onshore. Impacts to aquatic habitats may include temporarily lowering dissolved oxygen levels, which would temporarily affect fish and aquatic organisms. Some pollutants, such as heavy metals or those that do not break down in water, could be retained in sediments and may bioaccumulate in fish and other aquatic organisms, possibly having a long-term effect on their health and animals that forage on them.

11.13.5 Mitigation Measures

The overall approach to mitigation for potential wetland habitat impacts is to first avoid impacts to these areas to the extent possible, through careful site planning, design, construction techniques, and strict adherence to BMPs. If impacts do occur, then one the preferred mitigation measures that could be implemented include provisions for compensatory mitigation through the replacement of lost wetlands.

11.13.5.1 Mitigation Measures during Construction

Regulatory requirements pertaining to wetlands habitats will be strictly followed during the construction of the JDWWTP. Construction activities that would be regulated include temporary and permanent impacts on wetland and Juan Diaz River buffers, filling or excavation of wetlands and construction activities in and around wetlands. All mitigation measures required by the GOP for protecting wetlands, streams will be implemented. Construction activities in or near sensitive areas would require minimizing potential impacts and compensating for unavoidable impacts. Standard construction procedures will include identifying construction boundaries to avoid unnecessary encroachment into adjacent wetland areas, minimizing clearing of vegetation and strictly adhering to BMPs.

Contractors will prepare BMPs plan as a precondition for mobilization and start of the construction phase of the project. The BMPs plan will detail the procedures for implementing the dewatering activities, a hazardous spill prevention plan and the plan for restoring any areas temporarily impacted during the construction of the facility. In addition, the BMPs plan will include specific mitigation measures to meet current regulatory requirements of the GOP.

As part of the construction phase, revegetation of wetlands and buffer areas of the Juan Diaz River would be implemented so that it provides the same or greater functional value as the vegetation lost. Mitigation for wetland impacts will be implemented in accordance with Panamanian regulations.

11.13.5.2 Mitigation Measures during Operation

Careful planning and operation of the wastewater treatment plant will prevent emergency overflows of wastewater that may potentially affect water quality in the receiving bodies of water. Potential for accidental and incidental discharge of hazardous pollutants due to spills, such

as petroleum products, during operation of the plant is minimal. BMPs and adherence to a spill prevention plan would avoid accidental discharges. The impacts of increased impervious surface within the facility, would be offset by minimizing the building, parking, and roadway footprints, using permeable materials for roads and parking areas, collecting roof runoff and providing areas for reinfiltration, and by restoring and replanting the vegetation in areas not required for facilities.

11.13.5.3 Unavoidable Impacts

Siting, construction and operation of the JDWWTP at the proposed site would result in permanent loss of 36 hectares of wetland. These impacts are unavoidable because the site is located in a wetland area in which approximately 18 hectares would be filled for the construction of the treatment units and the remaining 18 hectares would be excavated for the construction of the sludge fill cells.

Due to the high quality of the wetland habitat to be lost, this is considered a significant, unavoidable adverse impact that cannot be fully mitigated. Restoring forested buffer habitat along the Juan Diaz River is expected to provide partial compensation for losses of wetland habitat. Other areas for wetland compensation would need to be identified and mitigated as part of the project.

11.14 Environmental Health

This chapter addresses the environmental health issues and impacts related to the proposed JDWWTP and VWWTP. The discussion focuses on those constituents potentially found in wastewater and sludge (also referred to as biosolids) that could present an environmental health risk. The discussion also includes information on chemicals and gases either used in or produced by the treatment process that could pose a potential health or safety risk. The potential risk of exposure to these constituents is discussed in the following section. It is important to note that one of the major purposes of constructing and operating wastewater treatment and conveyance facilities is to reduce potential environmental health impacts. Constructing and operating any large infrastructure project is not without risk.

11.14.1 Environmental Health Risks

The main purpose of the JDWWTP and VWWTP is to reduce overall environmental health risks associated with the discharge of raw sewage to bodies of water. However, environmental health risks related to wastewater treatment facilities include the storage of chemicals and potential harmful substances, discharge of chemicals in treated wastewater to fresh and marine environments, partially treated sewage discharge, emergency spills and potential leaks of hazardous substances including airborne releases, emergency overflows, biosolids management including onsite treatment, transport and application. The potential for exposure to these environmental health risk factors as a result of the JDWWTP and VWWTP are discussed in the following section.

11.14.2 Regulatory Framework

The regulatory framework for environmental health including regulations governing wastewater conveyance, treatment, and discharge, water quality in receiving waters, and application, safety at wastewater treatment facilities is within the jurisdiction of the "Direccion del Subsector de Agua Potable y Alcantarillado del Ministerio de Salud (MINSA)."

11.14.3 Impacts

11.14.3.1 Potential Impacts during Construction

Spills and Leaks

Spills of hazardous or toxic materials could occur during construction of the treatment plant. These materials could include petroleum products, solvents, lubricants, and other materials used for operating construction equipment. Construction environmental health impacts at the sites of the JDWWTP and VWWTP are related to potential exposure to spills or leaks during construction. Contaminants attached to soil particles could become airborne. The greatest risk of exposure to contaminants would be to construction workers at the site, associated with inhaling dust particles during construction.

There is minimal potential for the public to come in contact with spilled materials because the site will be fenced and spill containment will be provided for all active construction areas. Construction activities will not require use or storage of hazardous materials other than materials used for the operation of construction equipment.

11.14.3.2 Potential Impacts during Operation

Chemicals Stored and Used

Several chemicals would be stored and used at the JDWWTP and VWWTP, including substances classified as health hazards. Chlorine gas (Cl_2), sodium hydroxide (NaOH), and acid and chemical substances used for odor control are all classified as health hazards. A brief description of the harmful characteristics of chemicals commonly use in wastewater treatment facilities similar to the JDWWTP is presented in the following page. In addition, fuel and other petroleum hydrocarbons would be stored and used at the site. These chemicals have the potential to produce conditions hazardous to life or property.

