City of Riverside Public Works Department

Update of the Integrated Master Plan for the Wastewater Collection and Treatment Facilities

VOLUME 4: WASTEWATER TREATMENT SYSTEMS

CHAPTER 4: PRELIMINARY TREATMENT

APPENDIX 4A: RWQCP INFLUENT FLOWMETERS

FINAL | June 2019

City of Riverside Public Works Department

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APPENDIX 4A: RWQCP INFLUENT FLOWMETERS

Carollo Project No. 10495A00

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Date: 2019.07.17 06:27:24-07'00'

Contents

Attachments

Tables

Figures

Section 1

PURPOSE

The purpose of this report is to summarize the evaluation of options for installing centralized magnetic flowmeters for the Acorn, Arlanza, and Santa Ana Trunk Sewers, as well as considering a single combined master meter to measure all flow entering the plant. The following was included in the analysis:

- An option for installing a centralized flow metering structure for all the influent flow to the RWQCP, a master meter.
- Options for installing a common magnetic flowmeter for the Acorn and Arlanza Trunk Sewers.
- Confirmation of the proposed location for the Santa Trunk Sewer magnetic flowmeter.
- Developing a preliminary layout for the two metering structures, including the location of automatic water quality sampling equipment.
- Evaluation of hydraulics to identify impacts to upstream trunk sewers as well as existing downstream facilities such as the headworks, primary clarifiers, and PE EQ basins.
- Developing a preliminary construction cost estimate for the most viable metering project to be included as a project in the Headworks area in the CIP.

Section 2

BACKGROUND

The City's Public Works Department operates a comprehensive wastewater treatment and disposal system that serves most of the City, as well as the CSDs of Jurupa, Rubidoux, and Edgemont, and the community of Highgrove. The City added an evaluation of options to improve the influent flow metering to RWQCP to the scope of this update to the Master Plan.

The influent flow to the RWQCP is routed through five trunk sewers and is metered as follows:

- Rubidoux trunk sewer: 14-inch ABB MagMaster electromagnetic flowmeter.
- Jurupa trunk sewer: Flo-Dar radar velocity and ultrasonic depth flowmeter.
- Acorn and Arlanza trunk sewers: Combined at a junction structure within the Plant and their combined flow is metered with a Flo-Dar unit.
- Santa Ana River (Riverside/Hillside) trunk sewers: Combined at a junction structure upstream of the Plant and their combined flow is also metered with a Flo-Dar unit.

These four meters are at different locations and have varying accuracy. A study commissioned by the City and completed by URS proposed adding three magnetic flowmeters on the influent lines along Acorn, Arlanza, and Santa Ana trunk sewers. A copy of URS's 2014 report is included in Attachment A.

Section 3

DESIGN CONSIDERATIONS AND EVALUATION CRITERIA

The following sections summarize the design considerations for the magnetic flowmeter facilities as well as the criteria used to evaluate the magnetic flowmeter structures. These criteria include those discussed in Volume 3, Chapter 5, Planning Criteria and Design Flows, in this update to the Master Plan as well as design velocities and slopes specific to the flowmeter implementation requirements. Specifically, major facility design requirements and considerations that will ultimately impact the magnetic flowmeter site layout and hydraulics are included in the following sections.

3.1 Magnetic Flowmeters Design

Typical magnetic flowmeters have straight pipe requirements specified by the manufacturer. Straight pipe requirements are the minimum length of pipe required upstream and downstream of the flowmeter to ensure accuracy. Typically, straight pipe requirements are expressed as a multiple of the flowmeter's diameter (e.g., 5D meaning five times the pipe's diameter). URS's 2014 report reviewed four commercial vendors' straight pipe requirements. For conservative planning purposes preliminary layouts will use the longest straight pipe requirements of the four venders and is summarized below:

- Upstream straight pipe requirements is five times the pipe diameter.
- Downstream straight pipe requirements is three times the pipe diameter.

Typical magnetic flowmeters operate under full pipe flow conditions only. There are two methods to achieve such conditions in a gravity sewer system. First, you can reduce a section of pipe to a smaller diameter thus ensuring the smaller section of pipe is always full. The magnetic flowmeter would then be installed in this smaller section of pipe. However, due to diurnal low flow conditions, reducing the pipe to a diameter small enough to be full under low flow conditions would result in velocities that far exceed the acceptable maximum of 5 fps during average and peak conditions. Therefore, the second alternative is the inverted siphon. In this configuration, flows are diverted from the gravity sewer into a pipe segment that drops in elevation, hence the name "inverted siphon." The magnetic flowmeter is installed in the lowest portion of the pipe and is full at all times under all flow conditions. Recent developments in magnetic flow meter technology allow for partially full pipe operation, even for sewer lines. Because this approach is relatively new, there are not many examples of where it has been used. Therefore, for the purposes of this Master Plan Update, the inverted siphon approach has been assumed. The option to use magnetic flow meters that can operate with partially full pipes can be considered during preliminary design. Design considerations for inverted siphons are discussed in more detail in the following sections.

3.2 Inverted Siphon Design

An inverted siphon is a pipe that dips below the HGL meaning that it is always under pressurized conditions even at low flow. The following are things to consider when designing an inverted siphon:

- Solids depositions under low flow conditions (Metcalf & Eddy, 1981).
- Clogging from large objects caught on bends (Metcalf & Eddy, 1981).
- Frequent and challenging cleaning requirements (Metcalf & Eddy, 1981).
- Foul odors caused by positive pressures developed in the sewer atmosphere upstream from an inverted siphon because of the downstream movement of air induced by the sewer flow (ASCE No. 60).

The objective when sizing inverted siphons is to provide adequate self-cleaning velocities under a wide range of conditions. ASCE Manuals and Reports on Engineering Practice No. 60 outlines the following design considerations when designing inverted siphons.

- A velocity of 2 to 3 fps must be reached at least once each day.
- Some agencies limit the rising slope to 15 percent, but slopes as great as 50 percent are used in some places.
- There should be no change of pipe diameter within the length of a siphon to reduce issues with cleaning operations.

3.3 Evaluation Criteria

Inverted siphon velocity criteria was developed for minimum DWF, ADWF, and PWWF conditions, and is summarized in Table 1.

Table 1 Design Velocities for Given Flow Conditions

Flow Condition	Minimum Velocity (fps)	Maximum Velocity (fps)
Minimum DWF	>2 fps at least once every 24-hours	<10 fps
ADWF	>3 fps once every 24-hours and Average velocity >2 fps	<10 fps
PWWF	Average velocity >3 fps	<10 fps

Notes:
(1) ASCE Manual and Reports on Engineering Practice No. 60, Second Edition.

Section 4

CENTRALIZED MASTER FLOW METERING STRUCTURE

In order to address the issues related with existing flowmeters listed above, the first alternative considered was a centralized flow metering structure (master meter) to measure combined flow to the RWQCP. Figure 1 shows a preliminary layout and potential location of the centralized flow metering structure over the existing odor control biofilter. Influent flow from the Rubidoux,

Jurupa, and Santa Ana trunk sewers junction box north of the headworks, would be re-routed to the upstream side of the new metering structure. The pipe carrying flow from the A/A trunk sewer line would be extended so that it can also flow into the upstream side of the centralized metering structure.

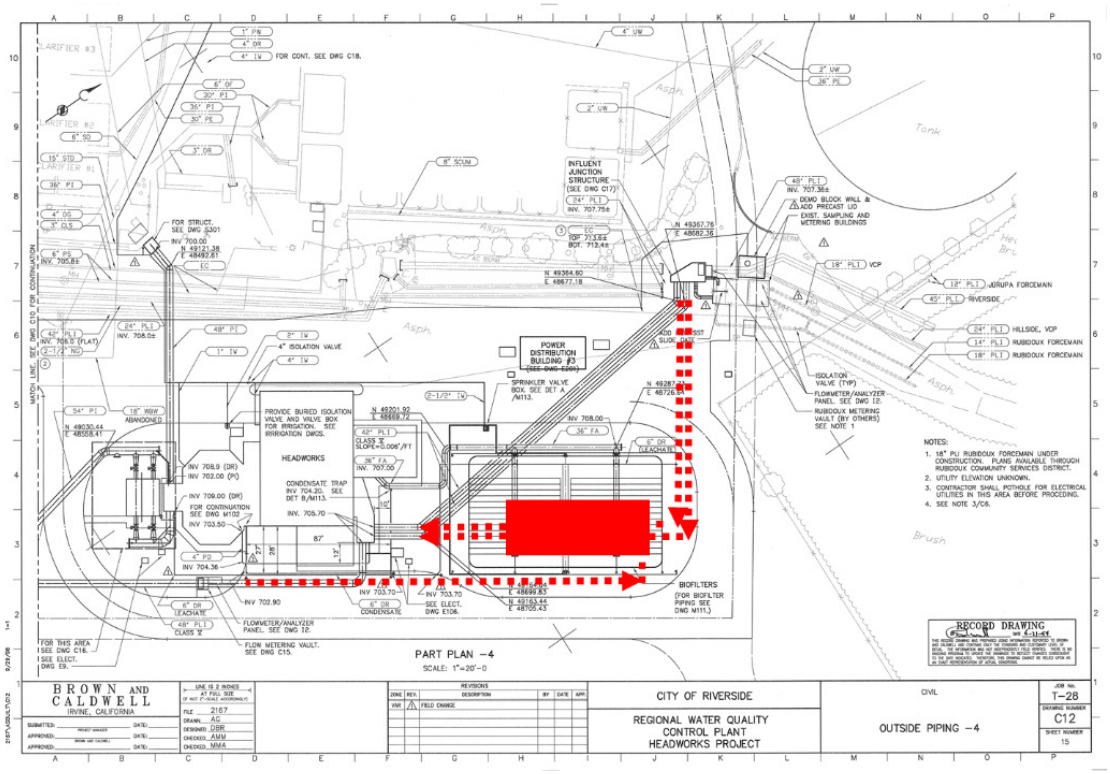

Figure 1 Centralized Flow Metering Structure Conceptual Layout

A preliminary hydraulics evaluation for the schematic layout in Figure 1 showed that about 4 feet of head is required for the flow metering structure to be operational. An earlier analysis of the capacity of the A/A Trunk Sewer, detailed in Volume 3, Chapter 7, Appendix 7A, Acorn/Arlanza Trunk Sewer Analysis, showed that this sewer is currently experiencing backwater conditions due to flow restrictions at the headworks. Modifications to the headworks would be needed to reduce the HGL by approximately 1 foot to prevent the backwater conditions.

Accordingly, to accommodate a reduction of 4-feet would require major modifications to the existing screenings channels and grit basins at the RWQCP, in order to gain the additional head for the flow metering structure. Some of the major modifications include:

1. Installing one new screenings channel.
2. Installing two new grit basins.
3. Relocating the odor control facility.

The approximate rehabilitation cost for such a headworks hydraulics project will be in the range of $50 to $70 million, including the cost for the new centralized metering structure and relocation of the existing odor control facility.

Because of the high cost of this project and the complexity of construction, this alternative has not been evaluated any further.

Section 5

HYDRAULIC ANALYSIS FOR SANTA ANA AND A/A TRUNK SEWERS

In this section, consideration is given to combining the Acorn and Arlanza meters into a single magnetic flowmeter to reduce the total number of influent meters, and the location of the proposed Santa Ana trunk sewer flowmeter is evaluated.

The hydraulic model developed as part of Volume 3, Chapter 7, Capacity Evaluation and Proposed Improvements, was updated to include details of the proposed flowmeter locations. One of the challenges is properly sizing the inverted siphon to meet evaluation criteria under varying conditions. The following sections summarize the hydraulic model results for the Santa Ana and A/A Trunk Sewer flowmeter structures.

5.1 Santa Ana Flowmeter

Figure 2 shows the modeled layout of the Santa Ana Flowmeter Facility. The facility site was chosen because it is downstream of the Santa Ana Trunk parallel sewer lines and avoids interfering with existing facilities. The facility consists of a diversion structure that will divert flow to the inverted siphon that is parallel to the existing trunk sewer. The existing trunk sewer will be converted to a bypass line when the inverted siphon requires maintenance. Table 2, Table 3, and Table 4 summarize the modeled velocities under various flow conditions, for 24-inch, 30-inch, and 36-inch diameter siphons, respectively.

As the data in the tables indicates, no single inverted siphon diameter is able to meet velocity evaluation criteria for both existing and build-out conditions. A 24-inch diameter meter would work well for existing conditions, but would be too small once build-out is reached. A 30-inch diameter meter would also work for existing conditions, but would be too small for the build-out peak flow conditions. A 36-inch diameter meter would be too big for existing conditions, but suitable for build-out.

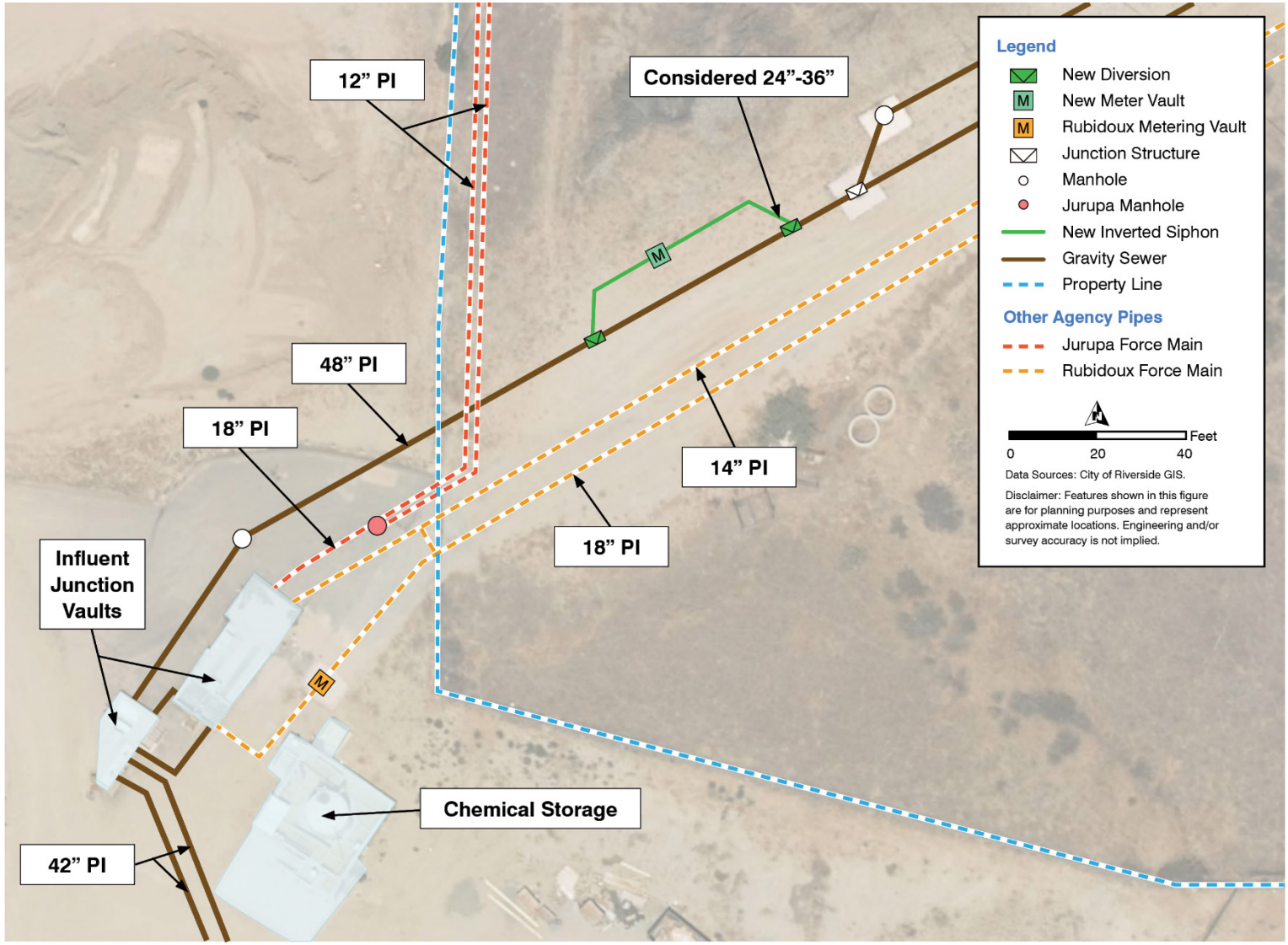

Figure 2 Modeled Santa Ana Trunk Flowmeter Facility

Table 2 Santa Ana 24-Inch Inverted Siphon - Velocity Summary

Velocity (fps)	Existing Minimum DWF(1)	Existing ADWF	Existing PWWF(2)	Build-Out ADWF	Build-Out PWWF(2)
Average	4.61	7.59	7.64	9.20	12.30
Maximum	5.66	9.36	9.34	11.53	15.01
Minimum	2.62	4.40	4.32	5.12	7.24

Notes:
(1) Minimum DWF = 34% ADWF.
(2) Assumes 10-year 24-hour storm event.

Table 3 Santa Ana 30-Inch Inverted Siphon - Velocity Summary

Velocity (fps)	Existing Minimum DWF(1)	Existing ADWF	Existing PWWF(2)	Build-Out ADWF	Build-Out PWWF(2)
Average	2.66	4.77	4.79	6.07	8.51
Maximum	3.37	5.99	5.98	7.53	12.97
Minimum	1.34	2.48	2.43	3.54	4.95

Notes:
(1) Minimum DWF = 34% ADWF.
(2) Assumes 10-year 24-hour storm event.

Table 4 Santa Ana 36-Inch Inverted Siphon - Velocity Summary

Velocity (fps)	Existing Minimum DWF(1)	Existing ADWF	Existing PWWF(2)	Build-Out ADWF	Build-Out PWWF(2)
Average	1.85	3.31	3.33	4.46	6.03
Maximum	2.33	4.16	4.15	5.51	9.07
Minimum	0.94	1.72	1.69	2.62	3.65

Notes:
(1) Minimum DWF = 34% ADWF.
(2) Assumes 10-year 24-hour storm event.

Accordingly, if the City were to construct this flowmeter facility, it is recommended that it is constructed so that the inverted siphons can be swapped with a larger-diameter pipeline in the future. It is recommended that the City initially install a 30-inch diameter inverted siphon to handle existing conditions. Eventually the City will replace this with a 36-inch diameter inverted siphon as flow rates increase.

It is hard to predict when the inverted siphon would need to be upsized because future RDII is unknown. For the purpose of this analysis, it is assumed that any upsize to the inverted siphon will occur when the diversion structure upstream of the siphon surcharges within 3 feet of the rim. The

hydraulic analysis shows that this condition will occur with the 30-inch diameter inverted siphon when flow reaches approximately 32 mgd in the Santa Ana trunk sewer, as shown in Figure 3.

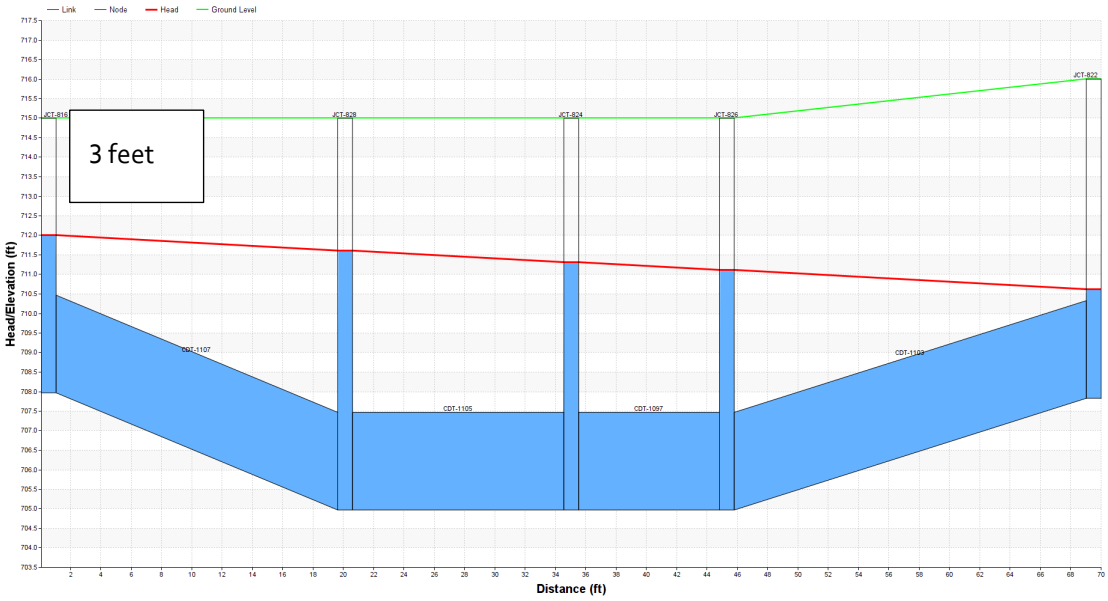

Figure 3 Santa Ana - 30-Inch Diameter Inverted Siphon HGL at 32 mgd

Figure 4 and Figure 5 show the HGL for the recommended 30-inch diameter and 36-inch diameter inverted siphons under existing and build-out PWWF conditions, respectively. The figures show that the recommended inverted siphon diameters will not exceed the surcharge criteria.

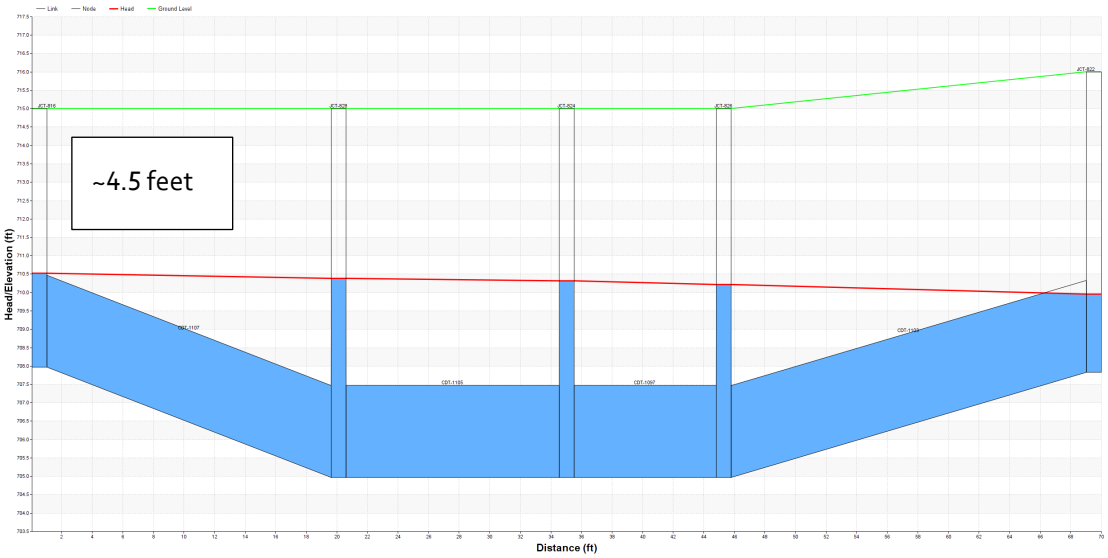

Figure 4 Santa Ana - 30-Inch Diameter Inverted Siphon HGL Under Existing PWWF Conditions

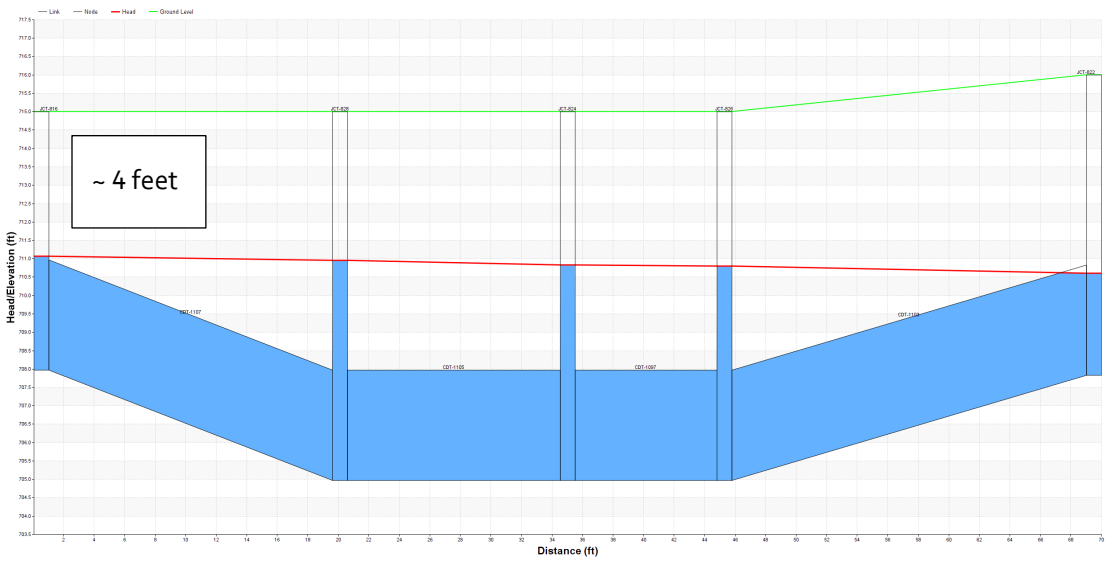

Figure 5 Santa Ana - 36-Inch Diameter Inverted Siphon HGL Under Build-Out PWWF Conditions

5.2 Acorn/Arlanza Combined Flowmeter

Previous studies recommend separate magnetic metering structures along the A/A Trunk Sewer. The City is interested in combining the flowmeter structures along the A/A Trunk Sewer to reduce costs. An earlier hydraulic analysis, as part of the Master Plan process, was completed to further understand the hydraulics of the A/A Trunk Sewer. A copy of this analysis can be found in Volume 3, Chapter 7, Appendix 7A, Acorn/Arlanza Trunk Sewer Analysis, of this update to the Master Plan. The hydraulic analysis showed that the A/A Trunk Sewer has sufficient capacity to convey existing PWWF conditions. Additionally, the analysis indicates that any surcharge conditions are caused by backwater effects created by hydraulic boundary conditions at the RWQCP's headworks.

For the purpose of this update to the Master plan, it is assumed that the combined flowmeter structure along the A/A Trunk Sewer would consist of a diversion structure to route flow to the inverted siphon parallel to the existing trunk sewer. The existing trunk sewer would be converted to a bypass line to be used when the inverted siphon requires maintenance.

Figure 6 shows the layout of the modeled A/A Trunk Sewer Flowmeter Facility. The hydraulic model showed that, when the metering site was moved further upstream, it caused backwater effects along the Arlanza trunk sewer. The site location on the A/A Trunk Sewer, on the north edge of the car park, was selected in order to minimize the impacts upstream and to be outside of the maintenance yard.

Figure 6 Modeled A/A Trunk Sewer Flowmeter Facility

Table 5, Table 6, and Table 7 summarize the modeled velocities under various flow conditions, for 24-inch, 30-inch, and 36-inch diameter siphons, respectively. According to Table 5, a 24-inch diameter inverted siphon satisfies the velocity criteria for both existing and build-out conditions. Figure 7 compares the minimum DWF conditions for the three different meter sizes and shows that a 24-inch diameter inverted siphon is able to maintain velocities above 2 fps for a majority of the day. On the other hand, the profiles for the 30-inch and 36-inch diameter flowmeters do not meet the veliocity criteria. A 30-inch diameter inverted siphon would only meet the velocity criteria of 2 fps only for a brief time period.

Further analysis of the 24-inch diameter inverted siphon (Figure 8) shows that this unit approaches the surcharge criteria under existing PWWF conditions. Figure 8 shows the HGL is almost 3 feet below the rim at the A/A Trunk Sewer junction structure for a 24-inch diameter inverted siphon. While the surcharge criteria is nearly exceeded, the more critical concern is the backwater conditions. Figure 8 also shows that the A/A Trunk Sewer downstream of the meter structure experiences backwater conditions that occur for various conditions, mainly RWQCP headworks boundary conditions. The only way to correct this is by improving the hydraulics at the headworks.

Table 5 A/A Trunk Sewer 24-Inch Inverted Siphon - Velocity Summary

Velocity (fps)	Existing Minimum DWF[(1)]	Existing ADWF	Existing PWWF[(2)]	Build-Out ADWF	Build-Out PWWF[(2)]
Average	2.60	4.91	4.95	5.84	6.93
Maximum	3.36	6.45	6.46	7.65	8.90
Minimum	1.30	2.47	2.43	2.75	4.18

Notes:
(1) Minimum DWF = 53% ADWF.
(2) Assumes 10-year 24-hour storm event.

Table 6 A/A Trunk Sewer 30-Inch Inverted Siphon - Velocity Summary

Velocity (fps)	Existing Minimum DWF[(1)]	Existing ADWF	Existing PWWF[(2)]	Build-Out ADWF	Build-Out PWWF[(2)]
Average	1.65	3.15	3.19	3.75	4.44
Maximum	2.15	4.13	4.14	4.89	5.68
Minimum	0.84	1.60	1.62	1.91	2.69

Notes:
(1) Minimum DWF = 53% ADWF.
(2) Assumes 10-year 24-hour storm event.

Table 7 A/A Trunk Sewer 36-Inch Inverted Siphon - Velocity Summary

Velocity (fps)	Existing Minimum DWF[(1)]	Existing ADWF	Existing PWWF[(2)]	Build-Out ADWF	Build-Out PWWF[(2)]
Average	1.15	2.19	2.21	2.59	3.08
Maximum	1.49	2.86	2.88	3.38	3.94
Minimum	0.57	1.16	1.14	1.28	1.88

Notes:
(1) Minimum DWF = 53% ADWF.
(2) Assumes 10-year 24-hour storm event.

