City of Riverside

WASTEWATER COLLECTION AND TREATMENT FACILITIES INTEGRATED MASTER PLAN

VOLUME 12: ASSET MANAGEMENT
CHAPTER 2: CONDITION ASSESSMENT

FINAL
February 2008

10540 TALBERT AVENUE, SUITE 200 EAST • FOUNTAIN VALLEY, CALIFORNIA 92708 • (714) 593-5100 • FAX (714) 593-5101

City of Riverside

WASTEWATER COLLECTION AND TREATMENT FACILITIES INTEGRATED MASTER PLAN

VOLUME 12: ASSET MANAGEMENT
CHAPTER 2: CONDITION ASSESSMENT

TABLE OF CONTENTS

Page No.

2.1 PURPOSE 2-1
2.2 CONCLUSIONS AND RECOMMENDATIONS 2-1
2.3 BACKGROUND 2-2
2.4 EXISTING FACILITY DESCRIPTION 2-3
2.5 PROJECT APPROACH 2-3
2.5.1 Methodology Overview 2-3
2.5.2 Condition Assessment 2-5
2.6 CONDITION ASSESSMENT RESULTS 2-6
2.6.1 Water/Wastewater Asset Manager™ Reports 2-6
2.7 REPAIR AND REPLACEMENT PROJECT LIST 2-15

APPENDIX A – SAMPLE FIELD SHEETS
APPENDIX B – SUMMARY OF ASSETS WITH THE LOWEST OVERALL CONDITION RANKING
APPENDIX C – SUMMARY OF ASSETS WITH GREATEST RISK
APPENDIX D – EVALUATED REMAINING USEFUL LIFE
APPENDIX E – ECONOMIC REMAINING USEFUL LIFE
APPENDIX F – SUMMARY OF ASSETS WITH GREATEST REPAIR COSTS

LIST OF TABLES

Table 2.1 Asset Condition Ranking Scale[(1)(2)] 2-7
Table 2.2 Criticality Ranking Scale[(1)(2)] 2-10
Table 2.3 Vulnerability Scale[(1)] 2-11
Table 2.4 Original Useful Life per Asset Type 2-12
Table 2.5 Preliminary List of Repair and Replacement Projects 2-17
Table 2.6 Preliminary List of Repair and Replacement Projects - Additional Items 2-19
Table 2.7 Preliminary List of Repair and Replacement Projects - Explanations 2-20

LIST OF FIGURES

Figure 2.1 RWQCP Overall Site Map 2-4
Figure 2.2 Summary of the Condition of Assets at the RWQCP 2-9

CONDITION ASSESSMENT

2.1 PURPOSE

The purpose of this chapter is to describe the procedures that were undertaken to complete a condition assessment, and to present the resulting replacement and rehabilitation (R&R) recommendations of the key Regional Water Quality Control Plant (RWQCP) assets.

2.2 CONCLUSIONS AND RECOMMENDATIONS

The primary emphasis of the Asset Condition Assessment is to determine the condition of the aboveground assets at the RWQCP and to develop a list of potential R&R projects for the overall Capital Improvement Plan (CIP).

Recommendations related to these work elements are listed below:

- **Condition Assessment:**

  The RWQCP has been operating since the 1940s and main process components were built in each decade thereafter. Over the years, the plant has been well maintained; this fact is evident in the small number of Condition 4 and 5 assets identified during the assessment. Currently, the City of Riverside (City) is anticipating and making plans for the R&R needs of the Plant 1 primary clarifiers, the Plant 2 secondary clarifiers, and the reclaimed water pump station.

  To ensure accurate and timely identification of future R&R projects, it is recommended that condition assessments be conducted on a regular basis and that assts identified for the R&R projects be monitored and assessed prior to implementation of the project.

  Accordingly, it is recommended that assets in poor condition (Condition 4 or 5) be assessed annually, and a comprehensive assessment of all of the aboveground RWQCP assets be conducted every 3 to 5 years. New assets (installed within the past year) should be evaluated concurrent to the comprehensive assessment, to ensure that the required information (such as acquisition cost, manufacturer, and installation year) is correctly input into Water/Wastewater Asset Manager™ (WAM™).

  The assessments should be conducted by a team of individuals including O&M staff and engineering staff, and discipline specialists in electrical, mechanical, and structural engineering. Information collected during future condition assessments should mirror the work completed in this work. Digital photos of the assets should also be taken to document the existing condition of each asset.

- **Repair and Replacement Project Costs:**

  The condition assessment identified several R&R projects that are recommended for implementation within the next 10 years. Based on the information obtained in the condition assessment, 36 R&R projects have been identified for inclusion in the City's CIP. When reasonable, these R&R projects may be bundled with the planned projects from other sections of the master plan. Also, the R&R list may be modified according to the conclusions from other sections of the master plan. For example, it may be uneconomical to repair certain assets if the overall process is scheduled for replacement. Also, some of the assets on the R&R list are already on the plant's existing CIP. Currently, the assets from the primary clarification process are on both the existing list and the list from this report.

  It is recommended that the City confirm the estimated project costs during the course of the preliminary and/or final engineering that will precede implementation of any of the target R&R projects.

In support of the ongoing effort related to this Asset Management program, other recommendations developed during this effort are as follows:

- **Update of the Water/Wastewater Asset Manager™ Database:**

  In the future, it will be necessary to update the 2006 WAM™ database. For example, as new assets are added to the RWQCP through expansion and improvements, they will need to be included in the asset listing and corresponding R&R project list. It is recommended that updates of the WAM™ and associated changes to LOS goals be conducted every 5 years, coincident to the recommended 3-to 5-year comprehensive condition assessment.

WAM™ is a powerful and dynamic tool that can be used to easily identify assets that require attention. However, it is imperative that professional judgment be used when developing projects, as there are often factors that may influence projects that are not contained or cannot be captured within the WAM™ database.

2.3 BACKGROUND

A comprehensive condition assessment is critical to the City's vision for implementing asset management within the RWQCP. The condition assessment involves collection of data through review of existing reports, plans, bid tabulations and databases for the existing facilities at the RWQCP; interviews with RWQCP staff; and field inspections of key aboveground assets. Condition data and estimated replacement costs are then compiled into an electronic database using a computer-based asset management tool known as the Carollo Engineers (Carollo) WAM™, which is able to organize the data to develop a list of potential R&R projects for the RWQCP's existing assets. The results of this condition

assessment are detailed in this chapter and will be used in conjunction with the results from subsequent Master Plan tasks to develop the overall CIP.

The overall objective of the condition assessment is to meet the goals developed in Volume 12, Chapter 1 - Strategic Vision by creating an updated asset inventory, evaluating the aboveground assets, estimating appropriate replacement costs for each asset, and developing prioritized R&R recommendations of key RWQCP assets. This process includes gaining a thorough understanding of each asset's condition, risk, criticality, vulnerability, remaining useful life, and associated costs.

2.4 EXISTING FACILITY DESCRIPTION

The RWQCP serves the City of Riverside and several outlying communities. The plant became regional in 1978 when service was extended to the communities of Jurupa and Rubidoux. The RWQCP has a current sustained treatment capacity of 40 mgd (annual average flow) with a peak hydraulic capacity of 88 mgd. Flows through the plant are divided between two treatment trains, including Plant 1 (20 mgd) and Plant 2 (20 mgd). Each plant is equipped with aeration and sedimentation basins. Secondary effluent is combined downstream of the two plants before filtration. Filtration at the RWQCP consists of 16 dual media filters operating in parallel. Filtered effluent flows to Chlorine Contact Basins 1 and 3 and subsequently to the Santa Ana River. A site plan of the existing treatment facilities at the RWQCP is shown on Figure 2.1.

2.5 PROJECT APPROACH

2.5.1 Methodology Overview

The following is a brief overview of the methodology implemented for the condition assessment.

1. **Asset Management Visioning Workshop:**

   A Visioning Workshop was held with the City to determine the City's vision and guidelines for asset management, and to demonstrate how the WAM™ data could be integrated into the City's current SPL system.

2. **Asset Definition and Inventory Development:**

   An "asset" was defined and an inventory, or list, of the assets of the RWQCP was developed and classified by treatment process through a review of plant documents provided by the RWQCP and input from Operations and Maintenance (O&M) staff. An "asset" was defined as a complete physical component of a facility that enables service to be provided, is critical to plant operation, and/or has a value greater than $25,000.

KEY

1. Headworks
2. Biofilter
3. Primary Sedimentation Basins for Plant 1
4. Primary Sedimentation Basins for Plant 2
5. Secondary Sedimentation Basins - Plant 1 (Abandoned)
6. Secondary Sedimentation Basins - Plant 2
7. Chlorine Contact Basins
8. Chlorine Injection Structure (Abandoned)
9. Waste Backwash Lagoons
10. Tertiary Filters
11. Dissolved Air Flotation Thickeners
12. Digesters
13. Sludge Hopper Building
14. Caustic Soda Feed Pump Station (Abandoned)
15. Combined Aeration Basin Distribution Structure
16. Maintenance/Storage Building
17. Pump Station
18. RAS Distribution Structure
19. Primary Effluent Distribution Structure
20. Equalization Distribution Structure
21. Distribution Structure
22. Trickling Filter Effluent Metering Structure
23. Solids Metering Structure
24. Final Effluent Metering Structure
25. Dewatering Flow Metering and Sampling Structure
26. Distribution Box 2 (Abandoned)
27. Junction Box
28. Grit Storage (Abandoned)
29. Junction Structure
30. Parshall Flume
31. Transformer
32. Electrical Pad
33. Motor Control Center, Operations Lab and Pump Station
34. Boiler 1 and Pump Station 9
35. Dechlorination Building
36. Digester Control Building and Pump Station
37. Digester Control Building
38. New Blower Building
39. Sewer Line Maintenance Building
40. Bioassay Studies Building
41. Office Maintenance Building
42. Landscape Maintenance Storage Building
43. Indian Rocks Reserve Area
44. Storage
45. Sampling Station
46. Equalization Ponds
47. Aeration Basins Plant 2
48. Aeration Basins Plant 1
49. Secondary Sedimentation Basin, Plant 1
50. Cogeneration
51. Belt Press Building
52. Storage/Electrical Shop
53. Maintenance Building
54. Chemical Building
55. Backwash Storage Tank
56. Lab/Administration Building
57. Old Administration Building

Legend

- Headworks
- Primary Treatment Facilities
- Secondary Treatment Facilities
- Tertiary Treatment Facilities
- Disinfection
- Equalization Ponds
- Solids Handling Facilities
- Cogeneration Building
- Waste Lagoons
- Supporting Facilities

EXISTING SITE PLAN

FIGURE 2.1

carollo
Engineers...Working Wonders With Water™

WASTEWATER COLLECTION AND TREATMENT FACILITIES INTEGRATED MASTER PLAN

CITY OF RIVERSIDE

20-Riverside2-08\Volume 12-F2.1-7472A00.cdr

3. **Software Customization:**

   Following development of the asset inventory, the WAM™ software tool was customized with an asset "tree" specific to the assets identified at the RWQCP.

