WATER SYSTEM SUMMARY

Introduction

This chapter presents an overview of Volume 2 Water System. There are nine chapters in the Volume providing an overview of the pumping, treatment, and distribution system facilities – both existing and planned.

A brief synopsis of each chapter is presented. Specific conclusions, recommendations, and Capital Improvement Program (CIP) impacts are presented at the end of each of the respective chapters as appropriate.

The Guam Waterworks Authority (GWA) distribution system is a collection of legacy systems beginning with the first Navy installations prior to the Second World War, some changes during the Japanese invasion, and further installations after Guam's liberation, during and after the war. The constructed distribution systems were turned over to the Government of Guam to operate for the civilian population.

GWA operates and maintains over 200 water facilities on the island in addition to over 380 miles of distribution system lines. The facility types can generally be classified as:

- Wells
- Springs
- Reservoirs
- Booster Stations
- Treatment Plants

Chapter 1 – Water System Description

Chapter 1 presents an overview of the system. GWA's water utility is comprised of three public water systems. The Northern and Central Public Water Systems are designated "Large" and the Southern Public Water System is designated "Small". These are "distribution" system classifications established by Guam Environmental Protection Agency (GEPA) and are based on the population served.

Transmission and distribution are combined into a common network for GWA's system. Water supply sources feed the same pipes to which service connections are made. The installed system provides severe challenges to GWA in attempting to meet the Safe Drinking Water Act (SDWA) disinfection requirements because some of the customer connections are adjacent to the wells, or close to the disinfection point. This shortcoming is one of the high priority CIP projects that must be pursued by GWA to enhance the integrity and reliability of its potable water system.

Water Sources

There are three water sources on the island - wells, springs, and surface water:

Wells

There are 120 wells, 18 of which are either inactive or secured. All of the active wells are in the Northern Water System; two secured wells are in the Southern Water System. Pump capacities range from 50 to 755 horsepower (hp). Twenty seven of the stations wells have emergency generators operated by GWA and 89 are operated the Guam Power Authority (GPA). Multi-stage submersible pumps are used to pump from the well into the distribution system.

Each well site consists of the well, the well head, an air relief valve, a check valve, a bypass line with a valve, and a flow meter. Buildings on the well site are used to house the emergency generator and (in most cases) chlorination facilities.

Springs

There are five springs that are serving or have served as sources in the Southern System. All springs except Asan and Santa Rita Springs are located in the Central System. All other springs are located in the Southern System. Only Santa Rita Spring is currently providing potable water.

Surface Water

Two surface water treatment plants provide water to customers in GWA's service area. The U.S. Navy's Fena Water Treatment Plant (WTP) serves customers in the Central System. The Ugum WTP is the major source of water supply for the Southern Public Water System and the only surface water treatment plant owned and operated by GWA.

Transmission and Distribution

The GWA distribution system is a collection of systems, many of which were installed prior to the Second World War. Transmission and distribution are combined into a common network. Because the distance can be short between source and initial user, this shortcoming is one of the high priority CIP projects that must be pursued by GWA to enhance the integrity and reliability of its potable water system. As noted above, there are approximately 380 miles of pipeline in the system.

The main water distribution/transmission pipes roughly follow the major transportation routes around the island. The island water system is highly integrated. Isolation and pressure reducing valves are used to ensure water supply reaches customers throughout the island. The southern system is the most vulnerable to water loss.

Pressure Control

GWA's water system is divided into a series of pressure zones established by the elevation of reservoirs that serve the area or (in some cases) booster stations where a reservoir does not exist. Dividing the pressure zones and regulating the transition of pressure in the water system from one zone to the next are a series of pressure reducing valve (PRV) stations or booster stations.

Pressure Reducing Valves (PRV)

The WRMP field study identified 37 PRVs, several of which were out of service or are questioned as to need. The PRVs control the pressure to the customers living at different elevations or being served by booster pumps.

Booster Pump Stations

There are 35 water booster pump stations, with six of the pump stations out of service or on standby. The water booster pump stations help maintain in-line pressure, fill reservoirs, and serve small communities where a reservoir is not available. The pump stations also serve as a means of dividing one pressure zone from another, particularly when there is no reservoir serving that pressure zone.