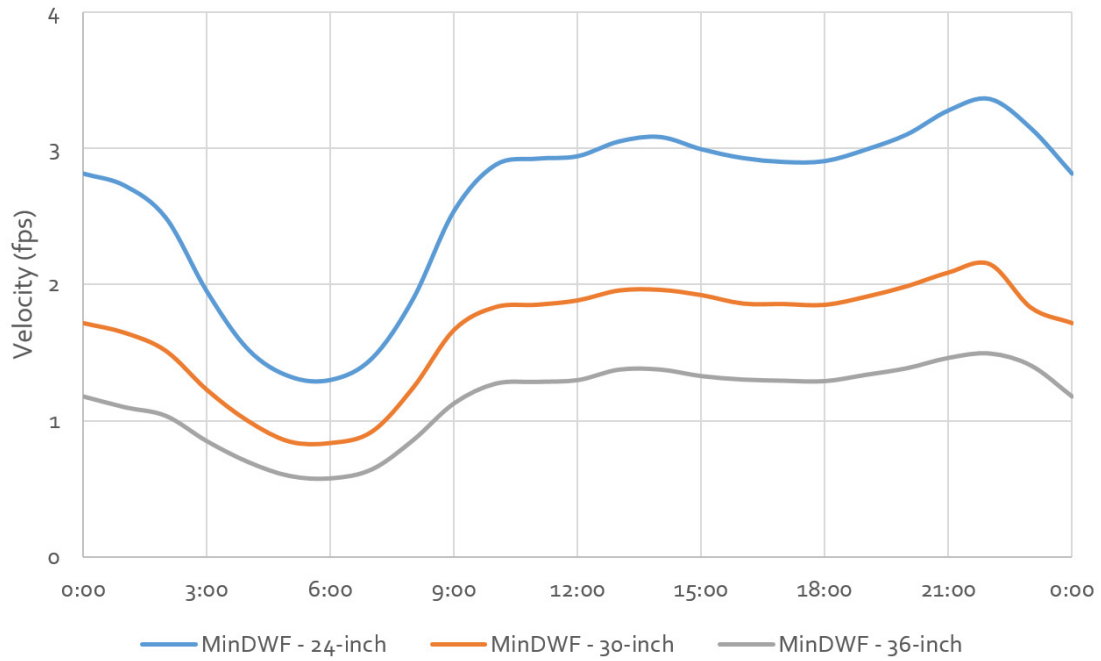

Figure 7 A/A Trunk Sewer - Velocity Under Existing Minimum DWF Conditions

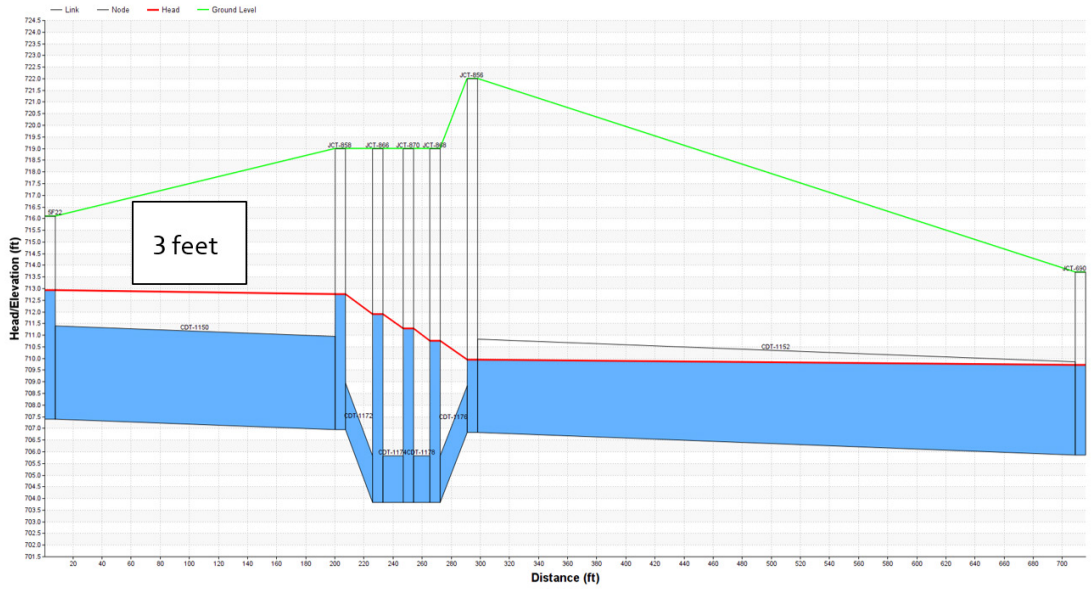

Figure 8 A/A Trunk Sewer - 24-Inch Inverted Siphon HGL Under Existing PWWF Conditions

Figure 9 and Figure 10 show the HGL under existing PWWF conditions for 30-inch and 36-inch diameter inverted siphons, respectively. These diameters meet the allowable surcharge conditions under existing PWWF conditions. However, a single inverted siphon diameter struggles to meet the design criteria under varying conditions.

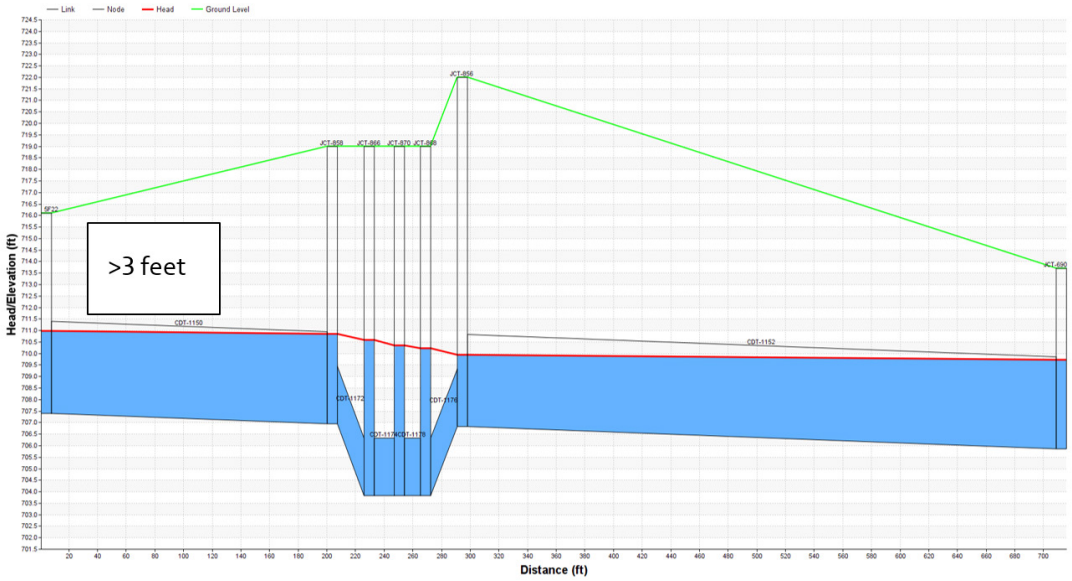

Figure 9 A/A Trunk Sewer - 30-Inch Inverted Siphon HGL Under Existing PWWF Conditions

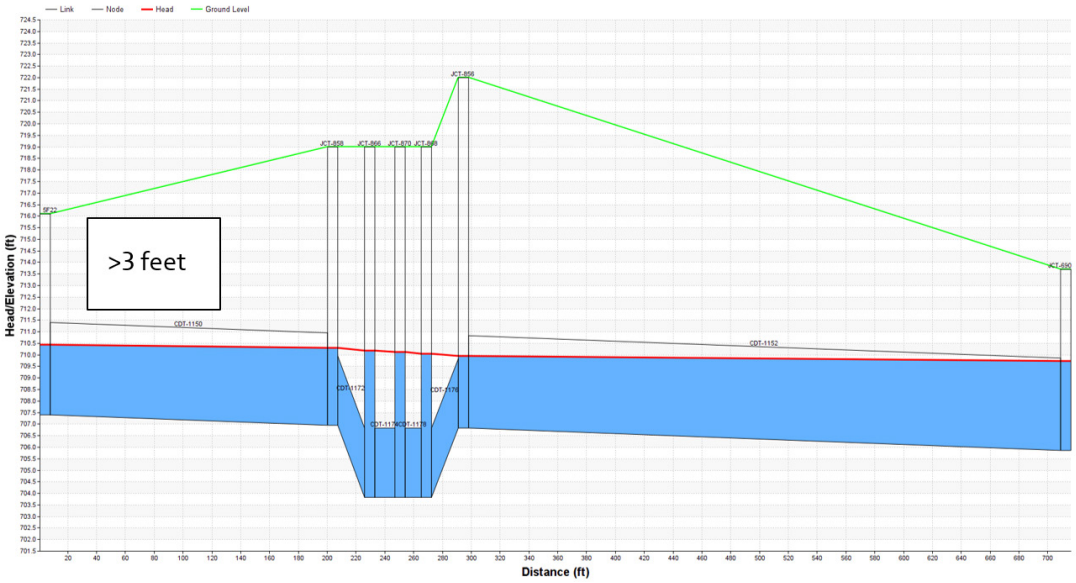

Figure 10 A/A Trunk Sewer - 36-Inch Inverted Siphon HGL Under Existing PWWF Conditions

The hydraulic analysis shows that having a single magnetic flowmeter along the A/A Trunk Sewer is not feasible and is not recommended for the following reasons:

- Pipe diameters are not operationally flexible.
- The impacts that backwater conditions at the headworks will have on the magnetic flowmeter are uncertain.
- The hydraulic model shows reverse flow through the inverted siphon, which could complicate operations and flowmeter performance.
- Increased operation and maintenance would be required to clean out settled solids through the bottom of the inverted siphon due to backwater conditions.

Accordingly, it is recommended that the City install two separate metering structures on the A/A Trunk Sewer line, as presented in URS's 2014 Study. A copy of this study is included in Attachment A.

Section 6

COSTS

This report confirms the proposed site layouts presented by the URS study in 2014, which can be referenced in Attachment A. The updated cost are presented below and have been escalated to 2018 dollar amounts. A more detailed cost estimate can be referenced in Attachment B. Note that for the Santa Ana metering system, the new meter may be located outside the plant boundary, but probably within the City's right-of-way. It was assumed that if the City has to purchase a small piece of land to accommodate construction, this would be less than $10,000.

Table 8 Summary of Costs for Influent Meter Project

Description	Cost
Metering System	
Santa Ana (Riverside-Hillside) Metering System(1)	$887,000
Acorn Metering System	$613,000
Arlanza Metering System	$886,000
Start-Up Testing and Training	$22,000
Prepare and Maintain Record Drawings	$11,000
Prepare Operation and Maintenance Manuals	$11,000
Allowances(2)	$608,000
Subtotal	$3,038,000
Construction Cost Subtotal(3)	$4,800,000
Total Project Cost(4)	$6,227,000

Notes:
(1) Assumes any land purchase to accommodate meter system would be less than $10,000.
(2) Allowances includes construction difficulty which is estimated at 25% of total construction cost.
(3) Construction cost includes 30% contingency, 10% General Conditions, 15% overhead, escalation to 2018 dollars, and sales tax.
(4) Project cost includes engineering, management, and legal, which is estimated at 30%.

Section 7

SUMMARY

As mentioned in Volume 4, Chapter 2, Summary of Planning Studies, the City commissioned URS to complete a Preliminary Design Report to address concerns regarding influent metering limitations. URS proposed new metering facilities and upgrades to electromagnetic flowmeters. In addition to the work completed by URS, the City asked Carollo to evaluate the potential of installing a single centralized master meter to measure the combined flow rate of all wastewater entering the plant. This alternative was found to be not feasible due to the hydraulic limitations at the headworks. The hydraulic losses through the headworks would need to be lowered by about 4 feet to make this alternative hydraulically feasible. This was estimated to cost between $50 and $70 million.

Centralized electromagnetic flowmeter for the A/A Trunk Sewer was also evaluated, and the location of the Santa Ana Trunk Sewer electromagnetic flowmeter structure was reviewed. The hydraulic analysis showed that a centralized electromagnetic flowmeter for the A/A Trunk Sewer is not feasible, but the selected location for the Santa Ana trunk sewer flowmeter was confirmed.

For planning purposes, this report includes the updated costs of three electromagnetic metering structures prepared by URS in the PDR as part of the CIP. The costs were updated to reflect the criteria laid out in Volume 2, Chapter 4, Basis of Cost Estimates.

Attachment A

2014 URS PDR FOR INFLUENT FLOW METERING PROJECT

PRELIMINARY DESIGN REPORT

INFLUENT FLOW METERING PROJECT
RIVERSIDE REGIONAL WATER QUALITY CONTROL PLANT

Prepared for:

City of Riverside
Public Works Department
Water Quality Control Plant Engineering Section
5950 Acorn Street
Riverside, California 92504

October 31, 2014

Prepared by:

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Contents

Acronyms and Abbreviations

AACE	American Association of Cost Engineering
AADF	Annual Average Daily Flow
ac	Acre
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
ADF	Maximum total average daily flow
ADWF	Average Dry Weather Flow
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
CCFRPM	Centrifugally cast fiberglass reinforced polymer mortar
cfs	Cubic Feet per Second
CSD	Community Services District
Elev	Elevation
fps	Feet per Second
ft	Foot
HART	Highway Addressable Remote Transducer
HEC	Hydraulic Engineering Circular
HGL	Hydraulic Grade Line
HSG	Hydrologic Soil Group
hr	Hour
in	Inch
IDF	Intensity-Duration-Frequency
mgd	Million gallons per day
mDWF	Minimum Dry Weather Flow
NEMA	National Electrical Manufacturers Association
NRCS	Natural Resources Conservation Service
OH&P	Overhead and Profit
PDWF	Peak Dry Weather Flow
PWWF	Peak Wet Weather Flow
RCP	Reinforced Concrete Pipe
RWQCP	Riverside Regional Water Quality Control Plant
SCS	Soil Conservation Service
SS	Stainless Steel
SSA	Autodesk Storm and Sanitary Analysis 2012 software
Tc	Time of Concentration
URS	URS Corporation
V	Volt
VCP	Vitrified Clay Pipe
WSEL	Water Surface Elevation
yr	Year

1.0 INTRODUCTION

URS Corporation (URS) has been contracted by the City of Riverside Public Works Department (City) to update the Influent Metering Study prepared by Carollo Engineers, Inc. (May 2005), prepare construction documents, and provide engineering support during construction for three new influent flow metering facilities for the Riverside Regional Water Quality Control Plant (RWQCP or Plant). The purpose of this project is to upgrade the flow meters on three existing influent sewage trunk lines entering the RWQCP to obtain more accurate and reliable flow measurements.

1.1 EXISTING INFLUENT METERING

Owned and operated by the City, RWQCP is located at 5950 Acorn Street in Riverside, California. The Plant receives domestic, commercial, and industrial wastewater from a 87.4-square mile service area that includes the City of Riverside, the community services districts (CSDs) of Edgemont, Jurupa, Rubidoux, and, starting in 2015, development in the Highgrove Community. The Plant is capable of generating tertiary effluent compliant with nitrified Title 22 standards for groundwater recharge, stream augmentation of the Santa Ana River, and landscape irrigation. The current design capacity of the Plant is 40 million gallons per day (mgd) on an average annual basis. The maximum total average daily flow (ADF) was 34.0 mgd in the year 2005 based on annual averages for the time period 2000 to 2012. At the completion of a Phase 1 expansion project, the Plant will be able to treat up to 46 mgd, which is higher than the projected flow rate for the year 2035. Future expansion may increase Plant capacity to 52 mgd.

Influent is currently conveyed to the RWQCP via five influent trunk sewers, which are metered as follows:

- Rubidoux trunk sewer: 14-inch ABB MagMaster electromagnetic flow meter.
- Jurupa trunk sewer: Marsh-McBirney Flo-Dar™ (Flo-Dar) radar velocity and ultrasonic depth flow meter.
- Acorn and Arlanza trunk sewers: Combined at a junction structure within the Plant and their combined flow is metered with a Flo-Dar unit.
- Santa Ana River (Riverside/Hillside) trunk sewers: Combined at a junction structure upstream of the Plant and their combined flow is metered with a Flo-Dar unit.

The ABB MagMaster electromagnetic flow meter on the Rubidoux trunk sewer measures full pipe flow with a rated accuracy of approximately ±0.3% for velocities above 1.64 feet per second (fps) and is checked for calibration on an annual basis. In contrast, the radar/ultrasonic flow meters on the other influent trunk sewers measure open channel flow with a manufacturer-stated accuracy of ±5% in uniform flow conditions without surcharge, and require more frequent (e.g., quarterly and after major storm events). Note that unsteady flow conditions or submergence of the meter during high flows can cause inaccurate flow reporting.

2.0 SCOPE OF WORK

The scope of this project is to replace the two existing Flo-Dar meters for the Acorn/Arlanza combined trunk sewers and Santa Ana River (Riverside/Hillside) combined trunk sewers with three electromagnetic flow meters (i.e., by adding separate meters for the Acorn and Arlanza trunk sewers) to allow the City to obtain more accurate influent flow data. This influent flow data is critical for RWQCP operations staff to monitor and control the Plant's treatment processes.

In addition, a separate project under consideration is to re-route the Jurupa trunk sewer into a sewer force main, which would relocate it from its current location and connect it to the 51-inch diameter Arlanza line within the Plant's property. The design of the new Arlanza metering facility is to accommodate a stub-out for the future addition of the Jurupa sewer force main.

This preliminary design report is the deliverable for "Task 4 – Preliminary Design Report Update" within "Phase I: Preliminary Design" of the project scope of work. The assessment of the existing flow metering facilities is based on URS' observations during site visits, review of existing documentation provided by the City, and an open channel flow study performed by URS. The scope of this preliminary design report includes:

- Calculations and analysis of the hydraulic performance of the existing metering facilities:
- Preliminary design criteria for the proposed metering facilities;
- A proposed design for the metering facilities based on the updated baseline and future flow rates for each of the trunk lines developed by URS in Technical Memorandum #1;
- A preliminary construction cost estimate;
- Preliminary design plans; and
- A proposed site investigation program.

3.0 HYDRAULIC DESIGN

3.1 DESIGN FLOW RATES

Using the data provided by the City and the URS' flow study, revised present and future design flow rates were developed in URS' Technical Memorandum #1 (November 25, 2013). Despite steady population growth in the Plant's service area over the time period from 2005 to 2013, influent flows have been on a relatively flat or declining trend due to water conservation practices and recent economic conditions. In part, the conservation has contributed to the reduction in the revised present design flows.

The City has developed flow projections based on projected population growth to the year 2035. In addition, the City plans to increase capacity of RWQCP from 40 mgd to 52 mgd. The ultimate flow rates for the individual lines were determined by using the contracted maximum capacities for Edgemont CSD, Jurupa CSD, Rubidoux CSD, and the Highgrove Community area. The remaining flows for the Santa Ana and Acorn/Arlanza trunk sewers were increased by preserving the same flow percentage for each influent line as in the revised present flows, and scaling up the result to the total combined flow of 52 mgd. Flow projections for each of the influent trunk sewers are summarized in Table 1. These revised present and future design flows were used to check the current capacity of the influent trunk lines, and also to design the proposed flow meters. Figure G-1 in Appendix A – Plans provides a site overview plan identifying the proposed metering locations.

Table 1: Revised Present and Future Design Flows for Plant Influent Trunk Sewers

RWQCP Influent Trunk Sewers	Revised Present Design Flows (mgd)					Ultimate Future Design Flows (mgd)				
	AADF	% of total flow	mDWF	PDWF	PWWF	AADF	% of total flow	mDWF	PDWF	PWWF
Rubidoux	2.0	6%	0.1	3.0	4.5	3.1	6%	0.1	4.6	6.7
Jurupa	3.2	10%	0.0	4.7	6.9	4.0	8%	0.0	6.0	8.8
Santa Ana	11.6	36%	5.8	17.4	25.5	21.9	42%	11.0	32.9	48.2
Riverside/Hillside	*11.0*	*34%*	*5.5*	*16.6*	*24.3*	*16.6*	*32%*	*8.3*	*25.0*	*36.6*
Edgemont	*0.6*	*2%*	*0.3*	*0.9*	*1.3*	*0.9*	*2%*	*0.4*	*1.3*	*2.0*
Highgrove	*0.0*	*0%*	*0.0*	*0.0*	*0.0*	*4.4*	*8%*	*2.2*	*6.6*	*9.7*
Acorn/Arlanza	15.9	49%	7.9	23.8	34.9	23.0	44%	11.5	34.5	50.6
Arlanza	*14.5*	*45%*	*7.3*	*21.8*	*32.0*	*21.1*	*41%*	*10.6*	*31.7*	*46.4*
Acorn	*1.3*	*4%*	*0.7*	*2.0*	*2.9*	*1.9*	*4%*	*1.0*	*2.9*	*4.2*
TOTALS	32.7	100%	13.8	49.0	71.8	52.0	100%	26.0	78.0	114.4

3.2 HYDRAULIC PROFILE MODELING

The Acorn, Arlanza, and Santa Ana influent trunk lines were hydraulically modeled to determine if each line has sufficient capacity for the present design flows and ultimate future design flows shown in Table 1 above. The model predicts hydraulic surcharges for each flow scenario. Also, the model determines if the addition of the proposed metering facilities will significantly impact the hydraulic profiles and, if so, can be used to identify locations of surcharge mitigation strategies.

Using as-built plans of the existing influent trunk lines provided by the City and the design flow rates, URS developed a tabular calculation to generate hydraulic grade line profiles of each influent trunk line. The downstream boundary condition for the hydraulic profiles was set at the Plant headworks and the upstream boundary condition was set at the manhole upstream of the proposed metering facilities (with the exception of the Santa Ana line, where the upstream boundary condition was set at the seventh manhole upstream of the proposed facilities).

Where data was lacking from the as-built plans provided by the City, reasonable assumptions were made for the purposes of this assessment. These assumed values are planned to be replaced with data obtained in the proposed field investigations (see Section 6.0 – Proposed Site Investigation).

3.3 HYDRAULIC CALCULATIONS METHODOLOGY

URS performed tabular calculations of the invert elevation changes, minor flow losses, and pipe friction losses to determine the hydraulic grade line (HGL) for each influent trunk line.

The Jurupa, Santa Ana (Riverside/Hillside), Acorn, and Arlanza influent trunk lines were evaluated from where they each connect to the headworks of the RWQCP. All influent trunk line invert elevations, lengths, diameters, flow rates, velocities, pipeline material, associated bends, manholes, and junction boxes were determined. From the headworks, each influent trunk line's minor headloss for all pipe bends, and all inlets and outlets from junction boxes and manholes were determined using the product of its associated minor loss coefficient and velocity head. The friction losses for influent trunk line lengths were determined using the Hazen-Williams equation. Using the water surface elevation within the headworks, the minor headloss and friction losses were added to the invert elevations throughout each influent trunk line to determine its HGL. The HGL was compared to the ground surface elevation of each manhole to determine if overflow could potentially occur. The calculations for the hydraulic profiles are provided in Appendix B – Calculations.

The tabular calculations were first performed for existing conditions to determine if the existing influent trunk lines had sufficient capacity at present and ultimate future flows. An additional set of tabular calculations was performed for the proposed metering facilities.

3.4 HYDRAULIC PROFILE RESULTS AND CONCLUSION

The hydraulic calculations show that surcharge or near surcharge conditions may occur under high flow scenarios for all of the Plant's influent lines in their existing condition. Adding the proposed metering facilities will increase hydraulic losses on the lines, and therefore will increase the likelihood of surcharge conditions. These results are summarized in Table 2. However, it should be noted that under the proposed condition, a bypass line will be added to prevent flooding at the metering facility. This bypass line will add additional capacity for large flow events, which should mitigate the impact of the increased head losses resulting from the addition of the proposed metering facilities.

Table 2: Hydraulic Analysis Results for Existing and Proposed Facilities

Scenario	Flow Criteria	Hydraulic Surcharge (Yes / No)			
		Minimum Dry Weather Flow (mDWF)	Annual Average Daily Flow (AADF)	Peak Dry Weather Flow (PDWF)	Peak Wet Weather Flow (PWWF)
Existing	Revised Present Flows	No	No	No	<1' Freeboard on Santa Ana and Arlanza
	Ultimate Future Flows	No	<1' Freeboard on Santa Ana	Yes, Santa Ana (0.47' surcharge); <1' Freeboard on Arlanza	Yes, Santa Ana (4.08' surcharge), Arlanza (6.62' surcharge), and Acorn (0.60' surcharge)
Proposed	Revised Present Flows	No	No	<1' Freeboard on Santa Ana	Yes, Santa Ana and Arlanza
	Ultimate Future Flows	No	Yes, Santa Ana (0.02' surcharge)	Yes, Santa Ana (2.69' surcharge) and Arlanza (0.73' surcharge)	Yes, Santa Ana (8.78' surcharge), Arlanza (9.92' surcharge), and Acorn (1.30' surcharge)

4.0 DESIGN CRITERIA AND METER SIZING

The design objective for the proposed flow meters is to achieve self-cleansing velocity at least once a day (i.e., greater than 2 feet per second [fps] minimum) while not exceeding pipe scouring velocity at the flow meter. For increased accuracy, design self-cleansing velocities were selected according to relative pipe diameter, based on recommended values for tractive force for sanitary sewers (Schafer, 1994). In addition, the proposed flow meters are designed to minimize scouring potential due to extremely high flow velocities. Industry-standard practice is to use 10 fps for maximum scouring velocity in pipes (e.g., in ASCE Manual 60), and 8 fps is commonly used for force mains.

As a secondary consideration, electromagnetic flow meters are typically more accurate at velocities greater than 1 to 2 fps. The design criteria for the proposed flow meters are summarized in Table 3:

Table 3: Flow Meter Design Criteria for Pipe Flow Velocities

Pipe Diameter	Self-Cleansing Velocity (min. velocity at present PDWF)	Pipe Scouring Velocity (max. velocity at future PDWF)
≤18”	3.6 fps desirable; 2.0 fps min.	7.0 fps
24”	3.8 fps	7.0 fps
36”	4.0 fps	7.5 fps
48”	4.3 fps	8.0 fps

The bypass pipe design will be such that, during wet weather events, the weir gates can be operated to divert flows from the metered run and avoid exceeding the maximum scouring velocities.

4.1 RECOMMENDED METER SIZES

The hydraulic calculations were used to predict the flow velocity within each proposed flow meter. The sizing of the flow meters and associated pipes were selected to meet the design criteria as close as feasible. Table 4 provides the recommended flow meter sizes for each influent trunk sewer. Note that the metered run of pipe is designed to always have full flow, and thus the diameter of this section of pipe is reduced in size compared to the existing trunk line to achieve higher flow velocities.

Table 4: Recommended Flow Meter Sizes for Plant Influent Trunk Sewers

Influent Trunk Line and Existing Diameter	Metered Run Pipe Diameter and Flow Meter Diameter	Self-Cleansing Velocity (min. velocity at present PDWF)	Pipe Scouring Velocity (max. velocity at future PDWF)
Acorn, 27”	16”	2.2 fps	3.2 fps
Arlanza, 51”	36”	4.8 fps	6.9 fps
Santa Ana, 48”	36”	3.8 fps	7.2 fps

5.0 PROPOSED DESIGN

5.1 ELECTROMAGNETIC FLOW METERS

Based on available electromagnetic flow meters that are considered suitable for the proposed metering facilities, two different meter types were initially considered:

1. Full flow meters: Although widely used, these meters require that the pipe run be depressed and/or use a smaller diameter pipe to achieve full flow.

2. Partial flow meters: Using a newer technology, these meters can accurately measure flow as long as the pipe is running approximately 10% full or more.

After further evaluation, partial flow meters were eliminated from consideration because of their significantly higher cost. Therefore, the preliminary design includes full flow type meters that meet the following criteria:

- Standard water temperatures
- Hard rubber flow tube lining
- Stainless steel (SS) flanges rated AWWA Class D (150 psi)
- NEMA 4X enclosures
- 316 SS electrodes
- Grounding rings
- Remote mounted transmitter with 5 meters of cable
- RS232/485 and HART protocol

Commercial vendors for Toshiba, ABB, Siemens, and Sparling provided budgetary quotes for suitable electromagnetic flow meters, as shown in Table 5.

Table 5: Quotations from Vendors for Recommended Electromagnetic Flow Meters

Manufacturer / Product line	Accuracy	Pipe flow Configuration	Straight Pipe Requirements	Budgetary Cost (24" Ø)	Budgetary Cost (48" Ø)
Toshiba LF664	±0.5% of flow rate	Full flow	3Ø upstream 0Ø downstream	$11,848	$40,285
ABB FEW	±0.4% of flow rate	Full flow	5Ø upstream 2Ø downstream	$20,600	$63,500
Siemens Mag 5100W	±2.0% of flow rate	Full flow	5Ø upstream 3Ø downstream	$11,591	$29,501
Sparling FM656	±1.0% of flow rate	Full flow	3Ø upstream 3Ø downstream	$11,560	$26,216

Notes:

1. *Upstream pipe length "L" of 5Ø for 90 bend, tee, diffuser, or fully opened sluice valve; L=10Ø for other valves (not fully opened); optional mount anywhere with L=3Ø*
2. *Budgetary costs are for meters only and do not include shipping, handling, installation, and contractor overhead and profit (OH&P).*

5.2 PROPOSED METERING FACILITIES

The proposed metering facility layout for each trunk line has been designed to meet the unique constraints at each specific location, to minimize cost, and to simplify construction. The configuration of the proposed metering facilities for the Acorn, Arlanza, and Santa Ana lines are similar in many respects. All three configurations include an influent diversion structure, a meter vault that protects the meter, an outlet diversion structure, and a bypass pipeline, as shown in Appendix A - Plans. Wastewater is directed to the flow meter or through the bypass line using sluice gates that are located within the influent diversion structure and outlet diversion structure. All flow meters will be located a full pipe diameter below the invert of the outlet structure to provide the full flow conditions required to obtain accurate readings. In the event the flow meter or bypass requires servicing, the sluice gates could be closed in such a manner that the flow meter or bypass line can be serviced.

Note that it is assumed that bypass flow events will be rare and that they are not required to be metered.

5.3 DIVERSION STRUCTURE SLUICE GATES

The Acorn, Arlanza, and Santa Ana flow meters will require sluice gates to divert wastewater through either the flow pipeline or the bypass line. The sluice gates will be selected based on the following design criteria:

- Mechanical actuation for ease of operation including:
  - Electric motor-driven floor stand. Electrical power requirement assumed to be 3-phase 480-volt (to be confirmed in subsequent design stages).
  - Hydraulic cylinder operator, which is optimal when there are multiple gates that can be operated from a single system.
  - Rising stem.
- Fabricated 316 SS preferred over cast iron to increase service life in the corrosive environment found at wastewater treatment plants.
- Seated and unseated design head will be determined during final design.
- Operating floor elevation and invert elevation will be determined during final design.

Recommended manufacturers include:

- **Rodney Hunt:** Manufacturer of sluice gates that are in full compliance with AWWA Standard C-560 and provide low leakage, complete drainage systems. A wide variety of sizes are available, ranging from 8-inch x 8-inch to 120-inch x 120-inch.
- **Waterman Industries**: Manufacturer of heavy duty sluice gates with different shapes and dimensions that are expected to meet the size requirements for the proposed influent metering system, from round to square gates ranging from 6-inch to 144-inch dimensions. These gates meet the leakage requirements of AWWA Standard C-561.

5.4 VAULTS

The influent diversion structure, the outlet diversion structure, and the meter vault structure selections were based on the following design criteria:

- Cast-in-place vaults
- Penetrations for pipes with seals
- Sump pump for interior space of the meter vault
- Vehicle loading H-20 rated hatches
- T-lock lining

Recommended vault manufacturers include:

- **OldCastle Precast:** Leading manufacturer of precast concrete, polymer concrete, and plastic products in the United States. They manufacture a wide range of utility vaults, reinforced concrete pipe, catch basins, retaining walls, and concrete barriers that meet all appropriate ACI, ASTM, and ACPA standards for precast concrete vaults.
- **Jensen Precast:** For over 40 years, Jensen Precast has designed and manufactured standard and custom precast concrete products to meet large-scale infrastructure demands for highway construction, retaining walls, electric and gas utility, telecommunications, water, on-site wastewater, and sewage applications.