4. **Asset Condition Assessment Approach:**

   This task included determination of the asset evaluation and condition ranking approach used during field inspection. Specific guidelines and condition ranking scales were developed for aboveground assets (including visual elements of belowground vaults) assets. The task also included establishment of an approach for determination of asset vulnerability, criticality, and risk.

5. **Facility Condition Assessment:**

   During this task information, risk, and condition data for each asset was collected, quantified, documented, and photographed through a field inspection. A Carollo team guided by a RWQCP staff member conducted the field inspection. The Carollo team included process, structural, mechanical, electrical, and instrumentation and control discipline specialists.

6. **Replacement Cost Development and Rationale:**

   Replacement cost data was developed for each asset. Estimates were developed based on information obtained from cost curves, recent bid tabulations, and recent Carollo asset management work conducted for other agencies. The level of accuracy of the cost estimates is consistent with that needed to make planning level decisions and other cost estimates throughout the Master Plan. The replacement cost data reflects total project costs including general conditions, contractor overhead and profit, engineering and legal, and a design contingency.

7. **Software Population:**

   Data collected during the facility inspection and replacement cost development tasks was entered into the customized WAM™ database.

8. **Development of Potential Repair and Replacement Projects:**

   Following data population, WAM™ was used to develop five separate lists of potential R&R projects. These lists were based on five different criteria: asset condition, risk, repair cost, evaluated remaining useful life, and economic remaining useful life. Based on specific criteria, key projects from each list were used to develop a single list of R&R projects. The developed list will be used in conjunction with the results from subsequent Master Plan tasks to develop a CIP for the RWQCP.

2.5.2 Condition Assessment

The condition assessment included a field evaluation of key assets by a multi-discipline engineering team licensed and experienced in the areas of civil/sanitary engineering, mechanical engineering, structural engineering, and electrical/instrumentation engineering.

The assessment team visited the RWQCP, inspected the major assets, and interviewed O&M personnel regarding the operation and maintenance history of the major facilities and assets.

The information gathered during the condition assessment provides a standardized record of the asset condition specific to each discipline. Data collected for each asset included, condition, installation year, and discipline specific data as applicable. In addition, other relevant information, such as recent performance history, and design and sizing criteria was gathered where available, and the existing condition of all assets was documented with digital photos. To standardize the process of determining an asset's condition, specific discipline-related questions were answered for each asset. Sample field sheets and discipline questions are presented in Appendix A. The assessment also included assigning criticality and vulnerability to each major asset, as well as useful life. Data from the assessment was organized for entry into the WAM™ database.

2.6 CONDITION ASSESSMENT RESULTS

2.6.1 Water/Wastewater Asset Manager™ Reports

Using the filtering capabilities for the selected criteria in the WAM™ software package, condition assessment data was translated into potential repair and rehabilitation projects. The main purpose behind generating the report was to better understand and determine true project needs at the plant. In addition, separate reports were created to prioritize the data for each criterion. The following sections detail each of the assessment data reports that were generated using the WAM™ software package. These reports/criterion are intended for use in prioritizing potential R&R projects at the plant. WAM™ reports were created for each of the following:

- Asset condition ranking.
- Asset risk.
- Economic remaining useful life.
- Evaluated remaining useful life.
- Asset replacement and repair cost.
- Summary report of assets that meet the five criteria listed above.

A photo of each asset is included in the WAM™ database. An electronic copy of the WAM™ software, specifically tailored to the RWQCP, will be provided separately to the City with this report.

2.6.1.1 Asset Condition

The ranking scale used in the condition assessment of each asset is shown in Table 2.1. Each asset was assigned a condition value based on the percentage of the value of the asset that was required to return each asset to essentially new condition (i.e., restored to original physical condition, useful life, etc.). This scale is an internationally accepted, industry-wide standard for designating asset condition. The condition ranking is related to the percentage of the value of an asset needed to repair/rehabilitate the asset to return it to its original condition. In the case where an asset was not accessible or was non-existent in the field, a ranking of 0 was assigned.

Table 2.1 Asset Condition Ranking Scale(1)(2)
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

Ranking	Description	Percentage of Asset Requiring Repair(2)
0	Non-Existent/Not Assessed	N/A
1	Very Good Condition	0%
2	Minor Defects	5%
3	Maintenance Required to Return to Accepted Level of Service	10 to 20%
4	Requires Rehabilitation	20 to 40%
5	Asset Unserviceable	>50%

Notes:
(1) Adapted from the International Infrastructure Management Manual.
(2) "Percentage of asset requiring repair" is that percentage of the value of the asset needed to return the asset to a condition ranking of 1.

The repair percentages associated with each condition ranking are used to calculate the evaluated remaining useful life, evaluated value, and the necessary repair/rehabilitation costs to return the component to its original condition.

Each major asset (including junction and distribution boxes) was divided into three disciplines (as appropriate) and each discipline was assessed individually. The three disciplines were:

1. Mechanical/Electrical/Instrumentation/Piping.
2. Structural/Architectural.
3. Civil/Site Work.

Members of the field condition assessment team separately assigned a condition ranking for each discipline. The discipline-specific condition rankings were then compiled into the WAM™ software package and averaged by the software into one overall component condition ranking based on a cost-weighted basis.

Appendix B lists the assets that received the lowest overall condition rankings (i.e., assets in greatest need of replacement or rehabilitation based on condition). All assets with a condition ranking greater than 3 are included in the list, as assets with a condition greater than 3 are in fair to poor condition. The listing is sorted first by condition and then by risk. Condition assessment information for each asset at the RWQCP is included in the WAM™ database. For comparison, Figure 2.2 indicates the number of assets that received each condition ranking score.

2.6.1.2 Level of Service

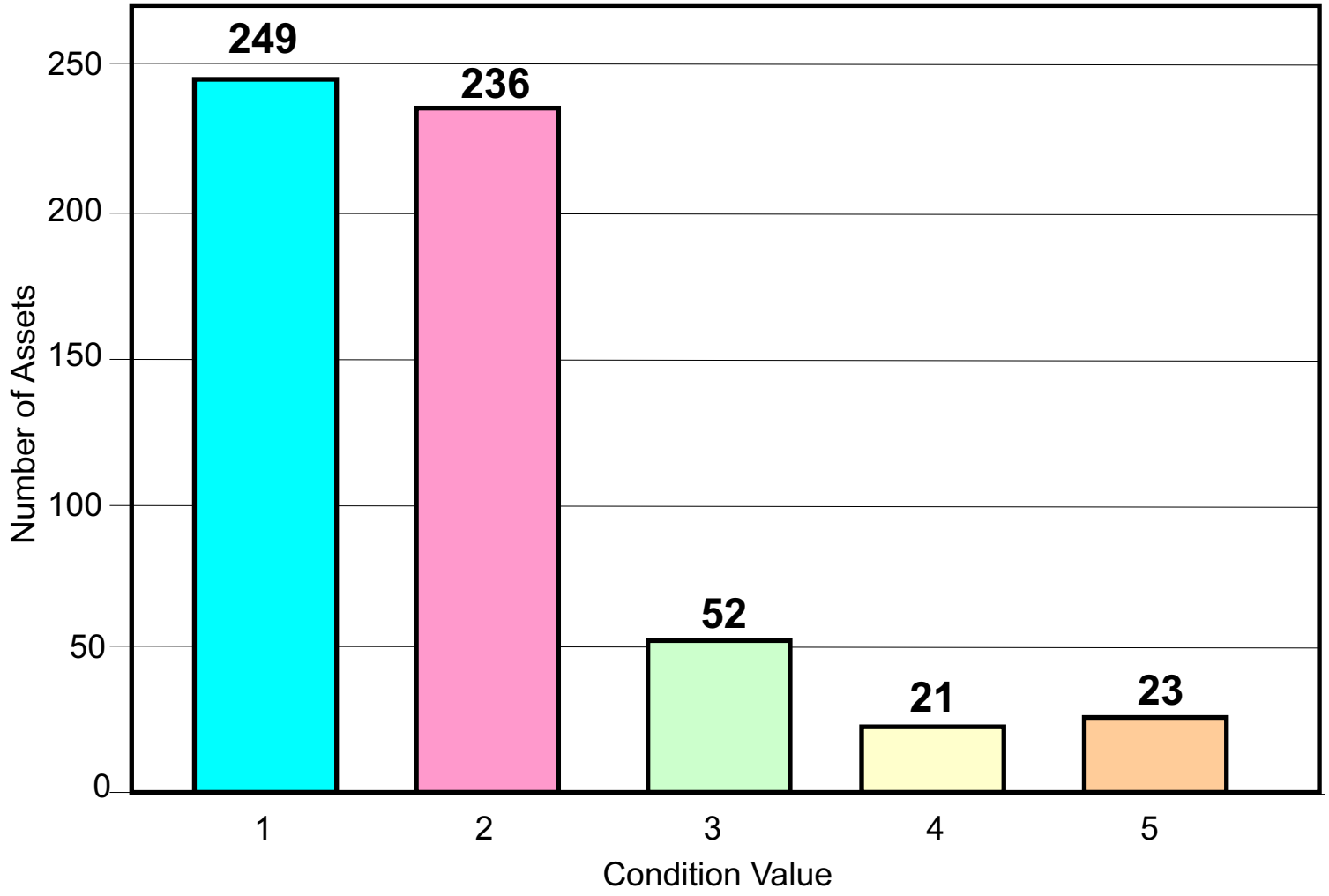
Level of Service (LOS) defines the target condition value desired for each asset. The ranking scale used to assign a LOS to each asset is the same as the condition scale shown in Table 2.1. Ideally, all assets would be a Condition/LOS of 1. Realistically, it is uneconomical to maintain all plant assets at a condition ranking of 1. Based on the City's internal goals for wastewater treatment, each asset was assigned a target LOS value of 2 (equivalent to an asset condition of 2; good condition). Although there are no specific reliability goals associated with the LOS rankings, an LOS value of 2 is considered reasonable for the City to meet its goals for wastewater treatment (i.e., if assets meet the LOS value of 2, and are therefore in good condition, it is expected that the City will meet its service goals).