Reservoirs

Reservoirs consist of ground-level and elevated tanks. The elevated tanks have on-site booster stations to supply water. There are a total of 36 reservoirs in varying levels of usability distributed into the three regional water systems. Seven of the reservoirs are out of service and one has been abandoned.

Summary

The WRMP identified a number of recommended improvements to the water system, which are introduced in this chapter and expanded on in following chapters. Each chapter has recommendations and the final chapter details specific water system CIP projects.

Chapter 2 – Water Regulatory Issues

GEPA oversees two programs that relate to drinking water protection: the Safe Drinking Water Program and the Water Resources Management Program. The Safe Drinking Water Program's primary goal is to ensure that potable water on Guam meets local and national standards. The Water Resources Management Program's primary goal is to protect and manage Guam's principal source aquifer from pollution and over pumping. In December 2005, GEPA adopted by reference the Environmental Protection Agency's Primary and Secondary Safe Drinking Water Regulations 40CFR Parts 141 and 143.

GEPA Safe Drinking Water Program

Public Water Supply Systems (PWSS) on Guam are regulated by the Safe Drinking Water Program through an Operating Permit issued by the Program. There are currently eleven permitted PWSS on Guam, three of which are operated by the GWA. GEPA has primary enforcement responsibility for the Safe Drinking Water Program. Major topics discussed under this topic are:

- Phase I, II, IIb and V Rules (rules regulating 69 contaminants)
- Surface Water Treatment Rule
- Lead and Copper Rule
- Total Coliform Rule
- Interim Enhanced Surface Water Treatment Rule
- Stage 1 Disinfection Byproduct Rule
- Filter Backwash Recycling Rule
- Long-term 1 Enhanced Surface Water Treatment Rule
- Water and Wastewater Operator Certification Regulations
- Guam Lead Ban Act
- Water Resources Management Program
- Primary Drinking Water Standards

- Secondary Drinking Water Standards

Additional EPA Regulations

Two regulations were promulgated by EPA after GEPA adopted other EPA drinking water regulations - the Long-Term 2 Enhanced Surface Water Treatment Rule and the Stage 2 Disinfection Byproducts Rule. The first dealt with measures to reduce potential cancer and reproductive and developmental health risks from disinfection byproducts in drinking water. The second dealt with reduction of disease incidence associated with *Cryptosporidium* and other pathogenic microorganisms in drinking water.

Ground Water Under the Direct Influence of Surface Water

Ground Water Under the Direct Influence of Surface Water (GWUDI) is a regulatory designation of a groundwater source for which analytical tests indicate that there is the possibility that untreated surface water could infiltrate the ground water near the source. This topic is also addressed in Volume 3, Chapter 6 – Septic Systems & Unsewered Areas.

GWA Regulatory Compliance History

GWA historical compliance history is presented. Eight separate topics are discussed in the chapter in detail:

- Total Coliform Rule
- Nitrate
- Lead-Copper Rule Compliance
- Organics Chemical Contaminants
- Radionuclides
- Surface Water Treatment Rules
- Secondary Treatment Standards
- Operator Certification Requirements

Summary

The chapter concludes that there have been marked improvements in meeting regulatory requirements during the past five years and continued improvements during the course of the data collection for the WRMP. Very few of the above discussed items have been out of compliance.

Chapter 3 – Water Budget

The information and conclusions presented in this chapter were drawn from a variety of sources listed in the References Section at the end of this chapter, in addition to numerous technical reports of the Water Environmental Research Institute (WERI): Western Pacific University of Guam. Information has also been extracted from less comprehensive reports, which are referred to in the text when appropriate. In addition, data have been obtained from the GEPA management reports and from GWA files. Other sources include Earth Tech Corporation data and data obtained during development of several golf courses on the island.

This chapter is divided into six major divisions.

- Hydrologic Budgets
- Water Resources Occurrence and Behavior
- Water Development
- Status of the Water Resources
- Quality of the Water Resources
- Water Resources Monitoring

A summary of the divisions follows:

Hydrologic Budgets

The goal of hydrologic budgeting is to determine a mass balance among input and output variables in the hydrologic cycle. Input variables include rainfall, together with other atmospheric moisture sources, and fluxes (surface water and groundwater) across boundaries in the area of interest. Output variables consist of direct surface runoff, evapotranspiration, deep percolation, and boundary fluxes. The section discusses these variables.