5.5 PIPES AND VALVES

For the proposed piping, we recommend using centrifugally cast fiberglass reinforced polymer mortar (CCFRPM) pipe and welded steel pipe. In addition because of its low pipe friction losses, CCFRPM pipe is also proposed to be used for the bypass pipe and the section of meter pipe downstream of the meter vault. A welded steel pipe is required for the metered pipe run from the influent vault, connecting via bolted flanges to the electromagnetic meter, and transitioning to CCFRPM beyond the meter vault. Rubber seals are proposed for all pipe penetrations through proposed vaults and manholes to provide water-tight seals.

Recommended pipe manufacturers include:

- **Northwest Pipe:** Northwest pipe has manufactured welded steel pipe since 1966. Their rolled and welded steel pipes are applicable to water transmission pipelines and water and wastewater treatment plants. Their pipes are designed to meet and exceed ASTM A53 for durability.
- **Hobas Pipe:** Hobas Pipe USA is a producer and supplier of CCFRPM pipe systems. Hobas Pipe meets ASTM D3262, ASTM D3754, AWWA C950, and AWWA M45 for non-pressure sanitary sewers, sewer force mains and industrial effluents, pressure water systems, and fiberglass design, respectively.

6.0 PROPOSED SITE INVESTIGATION

6.1 GEOTECHNICAL STUDY AND INVESTIGATION

URS proposes to advance one test borehole at each proposed metering facility using a standard truck-mounted drill rig and hollow-stem augers. The boreholes will be located as near the proposed meter vaults as feasible given site constraints (ground slope, existing aboveground and belowground facilities, etc.). The boreholes will be advanced to a depth of approximately 30 feet below ground surface or to hollow-stem auger refusal. Samples of the materials encountered will be taken at approximately 5-foot depth intervals using Standard Penetration Test (SPT) or California samplers.

Prior to drilling, URS will mark the proposed borehole locations at the site and will contact Underground Service Alert of Southern California (DigAlert) so that member agencies can review the proposed borehole locations for potential interference with existing underground facilities. The property owner will also be asked to review the drilling locations for potential damage to existing facilities.

URS will perform laboratory testing to classify subsurface materials. We anticipate that the soils encountered will be mainly granular, so the testing will primarily consist of particle-size distribution and water content tests.

URS will perform additional geotechnical analyses to support the recommendations for selection of the underground vaults. The analysis will include evaluation of soil bearing, lateral earth pressures acting on the proposed vaults, and resistance to lateral loading due to passive pressure. Engineering properties needed for the analyses will be based on the identified soil types and blow counts.

A single geotechnical report will be prepared for the three proposed metering sites. The report will include borehole logs and laboratory test results, a brief description of subsurface conditions, as well as recommendations for the facilities. The report will be stamped by the California-registered engineer in responsible charge of the work.

6.2 SITE SURVEY

URS proposes to utilize our surveyor subconsultant to locate surficial utility features (e.g., manholes, valve cans, etc.) and determine existing topography to develop a current base map. URS has collected as-built drawings from the City and others as necessary to create a utility base map. We will also perform a web search of USA Digalert's online database to locate all known utilities in the project vicinity as necessary and then contact each utility owner to request a copy of the available as-built drawings. In addition, the surveyor will locate missing invert elevations for manholes as required to finalize the hydraulic model.

6.3 POTHOLING

URS proposes to utilize our potholing subconsultant to perform utility potholing to determine the location and depth of the existing utilities. The potholing subconsultant will obtain accurate subsurface utility information using a non-destructive, minimally invasive, vacuum process, which exposes the utility for visual verification, identification, inspection, measurements, and vertical and horizontal location of the utility. URS will obtain, if required, encroachment permits from the City for the potholing fieldwork. URS anticipates that 20 utility potholes would be required.

7.0 CONSTRUCTION

Construction of the influent flow metering facilities is estimated to require approximately 10 months, which accounts for procurement lead time and sequencing of construction activities to maintain Plant operations. Construction of the metering systems will require the following:

- Mobilization
- Site demolition and clearing
- Open excavation
- Bypass pumping installation
- Existing pipe demolition
- Construction of inlet, outlet and meter vaults
- Installation of sluice gates, valves, hatches, and fittings
- Installation of bypass pipe, meter pipe, flow meter
- Backfill
- Demobilization

Excavations are likely to be vertically-sided and shored because of site constraints. Some existing utilities and pipelines may need to be temporarily relocated and supported.

7.1 PRELIMINARY CONSTRUCTION COSTS

An Engineer's Opinion of Probable Construction Costs for the project is included in Appendix C. This cost estimate is based on preliminary design data and was developed using commercial vendor quotes, recent cost data from similar projects, and the 2012 Caltrans Contract Cost Data Book. The estimate includes a 30% contingency, a 15% general contractor overhead and profit, a 3% escalation to construction midpoint, and a 10% owner's reserve for change orders. The accuracy of the cost estimate follows the guidelines established by the American Association of Cost Engineers for a preliminary (or concept level) design, with a +50% to -30% accuracy.

7.2 REGULATORY AUTHORITIES AND PERMITTING

Table 6 outlines the regulatory reviews and permits anticipated for this project.

Table 6: Regulatory Reviews and Permits for Proposed Metering Facilities

Agency	Approval/Permit Description
City of Riverside Public Works Department	Demolition Permit Building Permit Encroachment Permit Construction Permit

8.0 ENGINEERING CERTIFICATION

This report has been prepared under my direction as the professional engineer in direct responsible charge of the work, in accordance with the provisions of the Professional Engineer's Act of the State of California.

Bryan C. Paine, PE

Registration No.: C64334

Date: October 6, 2014

8.1 STATEMENT OF LIMITATIONS

This report has been prepared by URS for the sole use of the City in the evaluation of the Project described above and is not to be distributed to third parties outside the City's organization. The scope of services performed during this preliminary design stage may not be appropriate to satisfy the needs of other users, and any use or re-use of this document or of the findings, conclusions, or recommendations presented herein is at the sole risk of said user.

Background information, design bases, and other data have been furnished to URS by the City and/or third parties, which URS has used in preparing this report. URS has relied on this information as furnished, and is neither responsible for nor has confirmed the accuracy of this information. This report is based on data, site conditions and other information that is generally applicable as of October 2014, and the conclusions and recommendations herein are therefore applicable only to that time frame.

This report has been prepared based on certain key assumptions made by URS which substantially affect the conclusions and recommendations of this report. These assumptions, although thought to be reasonable and appropriate, may not prove to be true in the future. The conclusions and recommendations of URS are conditioned upon these assumptions.

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APPENDIX A – PLANS

SANTA ANA RIVER

RWQCP

PROPOSED SANTA ANA METERING FACILITIES (SEE FIGURES C-3 AND M-3)

PROPOSED ACORN METERING FACILITIES (SEE FIGURES C-1 AND M-1)

PROPOSED ARLANZA METERING FACILITIES (SEE FIGURES C-2 AND M-2)

VAN BUREN BLVD

ACORN ST

JURUPA AVE

N

0 150 300

SCALE: 1" = 300

PLAN

NOT FOR CONSTRUCTION

URS

CITY OF RIVERSIDE
PUBLIC WORKS DEPARTMENT
WATER QUALITY CONTROL PLANT ENGINEERING SECTION
5950 ACORN STREET
RIVERSIDE, CA 92504

SITE OVERVIEW PLAN

URS Proj. No.: 29880194	Date: OCTOBER 2014
Project: INFLUENT FLOW METERING PROJECT 30% PRELIMINARY DESIGN	Figure: G-1

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EXIST. ADMIN/LAB BUILDING

EXIST. 3" STL. NATURAL GAS

EXIST. 12" A.C. POTABLE WATER

EXIST. 27" RCP ACORN INFLUENT

EXIST. 36" RCP STORM DRAIN

PROPOSED MANHOLE AC-1

ACORN STREET

REMOVE EXIST. PIPE

EXIST. 36" RCP ACORN INFLUENT

TO EXIST. ACORN / ARLANZA LINE JUNCTION STRUCTURE

EXIST. CATCH BASIN, TYP.

EXIST. SIDEWALK

PROPOSED MANHOLE AC-3

EXIST. LIGHT STANDARD, TYP.

EXIST. ROCK LANDSCAPE AREA

PROPOSED MANHOLE AC-2

PROPOSED METER VAULT

PROPOSED OUTLET VAULT

RELOCATE EXIST. TREE AS NEEDED, TYP.

PROPOSED INFLUENT VAULT

EXIST. PARKING LOT

N

0 10 20

SCALE: 1" = 20

PLAN

NOT FOR CONSTRUCTION

URS

CITY OF RIVERSIDE
PUBLIC WORKS DEPARTMENT
WATER QUALITY CONTROL PLANT ENGINEERING SECTION
5950 ACORN STREET
RIVERSIDE, CA 92504

ACORN PLAN

URS Proj. No.: 29880194

Date: OCTOBER 2014

Project: INFLUENT FLOW METERING PROJECT
30% PRELIMINARY DESIGN

Figure: C-1

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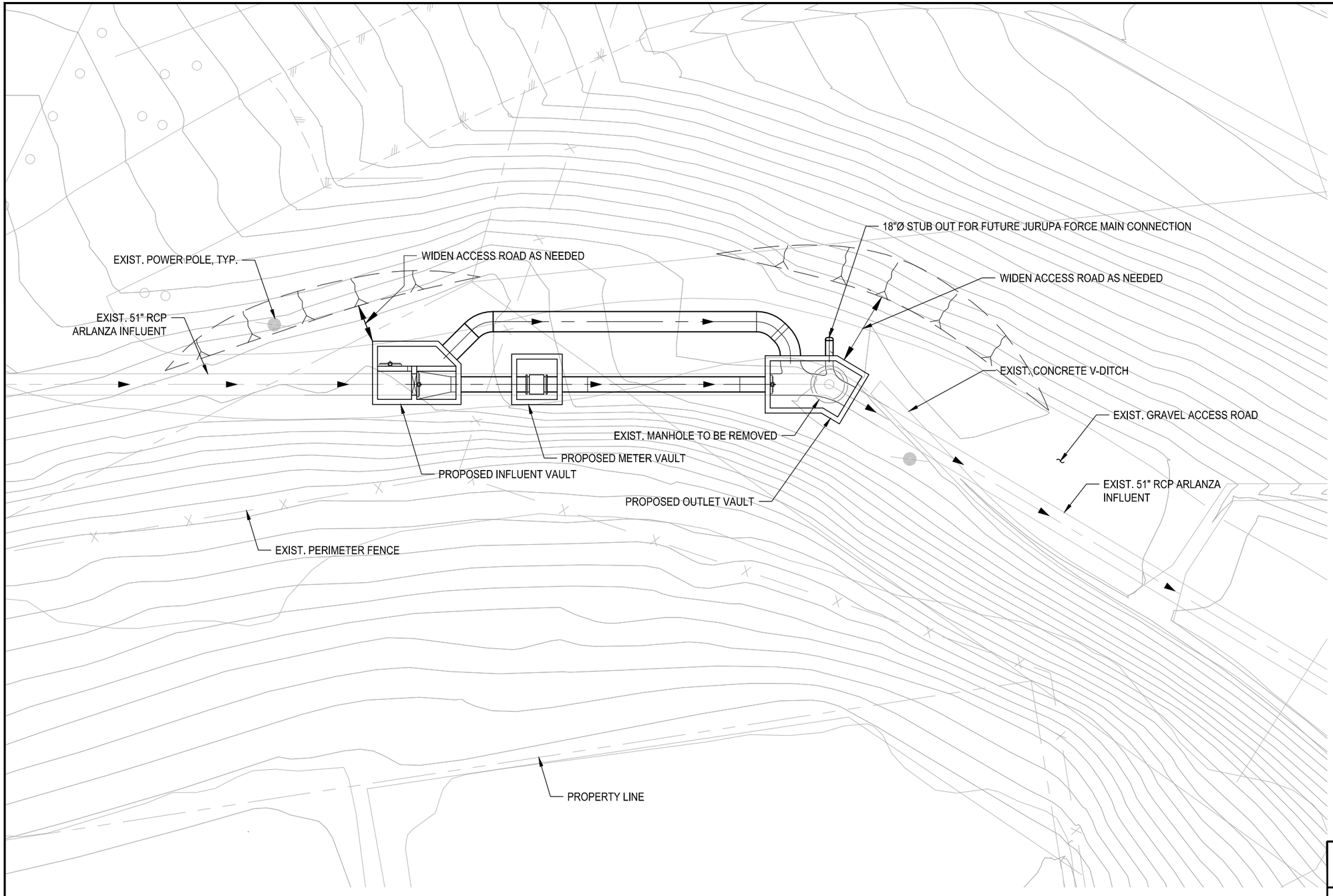

PLAN

N

0 10 20

SCALE: 1" = 20

NOT FOR CONSTRUCTION

URS

CITY OF RIVERSIDE
PUBLIC WORKS DEPARTMENT
WATER QUALITY CONTROL PLANT ENGINEERING SECTION
5950 ACORN STREET
RIVERSIDE, CA 92504

ARLANZA PLAN

URS Proj. No.: 29880194	Date: OCTOBER 2014
Project: INFLUENT FLOW METERING PROJECT 30% PRELIMINARY DESIGN	Figure: C-2

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EXIST. CHAIN LINK FENCE

REGRADE 3:1 SLOPE AS NEEDED

EXIST. DUAL 12" STL. JURUPA SEWER FORCEMAINS

PROPOSED METER VAULT

WIDEN ACCESS ROAD AS NEEDED

EXIST. BOLLARDS, TYP.

REMOVE INTERFERING PORTIONS OF EXIST. 45" PIPE (ABANDONED)

EXIST. MANHOLE, TYP.

PROPOSED OUTLET VAULT

PROPOSED INFLUENT VAULT

EXIST. JURUPA / RUBIDOUX INFLUENT MONITORING STATION

EXIST. 41" CCFRPM SEWER

EXIST. 21" CCFRPM SEWER

EXIST. 48" SANTA ANA INFLUENT

EXIST. 14" RUBIDOUX BYPASS STEEL SEWER FORCEMAIN

EXIST. 18" SEWER

EXIST. 18" RUBIDOUX SEWER FORCEMAIN

EXIST. GRAVEL ACCESS ROAD

EXIST. SANTA ANA INFLUENT MONITORING STATION

EXIST. DE ANZA GATE

EXIST. RUBIDOUX FLOW METERING VAULT

PROPERTY LINE

EXIST. 42" RCP TO HEADWORKS (TYP. OF 2)

PLAN

N

0 10 20

SCALE: 1" = 20

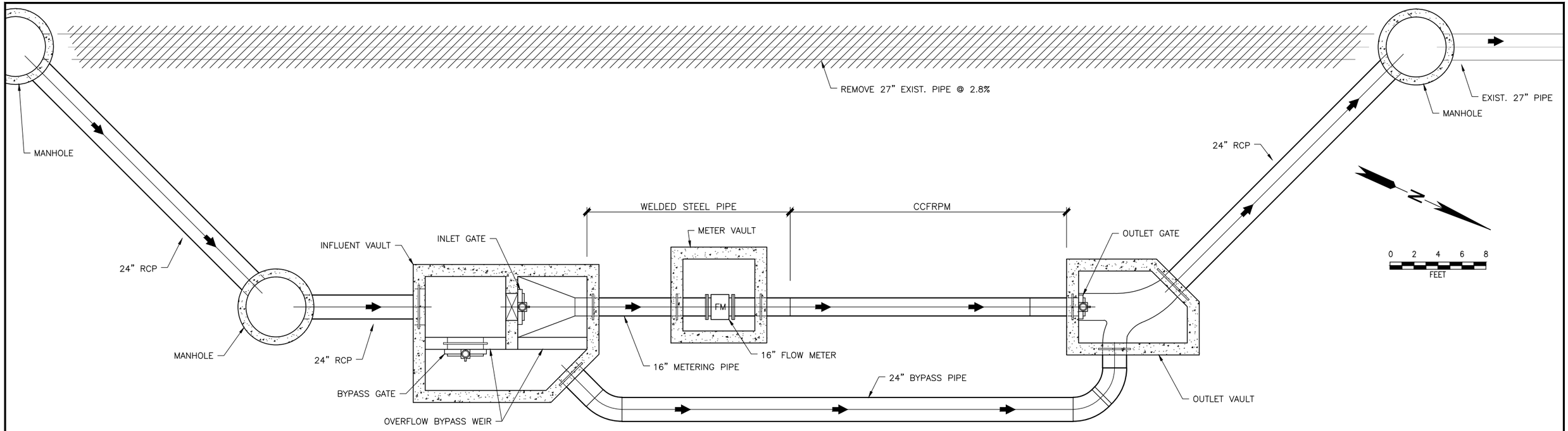
NOT FOR CONSTRUCTION

URS

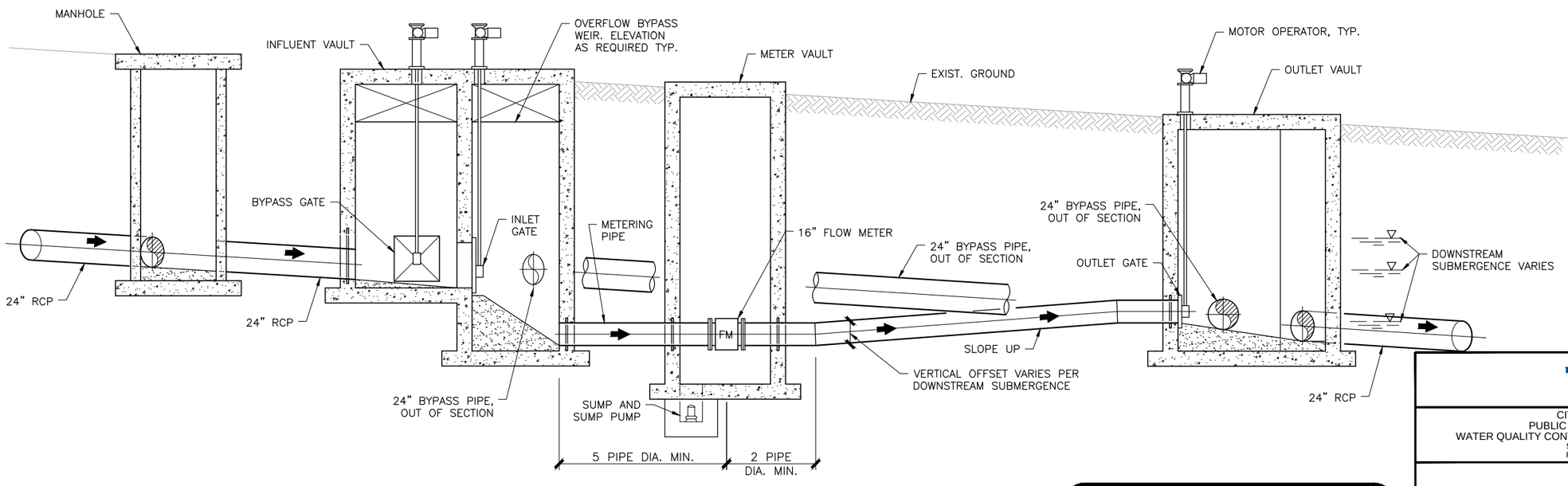
CITY OF RIVERSIDE
PUBLIC WORKS DEPARTMENT
WATER QUALITY CONTROL PLANT ENGINEERING SECTION
5950 ACORN STREET
RIVERSIDE, CA 92504

SANTA ANA PLAN

URS Proj. No.: 29880194	Date: OCTOBER 2014
Project: INFLUENT FLOW METERING PROJECT 30% PRELIMINARY DESIGN	Figure: C-3



ACORN PLAN



SECTION

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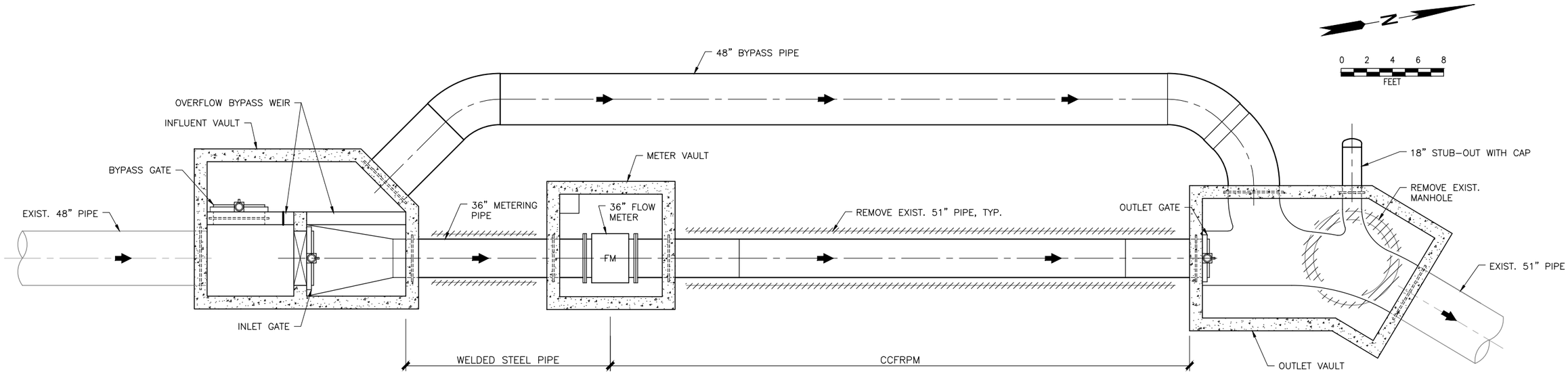
URS

CITY OF RIVERSIDE
PUBLIC WORKS DEPARTMENT
WATER QUALITY CONTROL PLANT ENGINEERING SECTION
5950 ACORN STREET
RIVERSIDE, CA 92504

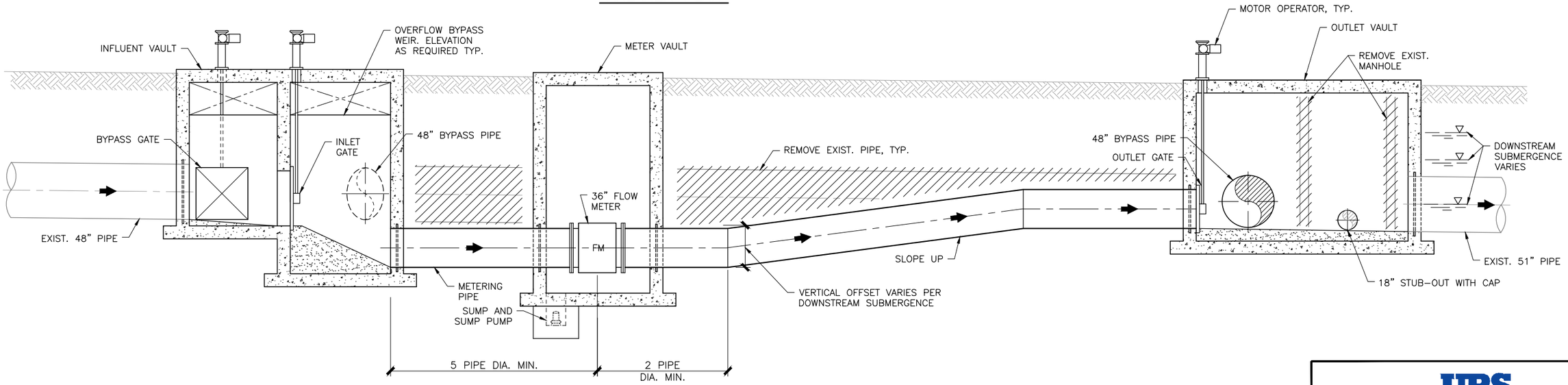
ACORN PLAN AND SECTION

URS Proj. No.: 29880194	Date: OCTOBER 2014
Project: INFLUENT FLOW METERING PROJECT 30% PRELIMINARY DESIGN	Figure: M-1

T:\071\City Of Riverside\Influent Flow Metering (29880194)\6 Engineering\CADD\020 Civil\M-Preliminary Vault Layouts.dwg , File date: 9/29/2014 6:54 PM , Print date: 10/1/2014 4:37 PM by: Chase, Nathan



ARLANZA PLAN



SECTION

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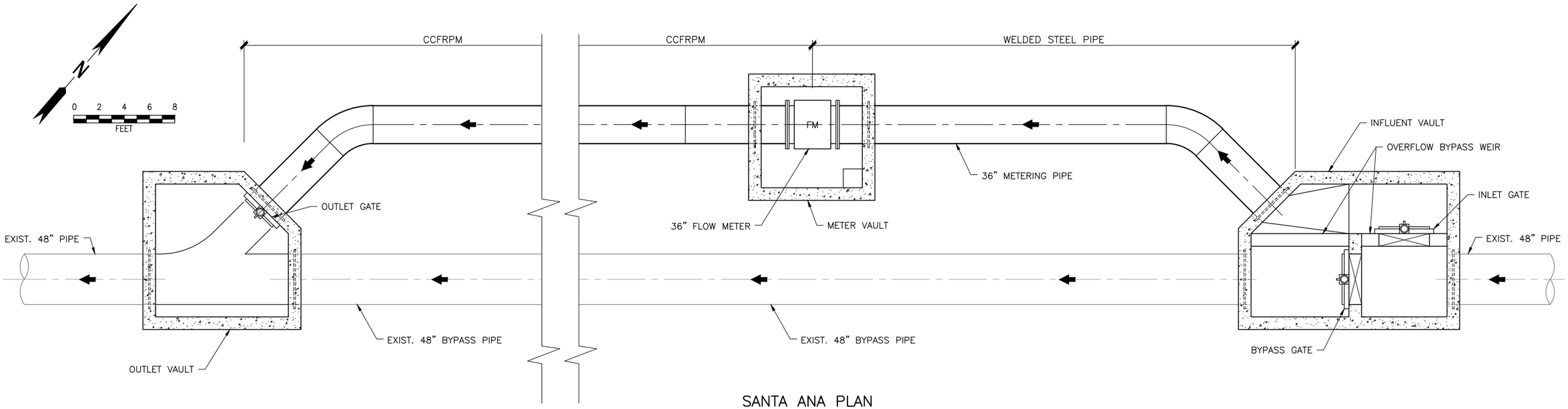
URS

CITY OF RIVERSIDE
PUBLIC WORKS DEPARTMENT
WATER QUALITY CONTROL PLANT ENGINEERING SECTION
5950 ACORN STREET
RIVERSIDE, CA 92504

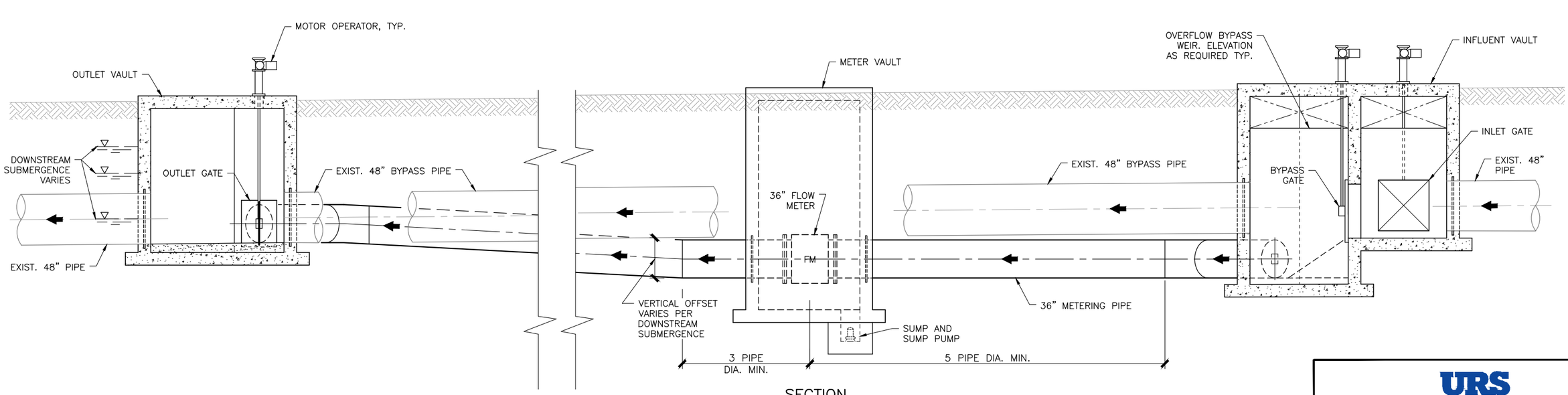
ARLANZA PLAN AND SECTION

URS Proj. No.: 29880194	Date: OCTOBER 2014
Project: INFLUENT FLOW METERING PROJECT 30% PRELIMINARY DESIGN	Figure: M-2

T:\071\City Of Riverside\Influent Flow Metering (29880194)\6 Engineering\CADD\020 Civil\M-Preliminary Vault Layouts.dwg , File date: 9/29/2014 6:54 PM , Print date: 10/1/2014 4:37 PM by: Chase, Nathan



SANTA ANA PLAN



SECTION

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URS

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WATER QUALITY CONTROL PLANT ENGINEERING SECTION
5950 ACORN STREET
RIVERSIDE, CA 92504

SANTA ANA PLAN AND SECTION

URS Proj. No.: 29880194	Date: OCTOBER 2014
Project: INFLUENT FLOW METERING PROJECT 30% PRELIMINARY DESIGN	Figure: M-3

T:\071\City Of Riverside\Influent Flow Metering (29880194)\6 Engineering\CADD\020 Civil\M-Preliminary Vault Layouts.dwg , File date: 9/29/2014 6:54 PM , Print date: 10/1/2014 4:37 PM by: Chase, Nathan

APPENDIX B – CALCULATIONS

EQUATIONS USED

HGL = *Hydraulic Grade Line*
HGL= *Downstream HGL + Head Losses*
Head Losses = *Minor Head Losses + Pipe Friction Losses*
Δh= *hm + hf*
where,
Δh= *Head Losses (ft)*
hm= *Minor Loss (ft)*
hf= *Friction Loss (ft)*

Minor Loss Equation

$$hm = \frac{Kv^2}{2g}$$

where,
hm= *Minor Loss (ft)*
K= *Minor Loss Coefficient*
v= *Velocity (ft/sec)*
g= *Gravitational Constant (32.2 ft/s²)*

Pipe Flow Velocity Equation

$$V = \frac{Q}{\pi D^2/4}$$

where,
Q= *Flow (cfs)*
D= *Pipe Diameter (ft)*
v= *Velocity (ft/sec)*

Hazen-Williams Pipe Friction Loss Equation

$$hf = \frac{4.727\ LQ^{1.85}}{D^{4.87}C^{1.85}}$$

where,
L= *Length of Pipe (ft)*
Q= *Flow Rate (cfs)*
D= *Diameter of Pipe (ft)*
C= *Hazen-Williams Coefficient (unitless)*

URS

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Flow for Rubidoux Interceptor (for use in Santa Ana hydraulic profile calculation)
Design Case: Revised Present Design Flow - PDWF
Calculated by: NTC Date: 9/26/2014
Checked by: BCP Date: 9/29/2014

Rubidoux Flow Rate = 3.0 MGD

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Acorn Interceptor
Design Case: Revised Present Design Flow - PDWF
Calculated by: NTC Date: 9/26/2014
Checked by: BCP Date: 9/29/2014

Acorn Flow Rate = 2.0 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Δh (ft)					
	Acorn/Arlanza Combined at Revised Present Design Flow - PDWF		*36.8*												
	Acorn at Revised Present Design Flow - PDWF		*3.1*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction Box												710.45		
3	**Inlet to Headworks Junction Box**	2	18.4	42	1.9	0.06	0.5			0.03	705.70		**710.48**	**713.70**	**3.22**
4	RCP (Headworks)	1	36.8	48				110	21	0.02	705.75	0.05	710.54		
5	90 Degree Bend	1	36.8	48	2.9	0.13	0.9			0.12	705.75	0.00	710.66		
6	RCP (Headworks)	1	36.8	48				110	79	0.06	705.94	0.19	710.91		
7	Meter Box Outlet	1	36.8	48	2.9	0.13	1			0.13	705.94	0.00	711.04		
8	**Meter Box Inlet**	1	36.8	48	2.9	0.13	0.5			0.07	705.96	0.02	**711.13**	**715.90**	**4.77**
9	RCP (Headworks)	1	36.8	48				110	491	0.36	707.10	1.14	712.63		
10	35 Degree Bend	1	36.8	48	2.9	0.13	0.4			0.05	707.10	0.00	712.68		
11	RCP (Headworks)	1	36.8	48				110	129	0.09	707.40	0.30	713.08		
12	Exit - Acorn/Arlanza Junction Box	1	36.8	48	2.9	0.13	1			0.13	707.40	0.00	713.21		
13	**Inlet - Acorn/Arlanza Junction Box**	1	3.1	48	0.2	0.00	0.5			0.00	707.40	0.00	**713.21**	**716.10**	**2.89**
14	RCP (Acorn)	1	3.1	36				110	148	0.00	711.31	3.91	717.12		
15	RCP (Acorn)	1	3.1	27				110	180	0.02	716.30	8.90	722.13		
16	Acorn Manhole #1 Exit	1	3.1	27	0.8	0.01	1			0.01	716.30	0.00	722.14		
17	**Acorn Manhole #1 Inlet**	1	3.1	27	0.8	0.01	0.5			0.00	716.30	0.00	**722.15**	**728.30**	**6.15**
18	RCP (Acorn)	1	3.1	27				110	339	0.04	735.49	19.19	741.38		
19	Acorn Manhole #2 Exit	1	3.1	27	0.8	0.01	1			0.01	735.49	0.00	741.39		
20	**Acorn Manhole #2 Inlet**	1	3.1	27	0.8	0.01	0.5			0.00	735.49	0.00	**741.39**	**747.50**	**6.11**

Data Source(s):
John A. Carollo Engineers. (1960). City of Riverside, California Sewage Treatment Plant Additions T5. Phoenix, Arizona.
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
Acorn/Arlanza Junction Box invert elevation and manhole elevation were found on C14 (Brown and Caldwell 1996).
Acorn manhole invert was estimated at 12 ft bgs based on a photograph of the inside of the manhole.
Acorn manhole elevation was determined using 2012 topographic survey.