The condition assessment was used to quantify any differences between the baseline level of service value and the current condition of each asset. If the current condition of the asset does not meet the designated LOS value, repairs will need to be made to improve the asset condition to meet the LOS goal. However, LOS goals for the assets can be modified based on the City's knowledge of the operations goals and maintenance history of individual assets. For example, if an asset will be replaced in the near future, the City may decide to decrease the LOS value for the existing asset. This would allow the condition of the existing asset to decrease slightly before it is replaced with a new asset, while preventing the expenditure of funds needed to maintain the existing asset in good condition (to meet the assigned LOS goal of 2). LOS is used to develop the repair costs in the WAM™ report.

2.6.1.3 Criticality

Criticality is defined as the relative overall consequence of asset failure. Criticality incorporates four main categories:

1. Public Health and Safety.
2. Effect on Customers.
3. Environmental Impacts.
4. Cost of Repair.



ASSESSMENTS RESULTS

FIGURE 2.2

Table 2.2 shows the criticality ranking scale used in the condition assessment of each asset. The criticality scoring for an asset (the sum of the individual categories) ranges from a possible high of 39 points (highly critical) to a possible low of 2 points (not critical). As can be seen in the table, each category is weighted differently; the categories with the highest criticality factors are Public Health and Safety and Environmental Impacts (ability to meet permit) because these two categories have the highest potential consequence, should an asset failure occur. Criticality is one of the two factors used to determine asset risk.

Table 2.2 Criticality Ranking Scale[(1)(2)]
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

Criticality Factor Description	Ranking
Public Health and Safety	
Multiple illness or injury	15
Illness of injury due to seasonal effects	10
Single illness or injury	5
No effect	0
Effect on Customers	
Major or repeat occurrence	8
Minor	4
No effect	0
Environmental Impacts	
Major	10
Minor	5
No effect	0
Cost of Repair	
More than $20,000	6
Between $5,000 and $20,000	4
Less than $5,000	2

Notes:
(1) Adapted from the International Infrastructure Management Manual.
(2) An overall criticality is developed by summing the rankings of the four categories.

2.6.1.4 Vulnerability

Vulnerability is the probability or likelihood of asset failure. Failure can occur from physical failure, performance failure, or technological obsolescence. The vulnerability of an asset is inversely proportional to the evaluated remaining useful life, which is determined as part of the condition assessment. Table 2.3 presents the probability of failure associated with the vulnerability failure timeframe. Vulnerability is the second factor used to determine asset risk.

Table 2.3	Vulnerability Scale[1] Wastewater Collection and Treatment Facilities Integrated Master Plan City of Riverside
Failure Timeframe	**Probability[2]**
1 year	0.9
2 years	0.7
3 years	0.4
4 to 5 years	0.2
6 to 10 years	0.1
11 to 20 years	0.05
21 to 50 years	0.02
51 to 100 years	0.01

Notes:
(1) Adapted from the International Infrastructure Management Manual.
(2) Probability of failure within the first year of the failure timeframe.

2.6.1.5 Asset Risk

Risk is the mathematical product of the criticality score and the vulnerability probability. Risk is a relative number used to identify the assets, which have a high probability and/or consequence related to their failure to meet prescribed level of service goals. The equation used to determine the risk associated with an asset is as follows:

$$\text{Risk} = \text{Criticality} \times \text{Vulnerability}$$

Risk provides information crucial to making more informed management decisions. For example, decisions must differentiate need and priority between replacing an asset with a high-risk value, or alternatively, choosing to implement an ongoing repair or maintenance strategy in lieu of replacement. Generally, assets with a high risk score should be higher on the priority list for capital improvements; however, there may be exceptions to this general rule. Table C.1 in Appendix C lists the top ranked assets that received the greatest risk scores at the RWQCP. For this report, the Appendix includes assets with a risk of 1.26 and greater. This cutoff was made based on the R&R rationale as outlined in Section 2.4.1.11. The risk assessment for every asset at the RWQCP is included in the WAM™ database.

2.6.1.6 Original and Remaining Useful Life

Original Useful Life is the number of years an asset is expected to be in service as a function of asset type (i.e., mechanical, structural, electrical, instrumentation and control) and Remaining Useful Life is the original useful life less the number of years an asset has been in service. Original useful life is used to develop the evaluated remaining useful life and economic remaining useful life. The original useful life values for different types of assets are presented in Table 2.4.

Table 2.4 Original Useful Life per Asset Type Wastewater Collection and Treatment Facilities Integrated Master Plan City of Riverside	
Asset Type	**Original Useful Life**
Mechanical	20 years
Structural	50 years
Electrical	30 years
Instrumentation	15 years

Notes:
(1) The biofilters were assigned an original useful life of 10 years.
(2) Exceptions such as the one for the biofilters are made on a case-by-case basis.

2.6.1.7 Evaluated Remaining Useful Life

Evaluated Remaining Useful Life (ERUL) is based on the current condition of the asset and is the estimated remaining number of years until the physical failure of the asset. ERUL is often used in conjunction with Remaining Useful Life to better understand project needs. ERUL differs from remaining useful life because it incorporates the asset condition ranking. For example, the original useful life for structural components is listed as 50 years. If that asset is 49 years old, the remaining useful life will be only 1 year. However, in reality, if that asset is still in excellent condition, the “true” remaining life will be much more than 1 year.

ERUL is one method used to take into account the existing condition and ongoing maintenance work on the asset. WAM™ calculates the ERUL for each asset. The table in Appendix D lists the assets at the RWQCP with the lowest ERUL. These assets have an ERUL of less than 16 years; the cutoff point was selected according to the criteria stated in Section 2.4.1.11. The evaluated remaining useful life of every asset is included in the WAM™ database.

2.6.1.8 Economic Remaining Useful Life

The economic remaining useful life of an asset is the estimated period between the date of the condition assessment and the time when the asset degrades to a condition where repairing the asset ceases to be cost effective. It is important to keep in mind that the economic remaining useful life is only an estimate of the feasible operating period of an asset. Factors such as the operating environment, maintenance schedule, and other extraneous variables will influence the actual economic remaining useful life. For example, the economic remaining useful life of a newly purchased pump is equal to 20 years; however, the economic remaining useful life may continue to be 20 years, even several years after purchase if the pump is well maintained and run under low-stress conditions. Ultimately, if the pump continues to be well maintained, it may be feasible to run it for more than 20 years. The table in Appendix E lists assets with the lowest economic remaining useful life. The cutoff for the table in Appendix E is 6 years and less. This cutoff was based on the criteria stated in Section 2.3.1.11. The WAM™ database contains the economic remaining useful life data for all assets.

2.6.1.9 Replacement Value

For this project, replacement value is defined as the cost to replace the asset with a similar piece of equipment in August 2006 dollars.

Replacement costs were developed for each of the key assets at the RWQCP based on Carollo's experience with infrastructure costs at similar wastewater facilities. Ultimate project costs at the time of construction are dependent on actual labor and material costs, actual site conditions, competitive market conditions, final project scope, final project schedule, and other factors. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

The level of accuracy for construction cost estimates varies depending on the level of detail to which the project has been defined. Feasibility studies and master plans represent the lowest level of accuracy, while pre-bid estimates (based on detailed plans and specifications) represent a higher level. The American Association of Cost Engineers has developed the following guidelines for developing project cost estimates:

Type of Estimate	Anticipated Accuracy
Order-of-Magnitude (Master Plans)	+50% to -30%
Budget Estimate (Pre-design Report)	+30% to -15%
Budget Estimate (Pre-design Report)	+15% to -5%

The opinions of cost presented in this report should be considered order-of-magnitude estimates, with an anticipated level of accuracy of +50 to -30 percent. The cost opinions for each of the listed assets represent August 2006 dollars consistent with the 20-city Engineering News-Record (ENR) value of 7723. Location factors were used to adjust the costs to the Los Angeles region, so the dollars are also consistent with the Los Angeles ENR value of 8570.

Base construction costs were adjusted to develop total project costs, and included the following:

- Contingency of 30 percent. This contingency represents undeveloped or unforeseen design details at the planning stage (i.e., master plans). Design for additional or required process equipment and structures that are known, but not yet defined, were also included. Costs for the maintenance or operations during construction were not included.
- General conditions estimate of 10 percent. This value includes all items contained within Division 01 of most project specifications including: mobilization/demobilization, contractor temporary facilities, contractor's field supervision, and bonds and insurance.
- Contractor overhead and profit of 15 percent. This value includes general contractor home office overheads and profit.

- Sales tax of 7.75 percent on 50 percent of the total direct cost plus the order of magnitude contingency.
- Bid market allowance of 15 percent. This value includes costs due to the volatile nature of the current bidding market throughout the United States and especially California.
- Engineering, Legal, Administrative, and Construction management costs (ELAC) of 30 percent. Legal and administrative costs reflect assistance with permitting and financing.

The costs developed herein are based on estimated total project costs, including all costs that may be required to complete the replacement project. Therefore, each cost was calculated as the sum of the construction, general conditions, contractor's costs, bid market allowance, sales tax, and ELAC. It is recognized that, depending on the project, total project costs may include items such as repaving or relocation of utilities. Such additional costs are difficult to predict in the absence of detailed engineering information. However, based on Carollo's experience, the presented planning level contingencies generally cover added cost elements such that the total project costs (i.e., the asset "replacement value") used to predict future expenditures are reflective of actual project costs. It is recommended that the RWQCP revise any estimated total project costs during the course of preliminary and/or final engineering projects that will precede implementation of any of the projects.

2.6.1.10 Repair Costs

Repair costs are defined as the cost required to return an asset to a specified level of service, in this case a LOS of 2. Repair costs were estimated by WAM™ as a percentage of the replacement cost based on the assessed condition. In the case of assets with a condition of 5, repair costs are equivalent to replacement costs. It should be noted that the developed repair costs represent relative numbers useful for prioritizing R&R projects. These costs are not intended to directly correlate to potential alternatives related to each asset. In some cases, it may be more practical not to repair specific assets, but rather to replace them when their various remaining useful lives expire. For these reasons, the repair costs identified herein for each asset should be revisited prior to implementing repair projects. Table F.1 in Appendix F lists the top ranked assets with the greatest repair cost evaluated as part of the condition assessment. Cost information for every asset at the RWQCP is included in the WAM™ database.

2.6.1.11 Repair and Replacement Rationale

The goal of creating the different tables was to bring attention to assets according to varying criteria. The cutoff points for each asset table were based on past experience and the current framework of this 20-year master plan. Accordingly, this report looks at R&R greater than $25,000 for the Repair Cost table and ERULs of less than 20 years for the ERUL table. It is assumed that most repair costs less than $25,000 will be covered by the

plant's annual maintenance budget. Since assets with an ERUL between 16 and 20 years were either Condition 2 or 3, and only assets with Condition 3.8 or greater are included in the Condition table), the ERUL table in Appendix D only includes assets with an ERUL of 16 years and less.