Airborne Releases

Aerosols are microscopic airborne droplets that may be carried through the atmosphere. Aeration basins and other aerated process points in a wastewater treatment plant can serve as a source of aerosols. At wastewater treatment facilities, these aerosols may contain particulates, toxic chemicals, and viable microorganisms, some of which may be pathogenic to humans. In addition, volatile organic compounds (VOCs) are present in wastewater and are emitted at wastewater treatment plants. VOCs contribute to atmospheric photochemical reactions that may lead to the production of ozone. The VOC emissions from a facility may include chemicals that are not only photochemically reactive, but are also toxic chemicals. Wastewater treatment plant operators are the individuals that would receive the greatest exposure to airborne releases of toxic chemicals, and pathogens. The potential for the public to be exposed to aerosols is very low.

Polymers

Polymers are nonhazardous synthetic organic substances with an electrical charge that attract fine particles to form larger particles. Polymers can be in three forms: liquid, dry, and emulsion. Polymers are not flammable, combustible, corrosive, or reactive. They are, however, long chain molecules that contain acrylamide, which can be toxic. However, when used in wastewater applications the organic matter binds with the acrylamide and makes it unavailable.

Gaseous Chloride

Gaseous Chloride is the wastewater disinfectant most often employed because of its significantly lower cost; however, transportation of gaseous chloride does impose a certain risk of serious accidents and some facilities have switched to sodium hypochlorite in order to circumvent safety problems in densely populated areas.

Sodium Hydroxide

Sodium hydroxide (commonly known as caustic soda) is a highly reactive and corrosive liquid. It is used to manage pH in odor control facilities. It is nonflammable, but may cause fire and explosions when in contact with incompatible materials. It may cause burns to eyes or blindness, burns to skin or scarring, burns to the respiratory and digestive tracts, or death.

Spills, Leaks, or Other Releases

The JDWWTP and VWWTP will be designed in accordance with all applicable UFC requirements, which include spill containment requirements. Areas used for loading and unloading materials would include similar spill containment. Stormwater to be collected from some areas of the treatment plant where there is a risk of chemical or biosolids spills, such as loading areas, will include provision for its routing to the treatment plant to ensure that spills are contained and treated. The greatest potential exposure would be to treatment plant operators; the risk of hazardous or toxic materials being transported offsite is minimal. Emergency spill response procedures will be in place at all facilities, and employees will be trained to respond appropriately.

Emergency Overflows

The JDWWTP and VWWTP will be designed to prevent overflows and discharges of inadequately treated wastewater. However, during emergencies due to extreme storms, inflows exceed the capacity of the treatment plant or when multiple equipment and power failures occur, emergency releases would be possible.

Potential effects from emergency overflows include immediate, but short-term, public health impacts. An emergency overflow would have a temporary adverse impact on environmental health by increasing concentrations of bacteria, viruses, and toxicants in receiving waters. However, overflows would tend to occur during extreme storm events when in-water recreation is low, but people could come into contact with contaminated sediments or debris while walking along shoreline areas immediately following an overflow event. In such an occurrence, the MINSA should place signs in potentially affected shoreline areas notifying the public that it is unsafe to come in contact with water, sediments, or debris. The MINSA would also monitor

water quality to determine when water contact would be safe. These efforts should minimize public health risks.

Sludge Management at the JDWWTP

Sludge that would be produced at the JDWWTP would be undergo thickening, anaerobic digestion, stabilization, conditioning and dewatering. As such it would meet strict quality standards with regard to pathogen levels, putrescibility and biodegradability. In addition, stabilization will ensure a neutral pH and dewatering will increase solids concentration. Possible exposure pathways include:

- Accident during transport from the sludge conditioning building to the sludge landfill.
- Contact with biosolids at an sludge landfill cell during application.
- Release from an open sludge landfill cell due to high wind conditions.

Dewatered biosolids and grit will be transported from the treatment plant to the adjacent field application site in custom-designed dump trucks and The potential for the public to be exposed to biosolids and grit is low.

The potential for public contact with biosolids at the proposed sludge landfill is unlikely given the barriers to public access (gates and signs) that would be installed at the facility. It is similarly unlikely that the public could come into contact with biosolids at the treatment plant site or the biosolids transfer areas as neither of these two areas will be accessible to the public.

Risks from exposure to pathogens during sludge application is low due to the reduced level of pathogens expected in processed sludge. In fact the level of treatment that will be provided to the biosolids would permit selling or giving away sludge for use in lawns and home gardens.

Screenings and Grit Handling, Transport and Disposal

All screenings and grit would be handled, transported and disposed of in accordance with the procedures described for biosolids. There would be very low opportunity for the public to come in contact with screenings at the site because those areas have limited public access. Disposal occurs at the sludge landfill will be in accordance with all applicable requirements to protect public health.

Treated Effluent Discharge

The potential human health risks associated with treated effluents are generally directly or indirectly related to three categories of contaminants: (1) bacteria, viruses, and other pathogens; (2) nutrients; and (3) metals and organic chemicals. Overall, potential environmental health risks associated with discharge of treated effluent are substantially lower than those associated with the current discharge of untreated or partially treated wastewater, and represent a very low risk to human health. However, if direct human contact with the constituents in treated wastewater

could occur there would be potential health hazards. People could be exposed to bacteria, viruses, and other pathogens in treated effluent while swimming or wading, through contact with or ingestion of receiving water, or through other activities such as windsailing or SCUBA diving.