Water Resources Occurrence and Behavior

Two major area characteristics are discussed. The occurrence of fresh water is limited to groundwater in permeable limestone aquifers in the north where there are no major streams, although there are a few small springs. In the south surface runoff in the form of springs, streams and rivers represent the dominant sources of fresh water. Some small areas of limestone contain groundwater but in trivial amounts compared with the aquifers of the north.

Water Development

Under current production rates in the north, the unused sustainable yield available to GWA totals about 18 mgd. No wells are used by GWA in the south, although two wells previously provided local supply. Development options are explored for the northern and southern areas.

Northern Guam

Additional wells are the main option for additional supply in the north. If GWA decides to further exploit groundwater, a monitoring network is recommended to monitor chloride concentrations in the aquifer.

Southern Guam

Both groundwater and surface water are developed in Southern Guam, but surface water offers the most voluminous source of supply. Surface water options are discussed relevant to treatment systems and potential diversion sites. Numerous attempts have been made to extract groundwater from both the limestone and volcanic aquifers in the south. By and large, the efforts have not yielded sufficient water to justify extensive development of the resources.

Status of Water Resources

Several instances of groundwater contamination have been noted in the northern aquifers. In Northern Guam, increases in salinity in some wells imply saltwater intrusion. Several wells have had to be abandoned and others may have to be reconfigured.

In Southern Guam, the only water development of consequence is GWA's Ugum River diversion. It was concluded that as the population grows and the demand on the northern Guam aquifers increase, additional surface water development opportunities in the south may have to be explored.

Quality of Water Resources

The water resources of Guam developed for public consumption have not met EPA drinking water standards in many instances. One reason for this is that the groundwater in northern Guam occurs in highly porous limestone that extends from the ground surface through the vadose zone into the saturated aquifers.

In the south, groundwater in the limestone formations and volcanic soils follow a similar path, but far less activity that might affect groundwater quality takes place. The surface water exploited in the south drains areas that are free of significant anthropomorphic sources of potential contamination.

Water Resource Monitoring

Historical and current monitoring practices are discussed in this section. Salinity has been measured for a number of years, but more extensive investigations were not implemented until 1982. Several stream gauges have been in continuous use since 1952; others originally installed have been abandoned.

Several deep borings were drilled in northern Guam to collect information about hydrologic conditions in the basal lenses. Eight of the wells were successful for use to collect water level and salinity data and to track changes in the thickness of the freshwater portion of the lens.

Summary

Guam's water system is divided into the northern and southern areas of the island. Each has different characteristics mainly due to the underlying geologic formations. The northern geologic formation is favorable for wells penetrating deep limestone while the southern formation is dominated by poorly permeable volcanic soil and the water source is mainly stream flow. A number of relevant water resource issues are covered in the chapter.

Chapter 4 – Water Loss Control

There was insufficient data available in GWA's records to conduct a water audit as part of the master plan process. This chapter outlines the process for additional data collection activities to enable GWA to perform a comprehensive audit with more detailed recommendations. As a first step in 2005, and as a part of the master plan activities, GWA initiated a water loss control program to identify leaks and illegal connections to its water transmission and distribution system.

Leak Detection Program Assistance and Recommended Future Actions

Three tasks are presented to carry out the process of detection and to use the results effectively:

- Overhead Reduction Tasks
- Revenue Stream Enhancement Tasks
- Billing Structure, Analysis and Improvement Tasks

Recommended Priorities for System Repairs and Data Collection

Two key areas are identified to focus on for water loss strategies. These are to quantify water losses by type and to recover the highest dollar value and highest volume loss quickly. A list of priority items is defined in this section.

Leak Detection Study Results

A Water Leak Detection Team was formed. They prepared a detailed report documenting leaks of approximately 600,000 gallons per day, which amounted to $1,440 to $2,100 per day of lost revenue. The results of this study were GWA's first effort at leak detection. It represents a small portion of the anticipated leaks in the system.

Comprehensive Water Distribution System Audit

A Water Audit format was presented in this section. Data collected by GWA staff in 2006 will be used in the future to continue to track "non-revenue" water and achievements to reduce water losses. A comprehensive approach with 20 steps is laid out for performing the audits in the future.

Summary

Water loss detection had not been practiced by GWA as a dedicated activity until begun during the course of the master planning project. This chapter outlined the initial activities by a leak detection team and identified the recommended process for continuing the quest for lost water and lost revenue.