The remaining economic useful life table in Appendix F has a cutoff of 6 years and less. This cutoff captures the most critical assets (Conditions 4 and 5). Almost all assets with a greater economic remaining useful life have a condition ranking of 3 or better. The few Condition 4 assets above the 6-year threshold are included in the condition-ranking table, in Appendix B.

For the risk table in Appendix C, the cutoff is 1.26 and this number is based roughly on a criticality greater than 20 (moderate criticality) and an ERUL of less than 15 years (vulnerability = 1/ERUL). The ERUL of 15 years fits within the timeframe of the master plan and the criticality of 20 is a median value within the criticality range. It is expected that most assets below the 1.26 value have a low consequence and probability related to failure.

The final R&R list will have exceptions to the individual table cutoffs. For example, an asset with a high repair cost could also have a high ERUL. The high repair cost would warrant the asset's placement on the final list even though the ERUL is greater than 20 years. The final R&R list will have exceptions to the individual table cutoffs. For example, an asset with a high repair cost could also have a high ERUL. The high repair cost would warrant the asset's placement on the final list even though the ERUL is greater than 20 years. Conversely, an asset with a high risk rating but a low (good) condition rating may not be placed on the final list, even though the risk rating is high. Professional judgment may indicate that because of the good condition rating, it is not appropriate to place the asset on the list. However, it is suggested that in cases of exceptions, those assets should be carefully monitored.

WAM™ was used to filter and create the initial R&R list based on the above criteria. The reports based on the individual criterion were used to fine-tune the WAM™ generated R&R list. Based on professional judgment the WAM™ generated list was supplemented with items from the individual reports. The final R&R list is a combination of the initial WAM™ generated list and these additional items. This final list will aid the City in making economic planning decisions related to plant maintenance and operation, as well as capital decisions.

2.7 REPAIR AND REPLACEMENT PROJECT LIST

A list of potential R&R projects is detailed in Tables 2.5 and 2.6. Explanations for each R&R project are detailed in Table 2.7. Table 2.5 is a list of the assets compiled from the WAM™ program using the criteria discussed in Section 2.4.1.11, and Table 2.6 includes additional assets that were included based on professional judgment. The items in Table 2.7 have mechanical components that are in very poor condition. Since the structural components of these items are in good condition, they have a cost weighted condition ranking below the

cutoff value of 3. It was necessary to add these items to the R&R list because the mechanical components need rehabilitation or replacement. The total repair cost for the items in Table 2.5 is $14,093,000 and the total repair cost for the items in Table 2.6 is $2,446,000. The overall total repair cost is $16,539,000. Repair costs are only planning level estimates (anticipated accuracy of +50% to -30%), and specific repair costs should be more closely examined prior to implementation of a project.

Items can either be added or removed form the list in accordance to plant needs and expectations. This list is conditional and the final version will include input from RWQCP staff members. Once the City approves the list, it will be used in conjunction with subsequent Integrated Master Plan tasks to develop the overall CIP.

Tables 2.5, 2.6, and 2.7 show the recommended items for the final R&R list and their explanations. Although the primary goal of the assessment was to document the condition of the plant's assets and recommend the most critical for the R&R list, a few additional issues were documented during the assessment. These issues are related to the following:

- Tertiary - Influent Pump 1 (Filters 1-10).
- Tertiary - Influent Pump 2 (Filters 1-10).
- Tertiary - Influent Pump 3 (Filters 1-10).
- Old Administration Building.

The tertiary influent pumps are ranked a Condition 3. Although this ranking does not warrant the inclusion of these items with the other items in the R&R list, it is necessary to closely watch these items since they have a risk value of 1.26. Currently, some parts of the pumps are corroded and some of the seals are leaking. If proper maintenance is not performed, repair costs could escalate and equipment failure could occur. Consequently, these pumps have the potential of costing the plant a considerable amount of money if they are not closely monitored. The old administration building is also ranked a Condition 3. Even though the building is in relatively good condition, seismic bracing is required. Retrofitting the building with seismic upgrades has the potential of being a costly item, and therefore, the City might want to plan for the eventual upgrade of this structure.

Table 2.5 Preliminary List of Repair and Replacement Projects
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/ Basin/Zone	Major Component/ Subbasin/ Subzone	Condition[3]	Risk	Criticality	Replacement Value	Repair Cost[2][4]	Original Useful Life	Evaluated Remaining Useful Life	Economic Remaining Useful Life
1	Primary	Primary Clarifier 5 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0
2	Primary	Primary Clarifier 6 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0
3	Primary	Primary Clarifier 7 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0
4	Primary	Primary Clarifier 8 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0
5	Primary	Primary Clarifier 9 (Plant 1B)	5	2.48	25	$2,121,000	$2,121,000	20	10	0
6	Primary	Primary Clarifier 10 (Plant 1B)	5	2.48	25	$2,121,000	$2,121,000	20	10	0
7	Electrical	Switchgear M (Plant 2)	5	2.25	34	$109,000	$109,000	30	15	0
8	Electrical	Switchgear W (Plant 2)	5	2.25	34	$66,000	$66,000	30	15	0
9	Primary	Primary MCC 1 (Plant 1A, Pump Station 12)	5	1.78	18	$66,000	$66,000	20	10	0
10	Primary	Primary MCC 2 (Plant 1B, Pumps Station 13)	5	1.78	18	$66,000	$66,000	20	10	0
11	Primary	Sludge Pump 5	5	1.49	15	$127,000	$127,000	20	10	0
12	Primary	Sludge Pump 6	5	1.49	15	$127,000	$127,000	20	10	0
13	Primary	Sludge Pump 7	5	1.49	15	$127,000	$127,000	20	10	0
14	Primary	Sludge Pump 8	5	1.49	15	$127,000	$127,000	20	10	0
15	Primary	Sludge Pump 9	5	1.49	15	$127,000	$127,000	20	10	0
16	Primary	Primary Clarifier Structure Plant 1A	5	0.99	25	$1,745,000	$1,745,000	50	25	0
17	Primary	Primary Clarifier Structure Plant 1B	5	0.99	25	$1,818,000	$1,818,000	50	25	0

Table 2.5 Preliminary List of Repair and Replacement Projects
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/ Basin/Zone	Major Component/ Subbasin/ Subzone	Condition[3]	Risk	Criticality	Replacement Value	Repair Cost[2][4]	Original Useful Life	Evaluated Remaining Useful Life	Economic Remaining Useful Life
18	Water Recycle	VFD for Recycle Pump 1	5	0.93	14	$73,000	$73,000	30	15	0
19	Primary	Pump Station 14	5	0.79	20	$198,000	$198,000	50	25	0
20	Primary	Distribution Box (Plant 1)	5	0.71	18	$147,000	$147,000	50	25	0
21	Digestion	Waste Gas Burner	4	2.23	31	$954,000	$250,797	20	14	4
22	Headworks	Biofilter 1	4	1.86	13	$336,000	$88,000	10	7	2
23	Headworks	Biofilter 2	4	1.86	13	$336,000	$88,000	10	7	2
24	Water Recycle	Water Recycle Pump 6	4	1.01	14	$191,000	$50,000	20	14	4
25	Digestion	Pump Station 1	4	0.57	20	$233,000	$61,000	50	35	10
26	Buildings	Headquarters for Sewer Line Maintenance	4	0.17	6	$1,209,000	$318,000	50	35	10
							Total Repair Cost	**$14,093,000**		

Notes:
(1) Because of Title 22 requirements, all pumps will be replaced and relocated to Chlorine Contact Basin 2.
(2) Repair costs are project costs that include a contingency, general conditions, contractor overhead, sales tax, bid market allowances, and engineering, legal and construction fees.
(3) Condition rankings are a cost weighted average of discipline-specific condition rankings, and where applicable the mechanical and structural rankings are shown in parentheses by an M or S, respectively.
(4) The overall total repair cost for the items in both Tables 2.5 and 2.6 is $16,539,000.

Table 2.6 Preliminary List of Repair and Replacement Projects - Additional Items
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/ Basin/Zone	Major Component/ Subbasin/Subzone	Condition[3]	Risk	Criticality	Replacement Value	Repair Cost[2][4]	Original Useful Life	Evaluated Remaining Useful Life	Economic Remaining Useful Life
27	Cogeneration	Cooling Tower (Gas Treatment Area)	3.8 (M - 4, S -1)	0.76	13	$299,000	$73,000	22.7	17	6
28	Digestion	Anaerobic Digester 4	2.6 (M - 4, S - 2)	0.40	16	$10,907,000	$832,000	43.1	40	18
29	Aeration	Blower Building 2	2.4 (M - 4, S - 2)	0.35	15	$3,413,000	$145,000	46.3	43	20
30	Primary	Primary Clarifier 2 (Plant 2)	2.4 (M - 5, S - 1)	0.58	25	$2,310,000	$303,000	45	43	21
31	Primary	Primary Clarifier 4 (Plant 2)	2.4 (M - 5, S - 1)	0.58	25	$2,310,000	$303,000	45	43	21
32	Disinfection	Chlorine Contact Basin 1	2.3 (M - 5, S - 2)	0.57	26	$1,526,000	$77,000	48.2	45	21
33	Equalization	Junction Box 9	2.3 (M - 5, S - 1)	0.41	18	$494,000	$56,000	45.7	44	22
34	Secondary	Clarifier 3 (Plant 2)	2.2 (M - 4, S - 1)	0.59	25	$2,533,000	$185,000	43.7	42	21
35	Secondary	Clarifier 2 (Plant 2)	2.1 (M - 4, S - 1)	0.58	25	$3,573,000	$236,000	44.3	43	21
36	Secondary	Clarifier 1 (Plant 2)	2.1 (M - 4, S - 1)	0.58	25	$3,573,000	$236,000	44.3	43	21
						Total Repair Cost	**$2,446,000**			

Notes:
(1) Because of Title 22 requirements, all pumps will be replaced and relocated to Chlorine Contact Basin 2.
(2) Repair costs are project costs that include a contingency, general conditions, contractor overhead, sales tax, bid market allowances, and engineering, legal and construction fees.
(3) Condition rankings are a cost weighted average of discipline-specific condition rankings, and where applicable the mechanical and structural rankings are shown in parentheses by an M or S, respectively.
(4) The overall total repair cost for the items in both Tables 2.5 and 2.6 is $16,539,000.