URS

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Arlanza Interceptor
Design Case: Revised Present Design Flow - PDWF
Calculated by: NTC Date: 9/26/2014
Checked by: BCP Date: 9/29/2014

Arlanza Flow Rate = 21.8 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Delta h (ft)					
	Acorn/Arlanza Combined at Revised Present Design		*36.8*												
	Arlanza at Revised Present Design Flow - PDWF		*33.7*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction												710.45		
3	**Inlet to Headworks Junction**	2	18.4	42	1.9	0.06	0.5			0.03	705.70		**710.48**	**713.70**	**3.22**
4	RCP (Headworks)	1	36.8	48				110	21	0.02	705.75	0.05	709.71		
5	90 Degree Bend	1	36.8	48	2.9	0.13	0.9			0.12	705.75	0.00	709.83		
6	RCP (Headworks)	1	36.8	48				110	79	0.06	705.94	0.19	710.07		
7	Meter Box Outlet	1	36.8	48	2.9	0.13	1			0.13	705.94	0.00	710.21		
8	**Meter Box Inlet**	1	36.8	48	2.9	0.13	0.5			0.07	705.96	0.02	**710.30**	**716.00**	**5.70**
9	RCP (Headworks)	1	36.8	48				110	491	0.36	707.10	1.14	711.79		
10	35 Degree Bend	1	36.8	48	2.9	0.13	0.4			0.05	707.10	0.00	711.84		
11	RCP (Headworks)	1	36.8	48				110	129	0.09	707.40	0.30	712.24		
12	Exit - Acorn/Arlanza Junction Box	1	36.8	48	2.9	0.13	1			0.13	707.40	0.00	712.37		
13	**Inlet - Acorn/Arlanza Junction Box**	2	18.4	48	1.5	0.03	0.5			0.02	707.40	0.00	**712.39**	**716.10**	**3.71**
14	RCP (Arlanza)	2	16.9	48				110	293	0.05	708.00	0.60	713.04		
15	Arlanza Junction Box Exit	2	16.9	48	1.3	0.03	1			0.03	708.00	0.00	713.07		
16	**Inlet - Arlanza Junction Box #1**	1	33.7	51	2.4	0.09	0.5			0.04	708.00	0.00	**713.11**	**717.50**	**4.39**
17	RCP (Arlanza)	1	33.7	51				110	5	0.00	708.02	0.02	713.13		
18	30 Degree Bend	1	33.7	51	2.4	0.09	0.4			0.04	708.02	0.00	713.17		
19	RCP (Arlanza)	1	33.7	51				110	17	0.01	708.08	0.06	713.23		
20	20 Degree Bend	1	33.7	51	2.4	0.09	0.25			0.02	708.08	0.00	713.26		
21	RCP (Arlanza)	1	33.7	51				110	86	0.04	708.39	0.31	713.61		
22	Arlanza Manhole #1 Outlet	1	33.7	51	2.4	0.09	1			0.09	708.39	0.00	713.69		
23	**Arlanza Manhole #1 Inlet**	1	33.7	51	2.4	0.09	0.5			0.04	708.39	0.00	**713.74**	**724.80**	**11.06**
24	RCP (Arlanza)	1	33.7	51				110	161	0.07	708.97	0.58	714.39		
25	50 Degree Bend	1	33.7	51	2.4	0.09	0.7			0.06	708.97	0.00	714.45		
26	RCP (Arlanza)	1	33.7	51				110	24	0.01	709.05	0.09	714.55		
27	Arlanza Manhole #2 Outlet	1	33.7	51	2.4	0.09	1			0.09	709.05	0.00	714.64		
28	**Arlanza Manhole #2 Inlet**	1	33.7	51	2.4	0.09	0.5			0.04	709.05	0.00	**714.68**	**727.50**	**12.82**
29	RCP (Arlanza)	1	33.7	51				110	150	0.07	709.59	0.54	715.29		
30	Exit - Junction Box	1	33.7	51	2.4	0.09	1			0.09	709.59	0.00	715.38		
31	**Inlet - Arlanza Junction Box #2**	1	33.7	51	2.4	0.09	0.5			0.04	709.59	0.00	**715.42**	**725.00**	**9.58**
32	RCP (Arlanza)	1	33.7	51				110	303	0.14	710.68	1.09	716.65		
33	20 Degree Bend	1	33.7	51	2.4	0.09	0.25			0.02	710.68	0.00	716.67		

URS

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Arlanza Interceptor
Design Case: Revised Present Design Flow - PDWF
Calculated by: NTC Date: 9/26/2014
Checked by: BCP Date: 9/29/2014

Arlanza Flow Rate = 21.8 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Delta h (ft)					
34	RCP (Arlanza)	1	33.7	51				110	495	0.23	712.46	1.78	718.68		
35	Arlanza Manhole #3 Outlet	1	33.7	51	2.4	0.09	1			0.09	712.46	0.00	718.77		
36	**Arlanza Manhole #3 Inlet**	1	33.7	51	2.4	0.09	0.5			0.04	712.46	0.00	**718.81**	**724.00**	**5.19**
37	RCP (Arlanza)	1	33.7	51				110	428	0.20	713.32	0.86	719.87		
38	Arlanza Manhole #4 Outlet	1	33.7	51	2.4	0.09	1			0.09	713.32	0.00	719.95		
39	**Arlanza Manhole #4 Inlet**	1	33.7	51	2.4	0.09	0.5			0.04	713.32	0.00	**720.00**	**726.30**	**6.30**
40	RCP (Arlanza)	1	33.7	51				110	428	0.20	714.06	0.74	720.94		
41	Arlanza Manhole #5 Outlet	1	33.7	51	2.4	0.09	1			0.09	714.06	0.00	721.03		
42	**Arlanza Manhole #5 Inlet**	1	33.7	51	2.4	0.09	0.5			0.04	714.06	0.00	**721.07**	**725.60**	**4.53**
40	RCP (Arlanza)	1	33.7	51	2.4	0.09		110	246	0.11	718.46	4.40	725.59		
41	Arlanza Manhole #6 Outlet	1	33.7	51	2.4	0.09	1			0.09	718.46	0.00	725.67		
42	**Arlanza Manhole #6 Inlet**	1	33.7	51	2.4	0.09	0.5			0.04	718.46	0.00	**725.72**	**730.00**	**4.28**

Data Source(s):
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.
Arlanza Pipeline: John Carollo Engineers. (1990). City of Riverside, CA Department of Public Works Water Quality Control Plant 1990 Tertiary Expansion. Phoenix, AZ.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
Acorn/Arlanza Junction Box invert elevation and manhole elevation were found on C14 (Brown and Caldwell 1996).
Arlanza Junction Box #1 invert elevation and manhole elevation were found on C15 (Brown and Caldwell 1996)
Arlanza Manhole #3 invert elevation was found on drawing Y-6 (John Carollo Engineers, 1990).
The average slope from the Arlanza junction box (708.0 ft invert elevation) and the Arlanza Manhole #3 (717.25 invert elevation) was determined to be 0.0074 ft/ft, using the length between the Arlanza junction box and the Arlanza Manhole #3.
Arlanza Manholes #1- #3 invert elevations were determined using a slc 0.00359 ft/ft and pipe lengths between each manhole.
The slope between Arlanza Manhole #3 and Arlanza Manhole #5 was determined 0.002 ft/ft
Arlanza Manhole #4 was determined using the slope between Arlanza Manhole #3 and Arlanza Manhole #5 and the pipe length between Arlanza Manhole #3 and Arlanza Manhole #4.

URS

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Santa Ana (Riverside/Hillside) Interceptor
Flow Projection: Revised Present Design Flow - PDWF
Calculated by: NTC Date: 9/26/2014 **Santa Ana Flow Rate =** 17.4 MGD
Checked by: BCP Date: 9/29/2014

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Δh (ft)					
	Rubidoux, Jurupa, Santa Ana (Riverside/Hillside) at Revised Present Design Flow - PDWF		*36.6*												
	Santa Ana (Riverside/Hillside) at Revised Present Design Flow - PDWF		*26.9*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction												710.45		
3	**Inlet to Headworks Junction**	2	18.3	42	1.9	0.06	0.5			0.03	705.70		**710.48**	**713.70**	**3.22**
4	RCP (Headworks)	2	18.3	42				125	28	0.01	705.87	0.17	710.66		
5	35 Degree Bend	2	18.3	42	1.9	0.06	0.4			0.02	705.87	0.00	710.68		
6	RCP (Headworks)	2	18.3	42				125	200	0.06	1285.53	579.66	1290.40		
7	35 Degree Bend	2	18.3	42	1.9	0.06	0.4			0.02	1285.53	0.00	1290.42		
8	RCP (Headworks)	2	18.3	42				125	16	0.00	707.18	-578.35	712.08		
9	Exit from Junction	2	18.3	42	1.9	0.06	1			0.06	707.18	0.00	712.13		
10	**Inlet to Junction**	1	26.9	48	2.1	0.07	0.5			0.04	707.18	0.00	**712.17**	**717.00**	**4.83**
11	RCP (Headworks)	1	26.9	48				125	10	0.00	707.30	0.12	712.29		
12	CCFRPM Pipe (Riverside/Hillside)	1	26.9	48				155	35	0.01	707.70	0.40	712.70		
13	Manhole #1 Exit	1	26.9	48	2.1	0.07	1			0.07	707.70	0.00	712.77		
14	**Manhole #1 Inlet**	1	26.9	48	2.1	0.07	0.5			0.04	707.70	0.00	**712.81**	**716.20**	**3.39**
15	CCFRPM Pipe (Riverside/Hillside)	1	26.9	48				155	174	0.04	708.06	0.36	713.20		
16	Manhole #2 Exit	1	26.9	48	2.1	0.07	1			0.07	708.06	0.00	713.28		
17	**Manhole #2 Inlet**	1	26.9	41	2.9	0.13	0.5			0.07	708.06	0.00	**713.34**	**714.60**	**1.26**
18	CCFRPM Pipe (Riverside/Hillside)	1	23.5	41				155	13	0.00	708.10	0.04	713.39		
19	Manhole #3 Exit	1	23.5	41	2.6	0.10	1			0.10	708.10	0.00	713.49		
20	**Manhole #3 Inlet**	1	23.5	41	2.6	0.10	0.5			0.05	708.10	0.00	**713.54**	**714.90**	**1.36**
21	CCFRPM Pipe (Riverside/Hillside)	1	23.5	41				155	95	0.03	708.26	0.16	713.73		
22	Manhole #4 Exit	1	23.5	41	2.6	0.10	1			0.10	708.26	0.00	713.84		
23	**Manhole #4 Inlet**	1	23.5	41	2.6	0.10	0.5			0.05	708.26	0.00	**713.89**	**715.50**	**1.61**
24	CCFRPM Pipe (Riverside/Hillside)	1	23.5	41				155	13	0.00	708.29	0.03	713.92		
25	Manhole #5 Exit	1	23.5	41	2.6	0.10	1			0.10	708.29	0.00	714.02		
26	**Manhole #5 Inlet**	1	26.9	48	2.1	0.07	0.5			0.04	708.29	0.00	**714.06**	**716.30**	**2.24**
27	CCFRPM Pipe (Riverside/Hillside)	1	26.9	48				155	78	0.02	708.43	0.14	714.22		
28	Manhole #6 Exit	1	26.9	48	2.1	0.07	1			0.07	708.43	0.00	714.29		
29	**Manhole #6 Inlet**	1	26.9	48	2.1	0.07	0.5			0.04	708.43	0.00	**714.32**	**719.40**	**5.08**
30	CCFRPM Pipe (Riverside/Hillside)	1	26.9	48				155	55	0.01	708.53	0.10	714.44		
31	Manhole #7 Exit	1	26.9	48	2.1	0.07	1			0.07	708.53	0.00	714.51		
32	**Manhole #7 Inlet**	1	26.9	48	2.1	0.07	0.5			0.04	708.53	0.00	**714.54**	**719.40**	**4.86**
33	CCFRPM Pipe (Riverside/Hillside)	1	26.9	48				155	215.5	0.05	708.92	0.39	714.98		
34	Manhole #8 Exit	1	26.9	48	2.1	0.07	1			0.07	708.92	0.00	715.05		

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Santa Ana (Riverside/Hillside) Interceptor
Flow Projection: Revised Present Design Flow - PDWF
Calculated by: NTC Date: 9/26/2014 **Santa Ana Flow Rate =** 17.4 MGD
Checked by: BCP Date: 9/29/2014

35	**Manhole #8 Inlet**	1	26.9	48	2.1	0.07	0.5			0.04	708.92	0.00	**715.09**	**722.20**	**7.11**

Data Source(s):
Riverside/Hillside Pipeline: Brown and Caldwell. (2011). Riverside California Public Works Department Santa Ana River Trunk Sewer Replacement Project - Phase 1. San Diego, CA.
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
There is no junction elevation rise between 42" and 48" pipe based on S-2054 Sheet 6 of 33 (Brown & Caldwell 2011).
The length of pipes between the manholes were determined using S-2054 Sheet 6 of 33 (Brown and Caldwell 2011).
Invert elevations were determined using (Brown & Caldwell 1996, 2011).
The Riverside/Hillside CCFRPM pipeline was constructed in 2012; based on the pipe's age, a Hazen Williams coefficient of 155 was chosen.
The dual 42" RCPs to headworks were constructed in 1996; based on the pipe's age, a Hazen Williams coefficient of 125 was chosen.

URS

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Flow for Rubidoux Interceptor (for use in Santa Ana hydraulic profile calculation)
Design Case: Revised Present Design Flow - PWWF

Calculated by: NTC Date: 9/26/2014
Checked by: BCP Date: 9/29/2014

Rubidoux Flow Rate = 4.5 MGD

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Acorn Interceptor
Design Case: Revised Present Design Flow - PWWF
Calculated by: NTC Date: 9/26/2014
Checked by: BCP Date: 9/29/2014

Acorn Flow Rate = 2.9 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Δh (ft)					
	Acorn/Arlanza Combined at Revised Present Design Flow - PWWF		*54.0*												
	Acorn at Revised Present Design Flow - PWWF		*4.5*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction Box												710.45		
3	**Inlet to Headworks Junction Box**	2	27.0	42	2.8	0.12	0.5			0.06	705.70		**710.51**	**713.70**	**3.19**
4	RCP (Headworks)	1	54.0	48				110	21	0.03	705.75	0.05	710.59		
5	90 Degree Bend	1	54.0	48	4.3	0.29	0.9			0.26	705.75	0.00	710.85		
6	RCP (Headworks)	1	54.0	48				110	79	0.12	705.94	0.19	711.16		
7	Meter Box Outlet	1	54.0	48	4.3	0.29	1			0.29	705.94	0.00	711.44		
8	**Meter Box Inlet**	1	54.0	48	4.3	0.29	0.5			0.14	705.96	0.02	**711.61**	**715.90**	**4.29**
9	RCP (Headworks)	1	54.0	48				110	491	0.73	707.10	1.14	713.48		
10	35 Degree Bend	1	54.0	48	4.3	0.29	0.4			0.11	707.10	0.00	713.59		
11	RCP (Headworks)	1	54.0	48				110	129	0.19	707.40	0.30	714.08		
12	Exit - Acorn/Arlanza Junction Box	1	54.0	48	4.3	0.29	1			0.29	707.40	0.00	714.37		
13	**Inlet - Acorn/Arlanza Junction Box**	1	4.5	48	0.4	0.00	0.5			0.00	707.40	0.00	**714.37**	**716.10**	**1.73**
14	RCP (Acorn)	1	4.5	36				110	148	0.01	711.31	3.91	718.29		
15	RCP (Acorn)	1	4.5	27				110	180	0.04	716.30	8.90	723.31		
16	Acorn Manhole #1 Exit	1	4.5	27	1.1	0.02	1			0.02	716.30	0.00	723.33		
17	**Acorn Manhole #1 Inlet**	1	4.5	27	1.1	0.02	0.5			0.01	716.30	0.00	**723.34**	**728.30**	**4.96**
18	RCP (Acorn)	1	4.5	27				110	339	0.08	735.49	19.19	742.61		
19	Acorn Manhole #2 Exit	1	4.5	27	1.1	0.02	1			0.02	735.49	0.00	742.63		
20	**Acorn Manhole #2 Inlet**	1	4.5	27	1.1	0.02	0.5			0.01	735.49	0.00	**742.64**	**747.50**	**4.86**

Data Source(s):
John A. Carollo Engineers. (1960). City of Riverside, California Sewage Treatment Plant Additions T5. Phoenix, Arizona.
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
Acorn/Arlanza Junction Box invert elevation and manhole elevation were found on C14 (Brown and Caldwell 1996).
Acorn manhole invert was estimated at 12 ft bgs based on a photograph of the inside of the manhole.
Acorn manhole elevation was determined using 2012 topographic survey.

URS

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Arlanza Interceptor
Design Case: Revised Present Design Flow - PWWF
Calculated by: NTC Date: 9/26/2014
Checked by: BCP Date: 9/29/2014

Arlanza Flow Rate = 32.0 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Delta h (ft)					
	Acorn/Arlanza Combined at Revised Present Design		*54.0*												
	Arlanza at Revised Present Design Flow - PWWF		*49.5*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction												710.45		
3	**Inlet to Headworks Junction**	2	27.0	42	2.8	0.12	0.5			0.06	705.70		**710.51**	**713.70**	**3.19**
4	RCP (Headworks)	1	54.0	48				110	21	0.03	705.75	0.05	709.72		
5	90 Degree Bend	1	54.0	48	4.3	0.29	0.9			0.26	705.75	0.00	709.98		
6	RCP (Headworks)	1	54.0	48				110	79	0.12	705.94	0.19	710.29		
7	Meter Box Outlet	1	54.0	48	4.3	0.29	1			0.29	705.94	0.00	710.57		
8	**Meter Box Inlet**	1	54.0	48	4.3	0.29	0.5			0.14	705.96	0.02	**710.74**	**716.00**	**5.26**
9	RCP (Headworks)	1	54.0	48				110	491	0.73	707.10	1.14	712.60		
10	35 Degree Bend	1	54.0	48	4.3	0.29	0.4			0.11	707.10	0.00	712.72		
11	RCP (Headworks)	1	54.0	48				110	129	0.19	707.40	0.30	713.21		
12	Exit - Acorn/Arlanza Junction Box	1	54.0	48	4.3	0.29	1			0.29	707.40	0.00	713.50		
13	**Inlet - Acorn/Arlanza Junction Box**	2	27.0	48	2.1	0.07	0.5			0.04	707.40	0.00	**713.53**	**716.10**	**2.57**
14	RCP (Arlanza)	2	24.7	48				110	293	0.10	708.00	0.60	714.23		
15	Arlanza Junction Box Exit	2	24.7	48	2.0	0.06	1			0.06	708.00	0.00	714.29		
16	**Inlet - Arlanza Junction Box #1**	1	49.5	51	3.5	0.19	0.5			0.09	708.00	0.00	**714.39**	**717.50**	**3.11**
17	RCP (Arlanza)	1	49.5	51				110	5	0.00	708.02	0.02	714.41		
18	30 Degree Bend	1	49.5	51	3.5	0.19	0.4			0.08	708.02	0.00	714.49		
19	RCP (Arlanza)	1	49.5	51				110	17	0.02	708.08	0.06	714.56		
20	20 Degree Bend	1	49.5	51	3.5	0.19	0.25			0.05	708.08	0.00	714.61		
21	RCP (Arlanza)	1	49.5	51				110	86	0.08	708.39	0.31	715.00		
22	Arlanza Manhole #1 Outlet	1	49.5	51	3.5	0.19	1			0.19	708.39	0.00	715.19		
23	**Arlanza Manhole #1 Inlet**	1	49.5	51	3.5	0.19	0.5			0.09	708.39	0.00	**715.28**	**724.80**	**9.52**
24	RCP (Arlanza)	1	49.5	51				110	161	0.15	708.97	0.58	716.01		
25	50 Degree Bend	1	49.5	51	3.5	0.19	0.7			0.13	708.97	0.00	716.15		
26	RCP (Arlanza)	1	49.5	51				110	24	0.02	709.05	0.09	716.26		
27	Arlanza Manhole #2 Outlet	1	49.5	51	3.5	0.19	1			0.19	709.05	0.00	716.44		
28	**Arlanza Manhole #2 Inlet**	1	49.5	51	3.5	0.19	0.5			0.09	709.05	0.00	**716.54**	**727.50**	**10.96**
29	RCP (Arlanza)	1	49.5	51				110	150	0.14	709.59	0.54	717.22		
30	Exit - Junction Box	1	49.5	51	3.5	0.19	1			0.19	709.59	0.00	717.41		
31	**Inlet - Arlanza Junction Box #2**	1	49.5	51	3.5	0.19	0.5			0.09	709.59	0.00	**717.50**	**725.00**	**7.50**
32	RCP (Arlanza)	1	49.5	51				110	303	0.28	710.68	1.09	718.88		
33	20 Degree Bend	1	49.5	51	3.5	0.19	0.25			0.05	710.68	0.00	718.92		

URS

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Arlanza Interceptor
Design Case: Revised Present Design Flow - PWWF
Calculated by: NTC Date: 9/26/2014
Checked by: BCP Date: 9/29/2014

Arlanza Flow Rate = 32.0 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Delta h (ft)					
34	RCP (Arlanza)	1	49.5	51				110	495	0.46	712.46	1.78	721.17		
35	Arlanza Manhole #3 Outlet	1	49.5	51	3.5	0.19	1			0.19	712.46	0.00	721.36		
36	**Arlanza Manhole #3 Inlet**	1	49.5	51	3.5	0.19	0.5			0.09	712.46	0.00	**721.45**	**724.00**	**2.55**
37	RCP (Arlanza)	1	49.5	51				110	428	0.40	713.32	0.86	722.71		
38	Arlanza Manhole #4 Outlet	1	49.5	51	3.5	0.19	1			0.19	713.32	0.00	722.90		
39	**Arlanza Manhole #4 Inlet**	1	49.5	51	3.5	0.19	0.5			0.09	713.32	0.00	**722.99**	**726.30**	**3.31**
40	RCP (Arlanza)	1	49.5	51				110	428	0.40	714.06	0.74	724.14		
41	Arlanza Manhole #5 Outlet	1	49.5	51	3.5	0.19	1			0.19	714.06	0.00	724.33		
42	**Arlanza Manhole #5 Inlet**	1	49.5	51	3.5	0.19	0.5			0.09	714.06	0.00	**724.42**	**725.60**	**1.18**
40	RCP (Arlanza)	1	49.5	51	3.5	0.19		110	246	0.23	718.46	4.40	729.05		
41	Arlanza Manhole #6 Outlet	1	49.5	51	3.5	0.19	1			0.19	718.46	0.00	729.24		
42	**Arlanza Manhole #6 Inlet**	1	49.5	51	3.5	0.19	0.5			0.09	718.46	0.00	**729.34**	**730.00**	**0.66**

Data Source(s):
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.
Arlanza Pipeline: John Carollo Engineers. (1990). City of Riverside, CA Department of Public Works Water Quality Control Plant 1990 Tertiary Expansion. Phoenix, AZ.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
Acorn/Arlanza Junction Box invert elevation and manhole elevation were found on C14 (Brown and Caldwell 1996).
Arlanza Junction Box #1 invert elevation and manhole elevation were found on C15 (Brown and Caldwell 1996)
Arlanza Manhole #3 invert elevation was found on drawing Y-6 (John Carollo Engineers, 1990).
The average slope from the Arlanza junction box (708.0 ft invert elevation) and the Arlanza Manhole #3 (717.25 invert elevation) was determined to be 0.0074 ft/ft, using the length between the Arlanza junction box and the Arlanza Manhole #3.
Arlanza Manholes #1- #3 invert elevations were determined using a slc 0.00359 ft/ft and pipe lengths between each manhole.
The slope between Arlanza Manhole #3 and Arlanza Manhole #5 was determined 0.002 ft/ft
Arlanza Manhole #4 was determined using the slope between Arlanza Manhole #3 and Arlanza Manhole #5 and the pipe length between Arlanza Manhole #3 and Arlanza Manhole #4.

URS

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Santa Ana (Riverside/Hillside) Interceptor
Flow Projection: Revised Present Design Flow - PWWF
Calculated by: NTC Date: 9/26/2014 **Santa Ana Flow Rate =** 25.5 MGD
Checked by: BCP Date: 9/29/2014

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Δh (ft)					
	Rubidoux, Jurupa, Santa Ana (Riverside/Hillside) at Revised Present Design Flow - PWWF		*51.4*												
	Santa Ana (Riverside/Hillside) at Revised Present Design Flow - PWWF		*39.5*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction												710.45		
3	**Inlet to Headworks Junction**	2	25.7	42	2.7	0.11	0.5			0.06	705.70		**710.51**	**713.70**	**3.19**
4	RCP (Headworks)	2	25.7	42				125	28	0.02	705.87	0.17	710.69		
5	35 Degree Bend	2	25.7	42	2.7	0.11	0.4			0.04	705.87	0.00	710.74		
6	RCP (Headworks)	2	25.7	42				125	200	0.11	1285.53	579.66	1290.50		
7	35 Degree Bend	2	25.7	42	2.7	0.11	0.4			0.04	1285.53	0.00	1290.55		
8	RCP (Headworks)	2	25.7	42				125	16	0.01	707.18	-578.35	712.21		
9	Exit from Junction	2	25.7	42	2.7	0.11	1			0.11	707.18	0.00	712.32		
10	**Inlet to Junction**	1	39.5	48	3.1	0.15	0.5			0.08	707.18	0.00	**712.40**	**717.00**	**4.60**
11	RCP (Headworks)	1	39.5	48				125	10	0.01	707.30	0.12	712.52		
12	CCFRPM Pipe (Riverside/Hillside)	1	39.5	48				155	35	0.02	707.70	0.40	712.94		
13	Manhole #1 Exit	1	39.5	48	3.1	0.15	1			0.15	707.70	0.00	713.10		
14	**Manhole #1 Inlet**	1	39.5	48	3.1	0.15	0.5			0.08	707.70	0.00	**713.17**	**716.20**	**3.03**
15	CCFRPM Pipe (Riverside/Hillside)	1	39.5	48				155	174	0.08	708.06	0.36	713.61		
16	Manhole #2 Exit	1	39.5	48	3.1	0.15	1			0.15	708.06	0.00	713.76		
17	**Manhole #2 Inlet**	1	39.5	41	4.3	0.29	0.5			0.14	708.06	0.00	**713.91**	**714.60**	**0.69**
18	CCFRPM Pipe (Riverside/Hillside)	1	34.4	41				155	13	0.01	708.10	0.04	713.96		
19	Manhole #3 Exit	1	34.4	41	3.8	0.22	1			0.22	708.10	0.00	714.18		
20	**Manhole #3 Inlet**	1	34.4	41	3.8	0.22	0.5			0.11	708.10	0.00	**714.28**	**714.90**	**0.62**
21	CCFRPM Pipe (Riverside/Hillside)	1	34.4	41				155	95	0.07	708.26	0.16	714.51		
22	Manhole #4 Exit	1	34.4	41	3.8	0.22	1			0.22	708.26	0.00	714.73		
23	**Manhole #4 Inlet**	1	34.4	41	3.8	0.22	0.5			0.11	708.26	0.00	**714.84**	**715.50**	**0.66**
24	CCFRPM Pipe (Riverside/Hillside)	1	34.4	41				155	13	0.01	708.29	0.03	714.88		
25	Manhole #5 Exit	1	34.4	41	3.8	0.22	1			0.22	708.29	0.00	715.10		
26	**Manhole #5 Inlet**	1	39.5	48	3.1	0.15	0.5			0.08	708.29	0.00	**715.18**	**716.30**	**1.12**
27	CCFRPM Pipe (Riverside/Hillside)	1	39.5	48				155	78	0.03	708.43	0.14	715.35		
28	Manhole #6 Exit	1	39.5	48	3.1	0.15	1			0.15	708.43	0.00	715.51		
29	**Manhole #6 Inlet**	1	39.5	48	3.1	0.15	0.5			0.08	708.43	0.00	**715.58**	**719.40**	**3.82**
30	CCFRPM Pipe (Riverside/Hillside)	1	39.5	48				155	55	0.02	708.53	0.10	715.71		
31	Manhole #7 Exit	1	39.5	48	3.1	0.15	1			0.15	708.53	0.00	715.86		
32	**Manhole #7 Inlet**	1	39.5	48	3.1	0.15	0.5			0.08	708.53	0.00	**715.94**	**719.40**	**3.46**
33	CCFRPM Pipe (Riverside/Hillside)	1	39.5	48				155	215.5	0.10	708.92	0.39	716.42		
34	Manhole #8 Exit	1	39.5	48	3.1	0.15	1			0.15	708.92	0.00	716.58		

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Santa Ana (Riverside/Hillside) Interceptor
Flow Projection: Revised Present Design Flow - PWWF
Calculated by: NTC Date: 9/26/2014 **Santa Ana Flow Rate =** 25.5 MGD
Checked by: BCP Date: 9/29/2014

35	**Manhole #8 Inlet**	1	39.5	48	3.1	0.15	0.5			0.08	708.92	0.00	**716.65**	**722.20**	**5.55**

Data Source(s):
Riverside/Hillside Pipeline: Brown and Caldwell. (2011). Riverside California Public Works Department Santa Ana River Trunk Sewer Replacement Project - Phase 1. San Diego, CA.
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
There is no junction elevation rise between 42" and 48" pipe based on S-2054 Sheet 6 of 33 (Brown & Caldwell 2011).
The length of pipes between the manholes were determined using S-2054 Sheet 6 of 33 (Brown and Caldwell 2011).
Invert elevations were determined using (Brown & Caldwell 1996, 2011).
The Riverside/Hillside CCFRPM pipeline was constructed in 2012; based on the pipe's age, a Hazen Williams coefficient of 155 was chosen.
The dual 42" RCPs to headworks were constructed in 1996; based on the pipe's age, a Hazen Williams coefficient of 125 was chosen.