Chapter 5 – Water Conservation

This chapter presents a summary of opportunities for GWA to undertake to improve the efficient use of existing water resources through urban water conservation. The point is made that water utilities worldwide are facing water shortages for a variety of reasons. A number of water conservation program elements are presented for GWA's consideration and recommendations for the design of a GWA water conservation program.

Methodology for Estimating Water Savings

This section provides an explanation of the methodology used to estimate projected water savings based on quantifiable and non-quantifiable Best Management Practices (BMPs). The BMPs considered are listed and the terminology and general assumptions are defined. Other considerations are covered in the following topics:

- Quantifiable and Non-Quantifiable BMPs
- Analysis Perspective
- Analysis Terminology and General Assumptions
- Benefit Cost Modeling Overview

Model Inputs and Data Analysis

This task had not been completed by GWA at the time of WRMP completion. The chapter outlines how model inputs (such as annual and unit costs) and water use characteristics can be included in the modeling analyses when available in the future. These analyses may be also be updated in the future when increasingly more accurate data becomes available. The data collected by GWA will include:

- Water demand by customer category
- Number of customers in each customer category
- System production
- Water loss

GWA Customer Characteristics

Four customer categories form the basis of highest potential water savings and thus warrant further analysis for water conservation program planning purposes. These four are the following with their relative usage shown in percentage:

- Residential customers (59.0%)
- Hotel commercial accounts (14.1%)
- Commercial customer category C (11.5%)
- Government sector (7.8%)

Annual Account Water Use

A basic analysis was performed to determine the water use in average gallons per day per account for each customer category. This information is presented in tabular form in the section. One key finding was GWA's average residential account water use of 339 gallons per day is high relative to mainland U.S. systems. A more common number is 200-275 gallons per account per day. This fact was noted as a potential for conservation measure application.

Other Areas to Review

Several other areas to review are profiled, these are:

- Indoor/outdoor water use
- Annual market penetration/implementation requirements
- Water conservation program costs inputs

Recommended Next Steps

The final section describes the overall next steps for the design of a water conservation program for GWA based on a Best Management Practice (BMP) analysis. The section notes that the water savings estimated in a BMP analysis will not occur unless the required activities and interventions are performed.

Summary

A recommended conservation program is laid out in the chapter with step-by-step procedures and suggested approaches based on findings during the master planning activities. It is evident that GWA has many opportunities to address.

Chapter 6 – Water System Hydraulic Modeling

This chapter discusses hydraulic network analysis noting that it is the process of using a water distribution system computer model to analyze performance capabilities and to define the requirements necessary to meet system design standards for pressure and flow. Applications of hydraulic network analysis generally fall into three categories: planning, design and operations. Each of these categories is defined in the chapter. Maps, charts, and representative model outputs are also profiled in the chapter.

Water Model Development Background

The GWA hydraulic model includes all distribution system facilities and pipelines (six inches in diameter and greater, as well as smaller pipelines where necessary to connect facilities and/or complete a loop). The model was designed to simulate the conditions and operation of the water distribution system over a 24-hour period. The hydraulic model provides GWA with a flexible tool for conducting network analysis tasks for the overall water distribution system.

Three versions of the Hydraulic Model were prepared for GWA:

- **2005 Existing Condition Model (ECM)** – This model was based on all available information as of the year 2005. It can be used for detailed calibration purposes when additional field data becomes available in the future.
- **2005 CIP Planning Model (CPM)** – This model is a modified version of the ECM. It was used to study different CIP alternatives to resolve the various system deficiencies identified by the ECM simulations under the 2005 Maximum Day Demand Scenarios. In the future, it will be used by GWA staff as a planning tool for evaluating existing and proposed water distribution facilities.
- **2025 CIP Investigating Model (CIM)** – This model is a modified version of the 2005 CPM. It was mainly used for two purposes:
    1. To investigate the impacts of future population increases on the GWA water system, and
    2. To investigate the feasibility of restructuring the North water system, so that most of the existing wells pump directly into reservoirs. Essentially, the North system capacity will be driven only by the reservoir hydraulic head without the added head from the well pumps.