Table 2.7 Preliminary List of Repair and Replacement Projects - Explanations
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/ Basin/Zone	Major Component/ Subbasin/Subzone	Explanation
1	Primary	Primary Clarifier 5 (Plant 1A)	The clarifiers are outdated, in poor condition, and need to be replaced.
2	Primary	Primary Clarifier 6 (Plant 1A)	The clarifiers are outdated, in poor condition, and need to be replaced.
3	Primary	Primary Clarifier 7 (Plant 1A)	The clarifiers are outdated, in poor condition, and need to be replaced.
4	Primary	Primary Clarifier 8 (Plant 1A)	The clarifiers are outdated, in poor condition, and need to be replaced.
5	Primary	Primary Clarifier 9 (Plant 1B)	The clarifiers are outdated, in poor condition, and need to be replaced.
6	Primary	Primary Clarifier 10 (Plant 1B)	The clarifiers are outdated, in poor condition, and need to be replaced.
7	Electrical	Switchgear M (Plant 2)	The switchgear appears corroded and is over 25 years old.
8	Electrical	Switchgear W (Plant 2)	The switchgear appears corroded and is over 25 years old.
9	Primary	Primary MCC 1 (Plant 1A, Pump Station 12)	This MCC unit is scheduled for replacement with the Plant 1 primary clarifiers.
10	Primary	Primary MCC 2 (Plant 1B, Pumps Station 13)	This MCC unit is scheduled for replacement with the Plant 1 primary clarifiers.
11	Primary	Sludge Pump 5	These pumps are old and will be replaced with the Plant 1 clarifiers.
12	Primary	Sludge Pump 6	These pumps are old and will be replaced with the Plant 1 clarifiers.
13	Primary	Sludge Pump 7	These pumps are old and will be replaced with the Plant 1 clarifiers.
14	Primary	Sludge Pump 8	These pumps are old and will be replaced with the Plant 1 clarifiers.
15	Primary	Sludge Pump 9	These pumps are old and will be replaced with the Plant 1 clarifiers.
16	Primary	Primary Clarifier Structure Plant 1A	The structure has concrete spalling, corroded structural elements, and is scheduled for replacement.

Table 2.7 Preliminary List of Repair and Replacement Projects - Explanations
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/ Basin/Zone	Major Component/ Subbasin/Subzone	Explanation
17	Primary	Primary Clarifier Structure Plant 1B	The structure has concrete spalling, corroded structural elements, and is scheduled for replacement.
18	Water Recycle	VFD for Recycle Pump 1	This unit needs to be replaced.
19	Primary	Pump Station 14	The structure has concrete spalling, excessive corrosion, and is scheduled for replacement.
20	Primary	Distribution Box (Plant 1)	The structure has excessive spalling from corrosion.
21	Digestion	Waste Gas Burner	The exposed structural elements are corroded
22	Headworks	Biofilter 1	The media needs to be replaced.
23	Headworks	Biofilter 2	The media needs to be replaced.
24	Water Recycle(1)	Water Recycle Pump 6	The pump needs to be rebuilt because of excessive corrosion and a seal failure.
25	Digestion	Pump Station 1	The structure most likely requires a seismic retrofit.
26	Buildings	Headquarters for Sewer Line Maintenance	The tile roof is in need of repair, a seismic retrofit is required, and two trusses do not have wall anchorages.
27	Cogeneration	Cooling Tower (Gas Treatment Area)	The media needs replacement and the tower is leaking
28	Digestion	Anaerobic Digester 4	The mechanical elements of the asset are in fair to poor condition. The digester is leaking because the seal is in poor condition and a conduit is needed for wiring.
29	Aeration	Blower Building 2	Better ventilation is needed. The pipes and ducting are very corroded. The interior wall is not braced.

Table 2.7 Preliminary List of Repair and Replacement Projects - Explanations
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/ Basin/Zone	Major Component/ Subbasin/Subzone	Explanation
30	Primary	Primary Clarifier 2 (Plant 2)	The bridge needs to be repainted and the feedwells are sagging.
31	Primary	Primary Clarifier 4 (Plant 2)	The bridge needs to be repainted and the feedwells are sagging.
32	Disinfection	Chlorine Contact Basin 1	The mechanical elements of the asset are in fair to poor condition. The gates do not work, the ladder needs replacement, and some instruments need replacement.
33	Equalization	Junction Box 9	The box has been temporarily “repaired” to pull electricity from another box.
34	Secondary	Clarifier 3 (Plant 2)	The mechanical elements of the asset are in fair to poor condition. The drive mechanism and feedwell need rehabilitation. The weir stiffeners are severely corroded.
35	Secondary	Clarifier 2 (Plant 2)	The mechanical elements of the asset are in fair to poor condition. New stiffeners are needed, the skim bar is bent, and the center well needs repair.
36	Secondary	Clarifier 1 (Plant 2)	The weir stiffeners are corroded.

Notes:
(1) Because of Title 22 requirements, all pumps will be replaced and relocated to Chlorine Contact Basin 2.

Appendix A

SAMPLE FIELD SHEETS

Facility / System Condition Assessment Form

Facility / System:	Treatment Plant	Current Year	
Process / Basin / Zone:	Sample Process	Current ENR	
Component / Subbasin / Subzone:	Sample Component		
Discipline:	Structural / Architectural		

Main Tab

Level of Service *	1	2	3	4	5	0	
Criticality							
Public Health & Safety	Multiple	Single	Seasonal	No Effect			
Environmental	Major	Minor	No Effect				
Cost of Repair	>$20	$5-$20	<$5				
Effect on Customers	Major	Minor	No Effect				
Vulnerability	1	2	3	5	10	20	50	100	150
Condition *	1	2	3	4	5	0	

Annual Maintenance Cost

Installation Year

Original Useful Life

Date of Inspection

Assessed By

Photo #

Acquisition Cost

Replacement Value

Salvage Value

Component Information Tab

ID Number

Manufacturer/Model (nameplate info)

Comments

Spalling concrete?	Yes	No	N/A
Excessive corrosion to structure?	Yes	No	N/A
Excessive corrosion to members?	Yes	No	N/A
Corrosion coating intact and in place?	Yes	No	N/A
Paint in good condition?	Yes	No	N/A
Visible structural deformaties?	Yes	No	N/A
Foundation settling evident?	Yes	No	N/A
Major cracks?	Yes	No	N/A

*** Condition / Level of Service**

1 - Very Good

2 - Minor Defects

3 - Requires Significant Maintenance

4 - Requires Rehabilitation

5 - Requires Replacement (>50%)

0 - Non-Existent

Facility / System Condition Assessment Form

Facility / System:	Treatment Plant	Current Year	
Process / Basin / Zone:	Sample Process	Current ENR	
Component / Subbasin / Subzone:	Sample Component		
Discipline:	Mechanical / Electrical / Instrumentation / Piping		

Main Tab

Level of Service *	1	2	3	4	5	0			
Criticality									
Public Health & Safety	Multiple	Single	Seasonal	No Effect					
Environmental	Major	Minor	No Effect						
Cost of Repair	>$20	$5-$20	<$5						
Effect on Customers	Major	Minor	No Effect						
Vulnerability	1	2	3	5	10	20	50	100	150
Condition *	1	2	3	4	5	0			

Annual Maintenance Cost

Installation Year

Original Useful Life

Date of Inspection

Assessed By

Photo #

Acquisition Cost

Replacement Value

Salvage Value

Component Information Tab

ID Number

Manufacturer/Model (nameplate info)

Comments

Mechanical

Excessive vibration?	Yes	No	N/A
Excessive noise?	Yes	No	N/A
Excessive corrosion?	Yes	No	N/A
Excessive leaks?	Yes	No	N/A
Running hot?	Yes	No	N/A
Capable of running when inspected?	Yes	No	N/A
Support equipment functional?	Yes	No	N/A
Equipment or parts missing?	Yes	No	N/A
Parts for maintenance available?	Yes	No	N/A
Adequate for intended service?	Yes	No	N/A
Motor amps within rating?	Yes	No	N/A

Instrumentation

All critical indications functioning?	Yes	No	N/A
Alarms functional?	Yes	No	N/A
Equipment or parts missing?	Yes	No	N/A
Parts available for maintenance?	Yes	No	N/A

Electrical

Excessive corrosion?	Yes	No	N/A
Clean, well maintained contacts?	Yes	No	N/A
Parts available for maintenance?	Yes	No	N/A

Piping

Excessive corrosion?	Yes	No	N/A
Excessive leaks?	Yes	No	N/A
Paint in good condition?	Yes	No	N/A

*** Condition / Level of Service**

1 - Very Good

2 - Minor Defects

3 - Requires Significant Maintenance

4 - Requires Rehabilitation

5 - Requires Replacement (>50%)

0 - Non-Existent

Facility / System Condition Assessment Form

Facility / System:	Treatment Plant	Current Year	
Process / Basin / Zone:	Sample Process	Current ENR	
Component / Subbasin / Subzone:	Sample Component		
Discipline:	Civil / Sitework		

Main Tab

Level of Service *	1	2	3	4	5	0			
Criticality									
Public Health & Safety	Multiple	Single	Seasonal	No Effect					
Environmental	Major	Minor	No Effect						
Cost of Repair	>$20	$5-$20	<$5						
Effect on Customers	Major	Minor	No Effect						
Vulnerability	1	2	3	5	10	20	50	100	150
Condition *	1	2	3	4	5	0			

Annual Maintenance Cost
Installation Year
Original Useful Life
Date of Inspection
Assessed By
Photo #
Acquisition Cost
Replacement Value
Salvage Value

Component Information Tab

ID Number

Manufacturer/Model (nameplate info)

Comments

Sitework			
Several potholes?	Yes	No	N/A
Excessive erosion?	Yes	No	N/A
Severe road degradation evident?	Yes	No	N/A
Functional ground cover?	Yes	No	N/A
Fencing adequate and well maintained?	Yes	No	N/A
Facilities adequately secured?	Yes	No	N/A
Space for expansion?	Yes	No	N/A
Civil			
Presence of clay liner?	Yes	No	N/A
Excessive erosion on berm interior?	Yes	No	N/A
Excessive erosion on berm exterior?	Yes	No	N/A
Vegetation along berms?	Yes	No	N/A
Noticeable settlement of berms?	Yes	No	N/A
Presence of seepage on outer edge of berms?	Yes	No	N/A
Presence of burrow holes?	Yes	No	N/A
Presence of riprap or other erosion protection?	Yes	No	N/A
Adequate erosion protection?	Yes	No	N/A
Excessive algal blooms?	Yes	No	N/A
Adequate drainage?	Yes	No	N/A

*** Condition / Level of Service**

1 - Very Good

2 - Minor Defects

3 - Requires Significant Maintenance

4 - Requires Rehabilitation

5 - Requires Replacement (>50%)