11.14.4 Mitigation Measures

11.14.4.1 Mitigation Measures during Construction

Treatment plant, conveyance, and outfall facilities will be designed and constructed in accordance with stringent health and safety requirements. Contractors will be required compliance with strict BMP measures to avoid environmental health related impacts during the construction phase of the project. Among these measures, the construction site will include spill containment provisions to prevent offsite transport of spilled materials, but construction workers could potentially come in contact with the spilled fuel or hydraulic fluid. Construction workers will have available safety and cleanup equipment, including absorbents and other materials to deal with all the potential types of spilled materials. Health risks are no greater than at any other large construction projects in the Republic of Panamá.

11.14.4.2 Mitigation Measures during Operation

Chemicals Stored and Used

The volume of corrosive liquids to be stored and used at the treatment plants would likely require compliance with the provision of a permit. Permit requirements include, at a minimum, spill control, secondary containment, ventilation, and fire extinguisher systems. JDWWTP and VWWTP designs would incorporate all applicable requirements, thus reducing the potential environmental risk to levels considered acceptable by the Panamanian regulations.

Spills, Leaks, or Other Releases

Spill prevention and containment, including emergency spill response procedures, will be developed for the JDWWTP and VWWTP in accordance with current standard practice to prevent stormwater pollution. BMPs will be carried out at all times during the life of the project. As part of the BMPs, the stormwater collection system within the treatment plant will be designed to capture spills and route them to the treatment plant headwork instead of the Rio Juan Diaz or Panamá Bay.

The entire treatment system will be designed to meet strict US operational standards, which will minimize the potential for hazardous gas buildup. In addition, the treatment facilities will be regularly monitored for potentially harmful gases. As a standard procedure, any potentially hazardous gas buildups will be reduced by introduction of oxygen or other chemicals, and steps immediately taken to reduce future buildup of these substances.

Liquids processing areas where aerosols are generated, such as headworks and grit chambers, will be covered and contained, and air treated prior to discharge. Aerosols and other potential airborne contaminants, including VOCs, would be captured and treated as part of the onsite air and odor treatment system. All air emissions from the site will be in compliance with air quality standards.

Emergency Overflows

Several management strategies to reduce the occurrence of emergency overflows will be devised by the JDWWTP and VWWTP, these may include the following:

1. Using emergency generators to keep pump stations and wastewater treatment system operational during emergencies.

2. Wastewater controlled storage in the influent conveyance system.

3. Provide primary treatment and divert partially treated wastewater through the outfall system to Panamá Bay.

An overflow event cleanup plan will be part of the JDWWTP and VWWTP plan of operation and following an overflow event, the treatment plants operator will carry out the required cleanup measures and related procedures. As part of the cleanup measures, the operator would coordinate with MINSA to install temporary warning signs or provide other methods of notification in affected shoreline areas. Cleanup procedures after an emergency overflow event would include water quality monitoring in the receiving body of water and debris removal if necessary.

Screenings, Grit and Sludge Management

Screening, grit and sludge management will be done in accordance with strict health and hygiene occupational standard practice to reduce the potential for exposure to pathogen and contaminating matter. The entire operation including transport and disposal will be covered in the facility's plan of operation and as such will be subject to permitting and scrutiny from the GOP prior to its implementation.

Staff Training and Sludge Safety and Emergency Procedures – An Operations Manual will outline the following procedures to follow at JWWTP.

Chapter 1 First Aid and General Safety Rules

General safety rules
Safe driving rules

Chapter 2 What to Do in Case of a Spill

Definition of minor and major spills
What to do
Containment of the spilled material.
Incident or Spill Report.

Chapter 3 Responsibilities During a Spill

Biosolids Transportation Coordinator
Landfill Coordinator
Water Quality Coordinator
Facility Manager

Chapter 4 Responding to Incidents Other than Spills

Chapter 5 Following Up After a Spill or Incident

Chapter 6 Incident Debriefing

Treated Effluent Discharge

The JDWWTP and VWWTP would use proven state-of-the-art technology to achieve a high level of treatment efficiency and its effluent will meet or exceed all MINSA and ANAM water quality standards and related applicable requirements.

These standards and requirements are designed to protect human health and the environment. Implementation of the JDWWTP and VWWTP will be a long-term measure to protect environmental health in the Panamá Bay. Effluent discharged from the treatment plant will be monitored as required by JDWWTP and VWWTP permits of operation, which will require compliance with all applicable water quality standards. JDWWTP and VWWTP discharges of treated effluent to Panamá Bay and the Pacific Ocean will pose no significant health risk to public health.

To ensure that the JDWWTP and VWWTP operate as designed and that the effluent discharged to Panamá Bay meets all applicable requirements, the operator will carry out periodic marine water and sediment quality monitoring programs through the life of the facility. It is also anticipated that MINSA and ANAM will conduct periodic inspections and water quality monitoring of the outfalls to verify that the JDWWTP and VWWTP are operating correctly. In addition, the operator will respond to any new scientific information emerging from ongoing or future scientific research programs with regard to improving the quality of secondary treated effluents an their influence on environmental health factors at the receiving body of water.

11.14.5 Unavoidable Impacts

Potential unavoidable impacts include the risk of emergency overflows and accompanying short-term environmental health risks associated with the discharge of raw or partially treated wastewater to the Juan Diaz River or Panamá Bay. Although, every effort will be taken to avoid emergency overflows, their incidence has the potential to occur. Consequently, short-term impacts may be unavoidable under rare cases of severe storms or unpredictable environmental emergencies. Such impacts should be short-term impacts that may only have a localized effect in the area of the outfall.

11.15 Noise and Vibration

This chapter addresses the affected environment, impacts to the environment, mitigation measures, and significant unavoidable adverse impacts related to noise and vibration for the JDWWTP and VWWTP.

11.15.1 Environmental Setting

11.15.1.1 Noise

The decibel (dB) scale is used to describe sound intensity. Because the human ear is not equally sensitive to all sound frequencies, instruments for measuring sound levels are designed to respond to or ignore certain frequencies. The frequency weighting most often used is A-weighting, because it corresponds closely to human perception of loudness. Measurements from instruments using this system are reported in units of "A-weighted decibels," or dBA. All noise levels described in this document are in dBA.