Model Network Development

Data from a number of different sources were necessary to develop the hydraulic model. Primary data needs for the model development are the following:

- Water system infrastructure geometry
- Water demand quantity and diurnal patterns

- Ground surface elevation
- Water System operating procedures and controls

The water system network includes:

- Pipes
- Nodes
- PRVs and pressure sustaining valves (PSVs)
- Check valves
- Closed valves
- Elevated tanks
- Ground reservoirs
- Booster pump stations (BPSs)

Water Demand Projection

Water demand projections for the water systems in the Existing Condition Model and CIP Planning Model were based on year 2005 GWA population. The demand projections were based on population projections within developed areas of the island. The population projections for each municipality were divided into census block groups. Water demand projections for the CIP Investigating Model were based on year 2025 GWA population.

Mass Balance and Demand per Capita

The GWA water supply was attributed to five sources, each of which provides varying quantities of potable water. The five used in the model were:

- Deep wells
- Navy water (FENA)
- Former Earth Tech wells
- Ugum Water Treatment Plant
- Santa Rita Spring

Conceptual Model Calibration

Although not a normal process, the conceptual model calibration effort was carried out on the 2005 Existing Condition Model using field measured pressure data from multiple days during the months of April 2006 to June 2006. In spite of this approach, it proved to be a good start and appears to be appropriate for this stage of the model building effort.

Model Simulation

Two basic types of analyses can be conducted using a hydraulic model. The first is steady-state simulation (SSS) that simulates the system at an instantaneous point in time and the extended period simulation (EPS) that simulates the distribution system as it changes over time. An SSS run is most often used for the initial validation of an "un-calibrated" hydraulic model and the EPS run can be used to assess the adequacy of booster pump stations and storage tanks over the course of time. Several simulation scenarios were used in for the three different Hydraulic Models (ECM, CPM, and CIM). These scenarios are described in detail in this chapter. The Hydraulic Models identified system deficiencies under different scenarios, which served as the basis for improvement projects described in Chapter 8 – Water System Facilities.

Summary

This chapter presents the process and components of the water model. Calibration and simulations are defined and demonstrated. It is recognized that this will be a valuable and dynamic tool as new information is added and GWA personnel gain more experience in model operation.

Chapter 7 – Water System Condition Assessment

A condition assessment of equipment associated with wells, booster stations, and the Ugum Water Treatment Plant was conducted in February and March 2005. The assessment was performed by visiting each of the sites and visually inspecting the equipment. When possible, the equipment was assessed during operation.

Assessment Approach

Three categories of equipment were surveyed using a 0 to 4 rating where "0" indicated "not applicable" and "4" indicated "well maintained condition". Volume 1, Chapter 12 – Electrical Assessment of this WRMP details the electrical system condition assessment and Volume 1, Chapter 13 – SCADA Assessment addresses the SCADA system condition assessment.

Six factors were considered in making the numerical judgments for the water system:

- Use
- Maintenance
- Power Quality
- Corrosive Environment
- Vandalism/Theft (observed or potential)
- Weather and Natural Disasters

Water System Facilities

Three categories of facilities were wells, booster stations and Ugum Water Treatment Plant. A summary of findings noted in the chapter were:

Wells

One hundred ten wells were assessed. Almost two-thirds of the 35 emergency generators operated by GWA were not functioning as intended. The chlorination pumps associated with the wells were in fair to good condition, but their installation was deemed to be poor.

Booster Stations

Overall, the booster stations have good functional ratings though the physical condition of many was found to be poor. Only seven of the booster station generators are owned and operated by GWA and most of them are in poor condition.

Ugum Water Treatment Plant

It was determined that most of the equipment at the Ugum Water Treatment Plant was in poor physical condition, but functional to provide potable water. There is little redundancy in the chemical feed equipment to ensure reliable operation.

Summary

Condition assessments were performed on three components of the water system. It was observed that essentially all the facilities were functional with the exception of emergency generators. Conclusions, recommendations, and CIP impacts are presented at the end of the chapter. Also, a summary of the in-depth details of the assessment are presented in a compact disk in the Appendix.

Chapter 8 – Water System Facilities

This chapter summarizes improvements needed to the water distribution lines, booster stations, reservoirs, wells, distribution and transmission lines, and water treatment facilities required to provide potable water in sufficient quantity and quality to meet the demands of GWA customers. Various significant factors are covered including dealing with water loss, fire protection, PRV station improvements, wells, treatment facilities, and future facilities improvements.