URS

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering

Calculation: Flow for Rubidoux Interceptor (for use in Santa Ana hydraulic profile calculation)

Design Case: Ultimate Future Design Flow - AADF

Calculated by: NTC Date: 9/26/2014

Checked by: BCP Date: 9/29/2014

Rubidoux Flow Rate = 3.1 MGD

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Acorn Interceptor
Design Case: Ultimate Future Design Flow - AADF
Calculated by: NTC Date: 9/26/2014
Checked by: BCP Date: 9/29/2014

Acorn Flow Rate = 1.9 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Δh (ft)					
	Acorn/Arlanza Combined at Ultimate Future Design Flow - AADF		*35.6*												
	Acorn at Ultimate Future Design Flow - AADF		*3.0*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction Box												710.45		
3	**Inlet to Headworks Junction Box**	2	17.8	42	1.9	0.05	0.5			0.03	705.70		**710.48**	**713.70**	**3.22**
4	RCP (Headworks)	1	35.6	48				110	21	0.01	705.75	0.05	710.54		
5	90 Degree Bend	1	35.6	48	2.8	0.12	0.9			0.11	705.75	0.00	710.65		
6	RCP (Headworks)	1	35.6	48				110	79	0.05	705.94	0.19	710.90		
7	Meter Box Outlet	1	35.6	48	2.8	0.12	1			0.12	705.94	0.00	711.02		
8	**Meter Box Inlet**	1	35.6	48	2.8	0.12	0.5			0.06	705.96	0.02	**711.11**	**715.90**	**4.79**
9	RCP (Headworks)	1	35.6	48				110	491	0.34	707.10	1.14	712.58		
10	35 Degree Bend	1	35.6	48	2.8	0.12	0.4			0.05	707.10	0.00	712.63		
11	RCP (Headworks)	1	35.6	48				110	129	0.09	707.40	0.30	713.02		
12	Exit - Acorn/Arlanza Junction Box	1	35.6	48	2.8	0.12	1			0.12	707.40	0.00	713.14		
13	**Inlet - Acorn/Arlanza Junction Box**	1	3.0	48	0.2	0.00	0.5			0.00	707.40	0.00	**713.14**	**716.10**	**2.96**
14	RCP (Acorn)	1	3.0	36				110	148	0.00	711.31	3.91	717.06		
15	RCP (Acorn)	1	3.0	27				110	180	0.02	716.30	8.90	722.06		
16	Acorn Manhole #1 Exit	1	3.0	27	0.7	0.01	1			0.01	716.30	0.00	722.07		
17	**Acorn Manhole #1 Inlet**	1	3.0	27	0.7	0.01	0.5			0.00	716.30	0.00	**722.08**	**728.30**	**6.22**
18	RCP (Acorn)	1	3.0	27				110	339	0.04	735.49	19.19	741.31		
19	Acorn Manhole #2 Exit	1	3.0	27	0.7	0.01	1			0.01	735.49	0.00	741.31		
20	**Acorn Manhole #2 Inlet**	1	3.0	27	0.7	0.01	0.5			0.00	735.49	0.00	**741.32**	**747.50**	**6.18**

Data Source(s):
John A. Carollo Engineers. (1960). City of Riverside, California Sewage Treatment Plant Additions T5. Phoenix, Arizona.
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
Acorn/Arlanza Junction Box invert elevation and manhole elevation were found on C14 (Brown and Caldwell 1996).
Acorn manhole invert was estimated at 12 ft bgs based on a photograph of the inside of the manhole.
Acorn manhole elevation was determined using 2012 topographic survey.

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EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Arlanza Interceptor
Design Case: Ultimate Future Design Flow - AADF
Calculated by: NTC Date: 9/26/2014
Checked by: BCP Date: 9/29/2014

Arlanza Flow Rate = 21.1 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Delta h (ft)					
	Acorn/Arlanza Combined at Ultimate Future Design		*35.6*												
	Arlanza at Ultimate Future Design Flow - AADF		*32.6*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction												710.45		
3	**Inlet to Headworks Junction**	2	17.8	42	1.9	0.05	0.5			0.03	705.70		**710.48**	**713.70**	**3.22**
4	RCP (Headworks)	1	35.6	48				110	21	0.01	705.75	0.05	709.70		
5	90 Degree Bend	1	35.6	48	2.8	0.12	0.9			0.11	705.75	0.00	709.82		
6	RCP (Headworks)	1	35.6	48				110	79	0.05	705.94	0.19	710.06		
7	Meter Box Outlet	1	35.6	48	2.8	0.12	1			0.12	705.94	0.00	710.19		
8	**Meter Box Inlet**	1	35.6	48	2.8	0.12	0.5			0.06	705.96	0.02	**710.27**	**716.00**	**5.73**
9	RCP (Headworks)	1	35.6	48				110	491	0.34	707.10	1.14	711.75		
10	35 Degree Bend	1	35.6	48	2.8	0.12	0.4			0.05	707.10	0.00	711.80		
11	RCP (Headworks)	1	35.6	48				110	129	0.09	707.40	0.30	712.18		
12	Exit - Acorn/Arlanza Junction Box	1	35.6	48	2.8	0.12	1			0.12	707.40	0.00	712.31		
13	**Inlet - Acorn/Arlanza Junction Box**	2	17.8	48	1.4	0.03	0.5			0.02	707.40	0.00	**712.32**	**716.10**	**3.78**
14	RCP (Arlanza)	2	16.3	48				110	293	0.05	708.00	0.60	712.97		
15	Arlanza Junction Box Exit	2	16.3	48	1.3	0.03	1			0.03	708.00	0.00	713.00		
16	**Inlet - Arlanza Junction Box #1**	1	32.6	51	2.3	0.08	0.5			0.04	708.00	0.00	**713.04**	**717.50**	**4.46**
17	RCP (Arlanza)	1	32.6	51				110	5	0.00	708.02	0.02	713.06		
18	30 Degree Bend	1	32.6	51	2.3	0.08	0.4			0.03	708.02	0.00	713.09		
19	RCP (Arlanza)	1	32.6	51				110	17	0.01	708.08	0.06	713.16		
20	20 Degree Bend	1	32.6	51	2.3	0.08	0.25			0.02	708.08	0.00	713.18		
21	RCP (Arlanza)	1	32.6	51				110	86	0.04	708.39	0.31	713.53		
22	Arlanza Manhole #1 Outlet	1	32.6	51	2.3	0.08	1			0.08	708.39	0.00	713.61		
23	**Arlanza Manhole #1 Inlet**	1	32.6	51	2.3	0.08	0.5			0.04	708.39	0.00	**713.65**	**724.80**	**11.15**
24	RCP (Arlanza)	1	32.6	51				110	161	0.07	708.97	0.58	714.30		
25	50 Degree Bend	1	32.6	51	2.3	0.08	0.7			0.06	708.97	0.00	714.36		
26	RCP (Arlanza)	1	32.6	51				110	24	0.01	709.05	0.09	714.45		
27	Arlanza Manhole #2 Outlet	1	32.6	51	2.3	0.08	1			0.08	709.05	0.00	714.53		
28	**Arlanza Manhole #2 Inlet**	1	32.6	51	2.3	0.08	0.5			0.04	709.05	0.00	**714.58**	**727.50**	**12.92**
29	RCP (Arlanza)	1	32.6	51				110	150	0.07	709.59	0.54	715.18		
30	Exit - Junction Box	1	32.6	51	2.3	0.08	1			0.08	709.59	0.00	715.26		
31	**Inlet - Arlanza Junction Box #2**	1	32.6	51	2.3	0.08	0.5			0.04	709.59	0.00	**715.30**	**725.00**	**9.70**
32	RCP (Arlanza)	1	32.6	51				110	303	0.13	710.68	1.09	716.52		
33	20 Degree Bend	1	32.6	51	2.3	0.08	0.25			0.02	710.68	0.00	716.54		

URS

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Arlanza Interceptor
Design Case: Ultimate Future Design Flow - AADF
Calculated by: NTC Date: 9/26/2014
Checked by: BCP Date: 9/29/2014

Arlanza Flow Rate = 21.1 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Delta h (ft)					
34	RCP (Arlanza)	1	32.6	51				110	495	0.22	712.46	1.78	718.54		
35	Arlanza Manhole #3 Outlet	1	32.6	51	2.3	0.08	1			0.08	712.46	0.00	718.62		
36	**Arlanza Manhole #3 Inlet**	1	32.6	51	2.3	0.08	0.5			0.04	712.46	0.00	**718.66**	**724.00**	**5.34**
37	RCP (Arlanza)	1	32.6	51				110	428	0.19	713.32	0.86	719.70		
38	Arlanza Manhole #4 Outlet	1	32.6	51	2.3	0.08	1			0.08	713.32	0.00	719.79		
39	**Arlanza Manhole #4 Inlet**	1	32.6	51	2.3	0.08	0.5			0.04	713.32	0.00	**719.83**	**726.30**	**6.47**
40	RCP (Arlanza)	1	32.6	51				110	428	0.19	714.06	0.74	720.76		
41	Arlanza Manhole #5 Outlet	1	32.6	51	2.3	0.08	1			0.08	714.06	0.00	720.84		
42	**Arlanza Manhole #5 Inlet**	1	32.6	51	2.3	0.08	0.5			0.04	714.06	0.00	**720.88**	**725.60**	**4.72**
40	RCP (Arlanza)	1	32.6	51	2.3	0.08		110	246	0.11	718.46	4.40	725.39		
41	Arlanza Manhole #6 Outlet	1	32.6	51	2.3	0.08	1			0.08	718.46	0.00	725.47		
42	**Arlanza Manhole #6 Inlet**	1	32.6	51	2.3	0.08	0.5			0.04	718.46	0.00	**725.51**	**730.00**	**4.49**

Data Source(s):
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.
Arlanza Pipeline: John Carollo Engineers. (1990). City of Riverside, CA Department of Public Works Water Quality Control Plant 1990 Tertiary Expansion. Phoenix, AZ.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
Acorn/Arlanza Junction Box invert elevation and manhole elevation were found on C14 (Brown and Caldwell 1996).
Arlanza Junction Box #1 invert elevation and manhole elevation were found on C15 (Brown and Caldwell 1996)
Arlanza Manhole #3 invert elevation was found on drawing Y-6 (John Carollo Engineers, 1990).
The average slope from the Arlanza junction box (708.0 ft invert elevation) and the Arlanza Manhole #3 (717.25 invert elevation) was determined to be 0.0074 ft/ft, using the length between the Arlanza junction box and the Arlanza Manhole #3.
Arlanza Manholes #1- #3 invert elevations were determined using a slc 0.00359 ft/ft and pipe lengths between each manhole.
The slope between Arlanza Manhole #3 and Arlanza Manhole #5 was determined 0.002 ft/ft
Arlanza Manhole #4 was determined using the slope between Arlanza Manhole #3 and Arlanza Manhole #5 and the pipe length between Arlanza Manhole #3 and Arlanza Manhole #4.

URS

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Santa Ana (Riverside/Hillside) Interceptor
Flow Projection: Ultimate Future Design Flow - AADF
Calculated by: NTC Date: 9/26/2014 **Santa Ana Flow Rate =** 21.9 MGD
Checked by: BCP Date: 9/29/2014

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Δh (ft)					
	Rubidoux, Jurupa, Santa Ana (Riverside/Hillside) at Ultimate Future Design Flow - AADF		*43.6*												
	Santa Ana (Riverside/Hillside) at Ultimate Future Design Flow - AADF		*33.9*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction												710.45		
3	**Inlet to Headworks Junction**	2	21.8	42	2.3	0.08	0.5			0.04	705.70		**710.49**	**713.70**	**3.21**
4	RCP (Headworks)	2	21.8	42				125	28	0.01	705.87	0.17	710.67		
5	35 Degree Bend	2	21.8	42	2.3	0.08	0.4			0.03	705.87	0.00	710.70		
6	RCP (Headworks)	2	21.8	42				125	200	0.08	1285.53	579.66	1290.44		
7	35 Degree Bend	2	21.8	42	2.3	0.08	0.4			0.03	1285.53	0.00	1290.47		
8	RCP (Headworks)	2	21.8	42				125	16	0.01	707.18	-578.35	712.14		
9	Exit from Junction	2	21.8	42	2.3	0.08	1			0.08	707.18	0.00	712.22		
10	**Inlet to Junction**	1	33.9	48	2.7	0.11	0.5			0.06	707.18	0.00	**712.27**	**717.00**	**4.73**
11	RCP (Headworks)	1	33.9	48				125	10	0.00	707.30	0.12	712.39		
12	CCFRPM Pipe (Riverside/Hillside)	1	33.9	48				155	35	0.01	707.70	0.40	712.81		
13	Manhole #1 Exit	1	33.9	48	2.7	0.11	1			0.11	707.70	0.00	712.92		
14	**Manhole #1 Inlet**	1	33.9	48	2.7	0.11	0.5			0.06	707.70	0.00	**712.98**	**716.20**	**3.22**
15	CCFRPM Pipe (Riverside/Hillside)	1	33.9	48				155	174	0.06	708.06	0.36	713.40		
16	Manhole #2 Exit	1	33.9	48	2.7	0.11	1			0.11	708.06	0.00	713.51		
17	**Manhole #2 Inlet**	1	33.9	41	3.7	0.21	0.5			0.11	708.06	0.00	**713.62**	**714.60**	**0.98**
18	CCFRPM Pipe (Riverside/Hillside)	1	29.6	41				155	13	0.01	708.10	0.04	713.66		
19	Manhole #3 Exit	1	29.6	41	3.2	0.16	1			0.16	708.10	0.00	713.82		
20	**Manhole #3 Inlet**	1	29.6	41	3.2	0.16	0.5			0.08	708.10	0.00	**713.91**	**714.90**	**0.99**
21	CCFRPM Pipe (Riverside/Hillside)	1	29.6	41				155	95	0.05	708.26	0.16	714.12		
22	Manhole #4 Exit	1	29.6	41	3.2	0.16	1			0.16	708.26	0.00	714.28		
23	**Manhole #4 Inlet**	1	29.6	41	3.2	0.16	0.5			0.08	708.26	0.00	**714.36**	**715.50**	**1.14**
24	CCFRPM Pipe (Riverside/Hillside)	1	29.6	41				155	13	0.01	708.29	0.03	714.40		
25	Manhole #5 Exit	1	29.6	41	3.2	0.16	1			0.16	708.29	0.00	714.56		
26	**Manhole #5 Inlet**	1	33.9	48	2.7	0.11	0.5			0.06	708.29	0.00	**714.62**	**716.30**	**1.68**
27	CCFRPM Pipe (Riverside/Hillside)	1	33.9	48				155	78	0.03	708.43	0.14	714.78		
28	Manhole #6 Exit	1	33.9	48	2.7	0.11	1			0.11	708.43	0.00	714.89		
29	**Manhole #6 Inlet**	1	33.9	48	2.7	0.11	0.5			0.06	708.43	0.00	**714.95**	**719.40**	**4.45**
30	CCFRPM Pipe (Riverside/Hillside)	1	33.9	48				155	55	0.02	708.53	0.10	715.07		
31	Manhole #7 Exit	1	33.9	48	2.7	0.11	1			0.11	708.53	0.00	715.18		
32	**Manhole #7 Inlet**	1	33.9	48	2.7	0.11	0.5			0.06	708.53	0.00	**715.24**	**719.40**	**4.16**
33	CCFRPM Pipe (Riverside/Hillside)	1	33.9	48				155	215.5	0.07	708.92	0.39	715.70		
34	Manhole #8 Exit	1	33.9	48	2.7	0.11	1			0.11	708.92	0.00	715.81		

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Santa Ana (Riverside/Hillside) Interceptor
Flow Projection: Ultimate Future Design Flow - AADF
Calculated by: NTC Date: 9/26/2014 **Santa Ana Flow Rate =** 21.9 MGD
Checked by: BCP Date: 9/29/2014

35	**Manhole #8 Inlet**	1	33.9	48	2.7	0.11	0.5			0.06	708.92	0.00	**715.87**	**722.20**	**6.33**

Data Source(s):
Riverside/Hillside Pipeline: Brown and Caldwell. (2011). Riverside California Public Works Department Santa Ana River Trunk Sewer Replacement Project - Phase 1. San Diego, CA.
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
There is no junction elevation rise between 42" and 48" pipe based on S-2054 Sheet 6 of 33 (Brown & Caldwell 2011).
The length of pipes between the manholes were determined using S-2054 Sheet 6 of 33 (Brown and Caldwell 2011).
Invert elevations were determined using (Brown & Caldwell 1996, 2011).
The Riverside/Hillside CCFRPM pipeline was constructed in 2012; based on the pipe's age, a Hazen Williams coefficient of 155 was chosen.
The dual 42" RCPs to headworks were constructed in 1996; based on the pipe's age, a Hazen Williams coefficient of 125 was chosen.

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EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Flow for Rubidoux Interceptor (for use in Santa Ana hydraulic profile calculation)
Design Case: Ultimate Future Design Flow - PDWF
Calculated by: NTC Date: 9/26/2014
Checked by: BCP Date: 9/29/2014

Rubidoux Flow Rate = 4.6 MGD

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Acorn Interceptor
Design Case: Ultimate Future Design Flow - PDWF
Calculated by: NTC Date: 9/26/2014
Checked by: BCP Date: 9/29/2014

Acorn Flow Rate = 2.9 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Δh (ft)					
	Acorn/Arlanza Combined at Ultimate Future Design Flow - PDWF		*53.4*												
	Acorn at Ultimate Future Design Flow - PDWF		*4.4*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction Box												710.45		
3	**Inlet to Headworks Junction Box**	2	26.7	42	2.8	0.12	0.5			0.06	705.70		**710.51**	**713.70**	**3.19**
4	RCP (Headworks)	1	53.4	48				110	21	0.03	705.75	0.05	710.59		
5	90 Degree Bend	1	53.4	48	4.2	0.28	0.9			0.25	705.75	0.00	710.84		
6	RCP (Headworks)	1	53.4	48				110	79	0.11	705.94	0.19	711.15		
7	Meter Box Outlet	1	53.4	48	4.2	0.28	1			0.28	705.94	0.00	711.43		
8	**Meter Box Inlet**	1	53.4	48	4.2	0.28	0.5			0.14	705.96	0.02	**711.59**	**715.90**	**4.31**
9	RCP (Headworks)	1	53.4	48				110	491	0.71	707.10	1.14	713.44		
10	35 Degree Bend	1	53.4	48	4.2	0.28	0.4			0.11	707.10	0.00	713.55		
11	RCP (Headworks)	1	53.4	48				110	129	0.19	707.40	0.30	714.04		
12	Exit - Acorn/Arlanza Junction Box	1	53.4	48	4.2	0.28	1			0.28	707.40	0.00	714.32		
13	**Inlet - Acorn/Arlanza Junction Box**	1	4.4	48	0.4	0.00	0.5			0.00	707.40	0.00	**714.32**	**716.10**	**1.78**
14	RCP (Acorn)	1	4.4	36				110	148	0.01	711.31	3.91	718.24		
15	RCP (Acorn)	1	4.4	27				110	180	0.04	716.30	8.90	723.26		
16	Acorn Manhole #1 Exit	1	4.4	27	1.1	0.02	1			0.02	716.30	0.00	723.28		
17	**Acorn Manhole #1 Inlet**	1	4.4	27	1.1	0.02	0.5			0.01	716.30	0.00	**723.29**	**728.30**	**5.01**
18	RCP (Acorn)	1	4.4	27				110	339	0.08	735.49	19.19	742.56		
19	Acorn Manhole #2 Exit	1	4.4	27	1.1	0.02	1			0.02	735.49	0.00	742.58		
20	**Acorn Manhole #2 Inlet**	1	4.4	27	1.1	0.02	0.5			0.01	735.49	0.00	**742.59**	**747.50**	**4.91**

Data Source(s):
John A. Carollo Engineers. (1960). City of Riverside, California Sewage Treatment Plant Additions T5. Phoenix, Arizona.
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
Acorn/Arlanza Junction Box invert elevation and manhole elevation were found on C14 (Brown and Caldwell 1996).
Acorn manhole invert was estimated at 12 ft bgs based on a photograph of the inside of the manhole.
Acorn manhole elevation was determined using 2012 topographic survey.

URS

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Arlanza Interceptor
Design Case: Ultimate Future Design Flow - PDWF
Calculated by: NTC Date: 9/26/2014
Checked by: BCP Date: 9/29/2014

Arlanza Flow Rate = 31.7 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Delta h (ft)					
	Acorn/Arlanza Combined at Ultimate Future Design		*53.4*												
	Arlanza at Ultimate Future Design Flow - PDWF		*49.0*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction												710.45		
3	**Inlet to Headworks Junction**	2	26.7	42	2.8	0.12	0.5			0.06	705.70		**710.51**	**713.70**	**3.19**
4	RCP (Headworks)	1	53.4	48				110	21	0.03	705.75	0.05	709.72		
5	90 Degree Bend	1	53.4	48	4.2	0.28	0.9			0.25	705.75	0.00	709.97		
6	RCP (Headworks)	1	53.4	48				110	79	0.11	705.94	0.19	710.28		
7	Meter Box Outlet	1	53.4	48	4.2	0.28	1			0.28	705.94	0.00	710.56		
8	**Meter Box Inlet**	1	53.4	48	4.2	0.28	0.5			0.14	705.96	0.02	**710.72**	**716.00**	**5.28**
9	RCP (Headworks)	1	53.4	48				110	491	0.71	707.10	1.14	712.57		
10	35 Degree Bend	1	53.4	48	4.2	0.28	0.4			0.11	707.10	0.00	712.68		
11	RCP (Headworks)	1	53.4	48				110	129	0.19	707.40	0.30	713.17		
12	Exit - Acorn/Arlanza Junction Box	1	53.4	48	4.2	0.28	1			0.28	707.40	0.00	713.45		
13	**Inlet - Acorn/Arlanza Junction Box**	2	26.7	48	2.1	0.07	0.5			0.04	707.40	0.00	**713.49**	**716.10**	**2.61**
14	RCP (Arlanza)	2	24.5	48				110	293	0.10	708.00	0.60	714.19		
15	Arlanza Junction Box Exit	2	24.5	48	1.9	0.06	1			0.06	708.00	0.00	714.25		
16	**Inlet - Arlanza Junction Box #1**	1	49.0	51	3.5	0.18	0.5			0.09	708.00	0.00	**714.34**	**717.50**	**3.16**
17	RCP (Arlanza)	1	49.0	51				110	5	0.00	708.02	0.02	714.36		
18	30 Degree Bend	1	49.0	51	3.5	0.18	0.4			0.07	708.02	0.00	714.43		
19	RCP (Arlanza)	1	49.0	51				110	17	0.02	708.08	0.06	714.51		
20	20 Degree Bend	1	49.0	51	3.5	0.18	0.25			0.05	708.08	0.00	714.56		
21	RCP (Arlanza)	1	49.0	51				110	86	0.08	708.39	0.31	714.95		
22	Arlanza Manhole #1 Outlet	1	49.0	51	3.5	0.18	1			0.18	708.39	0.00	715.13		
23	**Arlanza Manhole #1 Inlet**	1	49.0	51	3.5	0.18	0.5			0.09	708.39	0.00	**715.22**	**724.80**	**9.58**
24	RCP (Arlanza)	1	49.0	51				110	161	0.15	708.97	0.58	715.95		
25	50 Degree Bend	1	49.0	51	3.5	0.18	0.7			0.13	708.97	0.00	716.08		
26	RCP (Arlanza)	1	49.0	51				110	24	0.02	709.05	0.09	716.19		
27	Arlanza Manhole #2 Outlet	1	49.0	51	3.5	0.18	1			0.18	709.05	0.00	716.37		
28	**Arlanza Manhole #2 Inlet**	1	49.0	51	3.5	0.18	0.5			0.09	709.05	0.00	**716.47**	**727.50**	**11.03**
29	RCP (Arlanza)	1	49.0	51				110	150	0.14	709.59	0.54	717.14		
30	Exit - Junction Box	1	49.0	51	3.5	0.18	1			0.18	709.59	0.00	717.33		
31	**Inlet - Arlanza Junction Box #2**	1	49.0	51	3.5	0.18	0.5			0.09	709.59	0.00	**717.42**	**725.00**	**7.58**
32	RCP (Arlanza)	1	49.0	51				110	303	0.28	710.68	1.09	718.79		
33	20 Degree Bend	1	49.0	51	3.5	0.18	0.25			0.05	710.68	0.00	718.83		

URS

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Arlanza Interceptor
Design Case: Ultimate Future Design Flow - PDWF
Calculated by: NTC Date: 9/26/2014
Checked by: BCP Date: 9/29/2014

Arlanza Flow Rate = 31.7 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Delta h (ft)					
34	RCP (Arlanza)	1	49.0	51				110	495	0.46	712.46	1.78	721.07		
35	Arlanza Manhole #3 Outlet	1	49.0	51	3.5	0.18	1			0.18	712.46	0.00	721.25		
36	**Arlanza Manhole #3 Inlet**	1	49.0	51	3.5	0.18	0.5			0.09	712.46	0.00	**721.35**	**724.00**	**2.65**
37	RCP (Arlanza)	1	49.0	51				110	428	0.39	713.32	0.86	722.60		
38	Arlanza Manhole #4 Outlet	1	49.0	51	3.5	0.18	1			0.18	713.32	0.00	722.78		
39	**Arlanza Manhole #4 Inlet**	1	49.0	51	3.5	0.18	0.5			0.09	713.32	0.00	**722.87**	**726.30**	**3.43**
40	RCP (Arlanza)	1	49.0	51				110	428	0.39	714.06	0.74	724.01		
41	Arlanza Manhole #5 Outlet	1	49.0	51	3.5	0.18	1			0.18	714.06	0.00	724.20		
42	**Arlanza Manhole #5 Inlet**	1	49.0	51	3.5	0.18	0.5			0.09	714.06	0.00	**724.29**	**725.60**	**1.31**
40	RCP (Arlanza)	1	49.0	51	3.5	0.18		110	246	0.23	718.46	4.40	728.92		
41	Arlanza Manhole #6 Outlet	1	49.0	51	3.5	0.18	1			0.18	718.46	0.00	729.10		
42	**Arlanza Manhole #6 Inlet**	1	49.0	51	3.5	0.18	0.5			0.09	718.46	0.00	**729.19**	**730.00**	**0.81**

Data Source(s):
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.
Arlanza Pipeline: John Carollo Engineers. (1990). City of Riverside, CA Department of Public Works Water Quality Control Plant 1990 Tertiary Expansion. Phoenix, AZ.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
Acorn/Arlanza Junction Box invert elevation and manhole elevation were found on C14 (Brown and Caldwell 1996).
Arlanza Junction Box #1 invert elevation and manhole elevation were found on C15 (Brown and Caldwell 1996)
Arlanza Manhole #3 invert elevation was found on drawing Y-6 (John Carollo Engineers, 1990).
The average slope from the Arlanza junction box (708.0 ft invert elevation) and the Arlanza Manhole #3 (717.25 invert elevation) was determined to be 0.0074 ft/ft, using the length between the Arlanza junction box and the Arlanza Manhole #3.
Arlanza Manholes #1- #3 invert elevations were determined using a slc 0.00359 ft/ft and pipe lengths between each manhole.
The slope between Arlanza Manhole #3 and Arlanza Manhole #5 was determined 0.002 ft/ft
Arlanza Manhole #4 was determined using the slope between Arlanza Manhole #3 and Arlanza Manhole #5 and the pipe length between Arlanza Manhole #3 and Arlanza Manhole #4.