The following information is provided as an introductory background reference with regard to noise levels. Normal conversation ranges between 55 and 65 dBA when the speakers are 1 to 2 meters apart. Quiet urban night-time noise dBAs range in the low 40s; noise levels during the day in a noisy urban area are frequently as high as 80 dBA. Noise levels above 110 dBA become intolerable and can result in hearing loss.

Some land uses and activities are more sensitive to noise than others. Hospitals, schools, churches, residential areas are typical examples of noise-sensitive uses, also referred to as "sensitive receptors." Commercial activities are generally less sensitive to noise, while industrial areas are often sources of noise. For this reason, most noise regulations include a variety of permissible noise levels that are based on the land use or zoning of both the location where the noise is produced and the location at which it is heard. .

Table 11-4 shows typical noise standards.

Table 11-4
Typical Noise Standards (dBA)

Receiving →	Residential[1]	Commercial	Industrial
Source ↓			
Residential	55	57	60
Commercial	57	60	65
Industrial	60	65	70

[1]*:Between the hours of 10:00 p.m. and 7:00 a.m. the noise limitations shall be reduced by 10dBA for residential receiving properties.*

Source: Washington State Department of Ecology Regulations, WAC 173-60-040

11.15.1.2 Vibration

Vibration consists of rapidly ground fluctuating motions with an average motion of zero. Vibration is caused by events or activities such as earthquakes, vehicles traveling on highways and railroads, and the operation of construction equipment and machinery. Vibration is generally described in terms of the instantaneous speed of the ground movement. Because the net average of a vibration signal is zero, the average of the squared amplitude of the signal (root mean square, RMS) amplitude is used to describe the vibration amplitude. Decibel notation is commonly used for vibration. The abbreviation "VdB" is used in this document to avoid

confusion with sound decibels. Table 11-5 provides typical levels of human perception to ground-borne vibration. The human threshold of perception for vibration is approximately 65 VdB.

Table 11-5 Human Response to Different Levels of Ground-Borne Vibration[1]

RMS Vibration Velocity Level, VdB	Human Response	Typical Source
52		Typical background vibration
65	Approximately threshold perception for humans.	
75	Approximate dividing line between barely perceptible and distinctly perceptible.	
85	Vibration acceptable only if there are an infrequent number of events a day.	
93	Difficulty with tasks such as reading.	Bulldozer or other heavy equipment at a 15 meters distance.
100	Minor cosmetic damage to fragile buildings	Blasting from construction projects at 15 meters distance.

[1]: *Adapted from U.S. Department of Transportation, Federal Railroad Administration, Office of Railroad Development, December 1998, "High-Speed Ground Transportation Noise and Vibration Impact Assessment."*

11.15.2 Existing Noise and Vibration Sources

JDWWTP

Background noise levels in the vicinity of the site proposed for the JDWWTP are the direct result of its proximity to the Corredor Sur, one of the major roadways in Panamá City. Actual noise level information is not available at the location of the proposed facility; however, based on noise studies consulted for this report, noise level at approximately 60 meters from major roadways sources generally ranges between 50 and 80 decibels (dBA) depending upon the time of the day and day of the week.

The noise levels near residences on the north side of the Corredor Sur are also likely dominated by traffic noise. These residences are likely exposed to noise levels higher than the 60 dBA maximum permissible daytime noise levels for residential properties. It is highly possible that the 50 dBA nighttime maximum permissible level for residential areas is also frequently exceeded.

The Corredor Sur will be a source of vibration in the vicinity of the proposed site; however, there is no background information with regard to current vibration impacts.

VWWTP

The main Veracruz road that runs adjacent to the site is the main source of background noise. Actual noise level information is not available at the location of the proposed facility; however,

based on noise studies consulted for this report, noise level at approximately 60 meters from major roadways sources generally ranges between 50 and 80 decibels (dBA) depending upon the time of the day and day of the week.

The noise levels at the health center on the east side of the site is likely dominated by traffic noise. User of the health center would be exposed to noise levels higher than the 60 dBA maximum permissible daytime noise levels for residential properties during hours of heavy traffic. It is possible that the 50 dBA nighttime maximum permissible level for residential areas is also exceeded.

The main Veracruz road would be a source of vibration in the vicinity of the proposed site; however, there is no background information with regard to current vibration impacts.

11.15.3 Impacts

A research to investigate the level of noise and vibration expected from the construction and operation of a wastewater facility similar to the JDWWTP and VWWTP was undertaken to assess potential impacts expected from the project. Potential noise and vibration impacts were assessed based on the type of construction equipment expected at the site, and noise and vibration that could occur during the project operation. All impacts were assessed at the property line of the facility.

11.15.4 Potential Noise and Vibration Impacts during Construction

The expected maximum noise and vibration levels during construction would occur while operating pile drivers, the estimated noise level at 15 meters from this type of equipment is 100 dBA. These maximum noise levels would de reduced by approximately 7 dBA for each doubling of the distance between the noise source and the receptor. Thus, at 580 meters from the source, receptors would perceive approximately 65 dBA. Truck traffic during construction would also have the potential to cause increased noise level at residential receptors north of the Corredor Sur.

Vibration would also occur as a result of the operation of heavy equipment. Blasting activities during construction would generate approximately 100 VdB at the property line. Developing accurate estimates of ground-borne vibration at receptor locations is complicated by the many factors that can influence vibration levels at receiver position. Soil conditions are known to have a strong influence on the propagation of vibration. For example, vibration propagation is more efficient in clay soils. Several sources of information with regard to vibration propagation show that a source generating 90 VdB can be reduced to approximately 55 VdB within a 100 meters distance.