0 - Non-Existent

Appendix B

SUMMARY OF ASSETS WITH THE LOWEST OVERALL CONDITION RANKING

Table B.1 Summary of Assets with the Lowest Overall Condition Rankings[1]
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/Basin/ Zone	Major Component/Subbasin/ Subzone	Condition	Risk	Criticality	Replacement Value	Repair Cost[2]	Original Useful Life	Evaluated Remaining Useful Life	Economic Remaining Useful Life
1	Primary	Primary Clarifier 5 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0
2	Primary	Primary Clarifier 6 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0
3	Primary	Primary Clarifier 7 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0
4	Primary	Primary Clarifier 8 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0
5	Primary	Primary Clarifier 9 (Plant 1B)	5	2.48	25	$2,121,000	$2,121,000	20	10	0
6	Primary	Primary Clarifier 10 (Plant 1B)	5	2.48	25	$2,121,000	$2,121,000	20	10	0
7	Electrical	Switchgear M (Transformer 3, Plant 2)	5	2.25	34	$109,000	$109,000	30	15	0
8	Electrical	Switchgear W (Transformer 4, Plant 2)	5	2.25	34	$66,000	$66,000	30	15	0
9	Primary	Primary MCC 1 (Plant 1A, Pump Station 12)	5	1.78	18	$66,000	$66,000	20	10	0
10	Primary	Primary MCC 2 (Plant 1B, Pumps Station 13)	5	1.78	18	$66,000	$66,000	20	10	0
11	Primary	Sludge Pump 5	5	1.49	15	$127,000	$127,000	20	10	0
12	Primary	Sludge Pump 6	5	1.49	15	$127,000	$127,000	20	10	0
13	Primary	Sludge Pump 7	5	1.49	15	$127,000	$127,000	20	10	0
14	Primary	Sludge Pump 8	5	1.49	15	$127,000	$127,000	20	10	0
15	Primary	Sludge Pump 9	5	1.49	15	$127,000	$127,000	20	10	0
16	Primary	Primary Clarifier Structure Plant 1A	5	0.99	25	$1,745,000	$1,745,000	50	25	0

Table B.1 Summary of Assets with the Lowest Overall Condition Rankings[1]
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/Basin/ Zone	Major Component/Subbasin/ Subzone	Condition	Risk	Criticality	Replacement Value	Repair Cost[2]	Original Useful Life	Evaluated Remaining Useful Life	Economic Remaining Useful Life
17	Primary	Primary Clarifier Structure Plant 1B	5	0.99	25	$1,818,000	$1,818,000	50	25	0
18	Secondary	VFD for WAS 5 (Pump Station 6)	5	0.93	14	$14,000	$14,000	30	15	0
19	Secondary	VFD for WAS 6 (Pump Station 6)	5	0.93	14	$14,000	$14,000	30	15	0
20	Water Recycle	VFD for Recycle Pump 1	5	0.93	14	$73,000	$73,000	30	15	0
21	Primary	Pump Station 14	5	0.79	20	$198,000	$198,000	50	25	0
22	Primary	Distribution Box (Plant 1)	5	0.71	18	$147,000	$147,000	50	25	0
23	Primary	Steam Generator 2 (PS 4)	5	0.4	4	$485,000	$485,000	20	10	0
24	Digestion	Waste Gas Burner	4	2.23	31	$954,000	$250,797	20	14	4
24	Headworks	Biofilter 1	4	1.86	13	$336,000	$88,000	10	7	2
25	Headworks	Biofilter 2	4	1.86	13	$336,000	$88,000	10	7	2
26	Electrical	Transformer T1 (Plant 2)	4	1.63	34	$65,000	$17,000	30	21	6
27	Electrical	Transformer T2 (Plant 2)	4	1.63	34	$65,000	$17,000	30	21	6
28	Electrical	Transformer T3 (Plant 2)	4	1.63	34	$38,000	$10,000	30	21	6
29	Electrical	Transformer T4 (Plant 2)	4	1.63	34	$38,000	$10,000	30	21	6
30	Primary	Primary MCC 4 (S, Plant 2)	4	1.29	18	$66,000	$17,000	20	14	4
31	Water Recycle	Water Recycle Pump 6	4	1.01	14	$191,000	$50,000	20	14	4
32	Cogeneration	Air Compressor 1 (Pump and Air Compressor Room)	4	0.93	13	$6,000	$1,600	20	14	4

Table B.1 Summary of Assets with the Lowest Overall Condition Rankings[1]
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/Basin/ Zone	Major Component/Subbasin/ Subzone	Condition	Risk	Criticality	Replacement Value	Repair Cost[2]	Original Useful Life	Evaluated Remaining Useful Life	Economic Remaining Useful Life
33	Water Recycle	VFD for Recycle Pump 2	4	0.67	14	$73,000	$19,000	30	21	6
34	Water Recycle	VFD for Recycle Pump 5	4	0.67	14	$33,000	$9,000	30	21	6
35	Water Recycle	VFD for Recycle Pump 6	4	0.67	14	$33,000	$9,000	30	21	6
36	Water Recycle	VFD for Recycle Pump 7	4	0.67	14	$33,000	$9,000	30	21	6
37	Secondary	Scum Pump 2 (Plant 2)	4	0.65	9	$65,000	$17,000	20	14	4
38	Digestion	Pump Station 1	4	0.57	20	$233,000	$61,000	50	35	10
39	Buildings	Field Maintenance Storage Building	4	0.43	15	$376,000	$99,000	50	35	10
40	Dewatering	Polymer Bulk Transfer Pump 1	4	0.29	4	$18,000	$5,000	20	14	4
41	Dewatering	Polymer Bulk Transfer Pump 2	4	0.29	4	$18,000	$5,000	20	14	4
42	Buildings	Headquarters for Sewer Line Maintenance	4	0.17	6	$1,209,000	$318,000	50	35	10
43	Primary	Ferric Sulfate System (Plant 1)	3.9	0.9	18	$49,000	$14,000	31.3	20	4
44	Cogeneration	Cooling Tower (Gas Treatment Area)	3.8	0.76	13	$299,000	$73,000	22.7	17	6

Notes:
(1) Assets are ordered first by condition and second by risk values.
(2) Repair costs are project costs that include a contingency, general conditions, contractor overhead, sales tax, bid market allowances, and engineering, legal, and construction fees.

Appendix C

SUMMARY OF ASSETS WITH GREATEST RISK

Table C.1 Summary of Assets with Greatest Risk[1]
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/ Basin/Zone	Major Component/ Subbasin/ Subzone	Condition	Risk	Criticality	Replacement Value	Repair Cost[2]	Original Useful Life	Evaluated Remaining Useful Life	Economic Remaining Useful Life
1	Disinfection	Effluent Analyzers	2	2.59	37	$208,000	$-	15	14	6.8
2	Primary	Primary Clarifier 5 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0.1
3	Primary	Primary Clarifier 6 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0.1
4	Primary	Primary Clarifier 7 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0.1
5	Primary	Primary Clarifier 8 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0.1
6	Primary	Primary Clarifier 9 (Plant 1B)	5	2.48	25	$2,121,000	$2,121,000	20	10	0.1
7	Primary	Primary Clarifier 10 (Plant 1B)	5	2.48	25	$2,121,000	$2,121,000	20	10	0.1
8	Electrical	Switchgear M (Transformer 3, Plant 2)	5	2.25	34	$109,000	$109,000	30	15	0.1
9	Electrical	Switchgear W (Transformer 4, Plant 2)	5	2.25	34	$66,000	$66,000	30	15	0.1
10	Digestion	Waste Gas Burner	4	2.23	31	$954,000	$250,797	20	14	4
11	Disinfection	Sodium Bilsulfite Injector 1 (Basin 3)	2	1.94	37	$265,000	$-	20	19	9.1

Table C.1 Summary of Assets with Greatest Risk[1]
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/ Basin/Zone	Major Component/ Subbasin/ Subzone	Condition	Risk	Criticality	Replacement Value	Repair Cost[2]	Original Useful Life	Evaluated Remaining Useful Life	Economic Remaining Useful Life
12	Disinfection	Sodium Bilsulfite Injector 2 (Basin 3)	2	1.94	37	$265,000	$-	20	19	9.1
13	Disinfection	Sodium Hypo-Chlorite Injector 1 (Basin 3)	2	1.94	37	$265,000	$-	20	19	9.1
14	Disinfection	Sodium Hypo-Chlorite Injector 2 (Basin 3)	2	1.94	37	$265,000	$-	20	19	9.1
15	Headworks	Biofilter 1	4	1.86	13	$336,000	$88,000	10	7	2
16	Headworks	Biofilter 2	4	1.86	13	$336,000	$88,000	10	7	2
17	Disinfection	Sodium Bilsulfite Chemical Feed, North Unit	1	1.85	37	$15,000	$-	20	20	10
18	Disinfection	Sodium Bilsulfite Chemical Feed, South Unit	1	1.85	37	$15,000	$-	20	20	10
19	Disinfection	Sodium Hypo-Chlorite Injector 3	1	1.85	37	$265,000	$-	20	20	10
20	Disinfection	Sodium Hypo-Chlorite Injector 4	1	1.85	37	$265,000	$-	20	20	10
21	Primary	Primary MCC 1 (Plant 1A, Pump Station 12)	5	1.78	18	$66,000	$66,000	20	10	0

Table C.1 Summary of Assets with Greatest Risk[1]
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/ Basin/Zone	Major Component/ Subbasin/ Subzone	Condition	Risk	Criticality	Replacement Value	Repair Cost[2]	Original Useful Life	Evaluated Remaining Useful Life	Economic Remaining Useful Life
22	Primary	Primary MCC 2 (Plant 1B, Pumps Station 13)	5	1.78	18	$66,000	$66,000	20	10	0
23	Electrical	Transformer T1 (Plant 2)	4	1.63	34	$65,000	$17,000	30	21	6
24	Electrical	Transformer T2 (Plant 2)	4	1.63	34	$65,000	$17,000	30	21	6
25	Electrical	Transformer T3 (Plant 2)	4	1.63	34	$38,265	$10,059	30	21	6
26	Electrical	Transformer T4 (Plant 2)	4	1.63	34	$38,000	$10,000	30	21	6
27	Headworks	Headworks PLC	1	1.53	23	$26,000	$-	15	15	8
28	Primary	Sludge Pump 5	5	1.49	15	$127,000	$127,000	20	10	0
29	Primary	Sludge Pump 6	5	1.49	15	$127,000	$127,000	20	10	0
30	Primary	Sludge Pump 7	5	1.49	15	$127,000	$127,000	20	10	0
31	Primary	Sludge Pump 8	5	1.49	15	$127,000	$127,000	20	10	0
32	Primary	Sludge Pump 9	5	1.49	15	$127,000	$127,000	20	10	0
33	Tertiary	Control Panel	2	1.47	21	$26,000	$-	15	14	7
34	Primary	Primary Influent Meter (Plant 2)	2	1.4	20	$26,000	$-	15	14	7
35	Disinfection	MCC at CCB 3	2	1.37	39	$66,000	$-	30	29	14