Water Loss

"Unaccounted for water" that is being pumped out of the ground or diverted from surface waters and not reaching GWA's consumers is substantial. Water loss in the GWA system is estimated to be 50% of production. Water loss of 15% or less is considered the water industry standard. A separate chapter in Volume 2, Chapter 4 – Water Loss Control is devoted to this topic. GWA has taken some initial steps to begin to identify water loss.

Fire Protection

This section provides design criteria that are recommended as a basis for developing water distribution system improvements to meet fire protection needs. These criteria are also applied to identify specific system improvements needed to provide fire protection using the 2005 CIP Planning Model described in Chapter 7. Water supply and pressure problems for fire protection are also determined to be related to waterlines of insufficient size and inadequate layout creating insufficient water service volume and pressure.

PRV Station Improvements

Recommendations are given regarding the proper downstream Pressure Regulating Valve (PRV) station locations and settings, which depend upon the appropriate differential in pressure between the higher and lower pressure zones. There is a need for more maintenance to keep them in proper working order. In some instances, a Pressure Sustaining Valve (PSV) is needed on the upstream end of the PRV station in order to maintain adequate pressure and flow in the higher pressure zone.

Wells

This section recognizes that current operation of GWA's wells (though functional) poses operational challenges and some security risks. The uncertainty of designating the Northern System as GWUDI of surface water (discussed in detail in both Volume 2, Chapter 2 – Water Regulatory Issues and Volume 3, Chapter 6 – Septic Tanks & Unsewered Areas) necessitates consideration of alternatives to the current system design and operation. Given the uncertainty of the GWUDI designation, the ability of each well to meet the filtration avoidance criteria, and the security risks associated with the existing system design, transmission lines to potential common treatment points is a practical approach. These transmission lines would pick up well flow and allow it to be conveyed to storage as explained in detail in this section.

Water Treatment Facilities

This section identifies the Ugum Water Treatment Plant as the primary source of drinking water for the Southern Public Water System. Though performance reliability of the Ugum WTP has improved over the past two years, there are risks associated with existing equipment, structures, and capacity limiting factors. It is noted that use of Navy-supplied water could be eliminated entirely if the Ugum WTP production were increased to 7.2 mgd. This would entail several significant CIP projects as detailed in the section.

Future Water System Facilities Improvements

Increases in population throughout the island will increase water demand and create deficiencies in the water source, pumping and transmission, storage, and distribution system. Water system improvements required to support the growing population over the next 20 years were identified through modeling of the projected future conditions using the 2025 CIP Investigating Model described in Chapter 7.

Water System Criteria Review

The Stipulated Order suggested Hawaii Water System Standards (WSS) be used as a guide throughout the hydraulic analyses. When the WSS were used, certain criteria were unable to be met without extensive upgrades and extremely high capital expenditures. These criteria would require more improvements than what would be considered financially feasible for GWA. Therefore, it is important for GWA to develop its own water system standards that will allow for enough infrastructure redundancy to provide a safe and reliable system for its customers, while still being economically feasible to implement.

Summary

This chapter presents an overview of GWA's water system facilities including current conditions and necessary upgrades or replacements to bring those that require it, into regulatory compliance. The potential for GWUDI designation is a pending concern and could have a marked impact on system configuration and consequent expenditures. The need for significant expenditures over the next 20 to 30 years has been established. These needs are identified in this chapter and specific projects for identified facilities are detailed in Volume 2, Chapter 9 – Recommended Water System CIP.

Chapter 9 – Recommended Water System CIP

Proposed CIP projects for a 20 year period are detailed in this chapter for the water system facilities. Projects were identified during facility visits, review of available reports and studies, asset condition assessments, GIS development and hydraulic modeling. A summary table lists each of the projects and individual tables give specifics about each project.

CIP Ranking Method

As a means of verifying the priority of CIP projects, a system known as "pairwise comparison" process was used to rank the importance and hence at least partially, the scheduling of projects regardless of utility type (water, wastewater, etc.). The process involved making comparisons of six categories. These are:

- Life and Safety
- Regulatory Compliance
- System Reliability
- System Redundancy
- System Capacity
- Operation and Maintenance (O&M) and Rehabilitation Recommendations

Project Summary Tables

Over twenty separate project tables are listed, each providing specific information about the project description, estimated cost, type, etc. The results of the individual tables are compiled into a single table at the beginning of the chapter and also in Volume 1, Chapter 15 – Capital Improvement Program.