11.15.5 Potential Noise and Vibration Impacts during Operation

Our investigation at existing wastewater treatment plants indicates that maximum noise levels generated at these type of facilities do not exceed 60 dBA. Noise is generally exceeded by background noise sources such as traffic.

Operational vibration sources from wastewater treatment facilities can occur from mechanical equipment. The types of mechanical equipment that will be used during operation of the JDWWTP are not expected to be capable of generating vibration levels above 75 VdB, at this level vibration would be barely perceptible to residential receivers immediately adjacent to the site.

11.15.6 Mitigation Measures

11.15.6.1 Mitigation Measures during Construction Phase

Typical mitigation measures to reduce noise impacts during construction are related to compliance with standard requirements to keep all construction equipment with well maintained mufflers. At the same time, noisy portable equipment, such as generators or compressors, would be located as far away from sensitive receptors as practical and muffled within enclosures. As standard practice construction haul routes would be designated to minimize impacts on sensitive residential receptors.

In addition, noise barriers such as fencing, sound-limiting walls, and berms would be used if deemed necessary.

11.15.6.2 Mitigation Measures during Operation

The JDWWTP and VWWTP will be designed to operate at noise levels at or below the most stringent nighttime noise levels required by the GOP. As part of the design, ventilation air intakes, fans and blowers and exhausts of equipment rooms would be placed in a direction facing away from the north to avoid sensitive receivers located north of the Corredor Sur. Influent pump station and ventilation systems design would include attenuation of fan noise and pump and motor noise, as needed, to meet all applicable noise ordinances of the GOP.

11.15.7 Unavoidable Impacts

Construction activities at the site of the JDWWTP and VWWTP would cause unavoidable temporary increases in noise levels near the sites and along local haul routes. In some cases, these impacts may be locally significant, particularly during peak construction periods.

11.16 Land and Shoreline Use

This section describes current land and shoreline use in the project area, potential impacts associated with the siting of the JDWWTP, mitigation measures and unavoidable impacts.

11.16.1 Environmental Setting

JDWWTP

Siting of the JDWWTP is the result of a wastewater master planning for the Panamá City area that started in the late 1950s. The most recent master plan is dated November 1998 and was conducted by CESOC, a consortium led by Encibra, S.A. The results of the master plan prepared by CESOC have been further refined and summarized in the Consolidated Master Plan Supplement (CMP) of July 2002 prepared by the Coordinating Unit (CU) for the Sanitation of Panamá City and Panamá Bay, a project executing unit created by MINSA.

The CMP serves as the basis for loan requests to multilateral funding institutions for the implementation of the projects derived from the CESOC master plan. Although, several complementary studies have been found necessary to update the CESOC and meet current wastewater standards, the conceptual framework with regard to the location of the planned treatment facilities has remain as proposed in the CESOC report.

According to the CMP, demographic expansion in Panamá City is mostly to the east of the Panamá Canal due to land use restrictions imposed by the former Canal Zone. The peripheral area of the city has developed in a non-planned manner, in which residential land use mixes with commercial and industrial land uses. The planning area considered by the CESOC master plan included the entire urban and suburban zones of the Panamá City metropolitan area. The planning area was subdivided in three service areas: Juan Diaz, Panamá Canal Authority (PCA) and Veracruz. The PCA is implementing its own master plan and urban and suburban areas within its jurisdiction will not be included in the Sanitation of Panamá City and Panamá Bay project. The Juan Diaz service area cover approximately 20,931 hectares in the east side of the Panamá Canal and the Veracruz service area totals 1,408 hectares west of the Panamá Canal. The CESOC master plan recommended a wastewater treatment facility in the Juan Diaz service area. Subsequent CMP places the Juan Diaz treatment facility near the mouth of the Rio Juan Diaz.

In Panamá, the Ministerio de la Vivienda regulates land use. According to the "Plan de Desarrollo Urbano de las Áreas Metropolitanas de Pacifico y del Atlantico (1997)" low density residential areas predominate in the Panamá City Metropolitan area. Until now Betania, San Francisco y Bella Vista are the only medium to high density neighborhoods. The location recommended by the CU for the JDWWTP is located in an area characterized by open space. The closest populated areas are the Costa del Este, Urbanización, El Trebol, Villa Esperanza y el Porvenir. These are approximately 1 kilometer to the north and northeast of the proposed site. There are several industrial outfits along the shoreline and approximately 1.2 kilometers from the proposed site.

The shoreline use south of the proposed treatment plant site and in the area of the likely location of the outfall is characterized by a semi-intensive industrial use.

According to ANAM, the long-term water quality objectives for Panamá Bay are the creation of an aquatic environment that fosters the socioeconomic benefits of improved community health, promotes tourism and encourage investment. Specifically water quality in Panamá Bay should support fish and shellfish harvesting for human consumption, swimming and water sports including SCUBA diving, all forms of related tourism and the conservation of marine life.

In order to meet the water quality objectives established for Panamá Bay, the GOP has determined that municipal wastewater discharged to Panamá Bay should meet, as a minimum, secondary treatment standards.

11.16.2 Impacts

JDWWTP

Land use impacts directly related to the JDWWTP treatment plant construction would involve the conversion of approximately 36 hectares from open space and wetland land use to a public facility use. Although the proposed site has historically been occupied by wetlands, in the long-run the land at the site and surrounding areas would probably end up providing space for residential expansion to meet future housing demand. This is reflected by the recent and ongoing land developments a few kilometers from the site and along the Corredor Sur. Indeed, conversion of the site to a public facility use would result in a loss of wetland and also the loss of potential economic opportunities and housing capacity that could be accommodated at the site through mixed use development.

The primary impacts related to the siting of the JDWWTP at the proposed location is derived from its land use incompatibility with the current wetland environment. In addition, the operation of the JDWWTP may preclude or limit the extent of other planned uses north of the site and could influence how surrounding lands develop in the future.