Table C.1 Summary of Assets with Greatest Risk[1]
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/ Basin/Zone	Major Component/ Subbasin/ Subzone	Condition	Risk	Criticality	Replacement Value	Repair Cost[2]	Original Useful Life	Evaluated Remaining Useful Life	Economic Remaining Useful Life
36	Disinfection	MCC at the Dechlorination Bldg	2	1.37	39	$66,000	$-	30	29	14
37	Electrical	Switchgear A (Plant 2)	3	1.34	34	$109,000	$12,000	30	25	10
38	Electrical	Switchgear B (Plant 2)	3	1.34	34	$109,000	$12,000	30	25	10
39	Primary	Primary MCC 4 (S, Plant 2)	4	1.29	18	$66,000	$17,000	20	14	4
40	Headworks	Jurupa/Rubidoux Metering	2	1.26	18	$26,000	$-	15	14	7
41	Headworks	Riverside/Hillside Influent Metering	2	1.26	18	$26,000	$-	15	14	7
42	Tertiary	Influent Pump 1 (Filters 1-10)	3	1.26	21	$612,000	$66,000	20	17	7
43	Tertiary	Influent Pump 2 (Filters 1-10)	3	1.26	21	$612,000	$66,000	20	17	7
44	Tertiary	Influent Pump 3 (Filters 1-10)	3	1.26	21	$612,000	$66,000	20	17	7

Notes:
(1) Assets are ordered by risk values.
(2) Repair costs are project costs that include a contingency, general conditions, contractor overhead, sales tax, bid market allowances, and engineering, legal, and construction fees.

Appendix D

EVALUATED REMAINING USEFUL LIFE

Table D.1 Evaluated Remaining Useful Life[1]
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/ Basin/Zone	Major Component/ Subbasin/ Subzone	Condition	Risk	Criticality	Replacement Value	Repair Cost[2]	Original Useful Life	Evaluated Remaining Useful Life	Economic Remaining Useful Life
1	Headworks	Biofilter 1	4	1.86	13	$336,000	$88,000	10	7	2
2	Headworks	Biofilter 2	4	1.86	13	$336,000	$88,000	10	7	2
3	Primary	Primary Clarifier 5 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0
4	Primary	Primary Clarifier 6 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0
5	Primary	Primary Clarifier 7 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0
6	Primary	Primary Clarifier 8 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0
7	Primary	Primary Clarifier 9 (Plant 1B)	5	2.48	25	$2,121,000	$2,121,000	20	10	0
8	Primary	Primary Clarifier 10 (Plant 1B)	5	2.48	25	$2,121,000	$2,121,000	20	10	0
9	Primary	Primary MCC 1 (Plant 1A, Pump Station 12)	5	1.78	18	$66,000	$66,000	20	10	0
10	Primary	Primary MCC 2 (Plant 1B, Pumps Station 13)	5	1.78	18	$66,000	$66,000	20	10	0
11	Primary	Sludge Pump 5	5	1.49	15	$127,000	$127,000	20	10	0
12	Primary	Sludge Pump 6	5	1.49	15	$127,000	$127,000	20	10	0

Table D.1 Evaluated Remaining Useful Life[1]
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/ Basin/Zone	Major Component/ Subbasin/ Subzone	Condition	Risk	Criticality	Replacement Value	Repair Cost[2]	Original Useful Life	Evaluated Remaining Useful Life	Economic Remaining Useful Life
13	Primary	Sludge Pump 7	5	1.49	15	$127,000	$127,000	20	10	0
14	Primary	Sludge Pump 8	5	1.49	15	$127,000	$127,000	20	10	0
15	Primary	Sludge Pump 9	5	1.49	15	$127,000	$127,000	20	10	0
16	Primary	Steam Generator 2 (PS 4)	5	0.4	4	$485,000	$485,000	20	10	0
17	Primary	Primary MCC 4 (S, Plant 2)	4	1.29	18	$66,000	$17,000	20	14	4
18	Water Recycle	Water Recycle Pump 6	4	1.01	14	$191,000	$50,000	20	14	4
19	Cogeneration	Air Compressor 1 (Pump and Air Compressor Room)	4	0.93	13	$6,000	$2,000	20	14	4
20	Secondary	Scum Pump 2 (Plant 2)	4	0.65	9	$65,000	$17,000	20	14	4
21	Dewatering	Polymer Bulk Transfer Pump 1	4	0.29	4	$18,000	$5,000	20	14	4
22	Dewatering	Polymer Bulk Transfer Pump 2	4	0.29	4	$18,000	$5,000	20	14	4
23	Disinfection	Effluent Analyzers	2	2.59	37	$208,000	$-	15	14	7
24	Digestion	Waste Gas Burner	4	2.23	31	$954,000	$250,797	20	14	4
25	Tertiary	Control Panel	2	1.47	21	$26,000	$-	15	14	7

Table D.1 Evaluated Remaining Useful Life[1]
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/ Basin/Zone	Major Component/ Subbasin/ Subzone	Condition	Risk	Criticality	Replacement Value	Repair Cost[2]	Original Useful Life	Evaluated Remaining Useful Life	Economic Remaining Useful Life
26	Primary	Primary Influent Meter (Plant 2)	2	1.4	20	$26,000	$-	15	14	7
27	Headworks	Jurupa/Rubidoux Metering	2	1.26	18	$26,000	$-	15	14	7
28	Headworks	Riverside/Hillside Influent Metering	2	1.26	18	$26,000	$-	15	14	7
29	Headworks	Headworks PLC	1	1.53	23	$26,000	$-	15	15	8
30	Secondary	WAS Flow Meter 1 (Plant 1, Pump Station 22)	1	1.2	18	$11,000	$-	15	15	8
31	Secondary	WAS Flow Meter 2 (Plant 2, Pump Station 16)	1	1.2	18	$11,000	$-	15	15	8
32	Cogeneration	Cogen Monitoring System	1	1.2	18	$132,000	$-	15	15	8
33	Outfall/Effluent Disposal	Effluent Metering	1	1.2	18	$26,000	$-	15	15	8
34	Cogeneration	Calorimeter	1	0.53	8	$2,000	$-	15	15	8
35	Electrical	Switchgear M (Plant 2)	5	2.25	34	$109,000	$109,000	30	15	0
36	Electrical	Switchgear W (Plant 2)	5	2.25	34	$66,000	$66,000	30	15	0

Table D.1 Evaluated Remaining Useful Life[1]
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/ Basin/Zone	Major Component/ Subbasin/ Subzone	Condition	Risk	Criticality	Replacement Value	Repair Cost[2]	Original Useful Life	Evaluated Remaining Useful Life	Economic Remaining Useful Life
37	Secondary	VFD for WAS 5 (Pump Station 6)	5	0.93	14	$14,000	$14,000	30	15	0
38	Secondary	VFD for WAS 6 (Pump Station 6)	5	0.93	14	$14,000	$14,000	30	15	0
39	Water Recycle	VFD for Recycle Pump 1	5	0.93	14	$73,000	$73,000	30	15	0

Notes:
(1) Assets are ordered by first by Evaluated Remaining Useful Life and second by risk values.
(2) Repair costs are project costs that include a contingency, general conditions, contractor overhead, sales tax, bid market allowances, and engineering, legal, and construction fees.

Appendix E

ECONOMIC REMAINING USEFUL LIFE

Table E.1 Economic Remaining Useful Life[1]
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/ Basin/Zone	Major Component/ Subbasin/ Subzone	Condition	Risk	Criticality	Replacement Value	Repair Cost[2]	Original Useful Life	Evaluated Remaining Useful Life	Economic Remaining Useful Life
1	Primary	Primary Clarifier 5 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0
2	Primary	Primary Clarifier 6 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0
3	Primary	Primary Clarifier 7 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0
4	Primary	Primary Clarifier 8 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0
5	Primary	Primary Clarifier 9 (Plant 1B)	5	2.48	25	$2,121,000	$2,121,000	20	10	0
6	Primary	Primary Clarifier 10 (Plant 1B)	5	2.48	25	$2,121,000	$2,121,000	20	10	0
7	Electrical	Switchgear M (Transformer 3, Plant 2)	5	2.25	34	$109,000	$109,000	30	15	0
8	Electrical	Switchgear W (Transformer 4, Plant 2)	5	2.25	34	$66,000	$66,000	30	15	0
9	Primary	Primary MCC 1 (Plant 1A, Pump Station 12)	5	1.78	18	$66,000	$66,000	20	10	0

Table E.1 Economic Remaining Useful Life[1]
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/ Basin/Zone	Major Component/ Subbasin/ Subzone	Condition	Risk	Criticality	Replacement Value	Repair Cost[2]	Original Useful Life	Evaluated Remaining Useful Life	Economic Remaining Useful Life
10	Primary	Primary MCC 2 (Plant 1B, Pumps Station 13)	5	1.78	18	$66,000	$66,000	20	10	0
11	Primary	Sludge Pump 5	5	1.49	15	$127,000	$127,000	20	10	0
12	Primary	Sludge Pump 6	5	1.49	15	$127,000	$127,000	20	10	0
13	Primary	Sludge Pump 7	5	1.49	15	$127,000	$127,000	20	10	0
14	Primary	Sludge Pump 8	5	1.49	15	$127,000	$127,000	20	10	0
15	Primary	Sludge Pump 9	5	1.49	15	$127,000	$127,000	20	10	0
16	Secondary	VFD for WAS 5 (Pump Station 6)	5	0.93	14	$14,000	$14,000	30	15	0
17	Secondary	VFD for WAS 6 (Pump Station 6)	5	0.93	14	$14,000	$14,000	30	15	0
18	Water Recycle	VFD for Recycle Pump 1	5	0.93	14	$73,000	$73,000	30	15	0
19	Primary	Steam Generator 2 (PS 4)	5	0.4	4	$485,000	$485,000	20	10	0
20	Primary	Primary Clarifier Structure Plant 1A	5	0.99	25	$1,745,000	$1,745,000	50	25	0
21	Primary	Primary Clarifier Structure Plant 1B	5	0.99	25	$1,818,000	$1,818,000	50	25	0
22	Primary	Pump Station 14	5	0.79	20	$198,000	$198,000	50	25	0