URS

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Santa Ana (Riverside/Hillside) Interceptor
Flow Projection: Ultimate Future Design Flow - PDWF
Calculated by: NTC Date: 9/26/2014 **Santa Ana Flow Rate =** 32.9 MGD
Checked by: BCP Date: 9/29/2014

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Δh (ft)					
	Rubidoux, Jurupa, Santa Ana (Riverside/Hillside) at Ultimate Future Design Flow - PDWF		*62.9*												
	Santa Ana (Riverside/Hillside) at Ultimate Future Design Flow - PDWF		*50.9*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction												710.45		
3	**Inlet to Headworks Junction**	2	31.5	42	3.3	0.17	0.5			0.08	705.70		**710.53**	**713.70**	**3.17**
4	RCP (Headworks)	2	31.5	42				125	28	0.02	705.87	0.17	710.73		
5	35 Degree Bend	2	31.5	42	3.3	0.17	0.4			0.07	705.87	0.00	710.79		
6	RCP (Headworks)	2	31.5	42				125	200	0.17	1285.53	579.66	1290.61		
7	35 Degree Bend	2	31.5	42	3.3	0.17	0.4			0.07	1285.53	0.00	1290.68		
8	RCP (Headworks)	2	31.5	42				125	16	0.01	707.18	-578.35	712.35		
9	Exit from Junction	2	31.5	42	3.3	0.17	1			0.17	707.18	0.00	712.51		
10	**Inlet to Junction**	1	50.9	48	4.0	0.25	0.5			0.13	707.18	0.00	**712.64**	**717.00**	**4.36**
11	RCP (Headworks)	1	50.9	48				125	10	0.01	707.30	0.12	712.77		
12	CCFRPM Pipe (Riverside/Hillside)	1	50.9	48				155	35	0.02	707.70	0.40	713.20		
13	Manhole #1 Exit	1	50.9	48	4.0	0.25	1			0.25	707.70	0.00	713.45		
14	**Manhole #1 Inlet**	1	50.9	48	4.0	0.25	0.5			0.13	707.70	0.00	**713.58**	**716.20**	**2.62**
15	CCFRPM Pipe (Riverside/Hillside)	1	50.9	48				155	174	0.12	708.06	0.36	714.06		
16	Manhole #2 Exit	1	50.9	48	4.0	0.25	1			0.25	708.06	0.00	714.31		
17	**Manhole #2 Inlet**	1	50.9	41	5.6	0.48	0.5			0.24	708.06	0.00	**714.55**	**714.60**	**0.05**
18	CCFRPM Pipe (Riverside/Hillside)	1	44.3	41				155	13	0.02	708.10	0.04	714.61		
19	Manhole #3 Exit	1	44.3	41	4.8	0.36	1			0.36	708.10	0.00	714.97		
20	**Manhole #3 Inlet**	1	44.3	41	4.8	0.36	0.5			0.18	708.10	0.00	**715.15**	**714.90**	**-0.25**
21	CCFRPM Pipe (Riverside/Hillside)	1	44.3	41				155	95	0.11	708.26	0.16	715.43		
22	Manhole #4 Exit	1	44.3	41	4.8	0.36	1			0.36	708.26	0.00	715.79		
23	**Manhole #4 Inlet**	1	44.3	41	4.8	0.36	0.5			0.18	708.26	0.00	**715.97**	**715.50**	**-0.47**
24	CCFRPM Pipe (Riverside/Hillside)	1	44.3	41				155	13	0.02	708.29	0.03	716.02		
25	Manhole #5 Exit	1	44.3	41	4.8	0.36	1			0.36	708.29	0.00	716.38		
26	**Manhole #5 Inlet**	1	50.9	48	4.0	0.25	0.5			0.13	708.29	0.00	**716.51**	**716.30**	**-0.21**
27	CCFRPM Pipe (Riverside/Hillside)	1	50.9	48				155	78	0.05	708.43	0.14	716.70		
28	Manhole #6 Exit	1	50.9	48	4.0	0.25	1			0.25	708.43	0.00	716.96		
29	**Manhole #6 Inlet**	1	50.9	48	4.0	0.25	0.5			0.13	708.43	0.00	**717.08**	**719.40**	**2.32**
30	CCFRPM Pipe (Riverside/Hillside)	1	50.9	48				155	55	0.04	708.53	0.10	717.22		
31	Manhole #7 Exit	1	50.9	48	4.0	0.25	1			0.25	708.53	0.00	717.48		
32	**Manhole #7 Inlet**	1	50.9	48	4.0	0.25	0.5			0.13	708.53	0.00	**717.60**	**719.40**	**1.80**
33	CCFRPM Pipe (Riverside/Hillside)	1	50.9	48				155	215.5	0.15	708.92	0.39	718.15		
34	Manhole #8 Exit	1	50.9	48	4.0	0.25	1			0.25	708.92	0.00	718.40		

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Santa Ana (Riverside/Hillside) Interceptor
Flow Projection: Ultimate Future Design Flow - PDWF
Calculated by: NTC Date: 9/26/2014 **Santa Ana Flow Rate =** 32.9 MGD
Checked by: BCP Date: 9/29/2014

35	**Manhole #8 Inlet**	1	50.9	48	4.0	0.25	0.5			0.13	708.92	0.00	**718.53**	**722.20**	**3.67**

Data Source(s):
Riverside/Hillside Pipeline: Brown and Caldwell. (2011). Riverside California Public Works Department Santa Ana River Trunk Sewer Replacement Project - Phase 1. San Diego, CA.
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
There is no junction elevation rise between 42" and 48" pipe based on S-2054 Sheet 6 of 33 (Brown & Caldwell 2011).
The length of pipes between the manholes were determined using S-2054 Sheet 6 of 33 (Brown and Caldwell 2011).
Invert elevations were determined using (Brown & Caldwell 1996, 2011).
The Riverside/Hillside CCFRPM pipeline was constructed in 2012; based on the pipe's age, a Hazen Williams coefficient of 155 was chosen.
The dual 42" RCPs to headworks were constructed in 1996; based on the pipe's age, a Hazen Williams coefficient of 125 was chosen.

URS

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Flow for Rubidoux Interceptor (for use in Santa Ana hydraulic profile calculation)
Design Case: Ultimate Future Design Flow - PWWF

Calculated by: NTC Date: 9/26/2014
Checked by: BCP Date: 9/29/2014

Rubidoux Flow Rate = 6.7 MGD

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Acorn Interceptor
Design Case: Ultimate Future Design Flow - PWWF
Calculated by: NTC Date: 9/26/2014
Checked by: BCP Date: 9/29/2014

Acorn Flow Rate = 4.2 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Δh (ft)					
	Acorn/Arlanza Combined at Ultimate Future Design Flow - PWWF		*78.3*												
	Acorn at Ultimate Future Design Flow - PWWF		*6.5*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction Box												710.45		
3	**Inlet to Headworks Junction Box**	2	39.2	42	4.1	0.26	0.5			0.13	705.70		**710.58**	**713.70**	**3.12**
4	RCP (Headworks)	1	78.3	48				110	21	0.06	705.75	0.05	710.69		
5	90 Degree Bend	1	78.3	48	6.2	0.60	0.9			0.54	705.75	0.00	711.23		
6	RCP (Headworks)	1	78.3	48				110	79	0.23	705.94	0.19	711.66		
7	Meter Box Outlet	1	78.3	48	6.2	0.60	1			0.60	705.94	0.00	712.26		
8	**Meter Box Inlet**	1	78.3	48	6.2	0.60	0.5			0.30	705.96	0.02	**712.58**	**715.90**	**3.32**
9	RCP (Headworks)	1	78.3	48				110	491	1.45	707.10	1.14	715.17		
10	35 Degree Bend	1	78.3	48	6.2	0.60	0.4			0.24	707.10	0.00	715.41		
11	RCP (Headworks)	1	78.3	48				110	129	0.38	707.40	0.30	716.09		
12	Exit - Acorn/Arlanza Junction Box	1	78.3	48	6.2	0.60	1			0.60	707.40	0.00	716.69		
13	**Inlet - Acorn/Arlanza Junction Box**	1	6.5	48	0.5	0.00	0.5			0.00	707.40	0.00	**716.70**	**716.10**	**-0.60**
14	RCP (Acorn)	1	6.5	36				110	148	0.02	711.31	3.91	720.62		
15	RCP (Acorn)	1	6.5	27				110	180	0.09	716.30	8.90	725.68		
16	Acorn Manhole #1 Exit	1	6.5	27	1.6	0.04	1			0.04	716.30	0.00	725.72		
17	**Acorn Manhole #1 Inlet**	1	6.5	27	1.6	0.04	0.5			0.02	716.30	0.00	**725.75**	**728.30**	**2.55**
18	RCP (Acorn)	1	6.5	27				110	339	0.16	735.49	19.19	745.10		
19	Acorn Manhole #2 Exit	1	6.5	27	1.6	0.04	1			0.04	735.49	0.00	745.14		
20	**Acorn Manhole #2 Inlet**	1	6.5	27	1.6	0.04	0.5			0.02	735.49	0.00	**745.16**	**747.50**	**2.34**

Data Source(s):
John A. Carollo Engineers. (1960). City of Riverside, California Sewage Treatment Plant Additions T5. Phoenix, Arizona.
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
Acorn/Arlanza Junction Box invert elevation and manhole elevation were found on C14 (Brown and Caldwell 1996).
Acorn manhole invert was estimated at 12 ft bgs based on a photograph of the inside of the manhole.
Acorn manhole elevation was determined using 2012 topographic survey.

URS

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Arlanza Interceptor
Design Case: Ultimate Future Design Flow - PWWF
Calculated by: NTC Date: 9/26/2014
Checked by: BCP Date: 9/29/2014

Arlanza Flow Rate = 46.4 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Delta h (ft)					
	Acorn/Arlanza Combined at Ultimate Future Design		*78.3*												
	Arlanza at Ultimate Future Design Flow - PWWF		*71.8*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction												710.45		
3	**Inlet to Headworks Junction**	2	39.2	42	4.1	0.26	0.5			0.13	705.70		**710.58**	**713.70**	**3.12**
4	RCP (Headworks)	1	78.3	48				110	21	0.06	705.75	0.05	709.75		
5	90 Degree Bend	1	78.3	48	6.2	0.60	0.9			0.54	705.75	0.00	710.30		
6	RCP (Headworks)	1	78.3	48				110	79	0.23	705.94	0.19	710.72		
7	Meter Box Outlet	1	78.3	48	6.2	0.60	1			0.60	705.94	0.00	711.32		
8	**Meter Box Inlet**	1	78.3	48	6.2	0.60	0.5			0.30	705.96	0.02	**711.65**	**716.00**	**4.35**
9	RCP (Headworks)	1	78.3	48				110	491	1.45	707.10	1.14	714.23		
10	35 Degree Bend	1	78.3	48	6.2	0.60	0.4			0.24	707.10	0.00	714.47		
11	RCP (Headworks)	1	78.3	48				110	129	0.38	707.40	0.30	715.15		
12	Exit - Acorn/Arlanza Junction Box	1	78.3	48	6.2	0.60	1			0.60	707.40	0.00	715.75		
13	**Inlet - Acorn/Arlanza Junction Box**	2	39.2	48	3.1	0.15	0.5			0.08	707.40	0.00	**715.83**	**716.10**	**0.27**
14	RCP (Arlanza)	2	35.9	48				110	293	0.20	708.00	0.60	716.63		
15	Arlanza Junction Box Exit	2	35.9	48	2.9	0.13	1			0.13	708.00	0.00	716.76		
16	**Inlet - Arlanza Junction Box #1**	1	71.8	51	5.1	0.40	0.5			0.20	708.00	0.00	**716.96**	**717.50**	**0.54**
17	RCP (Arlanza)	1	71.8	51				110	5	0.01	708.02	0.02	716.99		
18	30 Degree Bend	1	71.8	51	5.1	0.40	0.4			0.16	708.02	0.00	717.15		
19	RCP (Arlanza)	1	71.8	51				110	17	0.03	708.08	0.06	717.24		
20	20 Degree Bend	1	71.8	51	5.1	0.40	0.25			0.10	708.08	0.00	717.34		
21	RCP (Arlanza)	1	71.8	51				110	86	0.16	708.39	0.31	717.81		
22	Arlanza Manhole #1 Outlet	1	71.8	51	5.1	0.40	1			0.40	708.39	0.00	718.21		
23	**Arlanza Manhole #1 Inlet**	1	71.8	51	5.1	0.40	0.5			0.20	708.39	0.00	**718.41**	**724.80**	**6.39**
24	RCP (Arlanza)	1	71.8	51				110	161	0.30	708.97	0.58	719.29		
25	50 Degree Bend	1	71.8	51	5.1	0.40	0.7			0.28	708.97	0.00	719.56		
26	RCP (Arlanza)	1	71.8	51				110	24	0.04	709.05	0.09	719.70		
27	Arlanza Manhole #2 Outlet	1	71.8	51	5.1	0.40	1			0.40	709.05	0.00	720.09		
28	**Arlanza Manhole #2 Inlet**	1	71.8	51	5.1	0.40	0.5			0.20	709.05	0.00	**720.29**	**727.50**	**7.21**
29	RCP (Arlanza)	1	71.8	51				110	150	0.28	709.59	0.54	721.11		
30	Exit - Junction Box	1	71.8	51	5.1	0.40	1			0.40	709.59	0.00	721.51		
31	**Inlet - Arlanza Junction Box #2**	1	71.8	51	5.1	0.40	0.5			0.20	709.59	0.00	**721.71**	**725.00**	**3.29**
32	RCP (Arlanza)	1	71.8	51				110	303	0.57	710.68	1.09	723.36		
33	20 Degree Bend	1	71.8	51	5.1	0.40	0.25			0.10	710.68	0.00	723.46		

URS

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Arlanza Interceptor
Design Case: Ultimate Future Design Flow - PWWF
Calculated by: NTC Date: 9/26/2014
Checked by: BCP Date: 9/29/2014

Arlanza Flow Rate = 46.4 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Delta h (ft)					
34	RCP (Arlanza)	1	71.8	51				110	495	0.93	712.46	1.78	726.17		
35	Arlanza Manhole #3 Outlet	1	71.8	51	5.1	0.40	1			0.40	712.46	0.00	726.57		
36	**Arlanza Manhole #3 Inlet**	1	71.8	51	5.1	0.40	0.5			0.20	712.46	0.00	**726.76**	**724.00**	**-2.76**
37	RCP (Arlanza)	1	71.8	51				110	428	0.80	713.32	0.86	728.42		
38	Arlanza Manhole #4 Outlet	1	71.8	51	5.1	0.40	1			0.40	713.32	0.00	728.82		
39	**Arlanza Manhole #4 Inlet**	1	71.8	51	5.1	0.40	0.5			0.20	713.32	0.00	**729.02**	**726.30**	**-2.72**
40	RCP (Arlanza)	1	71.8	51				110	428	0.80	714.06	0.74	730.56		
41	Arlanza Manhole #5 Outlet	1	71.8	51	5.1	0.40	1			0.40	714.06	0.00	730.96		
42	**Arlanza Manhole #5 Inlet**	1	71.8	51	5.1	0.40	0.5			0.20	714.06	0.00	**731.16**	**725.60**	**-5.56**
40	RCP (Arlanza)	1	71.8	51	5.1	0.40		110	246	0.46	718.46	4.40	736.02		
41	Arlanza Manhole #6 Outlet	1	71.8	51	5.1	0.40	1			0.40	718.46	0.00	736.42		
42	**Arlanza Manhole #6 Inlet**	1	71.8	51	5.1	0.40	0.5			0.20	718.46	0.00	**736.62**	**730.00**	**-6.62**

Data Source(s):
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.
Arlanza Pipeline: John Carollo Engineers. (1990). City of Riverside, CA Department of Public Works Water Quality Control Plant 1990 Tertiary Expansion. Phoenix, AZ.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
Acorn/Arlanza Junction Box invert elevation and manhole elevation were found on C14 (Brown and Caldwell 1996).
Arlanza Junction Box #1 invert elevation and manhole elevation were found on C15 (Brown and Caldwell 1996)
Arlanza Manhole #3 invert elevation was found on drawing Y-6 (John Carollo Engineers, 1990).
The average slope from the Arlanza junction box (708.0 ft invert elevation) and the Arlanza Manhole #3 (717.25 invert elevation) was determined to be 0.0074 ft/ft, using the length between the Arlanza junction box and the Arlanza Manhole #3.
Arlanza Manholes #1- #3 invert elevations were determined using a slc 0.00359 ft/ft and pipe lengths between each manhole.
The slope between Arlanza Manhole #3 and Arlanza Manhole #5 was determined 0.002 ft/ft
Arlanza Manhole #4 was determined using the slope between Arlanza Manhole #3 and Arlanza Manhole #5 and the pipe length between Arlanza Manhole #3 and Arlanza Manhole #4.

URS

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Santa Ana (Riverside/Hillside) Interceptor
Flow Projection: Ultimate Future Design Flow - PWWF
Calculated by: NTC Date: 9/26/2014 **Santa Ana Flow Rate =** 48.2 MGD
Checked by: BCP Date: 9/29/2014

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Δh (ft)					
	Rubidoux, Jurupa, Santa Ana (Riverside/Hillside) at Ultimate Future Design Flow - PWWF		*90.0*												
	Santa Ana (Riverside/Hillside) at Ultimate Future Design Flow - PWWF		*74.6*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction												710.45		
3	**Inlet to Headworks Junction**	2	45.0	42	4.7	0.34	0.5			0.17	705.70		**710.62**	**713.70**	**3.08**
4	RCP (Headworks)	2	45.0	42				125	28	0.04	705.87	0.17	710.83		
5	35 Degree Bend	2	45.0	42	4.7	0.34	0.4			0.14	705.87	0.00	710.97		
6	RCP (Headworks)	2	45.0	42				125	200	0.32	1285.53	579.66	1290.95		
7	35 Degree Bend	2	45.0	42	4.7	0.34	0.4			0.14	1285.53	0.00	1291.08		
8	RCP (Headworks)	2	45.0	42				125	16	0.03	707.18	-578.35	712.76		
9	Exit from Junction	2	45.0	42	4.7	0.34	1			0.34	707.18	0.00	713.10		
10	**Inlet to Junction**	1	74.6	48	5.9	0.55	0.5			0.27	707.18	0.00	**713.38**	**717.00**	**3.62**
11	RCP (Headworks)	1	74.6	48				125	10	0.02	707.30	0.12	713.51		
12	CCFRPM Pipe (Riverside/Hillside)	1	74.6	48				155	35	0.05	707.70	0.40	713.97		
13	Manhole #1 Exit	1	74.6	48	5.9	0.55	1			0.55	707.70	0.00	714.51		
14	**Manhole #1 Inlet**	1	74.6	48	5.9	0.55	0.5			0.27	707.70	0.00	**714.79**	**716.20**	**1.41**
15	CCFRPM Pipe (Riverside/Hillside)	1	74.6	48				155	174	0.25	708.06	0.36	715.40		
16	Manhole #2 Exit	1	74.6	48	5.9	0.55	1			0.55	708.06	0.00	715.94		
17	**Manhole #2 Inlet**	1	74.6	41	8.1	1.03	0.5			0.51	708.06	0.00	**716.46**	**714.60**	**-1.86**
18	CCFRPM Pipe (Riverside/Hillside)	1	65.0	41				155	13	0.03	708.10	0.04	716.53		
19	Manhole #3 Exit	1	65.0	41	7.1	0.78	1			0.78	708.10	0.00	717.31		
20	**Manhole #3 Inlet**	1	65.0	41	7.1	0.78	0.5			0.39	708.10	0.00	**717.70**	**714.90**	**-2.80**
21	CCFRPM Pipe (Riverside/Hillside)	1	65.0	41				155	95	0.23	708.26	0.16	718.09		
22	Manhole #4 Exit	1	65.0	41	7.1	0.78	1			0.78	708.26	0.00	718.87		
23	**Manhole #4 Inlet**	1	65.0	41	7.1	0.78	0.5			0.39	708.26	0.00	**719.26**	**715.50**	**-3.76**
24	CCFRPM Pipe (Riverside/Hillside)	1	65.0	41				155	13	0.03	708.29	0.03	719.32		
25	Manhole #5 Exit	1	65.0	41	7.1	0.78	1			0.78	708.29	0.00	720.10		
26	**Manhole #5 Inlet**	1	74.6	48	5.9	0.55	0.5			0.27	708.29	0.00	**720.38**	**716.30**	**-4.08**
27	CCFRPM Pipe (Riverside/Hillside)	1	74.6	48				155	78	0.11	708.43	0.14	720.63		
28	Manhole #6 Exit	1	74.6	48	5.9	0.55	1			0.55	708.43	0.00	721.18		
29	**Manhole #6 Inlet**	1	74.6	48	5.9	0.55	0.5			0.27	708.43	0.00	**721.45**	**719.40**	**-2.05**
30	CCFRPM Pipe (Riverside/Hillside)	1	74.6	48				155	55	0.08	708.53	0.10	721.63		
31	Manhole #7 Exit	1	74.6	48	5.9	0.55	1			0.55	708.53	0.00	722.18		
32	**Manhole #7 Inlet**	1	74.6	48	5.9	0.55	0.5			0.27	708.53	0.00	**722.45**	**719.40**	**-3.05**
33	CCFRPM Pipe (Riverside/Hillside)	1	74.6	48				155	215.5	0.31	708.92	0.39	723.15		
34	Manhole #8 Exit	1	74.6	48	5.9	0.55	1			0.55	708.92	0.00	723.70		

EXISTING CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Santa Ana (Riverside/Hillside) Interceptor
Flow Projection: Ultimate Future Design Flow - PWWF
Calculated by: NTC Date: 9/26/2014 **Santa Ana Flow Rate =** 48.2 MGD
Checked by: BCP Date: 9/29/2014

35	**Manhole #8 Inlet**	1	74.6	48	5.9	0.55	0.5			0.27	708.92	0.00	**723.97**	**722.20**	**-1.77**

Data Source(s):
Riverside/Hillside Pipeline: Brown and Caldwell. (2011). Riverside California Public Works Department Santa Ana River Trunk Sewer Replacement Project - Phase 1. San Diego, CA.
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
There is no junction elevation rise between 42" and 48" pipe based on S-2054 Sheet 6 of 33 (Brown & Caldwell 2011).
The length of pipes between the manholes were determined using S-2054 Sheet 6 of 33 (Brown and Caldwell 2011).
Invert elevations were determined using (Brown & Caldwell 1996, 2011).
The Riverside/Hillside CCFRPM pipeline was constructed in 2012; based on the pipe's age, a Hazen Williams coefficient of 155 was chosen.
The dual 42" RCPs to headworks were constructed in 1996; based on the pipe's age, a Hazen Williams coefficient of 125 was chosen.

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Flow for Rubidoux Interceptor (for use in Santa Ana hydraulic profile calculation)
Design Case: Revised Present Design Flow - AADF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Rubidoux Flow Rate = 2.0 MGD

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Acorn Interceptor
Design Case: Revised Present Design Flow - AADF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Acorn Flow Rate = 1.3 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Δh (ft)					
	Acorn/Arlanza Combined Flow		*24.5*												
	Acorn Flow		*2.0*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction Box												710.45		
3	**Inlet to Headworks Junction Box**	1	24.5	48	2.0	0.06	0.5			0.03	705.70		**710.48**	**713.70**	**3.22**
4	Reinforced Concrete Pipe (RCP, Headworks)	1	24.5	48				110	21	0.01	705.75	0.05	710.54		
5	90 Degree Bend	1	24.5	48	2.0	0.06	0.9			0.05	705.75	0.00	710.59		
6	Reinforced Concrete Pipe (RCP, Headworks)	1	24.5	48				110	79	0.03	705.94	0.19	710.81		
7	Meter Box Outlet	1	24.5	48	2.0	0.06	1			0.06	705.94	0.00	710.87		
8	**Meter Box Inlet**	1	24.5	48	2.0	0.06	0.5			0.03	705.96	0.02	**710.92**	**715.90**	**4.98**
9	Reinforced Concrete Pipe (RCP, Headworks)	1	24.5	48				110	491	0.17	707.10	1.14	712.23		
10	35 Degree Bend	1	24.5	48	2.0	0.06	0.4			0.02	707.10	0.00	712.25		
11	Reinforced Concrete Pipe (RCP, Headworks)	1	24.5	48				110	129	0.04	707.40	0.30	712.59		
12	Exit - Acorn/Arlanza Junction Box	1	24.5	48	2.0	0.06	1			0.06	707.40	0.00	712.65		
13	**Inlet - Acorn/Arlanza Junction Box**	1	2.0	48	0.2	0.00	0.5			0.00	707.40	0.00	**712.65**	**716.10**	**3.45**
14	RCP (Acorn)	1	2.0	36				110	109	0.00	711.29	3.89	716.55		
15	RCP (Acorn)	1	2.0	27				110	39	0.00	712.36	1.07	717.62		
16	New MH AC-3 Outlet	1	2.0	27	0.5	0.00	1			0.00	712.36	0.00	717.63		
17	45 Degree Bend	1	2.0	24	0.6	0.01	0.42			0.00	712.36	0.00	717.63		
18	**New MH AC-3 Inlet**	1	2.0	24	0.6	0.01	0.5			0.00	712.36	0.00	**717.63**	**720.70**	**3.07**
19	New RCP (Acorn)	1	2.0	24				140	28	0.00	712.93	0.57	718.20		
20	45 Degree Bend	1	2.0	24	0.6	0.01	0.42			0.00	714.24	1.31	719.51		
21	Tee from Bypass Run	1	2.0	24	0.6	0.01	0.6			0.00	714.24	0.00	719.52		
22	Outlet Gate	1	2.0	16	1.5	0.03	0.19			0.01	714.24	0.00	719.52		
23	Pipe Bend	1	2.0	16	1.5	0.03	0.2			0.01	712.74	-1.50	718.03		
24	New CCFRPM (Acorn Meter Run)	1	2.0	16				155	23	0.01	712.74	0.00	718.04		
25	New WSP (Acorn Meter Run)	1	2.0	16				140	17	0.01	712.74	0.00	718.04		
26	Inlet Structure Outlet	1	2.0	16	1.5	0.03	1			0.03	712.74	0.00	718.08		
27	Inlet Structure Losses	1	2.0	16	1.5	0.03	0.5			0.02	714.24	1.50	719.59		
28	Inlet Gate	1	2.0	16	1.5	0.03	0.19			0.01	714.24	0.00	719.60		
29	**Inlet Structure Inlet (Acorn)**	1	2.0	24	0.6	0.01	0.5			0.00	714.74	0.50	**720.10**	**724.00**	**3.90**
30	New RCP (Acorn)	1	2.0	24				140	12	0.00	714.98	0.24	720.34		
31	New MH AC-2 Outlet	1	2.0	24	0.6	0.01	1			0.01	714.98	0.00	720.35		
32	45 Degree Bend	1	2.0	24	0.6	0.01	0.42			0.00	714.98	0.00	720.35		
33	**New MH AC-2 Inlet**	1	2.0	24	0.6	0.01	0.5			0.00	714.98	0.00	**720.36**	**725.90**	**5.54**

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Acorn Interceptor
Design Case: Revised Present Design Flow - AADF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Acorn Flow Rate = 1.3 MGD

34	New RCP (Acorn)	1	2.0	24				140	31	0.00	715.60	0.62	720.98		
35	New MH AC-1 Outlet	1	2.0	24	0.6	0.01	1			0.01	715.60	0.00	720.99		
36	45 Degree Bend	1	2.0	24	0.6	0.01	0.42			0.00	715.60	0.00	720.99		
37	**New MH AC-1 Inlet**	1	2.0	27	0.5	0.00	0.5			0.00	715.60	0.00	**720.99**	**726.60**	**5.61**
38	RCP (Acorn)	1	2.0	27				110	25	0.00	716.30	0.70	721.69		
39	Acorn Manhole #1 Outlet	1	2.0	27	0.5	0.00	1			0.00	716.30	0.00	721.70		
40	**Acorn Manhole #1 Inlet**	1	2.0	27	0.5	0.00	0.5			0.00	716.30	0.00	**721.70**	**728.30**	**6.60**
41	RCP (Acorn)	1	2.0	27				110	339	0.02	735.49	19.19	740.91		
42	Acorn Manhole #2 Exit	1	2.0	27	0.5	0.00	1			0.00	735.49	0.00	740.91		
43	**Acorn Manhole #2 Inlet**	1	2.0	27	0.5	0.00	0.5			0.00	735.49	0.00	**740.91**	**747.50**	**6.59**

Data Source(s):
John A. Carollo Engineers. (1960). City of Riverside, California Sewage Treatment Plant Additions T5. Phoenix, Arizona.
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
Acorn/Arlanza Junction Box invert elevation and manhole elevation were found on C14 (Brown and Caldwell 1996).
Acorn manhole invert was estimated at 12 ft bgs based on a photograph of the inside of the manhole.
Acorn manhole elevation was determined using 2012 topographic survey.