No significant long-term land use impacts are anticipated at the location of the outfall. However, the land use of shoreline areas adjacent to the outfall zones will be limited and should not include recreational and residential uses.

VWWTP

Land use impacts directly related to the VWWTP treatment plant construction would involve the conversion of approximately 3.5 hectares from open space and wetland land use to a public facility use. In the long-run the land at the site and surrounding areas would probably end up providing space for residential expansion to meet future housing demand. This is reflected by the recent and ongoing land developments a few kilometers around the site. In fact, our preliminary appraisal indicates that residential homes would be built adjacent to the west boundary of the site in the near future. The site also offers potential for the development of a recreational area and beach waterfront. Therefore, conversion of the site to a public facility use would result in a loss of wetland and also the loss of potential economic opportunities related to housing and recreational use development.

The primary impacts related to the siting of the VWWTP at the proposed location is derived from its land use incompatibility with the current wetland environment. In addition, the operation of the VWWTP may preclude or limit the extent of other planned uses adjacent to the site and could influence how surrounding lands develop in the future.

No significant long-term land use impacts are anticipated at the location of the outfall. However, the land use of shoreline areas adjacent to the outfall zones will be limited and should not include recreational uses.

11.16.3 Mitigation Measures

The JDWWTP and VWWTP would be subject to strict site development standards. These are aimed at mitigating the impacts of such facilities. It is assumed that close coordination between MINSA and the facility's developer would result in a facility that is designed to meet all GOP requirements and minimize potential land use impacts.

The requirements to be established for the JDWWTP and VWWTP will include the minimum landscaped setback and size of the buffer areas, height of the buildings, size of the total lot, traffic sign and access facilities to avoid and mitigate impacts to current users of the existing roads, and screening and fencing. The VWWTP development plan will include a public park and recreational area between the wastewater facility and the shoreline.

Structures in the outfall area will be clearly marked and fenced to ensure that the public does not enter areas that may be hazardous. Temporary and permanent access routes will be developed to minimize disruption to current access roads. BMPs will be used for the operation of the outfall to protect the health of adjacent residential neighborhoods and recreational uses of the shoreline.

11.16.4 Unavoidable Impacts

JDWWTP

Development of the JDWWTP and the VWWTP at the site would displace existing onsite uses and would preclude the development of other uses at the site.

11.17 Aesthetics

This chapter addresses the affected environment, impacts to the environment, mitigation measures, and significant unavoidable adverse impacts related to the Aesthetics for the proposed JDWWTP System.

11.17.1 Environmental Setting

JDWWTP

This section describes existing aesthetic conditions, focusing on the visual quality of the proposed JDWWTP. Aesthetics standards and related visual settings establish building and structure height-mass relationships, building setbacks from property line and landscape screening. Aesthetic standards for wastewater facilities require compliance with guidelines primarily derived from the visual sensory standpoint and from design principles based on the technical function of the facility.

The site proposed for the JDWWTP is characterized by wetland and vegetation associated with forested mangroves. The Corredor Sur express roadway is seen immediately to the north of the site. Residential neighborhoods to the north of the Corredor Sur express roadway are blocked from view. The forested mangrove is seen immediately to the south and west. A low density industrial area bounds the forested mangrove on the south. The view from the site of the JDWWTP to the low density industrial area is blocked by forested mangrove trees. The site of the JDWWTP is visible from the Corredor Sur. There are not visual landmarks in the vicinity of

the proposed site vicinity. The site itself would become a major landmark due to its likely visibility in a wide wetland area.

The proposed outfall is located at the shoreline of Panamá Bay in an area dominated by wooded mangrove areas and low height bluffs that rise above the beach. An industrial land use dominates visual features adjacent to the outfall zone. There are no public beaches within view of the outfall area.

VWWTP

The site proposed for the VWWTP is characterized by low to medium quality wetland along the shoreline of the Pacific Ocean. The main Veracruz road is seen immediately to the north of the site. A health center and public cemetery are seen to the west. A low quality wetlands is seen to the east. The view of the Pacific Ocean is the main scenic view from the site. The site of the VWWTP is visible from the all four sides. The health center and cemetery are visual landmarks in the vicinity of the proposed site vicinity. The site itself would become a major landmark due to its likely visibility in a wide vacant area.

11.17.2 Potential Aesthetic Impacts during Construction

JDWWTP

The removal of existing vegetation from the site would generate temporary views of a denuded wetland area visible from the Corredor Sur. The grading of the site and other construction activity including construction equipment such as construction cranes and framing would be visible from the Corredor Sur. Therefore, there would be some short-term aesthetic impacts associated with construction activity.

Installation of the outfall pipelines may result in some visible sediment plumes near the shoreline, but the aesthetic impact would be temporary. The outfall pipes would be buried beneath the ground surface and would not be visible from the shoreline or the surface of Panamá Bay.

VWWTP

The grading of the site and other construction activity including construction equipment such as construction cranes and framing would be visible from the main Veracruz road and from the health center and cemetery. Therefore, there would be some short-term aesthetic impacts associated with construction activity.

Installation of the outfall pipelines may result in some visible sediment plumes near the shoreline, but the aesthetic impact would be temporary. The outfall pipes would be buried beneath the ground surface and would not be visible from the shoreline.

11.17.3 Potential Aesthetic Impacts during Operation

JDWWTP

The JDWWTP would be fully consistent with the aesthetic and visual compatibility generally acceptable for wastewater treatment facilities. Nevertheless, the height of process structures may rise over the horizon and could become visible from residential areas north of the Corredor Sur.

The principal aesthetic impact associated with the JDWWTP is the potential height of the structures required to house the 102-mgd wastewater processing units. The JDWWTP would be seen as large industrial building complex and industrial tank farm to user of the Corredor Sur express way and to distant viewers north of the Corredor Sur.

The collective aesthetic effect of the treatment plant would be the focus of the visual attention in an area characterized by open wetlands. The JDWWTP would become a major visual landmark.