Table E.1 Economic Remaining Useful Life[1]
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/ Basin/Zone	Major Component/ Subbasin/ Subzone	Condition	Risk	Criticality	Replacement Value	Repair Cost[2]	Original Useful Life	Evaluated Remaining Useful Life	Economic Remaining Useful Life
23	Primary	Distribution Box (Plant 1)	5	0.71	18	$147,000	$147,000	50	25	0
24	Headworks	Biofilter 1	4	1.86	13	$336,000	$88,000	10	7	2
25	Headworks	Biofilter 2	4	1.86	13	$336,000	$88,000	10	7	2
26	Digestion	Waste Gas Burner	4	2.23	31	$954,000	$250,797	20	14	4
27	Primary	Primary MCC 4 (S, Plant 2)	4	1.29	18	$66,000	$17,000	20	14	4
28	Water Recycle	Water Recycle Pump 6	4	1.01	14	$191,000	$50,000	20	14	4
29	Cogeneration	Air Compressor 1 (Pump and Air Compressor Room)	4	0.93	13	$6,000	$2,000	20	14	4
30	Secondary	Scum Pump 2 (Plant 2)	4	0.65	9	$65,000	$17,000	20	14	4
31	Dewatering	Polymer Bulk Transfer Pump 1	4	0.29	4	$18,000	$5,000	20	14	4
32	Dewatering	Polymer Bulk Transfer Pump 2	4	0.29	4	$18,000	$5,000	20	14	4
33	Primary	Ferric Sulfate System (Plant 1)	3.9	0.9	18	$49,000	$14,000	31	20	4
34	Cogeneration	Cooling Tower (Gas Treatment Area)	3.8	0.76	13	$299,000	$73,000	23	17	6

Table E.1 Economic Remaining Useful Life[1]
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/ Basin/Zone	Major Component/ Subbasin/ Subzone	Condition	Risk	Criticality	Replacement Value	Repair Cost[2]	Original Useful Life	Evaluated Remaining Useful Life	Economic Remaining Useful Life
35	Electrical	Transformer T1 (Plant 2)	4	1.63	34	$65,000	$17,000	30	21	6
36	Electrical	Transformer T2 (Plant 2)	4	1.63	34	$65,000	$17,000	30	21	6
37	Electrical	Transformer T3 (Plant 2)	4	1.63	34	$38,000	$10,000	30	21	6
38	Electrical	Transformer T4 (Plant 2)	4	1.63	34	$38,000	$10,000	30	21	6
39	Water Recycle	VFD for Recycle Pump 2	4	0.67	14	$73,000	$19,000	30	21	6
40	Water Recycle	VFD for Recycle Pump 5	4	0.67	14	$33,000	$10,000	30	21	6
41	Water Recycle	VFD for Recycle Pump 6	4	0.67	14	$33,000	$9,000	30	21	6
42	Water Recycle	VFD for Recycle Pump 7	4	0.67	14	$33,000	$9,000	30	21	6

Notes:
(1) Assets are ordered by first by Economic Remaining Useful Life and second by risk values.
(2) Repair costs are project costs that include a contingency, general conditions, contractor overhead, sales tax, bid market allowances, and engineering, legal, and construction fees.

Appendix F

SUMMARY OF ASSETS WITH GREATEST REPAIR COSTS

Table F.1 Summary of Assets with Greatest Repair Costs[1]
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/ Basin/Zone	Major Component/ Subbasin/Subzone	Condition	Risk	Criticality	Replacement Value	Repair Cost[2]	Original Useful Life	Evaluated Remaining Useful Life	Economic Remaining Useful Life
1	Primary	Primary Clarifier 9 (Plant 1B)	5	2.48	25	$2,121,000	$2,121,000	20	10	0
2	Primary	Primary Clarifier 10 (Plant 1B)	5	2.48	25	$2,121,000	$2,121,000	20	10	0
3	Primary	Primary Clarifier Structure Plant 1B	5	0.99	25	$1,818,000	$1,818,000	50	25	0
4	Primary	Primary Clarifier Structure Plant 1A	5	0.99	25	$1,745,000	$1,745,000	50	25	0
5	Primary	Primary Clarifier 5 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0
6	Primary	Primary Clarifier 6 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0
7	Primary	Primary Clarifier 7 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0
8	Primary	Primary Clarifier 8 (Plant 1A)	5	2.48	25	$1,018,000	$1,018,000	20	10	0
9	Digestion	Anaerobic Digester 4	2.6	0.40	16	$10,907,000	$832,000	43.1	40	18
10	Primary	Steam Generator 2 (PS 4)	5	0.4	4	$485,000	$485,000	20	10	0
11	Dewatering	Sludge Dewatering Building	3	0.14	6	$3,637,000	$394,000	50	42	17

Table F.1 Summary of Assets with Greatest Repair Costs[1]
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/ Basin/Zone	Major Component/ Subbasin/Subzone	Condition	Risk	Criticality	Replacement Value	Repair Cost[2]	Original Useful Life	Evaluated Remaining Useful Life	Economic Remaining Useful Life
12	Buildings	Headquarters for Sewer Line Maintenance	4	0.17	6	$1,209,000	$318,000	50	35	10
13	Primary	Primary Clarifier 2 (Plant 2)	2.4	0.58	25	$2,310,000	$303,000	45	43	21
14	Primary	Primary Clarifier 4 (Plant 2)	2.4	0.58	25	$2,310,000	$303,000	45	43	21
15	Buildings	Van Buren Storage	3	0.14	6	$2,424,000	$263,000	50	42	17
16	Digestion	Waste Gas Burner	4	2.23	31	$954,000	$250,797	20	14	4
17	Secondary	Clarifier 2 (Plant 2)	2.1	0.58	25	$3,573,000	$236,000	44.3	43	21
18	Secondary	Clarifier 1 (Plant 2)	2.1	0.58	25	$3,573,000	$236,000	44.3	43	21
19	Primary	Pump Station 14	5	0.79	20	$198,000	$198,000	50	25	0
20	Secondary	Clarifier 3 (Plant 2)	2.2	0.59	25	$2,533,000	$185,000	43.7	42	21
21	Aeration	Blower 2 (Blower Bldg 2)	3	0.59	10	$1,439,000	$156,000	20	17	7
22	Aeration	Blower 3 (Blower Bldg 2)	3	0.59	10	$1,439,000	$156,000	20	17	7
23	Aeration	Blower 4 (Blower Bldg 2)	3	0.59	10	$1,439,000	$156,000	20	17	7
24	Primary	Distribution Box (Plant 1)	5	0.71	18	$147,000	$147,000	50	25	0

Table F.1 Summary of Assets with Greatest Repair Costs[1]
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/ Basin/Zone	Major Component/ Subbasin/Subzone	Condition	Risk	Criticality	Replacement Value	Repair Cost[2]	Original Useful Life	Evaluated Remaining Useful Life	Economic Remaining Useful Life
25	Aeration	Blower Building 2	2.4	0.35	15	$3,413,000	$145,000	46.3	43	20
26	Buildings	Old Administration Building	3	0.14	6	$1,284,000	$139,000	50	42	17
27	Primary	Sludge Pump 5	5	1.49	15	$127,000	$127,000	20	10	0
28	Primary	Sludge Pump 6	5	1.49	15	$127,000	$127,000	20	10	0
29	Primary	Sludge Pump 7	5	1.49	15	$127,000	$127,000	20	10	0
30	Primary	Sludge Pump 8	5	1.49	15	$127,000	$127,000	20	10	0
31	Primary	Sludge Pump 9	5	1.49	15	$127,000	$127,000	20	10	0
32	Electrical	Switchgear M (Transformer 3, Plant 2)	5	2.25	34	$109,000	$109,000	30	15	0
33	Buildings	Maintenance Building	3	0.35	15	$973,000	$105,000	50	42	17
34	Buildings	Field Maintenance Storage Building	4	0.43	15	$376,000	$99,000	50	35	10
35	Headworks	Biofilter 1	4	1.86	13	$336,000	$88,000	10	7	2
36	Headworks	Biofilter 2	4	1.86	13	$336,000	$88,000	10	7	2
37	Disinfection	Chlorine Contact Basin 1	2.3	0.57	26	$1,526,000	$77,000	48.2	45	21
38	Cogeneration	Cooling Tower (Gas Treatment Area)	3.8	0.76	13	$299,000	$73,000	22.7	17	6

Table F.1 Summary of Assets with Greatest Repair Costs[1]
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/ Basin/Zone	Major Component/ Subbasin/Subzone	Condition	Risk	Criticality	Replacement Value	Repair Cost[2]	Original Useful Life	Evaluated Remaining Useful Life	Economic Remaining Useful Life
39	Water Recycle	VFD for Recycle Pump 1	5	0.93	14	$73,000	$73,000	30	15	0
40	Thickening	DAF Thickener 1	2.1	0.42	16	$1,575,000	$68,000	39.2	38	19
41	Tertiary	Influent Pump 1 (Filters 1-10)	3	1.26	16	$612,000	$66,000	20	17	7
42	Tertiary	Influent Pump 2 (Filters 1-10)	3	1.26	16	$612,000	$66,000	20	17	7
43	Tertiary	Influent Pump 3 (Filters 1-10)	3	1.26	16	$612,000	$66,000	20	17	7
44	Primary	Primary MCC 1 (Plant 1A, Pump Station 12)	5	1.78	18	$66,000	$66,000	20	10	0
45	Primary	Primary MCC 2 (Plant 1B, Pumps Station 13)	5	1.78	18	$66,000	$66,000	20	10	0
46	Electrical	Switchgear W (Transformer 4, Plant 2)	5	2.25	34	$66,000	$66,000	30	15	0
47	Digestion	Pump Station 1	4	0.57	20	$233,000	$61,000	50	35	10
48	Equalization	Junction Box 9	2.3	0.41	18	$494,000	$56,000	46	44	22

Table F.1 Summary of Assets with Greatest Repair Costs[1]
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

No.	Treatment Process/ Basin/Zone	Major Component/ Subbasin/Subzone	Condition	Risk	Criticality	Replacement Value	Repair Cost[2]	Original Useful Life	Evaluated Remaining Useful Life	Economic Remaining Useful Life
49	Primary	Steam Generator 1 (Plant 1)	3	0.24	4	$485,000	$53,000	20	17	7
50	Water Recycle	Water Recycle Pump 6	4	1.01	14	$191,000	$50,000	20	14	4

Notes:
(1) Assets are ordered by first by repair costs and second by risk values.
(2) Repair costs are project costs that include a contingency, general conditions, contractor overhead, sales tax, bid market allowances, and engineering, legal, and construction fees.