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Arlanza Interceptor
Design Case: Revised Present Design Flow - AADF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Arlanza Flow Rate = 14.5 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Delta h (ft)					
	Acorn/Arlanza Combined Flow		*24.5*												
	Arlanza Flow		*22.5*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction												710.45		
3	**Inlet to Headworks Junction**	1	24.5	48	2.0	0.06	0.5			0.03	705.70		**710.48**	**713.70**	**3.22**
4	Reinforced Concrete Pipe (RCP, Headworks)	1	24.5	48				110	21	0.01	705.75	0.05	709.70		
5	90 Degree Bend	1	24.5	48	2.0	0.06	0.9			0.05	705.75	0.00	709.75		
6	Reinforced Concrete Pipe (RCP, Headworks)	1	24.5	48				110	79	0.03	705.94	0.19	709.97		
7	Meter Box Outlet	1	24.5	48	2.0	0.06	1			0.06	705.94	0.00	710.03		
8	**Meter Box Inlet**	1	24.5	48	2.0	0.06	0.5			0.03	705.96	0.02	**710.08**	**716.00**	**5.92**
9	Reinforced Concrete Pipe (RCP, Headworks)	1	24.5	48				110	491	0.17	707.10	1.14	711.39		
10	35 Degree Bend	1	24.5	48	2.0	0.06	0.4			0.02	707.10	0.00	711.41		
11	Reinforced Concrete Pipe (RCP, Headworks)	1	24.5	48				110	129	0.04	707.40	0.30	711.75		
12	Exit - Acorn/Arlanza Junction Box	1	24.5	48	2.0	0.06	1			0.06	707.40	0.00	711.81		
13	**Inlet - Acorn/Arlanza Junction Box**	2	12.3	48	1.0	0.01	0.5			0.01	707.40	0.00	**711.82**	**716.10**	**4.28**
14	Reinforced Concrete Pipe (RCP, Arlanza)	2	11.2	48				110	293	0.02	708.00	0.60	712.44		
15	Arlanza Junction Box Exit	2	11.2	48	0.9	0.01	1			0.01	708.00	0.00	712.46		
16	**Arlanza Junction Box Inlet**	1	22.5	51	1.6	0.04	0.5			0.02	708.00	0.00	**712.48**	**717.50**	**5.02**
17	Reinforced Concrete Pipe (RCP, Arlanza)	1	22.5	51				110	5	0.00	708.02	0.02	712.50		
18	30 Degree Bend	1	22.5	51	1.6	0.04	0.4			0.02	708.02	0.00	712.51		
19	Reinforced Concrete Pipe (RCP, Arlanza)	1	22.5	51				110	17	0.00	708.08	0.06	712.58		
20	20 Degree Bend	1	22.5	51	1.6	0.04	0.25			0.01	708.08	0.00	712.59		
21	Reinforced Concrete Pipe (RCP, Arlanza)	1	22.5	51				110	86	0.02	708.39	0.31	712.91		
22	Arlanza Manhole #1 Outlet	1	22.5	51	1.6	0.04	1			0.04	708.39	0.00	712.95		
23	**Arlanza Manhole #1 Inlet**	1	22.5	51	1.6	0.04	0.5			0.02	708.39	0.00	**712.97**	**724.80**	**11.83**
24	Reinforced Concrete Pipe (RCP, Arlanza)	1	22.5	51				110	161	0.04	708.97	0.58	713.59		
25	50 Degree Bend	1	22.5	51	1.6	0.04	0.7			0.03	708.97	0.00	713.61		
26	Reinforced Concrete Pipe (RCP, Arlanza)	1	22.5	51				110	24	0.01	709.05	0.09	713.70		
27	Arlanza Manhole #2 Outlet	1	22.5	51	1.6	0.04	1			0.04	709.05	0.00	713.74		
28	**Arlanza Manhole #2 Inlet**	1	22.5	51	1.6	0.04	0.5			0.02	709.05	0.00	**713.76**	**727.50**	**13.74**
29	Reinforced Concrete Pipe (RCP, Arlanza)	1	22.5	51				110	150	0.03	709.59	0.54	714.33		
30	Exit - Junction Box	1	22.5	51	1.6	0.04	1			0.04	709.59	0.00	714.37		
31	**Inlet - Junction Box**	1	22.5	51	1.6	0.04	0.5			0.02	709.59	0.00	**714.39**	**725.00**	**10.61**
32	Reinforced Concrete Pipe (RCP, Arlanza)	1	22.5	51				110	303	0.07	710.68	1.09	715.55		
33	20 Degree Bend	1	22.5	51	1.6	0.04	0.25			0.01	710.68	0.00	715.56		

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Arlanza Interceptor
Design Case: Revised Present Design Flow - AADF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Arlanza Flow Rate = 14.5 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Delta h (ft)					
34	Reinforced Concrete Pipe (RCP, Arlanza)	1	22.5	51				110	495	0.11	712.46	1.78	717.45		
35	Arlanza Manhole #3 Outlet	1	22.5	51	1.6	0.04	1			0.04	712.46	0.00	717.48		
36	**Arlanza Manhole #3 Inlet**	1	22.5	51	1.6	0.04	0.5			0.02	712.46	0.00	**717.50**	**724.00**	**6.50**
37	Reinforced Concrete Pipe (RCP, Arlanza)	1	22.5	51				110	428	0.09	713.32	0.86	718.45		
38	Arlanza Manhole #4 Outlet	1	22.5	51	1.6	0.04	1			0.04	713.32	0.00	718.49		
39	**Arlanza Manhole #4 Inlet**	1	22.5	51	1.6	0.04	0.5			0.02	713.32	0.00	**718.51**	**726.30**	**7.79**
40	Reinforced Concrete Pipe (RCP, Arlanza)	1	22.5	51				110	428	0.09	714.06	0.74	719.35		
41	Arlanza Manhole #5 Outlet	1	22.5	51	1.6	0.04	1			0.04	714.06	0.00	719.39		
42	**Arlanza Manhole #5 Inlet**	1	22.5	51	1.6	0.04	0.5			0.02	714.06	0.00	**719.41**	**725.60**	**6.19**
43	RCP (Arlanza)	1	22.5	51				110	21	0.00	715.67	1.61	721.02		
44	Tee from future Jurupa Run	1	22.5	51	1.6	0.04	0.6			0.02	715.67	0.00	721.04		
45	Tee from Bypass Run	1	22.5	51	1.6	0.04	0.6			0.02	715.67	0.00	721.07		
46	Outlet Gate	1	22.5	51	1.6	0.04	0.19			0.01	715.67	0.00	721.07		
47	Pipe Bend	1	22.5	36	3.2	0.16	0.2			0.03	712.67	-3.00	718.11		
48	New CCFRPM (Arlanza Meter Run)	1	22.5	36				155	45	0.03	712.67	0.00	718.13		
49	New WSP (Arlanza Meter Run)	1	22.5	36				140	16	0.01	712.67	0.00	718.15		
50	Inlet Structure Outlet	1	22.5	36	3.2	0.16	1			0.16	712.67	0.00	718.30		
51	Inlet Structure Losses	1	22.5	48	1.8	0.05	0.5			0.02	715.67	3.00	721.33		
52	Inlet Gate	1	22.5	48	1.8	0.05	0.19			0.01	715.67	0.00	721.34		
53	**Inlet Structure Inlet (Arlanza)**	1	22.5	48	1.8	0.05	0.5			0.02	715.67	0.00	**721.36**	**731.00**	**9.64**
54	RCP (Arlanza)	1	22.5	51				110	156	0.03	718.46	2.79	724.19		
55	Arlanza Manhole #6 Outlet	1	22.5	51	1.6	0.04	1			0.04	718.46	0.00	724.23		
56	**Arlanza Manhole #6 Inlet**	1	22.5	51	1.6	0.04	0.5			0.02	718.46	0.00	**724.25**	**730.00**	**5.75**

Data Source(s):
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.
Arlanza Pipeline: John Carollo Engineers. (1990). City of Riverside, CA Department of Public Works Water Quality Control Plant 1990 Tertiary Expansion. Phoenix, AZ.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
Acorn/Arlanza Junction Box invert elevation and manhole elevation were found on C14 (Brown and Caldwell 1996).
Arlanza Junction Box invert elevation and manhole elevation were determined on C15 (Brown and Caldwell 1996)
Arlanza Manhole #3 invert elevation was found on drawing Y-6 (John Carollo Engineers, 1990).
The average slope from the Arlanza junction box (708.0 ft invert elevation) and the Arlanza Manhole #3 (717.25 invert elevation) was determined to be 0.0074 ft/ft, using the length between the Arlanza junction box and the Arlanza Manhole #3.
Arlanza Manholes #1- #3 invert elevations were determined using a slc 0.00359 ft/ft and pipe lengths between each manhole.
The slope between Arlanza Manhole #3 and Arlanza Manhole #5 was determined 0.002 ft/ft
Arlanza Manhole #4 was determined using the slope between Arlanza Manhole #3 and Arlanza Manhole #5 and the pipe length between Arlanza Manhole #3 and Arlanza Manhole #4.

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Santa Ana (Riverside/Hillside) Interceptor
Design Case: Revised Present Design Flow - AADF
Calculated by: NTC Date: 9/29/2014 **Santa Ana Flow Rate =** 11.6 MGD
Checked by: BCP Date: 9/30/2014

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Δh (ft)					
	Rubidoux, Jurupa, Santa Ana (Riverside/Hillside) Combined Flow		*28.4*												
	Santa Ana (Riverside/Hillside) Flow		*18.0*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction												710.45		
3	**Inlet to Headworks Junction**	2	14.2	42	1.5	0.03	0.5			0.02	705.70		**710.47**	**713.70**	**3.23**
4	Reinforced Concrete Pipe (RCP, Headworks)	2	14.2	42				125	28	0.01	705.87	0.17	710.64		
5	35 Degree Bend	2	14.2	42	1.5	0.03	0.4			0.01	705.87	0.00	710.66		
6	Reinforced Concrete Pipe (RCP, Headworks)	2	14.2	42				125	200	0.04	707.08	1.21	711.91		
7	35 Degree Bend	2	14.2	42	1.5	0.03	0.4			0.01	707.08	0.00	711.92		
8	Reinforced Concrete Pipe (RCP, Headworks)	2	14.2	42				125	16	0.00	707.18	0.10	712.02		
9	Exit from Junction	2	14.2	42	1.5	0.03	1			0.03	707.18	0.00	712.05		
10	**Inlet to Junction**	1	18.0	48	1.4	0.03	0.5			0.02	707.18	0.00	**712.07**	**717.00**	**4.93**
11	Reinforced Concrete Pipe (RCP, Headworks)	1	18.0	48				125	10	0.00	707.30	0.12	712.19		
12	CCFRPM Pipe (Santa Ana)	1	18.0	48				155	35	0.00	707.70	0.40	712.60		
13	Manhole #1 Exit	1	18.0	48	1.4	0.03	1			0.03	707.70	0.00	712.63		
14	**Manhole #1 Inlet**	1	18.0	48	1.4	0.03	0.5			0.02	707.70	0.00	**712.64**	**716.20**	**3.56**
15	New CCFRPM (Santa Ana)	1	18.0	36				155	12	0.00	707.99	0.29	712.94		
16	Tee from Bypass Run	1	18.0	36	2.5	0.10	0.6			0.06	707.99	0.00	713.00		
17	Outlet Gate	1	18.0	36	2.5	0.10	0.19			0.02	707.99	0.00	713.02		
18	Pipe Bend, vertical	1	18.0	36	2.5	0.10	0.2			0.02	704.99	-3.00	710.04		
19	New CCFRPM (Santa Ana Meter Run)	1	18.0	36				155	71	0.03	704.99	0.00	710.07		
20	New WSP (Santa Ana Meter Run)	1	18.0	36				140	38	0.02	704.99	0.00	710.09		
21	Inlet Structure Outlet	1	18.0	36	2.5	0.10	1			0.10	704.99	0.00	710.19		
22	Inlet Structure Losses	1	18.0	48	1.4	0.03	0.5			0.02	707.99	3.00	713.21		
23	Inlet Gate	1	18.0	48	1.4	0.03	0.19			0.01	707.99	0.00	713.21		
24	**Inlet Structure Inlet (Santa Ana)**	1	18.0	48	1.4	0.03	0.5			0.02	707.99	0.00	**713.23**	**717.80**	**4.57**
25	CCFRPM Pipe (Santa Ana)	1	18.0	48	1.4	0.03		155	31	0.00	708.06	0.07	713.30		
26	Manhole #2 Exit	1	18.0	48	1.4	0.03	1			0.03	708.06	0.00	713.33		
27	**Manhole #2 Inlet**	1	18.0	41	2.0	0.06	0.5			0.03	708.06	0.00	**713.36**	**714.60**	**1.24**
28	CCFRPM Pipe (Santa Ana)	1	15.7	41				155	13	0.00	708.10	0.04	713.40		
29	Manhole #3 Exit	1	15.7	41	1.7	0.05	1			0.05	708.10	0.00	713.45		
30	**Manhole #3 Inlet**	1	15.7	41	1.7	0.05	0.5			0.02	708.10	0.00	**713.47**	**714.90**	**1.43**
31	CCFRPM Pipe (Santa Ana)	1	15.7	41				155	95	0.02	708.26	0.16	713.64		
32	Manhole #4 Exit	1	15.7	41	1.7	0.05	1			0.05	708.26	0.00	713.69		
33	**Manhole #4 Inlet**	1	15.7	41	1.7	0.05	0.5			0.02	708.26	0.00	**713.71**	**715.50**	**1.79**
34	CCFRPM Pipe (Santa Ana)	1	15.7	41				155	13	0.00	708.29	0.03	713.74		
35	Manhole #5 Exit	1	15.7	41	1.7	0.05	1			0.05	708.29	0.00	713.79		

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Santa Ana (Riverside/Hillside) Interceptor
Design Case: Revised Present Design Flow - AADF
Calculated by: NTC Date: 9/29/2014 **Santa Ana Flow Rate =** 11.6 MGD
Checked by: BCP Date: 9/30/2014

36	**Manhole #5 Inlet**	1	18.0	48	1.4	0.03	0.5			0.02	708.29	0.00	**713.81**	**716.30**	**2.49**
37	CCFRPM Pipe (Santa Ana)	1	18.0	48				155	78	0.01	708.43	0.14	713.95		
38	Manhole #6 Exit	1	18.0	48	1.4	0.03	1			0.03	708.43	0.00	713.99		
39	**Manhole #6 Inlet**	1	18.0	48	1.4	0.03	0.5			0.02	708.43	0.00	**714.00**	**719.40**	**5.40**
40	CCFRPM Pipe (Santa Ana)	1	18.0	48				155	55	0.01	708.53	0.10	714.11		
41	Manhole #7 Exit	1	18.0	48	1.4	0.03	1			0.03	708.53	0.00	714.14		
42	**Manhole #7 Inlet**	1	18.0	48	1.4	0.03	0.5			0.02	708.53	0.00	**714.15**	**719.40**	**5.25**
43	CCFRPM Pipe (Santa Ana)	1	18.0	48				155	216	0.02	708.92	0.39	714.57		
44	Manhole #8 Exit	1	18.0	48	1.4	0.03	1			0.03	708.92	0.00	714.60		
45	**Manhole #8 Inlet**	1	18.0	48	1.4	0.03	0.5			0.02	708.92	0.00	**714.61**	**722.20**	**7.59**

Data Source(s):
Riverside/Hillside Pipeline: Brown and Caldwell. (2011). Riverside California Public Works Department Santa Ana River Trunk Sewer Replacement Project - Phase 1. San Diego, CA.
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
There is no junction elevation rise between 42" and 48" pipe based on S-2054 Sheet 6 of 33 (Brown & Caldwell 2011).
The length of pipes between the manholes were determined using S-2054 Sheet 6 of 33 (Brown and Caldwell 2011).
Invert elevations were determined using (Brown & Caldwell 1996, 2011).
The Riverside/Hillside CCFRPM pipeline was constructed in 2012; based on the pipe's age, a Hazen Williams coefficient of 155 was chosen.
The dual 42" RCPs to headworks were constructed in 1996; based on the pipe's age, a Hazen Williams coefficient of 125 was chosen.

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Flow for Rubidoux Interceptor (for use in Santa Ana hydraulic profile calculation)
Design Case: Revised Present Design Flow - PDWF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Rubidoux Flow Rate = 3.0 MGD

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Acorn Interceptor
Design Case: Revised Present Design Flow - PDWF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Acorn Flow Rate = 2.0 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Δh (ft)					
	Acorn/Arlanza Combined Flow		*36.8*												
	Acorn Flow		*3.1*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction Box												710.45		
3	**Inlet to Headworks Junction Box**	1	36.8	48	2.9	0.13	0.5			0.07	705.70		**710.52**	**713.70**	**3.18**
4	Reinforced Concrete Pipe (RCP, Headworks)	1	36.8	48				110	21	0.02	705.75	0.05	710.58		
5	90 Degree Bend	1	36.8	48	2.9	0.13	0.9			0.12	705.75	0.00	710.70		
6	Reinforced Concrete Pipe (RCP, Headworks)	1	36.8	48				110	79	0.06	705.94	0.19	710.95		
7	Meter Box Outlet	1	36.8	48	2.9	0.13	1			0.13	705.94	0.00	711.08		
8	**Meter Box Inlet**	1	36.8	48	2.9	0.13	0.5			0.07	705.96	0.02	**711.17**	**715.90**	**4.73**
9	Reinforced Concrete Pipe (RCP, Headworks)	1	36.8	48				110	491	0.36	707.10	1.14	712.67		
10	35 Degree Bend	1	36.8	48	2.9	0.13	0.4			0.05	707.10	0.00	712.72		
11	Reinforced Concrete Pipe (RCP, Headworks)	1	36.8	48				110	129	0.09	707.40	0.30	713.11		
12	Exit - Acorn/Arlanza Junction Box	1	36.8	48	2.9	0.13	1			0.13	707.40	0.00	713.25		
13	**Inlet - Acorn/Arlanza Junction Box**	1	3.1	48	0.2	0.00	0.5			0.00	707.40	0.00	**713.25**	**716.10**	**2.85**
14	RCP (Acorn)	1	3.1	36				110	109	0.00	711.29	3.89	717.15		
15	RCP (Acorn)	1	3.1	27				110	39	0.00	712.36	1.07	718.22		
16	New MH AC-3 Outlet	1	3.1	27	0.8	0.01	1			0.01	712.36	0.00	718.23		
17	45 Degree Bend	1	3.1	24	1.0	0.01	0.42			0.01	712.36	0.00	718.24		
18	**New MH AC-3 Inlet**	1	3.1	24	1.0	0.01	0.5			0.01	712.36	0.00	**718.24**	**720.70**	**2.46**
19	New RCP (Acorn)	1	3.1	24				140	28	0.00	712.93	0.57	718.81		
20	45 Degree Bend	1	3.1	24	1.0	0.01	0.42			0.01	714.24	1.31	720.13		
21	Tee from Bypass Run	1	3.1	24	1.0	0.01	0.6			0.01	714.24	0.00	720.14		
22	Outlet Gate	1	3.1	16	2.2	0.07	0.19			0.01	714.24	0.00	720.15		
23	Pipe Bend	1	3.1	16	2.2	0.07	0.2			0.01	712.74	-1.50	718.67		
24	New CCFRPM (Acorn Meter Run)	1	3.1	16				155	23	0.02	712.74	0.00	718.69		
25	New WSP (Acorn Meter Run)	1	3.1	16				140	17	0.02	712.74	0.00	718.70		
26	Inlet Structure Outlet	1	3.1	16	2.2	0.07	1			0.07	712.74	0.00	718.78		
27	Inlet Structure Losses	1	3.1	16	2.2	0.07	0.5			0.04	714.24	1.50	720.31		
28	Inlet Gate	1	3.1	16	2.2	0.07	0.19			0.01	714.24	0.00	720.33		
29	**Inlet Structure Inlet (Acorn)**	1	3.1	24	1.0	0.01	0.5			0.01	714.74	0.50	**720.84**	**724.00**	**3.16**
30	New RCP (Acorn)	1	3.1	24				140	12	0.00	714.98	0.24	721.08		
31	New MH AC-2 Outlet	1	3.1	24	1.0	0.01	1			0.01	714.98	0.00	721.09		
32	45 Degree Bend	1	3.1	24	1.0	0.01	0.42			0.01	714.98	0.00	721.10		
33	**New MH AC-2 Inlet**	1	3.1	24	1.0	0.01	0.5			0.01	714.98	0.00	**721.10**	**725.90**	**4.80**

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Acorn Interceptor
Design Case: Revised Present Design Flow - PDWF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Acorn Flow Rate = 2.0 MGD

34	New RCP (Acorn)	1	3.1	24				140	31	0.00	715.60	0.62	721.73		
35	New MH AC-1 Outlet	1	3.1	24	1.0	0.01	1			0.01	715.60	0.00	721.74		
36	45 Degree Bend	1	3.1	24	1.0	0.01	0.42			0.01	715.60	0.00	721.75		
37	**New MH AC-1 Inlet**	1	3.1	27	0.8	0.01	0.5			0.00	715.60	0.00	**721.75**	**726.60**	**4.85**
38	RCP (Acorn)	1	3.1	27				110	25	0.00	716.30	0.70	722.46		
39	Acorn Manhole #1 Outlet	1	3.1	27	0.8	0.01	1			0.01	716.30	0.00	722.47		
40	**Acorn Manhole #1 Inlet**	1	3.1	27	0.8	0.01	0.5			0.00	716.30	0.00	**722.47**	**728.30**	**5.83**
41	RCP (Acorn)	1	3.1	27				110	339	0.04	735.49	19.19	741.70		
42	Acorn Manhole #2 Exit	1	3.1	27	0.8	0.01	1			0.01	735.49	0.00	741.71		
43	**Acorn Manhole #2 Inlet**	1	3.1	27	0.8	0.01	0.5			0.00	735.49	0.00	**741.72**	**747.50**	**5.78**

Data Source(s):
John A. Carollo Engineers. (1960). City of Riverside, California Sewage Treatment Plant Additions T5. Phoenix, Arizona.
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
Acorn/Arlanza Junction Box invert elevation and manhole elevation were found on C14 (Brown and Caldwell 1996).
Acorn manhole invert was estimated at 12 ft bgs based on a photograph of the inside of the manhole.
Acorn manhole elevation was determined using 2012 topographic survey.

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Arlanza Interceptor
Design Case: Revised Present Design Flow - PDWF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Arlanza Flow Rate = 21.8 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Delta h (ft)					
	Acorn/Arlanza Combined Flow		*36.8*												
	Arlanza Flow		*33.7*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction												710.45		
3	**Inlet to Headworks Junction**	1	36.8	48	2.9	0.13	0.5			0.07	705.70		**710.52**	**713.70**	**3.18**
4	Reinforced Concrete Pipe (RCP, Headworks)	1	36.8	48				110	21	0.02	705.75	0.05	709.71		
5	90 Degree Bend	1	36.8	48	2.9	0.13	0.9			0.12	705.75	0.00	709.83		
6	Reinforced Concrete Pipe (RCP, Headworks)	1	36.8	48				110	79	0.06	705.94	0.19	710.07		
7	Meter Box Outlet	1	36.8	48	2.9	0.13	1			0.13	705.94	0.00	710.21		
8	**Meter Box Inlet**	1	36.8	48	2.9	0.13	0.5			0.07	705.96	0.02	**710.30**	**716.00**	**5.70**
9	Reinforced Concrete Pipe (RCP, Headworks)	1	36.8	48				110	491	0.36	707.10	1.14	711.79		
10	35 Degree Bend	1	36.8	48	2.9	0.13	0.4			0.05	707.10	0.00	711.84		
11	Reinforced Concrete Pipe (RCP, Headworks)	1	36.8	48				110	129	0.09	707.40	0.30	712.24		
12	Exit - Acorn/Arlanza Junction Box	1	36.8	48	2.9	0.13	1			0.13	707.40	0.00	712.37		
13	**Inlet - Acorn/Arlanza Junction Box**	2	18.4	48	1.5	0.03	0.5			0.02	707.40	0.00	**712.39**	**716.10**	**3.71**
14	Reinforced Concrete Pipe (RCP, Arlanza)	2	16.9	48				110	293	0.05	708.00	0.60	713.04		
15	Arlanza Junction Box Exit	2	16.9	48	1.3	0.03	1			0.03	708.00	0.00	713.07		
16	**Arlanza Junction Box Inlet**	1	33.7	51	2.4	0.09	0.5			0.04	708.00	0.00	**713.11**	**717.50**	**4.39**
17	Reinforced Concrete Pipe (RCP, Arlanza)	1	33.7	51				110	5	0.00	708.02	0.02	713.13		
18	30 Degree Bend	1	33.7	51	2.4	0.09	0.4			0.04	708.02	0.00	713.17		
19	Reinforced Concrete Pipe (RCP, Arlanza)	1	33.7	51				110	17	0.01	708.08	0.06	713.23		
20	20 Degree Bend	1	33.7	51	2.4	0.09	0.25			0.02	708.08	0.00	713.26		
21	Reinforced Concrete Pipe (RCP, Arlanza)	1	33.7	51				110	86	0.04	708.39	0.31	713.61		
22	Arlanza Manhole #1 Outlet	1	33.7	51	2.4	0.09	1			0.09	708.39	0.00	713.69		
23	**Arlanza Manhole #1 Inlet**	1	33.7	51	2.4	0.09	0.5			0.04	708.39	0.00	**713.74**	**724.80**	**11.06**
24	Reinforced Concrete Pipe (RCP, Arlanza)	1	33.7	51				110	161	0.07	708.97	0.58	714.39		
25	50 Degree Bend	1	33.7	51	2.4	0.09	0.7			0.06	708.97	0.00	714.45		
26	Reinforced Concrete Pipe (RCP, Arlanza)	1	33.7	51				110	24	0.01	709.05	0.09	714.55		
27	Arlanza Manhole #2 Outlet	1	33.7	51	2.4	0.09	1			0.09	709.05	0.00	714.64		
28	**Arlanza Manhole #2 Inlet**	1	33.7	51	2.4	0.09	0.5			0.04	709.05	0.00	**714.68**	**727.50**	**12.82**
29	Reinforced Concrete Pipe (RCP, Arlanza)	1	33.7	51				110	150	0.07	709.59	0.54	715.29		
30	Exit - Junction Box	1	33.7	51	2.4	0.09	1			0.09	709.59	0.00	715.38		
31	**Inlet - Junction Box**	1	33.7	51	2.4	0.09	0.5			0.04	709.59	0.00	**715.42**	**725.00**	**9.58**
32	Reinforced Concrete Pipe (RCP, Arlanza)	1	33.7	51				110	303	0.14	710.68	1.09	716.65		
33	20 Degree Bend	1	33.7	51	2.4	0.09	0.25			0.02	710.68	0.00	716.67		

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Arlanza Interceptor
Design Case: Revised Present Design Flow - PDWF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Arlanza Flow Rate = 21.8 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Delta h (ft)					
34	Reinforced Concrete Pipe (RCP, Arlanza)	1	33.7	51				110	495	0.23	712.46	1.78	718.68		
35	Arlanza Manhole #3 Outlet	1	33.7	51	2.4	0.09	1			0.09	712.46	0.00	718.77		
36	**Arlanza Manhole #3 Inlet**	1	33.7	51	2.4	0.09	0.5			0.04	712.46	0.00	**718.81**	**724.00**	**5.19**
37	Reinforced Concrete Pipe (RCP, Arlanza)	1	33.7	51				110	428	0.20	713.32	0.86	719.87		
38	Arlanza Manhole #4 Outlet	1	33.7	51	2.4	0.09	1			0.09	713.32	0.00	719.95		
39	**Arlanza Manhole #4 Inlet**	1	33.7	51	2.4	0.09	0.5			0.04	713.32	0.00	**720.00**	**726.30**	**6.30**
40	Reinforced Concrete Pipe (RCP, Arlanza)	1	33.7	51				110	428	0.20	714.06	0.74	720.94		
41	Arlanza Manhole #5 Outlet	1	33.7	51	2.4	0.09	1			0.09	714.06	0.00	721.03		
42	**Arlanza Manhole #5 Inlet**	1	33.7	51	2.4	0.09	0.5			0.04	714.06	0.00	**721.07**	**725.60**	**4.53**
43	RCP (Arlanza)	1	33.7	51				110	21	0.01	715.67	1.61	722.69		
44	Tee from future Jurupa Run	1	33.7	51	2.4	0.09	0.6			0.05	715.67	0.00	722.74		
45	Tee from Bypass Run	1	33.7	51	2.4	0.09	0.6			0.05	715.67	0.00	722.79		
46	Outlet Gate	1	33.7	51	2.4	0.09	0.19			0.02	715.67	0.00	722.81		
47	Pipe Bend	1	33.7	36	4.8	0.35	0.2			0.07	712.67	-3.00	719.88		
48	New CCFRPM (Arlanza Meter Run)	1	33.7	36				155	45	0.06	712.67	0.00	719.94		
49	New WSP (Arlanza Meter Run)	1	33.7	36				140	16	0.03	712.67	0.00	719.97		
50	Inlet Structure Outlet	1	33.7	36	4.8	0.35	1			0.35	712.67	0.00	720.32		
51	Inlet Structure Losses	1	33.7	48	2.7	0.11	0.5			0.06	715.67	3.00	723.38		
52	Inlet Gate	1	33.7	48	2.7	0.11	0.19			0.02	715.67	0.00	723.40		
53	**Inlet Structure Inlet (Arlanza)**	1	33.7	48	2.7	0.11	0.5			0.06	715.67	0.00	**723.46**	**731.00**	**7.54**
54	RCP (Arlanza)	1	33.7	51				110	156	0.07	718.46	2.79	726.32		
55	Arlanza Manhole #6 Outlet	1	33.7	51	2.4	0.09	1			0.09	718.46	0.00	726.41		
56	**Arlanza Manhole #6 Inlet**	1	33.7	51	2.4	0.09	0.5			0.04	718.46	0.00	**726.45**	**730.00**	**3.55**

Data Source(s):
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.
Arlanza Pipeline: John Carollo Engineers. (1990). City of Riverside, CA Department of Public Works Water Quality Control Plant 1990 Tertiary Expansion. Phoenix, AZ.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
Acorn/Arlanza Junction Box invert elevation and manhole elevation were found on C14 (Brown and Caldwell 1996).
Arlanza Junction Box invert elevation and manhole elevation were determined on C15 (Brown and Caldwell 1996)
Arlanza Manhole #3 invert elevation was found on drawing Y-6 (John Carollo Engineers, 1990).
The average slope from the Arlanza junction box (708.0 ft invert elevation) and the Arlanza Manhole #3 (717.25 invert elevation) was determined to be 0.0074 ft/ft, using the length between the Arlanza junction box and the Arlanza Manhole #3.
Arlanza Manholes #1- #3 invert elevations were determined using a slc 0.00359 ft/ft and pipe lengths between each manhole.
The slope between Arlanza Manhole #3 and Arlanza Manhole #5 was determined 0.002 ft/ft
Arlanza Manhole #4 was determined using the slope between Arlanza Manhole #3 and Arlanza Manhole #5 and the pipe length between Arlanza Manhole #3 and Arlanza Manhole #4.

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Santa Ana (Riverside/Hillside) Interceptor
Design Case: Revised Present Design Flow - PDWF
Calculated by: NTC Date: 9/29/2014 **Santa Ana Flow Rate =** 17.4 MGD
Checked by: BCP Date: 9/30/2014

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Δh (ft)					
	Rubidoux, Jurupa, Santa Ana (Riverside/Hillside) Combined Flow		*39.0*												
	Santa Ana (Riverside/Hillside) Flow		*26.9*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction												710.45		
3	**Inlet to Headworks Junction**	2	19.5	42	2.0	0.06	0.5			0.03	705.70		**710.48**	**713.70**	**3.22**
4	Reinforced Concrete Pipe (RCP, Headworks)	2	19.5	42				125	28	0.01	705.87	0.17	710.66		
5	35 Degree Bend	2	19.5	42	2.0	0.06	0.4			0.03	705.87	0.00	710.69		
6	Reinforced Concrete Pipe (RCP, Headworks)	2	19.5	42				125	200	0.07	707.08	1.21	711.97		
7	35 Degree Bend	2	19.5	42	2.0	0.06	0.4			0.03	707.08	0.00	711.99		
8	Reinforced Concrete Pipe (RCP, Headworks)	2	19.5	42				125	16	0.01	707.18	0.10	712.10		
9	Exit from Junction	2	19.5	42	2.0	0.06	1			0.06	707.18	0.00	712.16		
10	**Inlet to Junction**	1	26.9	48	2.1	0.07	0.5			0.04	707.18	0.00	**712.20**	**717.00**	**4.80**
11	Reinforced Concrete Pipe (RCP, Headworks)	1	26.9	48				125	10	0.00	707.30	0.12	712.31		
12	CCFRPM Pipe (Santa Ana)	1	26.9	48				155	35	0.01	707.70	0.40	712.73		
13	Manhole #1 Exit	1	26.9	48	2.1	0.07	1			0.07	707.70	0.00	712.80		
14	**Manhole #1 Inlet**	1	26.9	48	2.1	0.07	0.5			0.04	707.70	0.00	**712.83**	**716.20**	**3.37**
15	New CCFRPM (Santa Ana)	1	26.9	36				155	12	0.01	707.99	0.29	713.14		
16	Tee from Bypass Run	1	26.9	36	3.8	0.23	0.6			0.14	707.99	0.00	713.27		
17	Outlet Gate	1	26.9	36	3.8	0.23	0.19			0.04	707.99	0.00	713.32		
18	Pipe Bend, vertical	1	26.9	36	3.8	0.23	0.2			0.05	704.99	-3.00	710.36		
19	New CCFRPM (Santa Ana Meter Run)	1	26.9	36				155	71	0.06	704.99	0.00	710.42		
20	New WSP (Santa Ana Meter Run)	1	26.9	36				140	38	0.04	704.99	0.00	710.47		
21	Inlet Structure Outlet	1	26.9	36	3.8	0.23	1			0.23	704.99	0.00	710.69		
22	Inlet Structure Losses	1	26.9	48	2.1	0.07	0.5			0.04	707.99	3.00	713.73		
23	Inlet Gate	1	26.9	48	2.1	0.07	0.19			0.01	707.99	0.00	713.74		
24	**Inlet Structure Inlet (Santa Ana)**	1	26.9	48	2.1	0.07	0.5			0.04	707.99	0.00	**713.78**	**717.80**	**4.02**
25	CCFRPM Pipe (Santa Ana)	1	26.9	48	2.1	0.07		155	31	0.01	708.06	0.07	713.85		
26	Manhole #2 Exit	1	26.9	48	2.1	0.07	1			0.07	708.06	0.00	713.92		
27	**Manhole #2 Inlet**	1	26.9	41	2.9	0.13	0.5			0.07	708.06	0.00	**713.99**	**714.60**	**0.61**
28	CCFRPM Pipe (Santa Ana)	1	23.5	41				155	13	0.00	708.10	0.04	714.03		
29	Manhole #3 Exit	1	23.5	41	2.6	0.10	1			0.10	708.10	0.00	714.13		
30	**Manhole #3 Inlet**	1	23.5	41	2.6	0.10	0.5			0.05	708.10	0.00	**714.18**	**714.90**	**0.72**
31	CCFRPM Pipe (Santa Ana)	1	23.5	41				155	95	0.03	708.26	0.16	714.38		
32	Manhole #4 Exit	1	23.5	41	2.6	0.10	1			0.10	708.26	0.00	714.48		
33	**Manhole #4 Inlet**	1	23.5	41	2.6	0.10	0.5			0.05	708.26	0.00	**714.53**	**715.50**	**0.97**
34	CCFRPM Pipe (Santa Ana)	1	23.5	41				155	13	0.00	708.29	0.03	714.57		
35	Manhole #5 Exit	1	23.5	41	2.6	0.10	1			0.10	708.29	0.00	714.67		

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Santa Ana (Riverside/Hillside) Interceptor
Design Case: Revised Present Design Flow - PDWF
Calculated by: NTC Date: 9/29/2014 **Santa Ana Flow Rate =** 17.4 MGD
Checked by: BCP Date: 9/30/2014

36	**Manhole #5 Inlet**	1	26.9	48	2.1	0.07	0.5			0.04	708.29	0.00	**714.70**	**716.30**	**1.60**
37	CCFRPM Pipe (Santa Ana)	1	26.9	48				155	78	0.02	708.43	0.14	714.86		
38	Manhole #6 Exit	1	26.9	48	2.1	0.07	1			0.07	708.43	0.00	714.93		
39	**Manhole #6 Inlet**	1	26.9	48	2.1	0.07	0.5			0.04	708.43	0.00	**714.97**	**719.40**	**4.43**
40	CCFRPM Pipe (Santa Ana)	1	26.9	48				155	55	0.01	708.53	0.10	715.08		
41	Manhole #7 Exit	1	26.9	48	2.1	0.07	1			0.07	708.53	0.00	715.15		
42	**Manhole #7 Inlet**	1	26.9	48	2.1	0.07	0.5			0.04	708.53	0.00	**715.19**	**719.40**	**4.21**
43	CCFRPM Pipe (Santa Ana)	1	26.9	48				155	216	0.05	708.92	0.39	715.62		
44	Manhole #8 Exit	1	26.9	48	2.1	0.07	1			0.07	708.92	0.00	715.69		
45	**Manhole #8 Inlet**	1	26.9	48	2.1	0.07	0.5			0.04	708.92	0.00	**715.73**	**722.20**	**6.47**

Data Source(s):
Riverside/Hillside Pipeline: Brown and Caldwell. (2011). Riverside California Public Works Department Santa Ana River Trunk Sewer Replacement Project - Phase 1. San Diego, CA.
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
There is no junction elevation rise between 42" and 48" pipe based on S-2054 Sheet 6 of 33 (Brown & Caldwell 2011).
The length of pipes between the manholes were determined using S-2054 Sheet 6 of 33 (Brown and Caldwell 2011).
Invert elevations were determined using (Brown & Caldwell 1996, 2011).
The Riverside/Hillside CCFRPM pipeline was constructed in 2012; based on the pipe's age, a Hazen Williams coefficient of 155 was chosen.
The dual 42" RCPs to headworks were constructed in 1996; based on the pipe's age, a Hazen Williams coefficient of 125 was chosen.