There would be no long-term aesthetic impacts associated with the operation of the outfall. However, a distinctive plume would be visible during overflows and other emergency discharges.

VWWTP

The VWWTP would be fully consistent with the aesthetic and visual compatibility generally acceptable for wastewater treatment facilities. Nevertheless, the height of process structures may rise over the horizon and could become visible from the health center, cemetery and surrounding residential homes.

The principal aesthetic impact associated with the VWWTP is the potential height of the structures. The VWWTP would be seen as large industrial building complex to user of the main Veracruz road and viewers from the health center, cemetery and surrounding residential homes.

The collective aesthetic effect of the treatment plant would be the focus of the visual attention in an area characterized by open wetlands. The VWWTP would become a major visual landmark.

There would be no long-term aesthetic impacts associated with the operation of the outfall. However, a distinctive plume would be visible during overflows and other emergency discharges.

11.17.4 Mitigation Measures

The mitigation measures to address the aesthetic impacts identified in the previous section are mostly "design mitigation measures." These provide decision makers different approaches to address visual impacts related to the siting and design of the treatment plant. No aesthetic impact mitigation measures are considered necessary for the outfall site.

Design mitigation measures are developed through a multi-step process, that includes responding to the site analysis, impact and design guideline findings of the JDWWTP and VWWTP, as such a detail discussion of design mitigation measures is beyond the scope of this document. Design

mitigation measures generally involve the analysis of ways to hide the treatment plants from view through camouflaging or the screening elements. Screening elements are already contemplated in the engineering drawings prepared for the JDWWTP and VWWTP.

A small park with resident access will be constructed along the shoreline of the site of the VWWTP. Several covered outdoor shelters will be installed for public use to increase friendliness and public comfort.

11.17.5 Unavoidable Impacts

Short-term unavoidable adverse aesthetic impacts associated with construction activities would occur throughout the construction phase. These impacts would be temporary and would end when construction of the project has been completed. Due to its visual prominence, the JDWWTP and VWWTP would be exposed to view from the throughout all stages of its construction.

Long-term unavoidable adverse aesthetic impacts are present for the JDWWTP and the VWWTP. Although facility and site design would be directed at achieving consistency with applicable local regulations, policies, and codes and minimizing impacts to the greatest extent possible, there would be a significant and permanent change to the look and character of a prominent seasoned wetland environment.

11.18 Cultural Resources and Recreation

This chapter addresses the affected environment, impacts to the environment, mitigation measures, and significant unavoidable adverse impacts related to cultural resources and recreation for the proposed JDWWTP and VWWTP.

11.18.1 Environmental Setting

JDWWTP

The project area is not known to be part of aboriginal territories. The site is not part of a known cultural resources area that may include archaeological sites, other areas with a high probability for archaeological resources. The site does not have historic buildings and structures designated by national and local agencies. Our inspection of the area proposed for the JDWWTP did not reveal any existing recreation resources.

Nevertheless, construction activities associated with treatment plant and outfall facilities have the potential to disturb or destroy cultural resources including hunter-fisher-gatherer archaeological resources and historic period archaeological resources. Construction and/or operation of wastewater facilities could affect planned recreational facilities or related activities. Therefore, the project contractor should be required to perform a cultural resources assessment for the JDWWTP. In addition, information about any planned recreational facilities and activities in the vicinity of the treatment plant and outfall sites and along the discharge conveyance corridor should be gathered and assessed.

VWWTP

The project area is not known to be part of aboriginal territories. The site is not part of a known cultural resources area that may include archaeological sites or other areas with a high probability for archaeological resources. The site does not have historic buildings and structures designated by national and local agencies. A preliminary inspection of the area proposed for the VWWTP revealed an existing potential for development of recreation resources in its general vicinity. Since construction and/or operation of wastewater facilities could affect planned recreational facilities or related activities, the project contractor should be required to perform a cultural resources assessment for the VWWTP.

11.18.2 Impacts

11.18.2.1 Potential Impacts on Cultural Resources

Construction projects of magnitude such as the one proposed may affect unrecorded archaeological sites that may be significant. Direct and indirect impacts to archaeological deposits could include changes to the condition or location of archaeological materials, such as removal or disturbance of archaeological materials during construction excavation, or changes in the condition of archaeological deposits due to compaction from placement of fill, construction spoils, roadways, or buildings. Effects could also include modification or destruction of archaeological deposits during geotechnical sampling operations, dewatering operations, and subsurface construction excavation.

Because the absence of specific data may be due to the lack of a survey by an archaeologist, archeologists should investigate the probability for significant findings of archaeological materials within the area identified for the treatment plant sites.

11.18.2.2 Potential Impacts on Recreation Resources

Although no public recreational facilities are currently located in the area and vicinity of the proposed wastewater treatment plant sites. There are parcels held by a number of private land owners that include industrial and commercial land uses along the shoreline. Accordingly, there are potential recreational opportunities in the general vicinity of the proposed wastewater facility and outfall sites. These include passive recreational opportunities in the form of bird watching and wildlife observation along the extensive forested mangrove area south of the site proposed for the wastewater treatment plant. In addition, the shoreline area has the potential for developing recreational amenities such as a public saltwater fishing pier. These facilities could also serve sports fishing needs.

11.18.3 Mitigation Measures

11.18.3.1 Mitigation Measures with regard to Cultural Resources

Field reconnaissance will be conducted by an archaeologist in wetland areas on the sites prior to development of the project. In addition, because of the current lack of a survey by an archaeologist, or because deposits occur below the ground surface at depths that cannot be exposed using standard archaeological techniques, a archeologist will be at hand throughout the construction phase to identify previously unknown archaeological materials that may be significant and could be encountered during construction excavation. Construction activities

would be stopped to allow archaeologists the opportunity to evaluate the significance of any archeological findings and related deposits. If an identified archaeological site has integrity and is probably significant, then the archaeological site would be formally evaluated in consultation with the GOP.

11.18.3.2 Mitigation Measures with Regard to Recreational Resources

Recreational resources within the area that could be affected by the JDWWTP and VWWTP projects are managed by the GOP as well as by private non-profit and for-profit organizations. As part of the project development, there will be a comprehensive review of current plans by the government and private developers with regard to the development of public amenities and recreational facilities in the vicinity of the site. The framework for the development and management of the JDWWTP and VWWTP will be adjusted to meet the requirements of any recreational services and facilities planned for the area.

11.18.4 Unavoidable Impacts

11.18.4.1 Unavoidable Impacts on Cultural Resources

There are not archaeologists identified areas with a high probability for archaeological resources on the identified treatment plant sites based on the preliminary environmental data used for this report. However, there is need for a cultural resources assessment to determine the probability for archaeological resources and to obtain information on subsurface stratigraphy at the site.

Measures identified to mitigate adverse affects to significant cultural resources at treatment plant and outfall sites include developing an archaeological treatment and monitoring plan to address inadvertent discovery of significant archaeological resources. Development of the referred plan will require consultation with the GOP and affected or concerned private organizations and institutions.

11.18.4.2 Unavoidable Impacts on Recreation Resources

JDWWTP

Indirect impacts would likely occur over the course of construction at both treatment plant and outfall sites. Although, traffic access to nearby open space could be rerouted during site preparation there will be indirect impacts related to wildlife disturbance that would likely be intermittent over the course of construction phase.

As a result of the construction activities, the general vicinity would be subject to increased noise and dust and passive recreation could be temporarily disrupted during peak construction periods. Bird watching would likely be reduced because of construction noise. Elevated noise levels in general would likely deter passive recreation users during peak construction periods.

There are no anticipated long-term impacts to recreation resulting from the operation of JDWWTP. The JDWWTP will incorporate state-of-the-art odor and noise control; therefore, odors and noise that could indirectly affect adjacent recreational activities are not anticipated.

VWWTP

Direct impacts would likely occur over the course of construction at both treatment plant and outfall sites. Traffic access to the health center, cemetery and the town of Veracruz and its environment west of the proposed site would likely experience delay during the course of the construction phase. Construction activities would like have indirect impacts on wildlife as well. The type of disturbance would likely be intermittent over the course of construction phase.

As a result of the construction activities, the general vicinity would be subject to increased noise and dust and passive recreation could be temporarily disrupted during peak construction periods. Bird watching would likely be reduced because of construction noise. Elevated noise levels in general would likely deter passive recreation users during peak construction periods.

There are no anticipated long-term impacts to recreation resulting from the operation of VWWTP. The VWWTP will incorporate state-of-the-art odor and noise control; therefore, odors and noise that could indirectly affect adjacent recreational activities are not anticipated.

11.19 Public Services and Utilities

This section addresses public services and utilities related to the proposed JDWWTP and VWWTP. Public services required by the JDWWTP and VWWTP include fire protection, emergency medical services, law enforcement, solid waste, water, electricity, and communications.

11.19.1 Environmental Setting

Several public services and utilities provide services within the project area of the JDWWTP and VWWTP. Most of the distribution components of utility systems are located offsite and but in the vicinity of the sites.

- Fire Protection
- Emergency Medical Services
- Law Enforcement
- Solid Waste Services
- Water
- Electricity
- Communications

11.19.2 Impacts

11.19.2.1 Potential Public Service Impacts during Construction

Impacts to public services are generally caused by construction-related disruption of local roadways used by public and emergency service vehicles or temporary disruption of utility service.

No significant impact to public services is expected from construction activities; however, delays may occur on occasion. Traffic associated with treatment plant construction would utilize local roadways and could cause minor delays due to road closures or detours. The response time for

provision of public services during construction periods could temporarily increase. Increased traffic volumes could affect law enforcement, fire, and emergency service response times and result in delays for those trying to access nearby schools. Additional services that could be affected by such delays include hospitals, educational facilities, post offices, libraries, community and social service centers, government offices, and solid waste transport services.

11.19.2.2 Potential Public Service Impacts during Operation

No significant impacts to public services are expected from the long-term operation of the wastewater facilities. Development of the treatment plants may result in the need for emergency response to the site and routine inspections by the fire department; however, it is not expected to result in a significant increased demand for service. The average fire flow for a 1-hour period would be approximately 2,000-2,500 gpm of water. A portion of these flows can be provided from reclaimed water produced at the treatment plants.

Impacts to utility services would include an increased demand for power. Wastewater generated from each site will be routed directly to the headworks of the respective plant.

Traffic associated with the treatment plant is not expected to significantly impact emergency vehicle passage or response times or access to nearby schools.

No impacts to the public communication service is anticipated, as there several communication service providers with the capacity to provide the site with the required service.

11.19.3 Mitigation Measures

Construction impacts to utilities typically relate to the need to relocate a utility or temporarily disrupt utility service. Construction impacts would also include the extension of electrical service to the site. During the project design phase, utility purveyors would be contacted and utility location information would be requested in an attempt to avoid utility conflicts, where possible.

Impacts from these activities could include traffic delays, noise and dust. To minimize impacts, BMPs would be used to limit dust and noise impacts during construction.

All construction traffic routing would be coordinated with local emergency service providers, schools, and utilities to minimize potential impacts resulting from construction traffic to the public service sector, including nearby schools, libraries, post offices, and police and fire stations.

11.19.4 Unavoidable Impacts

Significant unavoidable adverse impacts to public services or utilities are not anticipated because of construction or operation of the treatment plants, or outfall zones. Temporary impacts related to traffic associated with construction and facility operation would not pose a significant adverse impact since detour routes would be provided during construction. BMPs will be implemented to control impacts such as dust, noise, and odors resulting from construction activities.