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Flow for Rubidoux Interceptor (for use in Santa Ana hydraulic profile calculation)
Design Case: Revised Present Design Flow - PWWF

Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Rubidoux Flow Rate = 4.5 MGD

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Acorn Interceptor
Design Case: Revised Present Design Flow - PWWF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Acorn Flow Rate = 2.9 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Δh (ft)					
	Acorn/Arlanza Combined Flow		*54.0*												
	Acorn Flow		*4.5*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction Box												710.45		
3	**Inlet to Headworks Junction Box**	1	54.0	48	4.3	0.29	0.5			0.14	705.70		**710.59**	**713.70**	**3.11**
4	Reinforced Concrete Pipe (RCP, Headworks)	1	54.0	48				110	21	0.03	705.75	0.05	710.67		
5	90 Degree Bend	1	54.0	48	4.3	0.29	0.9			0.26	705.75	0.00	710.93		
6	Reinforced Concrete Pipe (RCP, Headworks)	1	54.0	48				110	79	0.12	705.94	0.19	711.24		
7	Meter Box Outlet	1	54.0	48	4.3	0.29	1			0.29	705.94	0.00	711.53		
8	**Meter Box Inlet**	1	54.0	48	4.3	0.29	0.5			0.14	705.96	0.02	**711.69**	**715.90**	**4.21**
9	Reinforced Concrete Pipe (RCP, Headworks)	1	54.0	48				110	491	0.73	707.10	1.14	713.56		
10	35 Degree Bend	1	54.0	48	4.3	0.29	0.4			0.11	707.10	0.00	713.67		
11	Reinforced Concrete Pipe (RCP, Headworks)	1	54.0	48				110	129	0.19	707.40	0.30	714.16		
12	Exit - Acorn/Arlanza Junction Box	1	54.0	48	4.3	0.29	1			0.29	707.40	0.00	714.45		
13	**Inlet - Acorn/Arlanza Junction Box**	1	4.5	48	0.4	0.00	0.5			0.00	707.40	0.00	**714.45**	**716.10**	**1.65**
14	RCP (Acorn)	1	4.5	36				110	109	0.01	711.29	3.89	718.35		
15	RCP (Acorn)	1	4.5	27				110	39	0.01	712.36	1.07	719.43		
16	New MH AC-3 Outlet	1	4.5	27	1.1	0.02	1			0.02	712.36	0.00	719.45		
17	45 Degree Bend	1	4.5	24	1.4	0.03	0.42			0.01	712.36	0.00	719.46		
18	**New MH AC-3 Inlet**	1	4.5	24	1.4	0.03	0.5			0.02	712.36	0.00	**719.48**	**720.70**	**1.22**
19	New RCP (Acorn)	1	4.5	24				140	28	0.01	712.93	0.57	720.05		
20	45 Degree Bend	1	4.5	24	1.4	0.03	0.42			0.01	714.24	1.31	721.38		
21	Tee from Bypass Run	1	4.5	24	1.4	0.03	0.6			0.02	714.24	0.00	721.39		
22	Outlet Gate	1	4.5	16	3.2	0.16	0.19			0.03	714.24	0.00	721.42		
23	Pipe Bend	1	4.5	16	3.2	0.16	0.2			0.03	712.74	-1.50	719.96		
24	New CCFRPM (Acorn Meter Run)	1	4.5	16				155	23	0.04	712.74	0.00	719.99		
25	New WSP (Acorn Meter Run)	1	4.5	16				140	17	0.03	712.74	0.00	720.03		
26	Inlet Structure Outlet	1	4.5	16	3.2	0.16	1			0.16	712.74	0.00	720.19		
27	Inlet Structure Losses	1	4.5	16	3.2	0.16	0.5			0.08	714.24	1.50	721.77		
28	Inlet Gate	1	4.5	16	3.2	0.16	0.19			0.03	714.24	0.00	721.80		
29	**Inlet Structure Inlet (Acorn)**	1	4.5	24	1.4	0.03	0.5			0.02	714.74	0.50	**722.31**	**724.00**	**1.69**
30	New RCP (Acorn)	1	4.5	24				140	12	0.00	714.98	0.24	722.56		
31	New MH AC-2 Outlet	1	4.5	24	1.4	0.03	1			0.03	714.98	0.00	722.59		
32	45 Degree Bend	1	4.5	24	1.4	0.03	0.42			0.01	714.98	0.00	722.60		
33	**New MH AC-2 Inlet**	1	4.5	24	1.4	0.03	0.5			0.02	714.98	0.00	**722.62**	**725.90**	**3.28**

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Acorn Interceptor
Design Case: Revised Present Design Flow - PWWF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Acorn Flow Rate = 2.9 MGD

34	New RCP (Acorn)	1	4.5	24				140	31	0.01	715.60	0.62	723.25		
35	New MH AC-1 Outlet	1	4.5	24	1.4	0.03	1			0.03	715.60	0.00	723.28		
36	45 Degree Bend	1	4.5	24	1.4	0.03	0.42			0.01	715.60	0.00	723.29		
37	**New MH AC-1 Inlet**	1	4.5	27	1.1	0.02	0.5			0.01	715.60	0.00	**723.30**	**726.60**	**3.30**
38	RCP (Acorn)	1	4.5	27				110	25	0.01	716.30	0.70	724.01		
39	Acorn Manhole #1 Outlet	1	4.5	27	1.1	0.02	1			0.02	716.30	0.00	724.03		
40	**Acorn Manhole #1 Inlet**	1	4.5	27	1.1	0.02	0.5			0.01	716.30	0.00	**724.04**	**728.30**	**4.26**
41	RCP (Acorn)	1	4.5	27				110	339	0.08	735.49	19.19	743.31		
42	Acorn Manhole #2 Exit	1	4.5	27	1.1	0.02	1			0.02	735.49	0.00	743.33		
43	**Acorn Manhole #2 Inlet**	1	4.5	27	1.1	0.02	0.5			0.01	735.49	0.00	**743.34**	**747.50**	**4.16**

Data Source(s):
John A. Carollo Engineers. (1960). City of Riverside, California Sewage Treatment Plant Additions T5. Phoenix, Arizona.
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
Acorn/Arlanza Junction Box invert elevation and manhole elevation were found on C14 (Brown and Caldwell 1996).
Acorn manhole invert was estimated at 12 ft bgs based on a photograph of the inside of the manhole.
Acorn manhole elevation was determined using 2012 topographic survey.

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Arlanza Interceptor
Design Case: Revised Present Design Flow - PWWF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Arlanza Flow Rate = 32.0 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Delta h (ft)					
	Acorn/Arlanza Combined Flow		*54.0*												
	Arlanza Flow		*49.5*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction												710.45		
3	**Inlet to Headworks Junction**	1	54.0	48	4.3	0.29	0.5			0.14	705.70		**710.59**	**713.70**	**3.11**
4	Reinforced Concrete Pipe (RCP, Headworks)	1	54.0	48				110	21	0.03	705.75	0.05	709.72		
5	90 Degree Bend	1	54.0	48	4.3	0.29	0.9			0.26	705.75	0.00	709.98		
6	Reinforced Concrete Pipe (RCP, Headworks)	1	54.0	48				110	79	0.12	705.94	0.19	710.29		
7	Meter Box Outlet	1	54.0	48	4.3	0.29	1			0.29	705.94	0.00	710.57		
8	**Meter Box Inlet**	1	54.0	48	4.3	0.29	0.5			0.14	705.96	0.02	**710.74**	**716.00**	**5.26**
9	Reinforced Concrete Pipe (RCP, Headworks)	1	54.0	48				110	491	0.73	707.10	1.14	712.60		
10	35 Degree Bend	1	54.0	48	4.3	0.29	0.4			0.11	707.10	0.00	712.72		
11	Reinforced Concrete Pipe (RCP, Headworks)	1	54.0	48				110	129	0.19	707.40	0.30	713.21		
12	Exit - Acorn/Arlanza Junction Box	1	54.0	48	4.3	0.29	1			0.29	707.40	0.00	713.50		
13	**Inlet - Acorn/Arlanza Junction Box**	2	27.0	48	2.1	0.07	0.5			0.04	707.40	0.00	**713.53**	**716.10**	**2.57**
14	Reinforced Concrete Pipe (RCP, Arlanza)	2	24.7	48				110	293	0.10	708.00	0.60	714.23		
15	Arlanza Junction Box Exit	2	24.7	48	2.0	0.06	1			0.06	708.00	0.00	714.29		
16	**Arlanza Junction Box Inlet**	1	49.5	51	3.5	0.19	0.5			0.09	708.00	0.00	**714.39**	**717.50**	**3.11**
17	Reinforced Concrete Pipe (RCP, Arlanza)	1	49.5	51				110	5	0.00	708.02	0.02	714.41		
18	30 Degree Bend	1	49.5	51	3.5	0.19	0.4			0.08	708.02	0.00	714.49		
19	Reinforced Concrete Pipe (RCP, Arlanza)	1	49.5	51				110	17	0.02	708.08	0.06	714.56		
20	20 Degree Bend	1	49.5	51	3.5	0.19	0.25			0.05	708.08	0.00	714.61		
21	Reinforced Concrete Pipe (RCP, Arlanza)	1	49.5	51				110	86	0.08	708.39	0.31	715.00		
22	Arlanza Manhole #1 Outlet	1	49.5	51	3.5	0.19	1			0.19	708.39	0.00	715.19		
23	**Arlanza Manhole #1 Inlet**	1	49.5	51	3.5	0.19	0.5			0.09	708.39	0.00	**715.28**	**724.80**	**9.52**
24	Reinforced Concrete Pipe (RCP, Arlanza)	1	49.5	51				110	161	0.15	708.97	0.58	716.01		
25	50 Degree Bend	1	49.5	51	3.5	0.19	0.7			0.13	708.97	0.00	716.15		
26	Reinforced Concrete Pipe (RCP, Arlanza)	1	49.5	51				110	24	0.02	709.05	0.09	716.26		
27	Arlanza Manhole #2 Outlet	1	49.5	51	3.5	0.19	1			0.19	709.05	0.00	716.44		
28	**Arlanza Manhole #2 Inlet**	1	49.5	51	3.5	0.19	0.5			0.09	709.05	0.00	**716.54**	**727.50**	**10.96**
29	Reinforced Concrete Pipe (RCP, Arlanza)	1	49.5	51				110	150	0.14	709.59	0.54	717.22		
30	Exit - Junction Box	1	49.5	51	3.5	0.19	1			0.19	709.59	0.00	717.41		
31	**Inlet - Junction Box**	1	49.5	51	3.5	0.19	0.5			0.09	709.59	0.00	**717.50**	**725.00**	**7.50**
32	Reinforced Concrete Pipe (RCP, Arlanza)	1	49.5	51				110	303	0.28	710.68	1.09	718.88		
33	20 Degree Bend	1	49.5	51	3.5	0.19	0.25			0.05	710.68	0.00	718.92		

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Arlanza Interceptor
Design Case: Revised Present Design Flow - PWWF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Arlanza Flow Rate = 32.0 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Delta h (ft)					
34	Reinforced Concrete Pipe (RCP, Arlanza)	1	49.5	51				110	495	0.46	712.46	1.78	721.17		
35	Arlanza Manhole #3 Outlet	1	49.5	51	3.5	0.19	1			0.19	712.46	0.00	721.36		
36	**Arlanza Manhole #3 Inlet**	1	49.5	51	3.5	0.19	0.5			0.09	712.46	0.00	**721.45**	**724.00**	**2.55**
37	Reinforced Concrete Pipe (RCP, Arlanza)	1	49.5	51				110	428	0.40	713.32	0.86	722.71		
38	Arlanza Manhole #4 Outlet	1	49.5	51	3.5	0.19	1			0.19	713.32	0.00	722.90		
39	**Arlanza Manhole #4 Inlet**	1	49.5	51	3.5	0.19	0.5			0.09	713.32	0.00	**722.99**	**726.30**	**3.31**
40	Reinforced Concrete Pipe (RCP, Arlanza)	1	49.5	51				110	428	0.40	714.06	0.74	724.14		
41	Arlanza Manhole #5 Outlet	1	49.5	51	3.5	0.19	1			0.19	714.06	0.00	724.33		
42	**Arlanza Manhole #5 Inlet**	1	49.5	51	3.5	0.19	0.5			0.09	714.06	0.00	**724.42**	**725.60**	**1.18**
43	RCP (Arlanza)	1	49.5	51				110	21	0.02	715.67	1.61	726.05		
44	Tee from future Jurupa Run	1	49.5	51	3.5	0.19	0.6			0.11	715.67	0.00	726.16		
45	Tee from Bypass Run	1	49.5	51	3.5	0.19	0.6			0.11	715.67	0.00	726.28		
46	Outlet Gate	1	49.5	51	3.5	0.19	0.19			0.04	715.67	0.00	726.31		
47	Pipe Bend	1	49.5	36	7.0	0.76	0.2			0.15	712.67	-3.00	723.46		
48	New CCFRPM (Arlanza Meter Run)	1	49.5	36				155	45	0.12	712.67	0.00	723.59		
49	New WSP (Arlanza Meter Run)	1	49.5	36				140	16	0.05	712.67	0.00	723.64		
50	Inlet Structure Outlet	1	49.5	36	7.0	0.76	1			0.76	712.67	0.00	724.40		
51	Inlet Structure Losses	1	49.5	48	3.9	0.24	0.5			0.12	715.67	3.00	727.52		
52	Inlet Gate	1	49.5	48	3.9	0.24	0.19			0.05	715.67	0.00	727.57		
53	**Inlet Structure Inlet (Arlanza)**	1	49.5	48	3.9	0.24	0.5			0.12	715.67	0.00	**727.69**	**731.00**	**3.31**
54	RCP (Arlanza)	1	49.5	51				110	156	0.15	718.46	2.79	730.63		
55	Arlanza Manhole #6 Outlet	1	49.5	51	3.5	0.19	1			0.19	718.46	0.00	730.81		
56	**Arlanza Manhole #6 Inlet**	1	49.5	51	3.5	0.19	0.5			0.09	718.46	0.00	**730.91**	**730.00**	**-0.91**

Data Source(s):
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.
Arlanza Pipeline: John Carollo Engineers. (1990). City of Riverside, CA Department of Public Works Water Quality Control Plant 1990 Tertiary Expansion. Phoenix, AZ.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
Acorn/Arlanza Junction Box invert elevation and manhole elevation were found on C14 (Brown and Caldwell 1996).
Arlanza Junction Box invert elevation and manhole elevation were determined on C15 (Brown and Caldwell 1996)
Arlanza Manhole #3 invert elevation was found on drawing Y-6 (John Carollo Engineers, 1990).
The average slope from the Arlanza junction box (708.0 ft invert elevation) and the Arlanza Manhole #3 (717.25 invert elevation) was determined to be 0.0074 ft/ft, using the length between the Arlanza junction box and the Arlanza Manhole #3.
Arlanza Manholes #1- #3 invert elevations were determined using a slc 0.00359 ft/ft and pipe lengths between each manhole.
The slope between Arlanza Manhole #3 and Arlanza Manhole #5 was determined 0.002 ft/ft
Arlanza Manhole #4 was determined using the slope between Arlanza Manhole #3 and Arlanza Manhole #5 and the pipe length between Arlanza Manhole #3 and Arlanza Manhole #4.

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Santa Ana (Riverside/Hillside) Interceptor
Design Case: Revised Present Design Flow - PWWF
Calculated by: NTC Date: 9/29/2014 **Santa Ana Flow Rate =** 25.5 MGD
Checked by: BCP Date: 9/30/2014

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Δh (ft)					
	Rubidoux, Jurupa, Santa Ana (Riverside/Hillside) Combined Flow		*53.7*												
	Santa Ana (Riverside/Hillside) Flow		*39.5*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction												710.45		
3	**Inlet to Headworks Junction**	2	26.9	42	2.8	0.12	0.5			0.06	705.70		**710.51**	**713.70**	**3.19**
4	Reinforced Concrete Pipe (RCP, Headworks)	2	26.9	42				125	28	0.02	705.87	0.17	710.70		
5	35 Degree Bend	2	26.9	42	2.8	0.12	0.4			0.05	705.87	0.00	710.75		
6	Reinforced Concrete Pipe (RCP, Headworks)	2	26.9	42				125	200	0.12	707.08	1.21	712.08		
7	35 Degree Bend	2	26.9	42	2.8	0.12	0.4			0.05	707.08	0.00	712.13		
8	Reinforced Concrete Pipe (RCP, Headworks)	2	26.9	42				125	16	0.01	707.18	0.10	712.24		
9	Exit from Junction	2	26.9	42	2.8	0.12	1			0.12	707.18	0.00	712.36		
10	**Inlet to Junction**	1	39.5	48	3.1	0.15	0.5			0.08	707.18	0.00	**712.44**	**717.00**	**4.56**
11	Reinforced Concrete Pipe (RCP, Headworks)	1	39.5	48				125	10	0.01	707.30	0.12	712.56		
12	CCFRPM Pipe (Santa Ana)	1	39.5	48				155	35	0.02	707.70	0.40	712.98		
13	Manhole #1 Exit	1	39.5	48	3.1	0.15	1			0.15	707.70	0.00	713.13		
14	**Manhole #1 Inlet**	1	39.5	48	3.1	0.15	0.5			0.08	707.70	0.00	**713.21**	**716.20**	**2.99**
15	New CCFRPM (Santa Ana)	1	39.5	36				155	12	0.02	707.99	0.29	713.52		
16	Tee from Bypass Run	1	39.5	36	5.6	0.49	0.6			0.29	707.99	0.00	713.82		
17	Outlet Gate	1	39.5	36	5.6	0.49	0.19			0.09	707.99	0.00	713.91		
18	Pipe Bend, vertical	1	39.5	36	5.6	0.49	0.2			0.10	704.99	-3.00	711.00		
19	New CCFRPM (Santa Ana Meter Run)	1	39.5	36				155	71	0.13	704.99	0.00	711.13		
20	New WSP (Santa Ana Meter Run)	1	39.5	36				140	38	0.08	704.99	0.00	711.21		
21	Inlet Structure Outlet	1	39.5	36	5.6	0.49	1			0.49	704.99	0.00	711.70		
22	Inlet Structure Losses	1	39.5	48	3.1	0.15	0.5			0.08	707.99	3.00	714.78		
23	Inlet Gate	1	39.5	48	3.1	0.15	0.19			0.03	707.99	0.00	714.81		
24	**Inlet Structure Inlet (Santa Ana)**	1	39.5	48	3.1	0.15	0.5			0.08	707.99	0.00	**714.88**	**717.80**	**2.92**
25	CCFRPM Pipe (Santa Ana)	1	39.5	48	3.1	0.15		155	31	0.01	708.06	0.07	714.96		
26	Manhole #2 Exit	1	39.5	48	3.1	0.15	1			0.15	708.06	0.00	715.11		
27	**Manhole #2 Inlet**	1	39.5	41	4.3	0.29	0.5			0.14	708.06	0.00	**715.26**	**714.60**	**-0.66**
28	CCFRPM Pipe (Santa Ana)	1	34.4	41				155	13	0.01	708.10	0.04	715.31		
29	Manhole #3 Exit	1	34.4	41	3.8	0.22	1			0.22	708.10	0.00	715.53		
30	**Manhole #3 Inlet**	1	34.4	41	3.8	0.22	0.5			0.11	708.10	0.00	**715.64**	**714.90**	**-0.74**
31	CCFRPM Pipe (Santa Ana)	1	34.4	41				155	95	0.07	708.26	0.16	715.87		
32	Manhole #4 Exit	1	34.4	41	3.8	0.22	1			0.22	708.26	0.00	716.09		
33	**Manhole #4 Inlet**	1	34.4	41	3.8	0.22	0.5			0.11	708.26	0.00	**716.20**	**715.50**	**-0.70**
34	CCFRPM Pipe (Santa Ana)	1	34.4	41				155	13	0.01	708.29	0.03	716.24		
35	Manhole #5 Exit	1	34.4	41	3.8	0.22	1			0.22	708.29	0.00	716.45		

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Santa Ana (Riverside/Hillside) Interceptor
Design Case: Revised Present Design Flow - PWWF
Calculated by: NTC Date: 9/29/2014 **Santa Ana Flow Rate =** 25.5 MGD
Checked by: BCP Date: 9/30/2014

36	**Manhole #5 Inlet**	1	39.5	48	3.1	0.15	0.5			0.08	708.29	0.00	**716.53**	**716.30**	**-0.23**
37	CCFRPM Pipe (Santa Ana)	1	39.5	48				155	78	0.03	708.43	0.14	716.71		
38	Manhole #6 Exit	1	39.5	48	3.1	0.15	1			0.15	708.43	0.00	716.86		
39	**Manhole #6 Inlet**	1	39.5	48	3.1	0.15	0.5			0.08	708.43	0.00	**716.94**	**719.40**	**2.46**
40	CCFRPM Pipe (Santa Ana)	1	39.5	48				155	55	0.02	708.53	0.10	717.06		
41	Manhole #7 Exit	1	39.5	48	3.1	0.15	1			0.15	708.53	0.00	717.21		
42	**Manhole #7 Inlet**	1	39.5	48	3.1	0.15	0.5			0.08	708.53	0.00	**717.29**	**719.40**	**2.11**
43	CCFRPM Pipe (Santa Ana)	1	39.5	48				155	216	0.10	708.92	0.39	717.78		
44	Manhole #8 Exit	1	39.5	48	3.1	0.15	1			0.15	708.92	0.00	717.93		
45	**Manhole #8 Inlet**	1	39.5	48	3.1	0.15	0.5			0.08	708.92	0.00	**718.01**	**722.20**	**4.19**

Data Source(s):
Riverside/Hillside Pipeline: Brown and Caldwell. (2011). Riverside California Public Works Department Santa Ana River Trunk Sewer Replacement Project - Phase 1. San Diego, CA.
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
There is no junction elevation rise between 42" and 48" pipe based on S-2054 Sheet 6 of 33 (Brown & Caldwell 2011).
The length of pipes between the manholes were determined using S-2054 Sheet 6 of 33 (Brown and Caldwell 2011).
Invert elevations were determined using (Brown & Caldwell 1996, 2011).
The Riverside/Hillside CCFRPM pipeline was constructed in 2012; based on the pipe's age, a Hazen Williams coefficient of 155 was chosen.
The dual 42" RCPs to headworks were constructed in 1996; based on the pipe's age, a Hazen Williams coefficient of 125 was chosen.

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Flow for Rubidoux Interceptor (for use in Santa Ana hydraulic profile calculation)
Design Case: Ultimate Future Design Flow - AADF

Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Rubidoux Flow Rate = 3.1 MGD

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Acorn Interceptor
Design Case: Ultimate Future Design Flow - AADF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Acorn Flow Rate = 1.9 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Δh (ft)					
	Acorn/Arlanza Combined Flow		*35.6*												
	Acorn Flow		*3.0*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction Box												710.45		
3	**Inlet to Headworks Junction Box**	1	35.6	48	2.8	0.12	0.5			0.06	705.70		**710.51**	**713.70**	**3.19**
4	Reinforced Concrete Pipe (RCP, Headworks)	1	35.6	48				110	21	0.01	705.75	0.05	710.58		
5	90 Degree Bend	1	35.6	48	2.8	0.12	0.9			0.11	705.75	0.00	710.69		
6	Reinforced Concrete Pipe (RCP, Headworks)	1	35.6	48				110	79	0.05	705.94	0.19	710.93		
7	Meter Box Outlet	1	35.6	48	2.8	0.12	1			0.12	705.94	0.00	711.06		
8	**Meter Box Inlet**	1	35.6	48	2.8	0.12	0.5			0.06	705.96	0.02	**711.14**	**715.90**	**4.76**
9	Reinforced Concrete Pipe (RCP, Headworks)	1	35.6	48				110	491	0.34	707.10	1.14	712.62		
10	35 Degree Bend	1	35.6	48	2.8	0.12	0.4			0.05	707.10	0.00	712.67		
11	Reinforced Concrete Pipe (RCP, Headworks)	1	35.6	48				110	129	0.09	707.40	0.30	713.05		
12	Exit - Acorn/Arlanza Junction Box	1	35.6	48	2.8	0.12	1			0.12	707.40	0.00	713.18		
13	**Inlet - Acorn/Arlanza Junction Box**	1	3.0	48	0.2	0.00	0.5			0.00	707.40	0.00	**713.18**	**716.10**	**2.92**
14	RCP (Acorn)	1	3.0	36				110	109	0.00	711.29	3.89	717.08		
15	RCP (Acorn)	1	3.0	27				110	39	0.00	712.36	1.07	718.15		
16	New MH AC-3 Outlet	1	3.0	27	0.7	0.01	1			0.01	712.36	0.00	718.16		
17	45 Degree Bend	1	3.0	24	0.9	0.01	0.42			0.01	712.36	0.00	718.17		
18	**New MH AC-3 Inlet**	1	3.0	24	0.9	0.01	0.5			0.01	712.36	0.00	**718.17**	**720.70**	**2.53**
19	New RCP (Acorn)	1	3.0	24				140	28	0.00	712.93	0.57	718.74		
20	45 Degree Bend	1	3.0	24	0.9	0.01	0.42			0.01	714.24	1.31	720.06		
21	Tee from Bypass Run	1	3.0	24	0.9	0.01	0.6			0.01	714.24	0.00	720.07		
22	Outlet Gate	1	3.0	16	2.1	0.07	0.19			0.01	714.24	0.00	720.08		
23	Pipe Bend	1	3.0	16	2.1	0.07	0.2			0.01	712.74	-1.50	718.59		
24	New CCFRPM (Acorn Meter Run)	1	3.0	16				155	23	0.02	712.74	0.00	718.61		
25	New WSP (Acorn Meter Run)	1	3.0	16				140	17	0.02	712.74	0.00	718.63		
26	Inlet Structure Outlet	1	3.0	16	2.1	0.07	1			0.07	712.74	0.00	718.70		
27	Inlet Structure Losses	1	3.0	16	2.1	0.07	0.5			0.03	714.24	1.50	720.23		
28	Inlet Gate	1	3.0	16	2.1	0.07	0.19			0.01	714.24	0.00	720.24		
29	**Inlet Structure Inlet (Acorn)**	1	3.0	24	0.9	0.01	0.5			0.01	714.74	0.50	**720.75**	**724.00**	**3.25**
30	New RCP (Acorn)	1	3.0	24				140	12	0.00	714.98	0.24	720.99		
31	New MH AC-2 Outlet	1	3.0	24	0.9	0.01	1			0.01	714.98	0.00	721.01		
32	45 Degree Bend	1	3.0	24	0.9	0.01	0.42			0.01	714.98	0.00	721.01		
33	**New MH AC-2 Inlet**	1	3.0	24	0.9	0.01	0.5			0.01	714.98	0.00	**721.02**	**725.90**	**4.88**

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Acorn Interceptor
Design Case: Ultimate Future Design Flow - AADF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Acorn Flow Rate = 1.9 MGD

34	New RCP (Acorn)	1	3.0	24				140	31	0.00	715.60	0.62	721.64		
35	New MH AC-1 Outlet	1	3.0	24	0.9	0.01	1			0.01	715.60	0.00	721.66		
36	45 Degree Bend	1	3.0	24	0.9	0.01	0.42			0.01	715.60	0.00	721.66		
37	**New MH AC-1 Inlet**	1	3.0	27	0.7	0.01	0.5			0.00	715.60	0.00	**721.67**	**726.60**	**4.93**
38	RCP (Acorn)	1	3.0	27				110	25	0.00	716.30	0.70	722.37		
39	Acorn Manhole #1 Outlet	1	3.0	27	0.7	0.01	1			0.01	716.30	0.00	722.38		
40	**Acorn Manhole #1 Inlet**	1	3.0	27	0.7	0.01	0.5			0.00	716.30	0.00	**722.38**	**728.30**	**5.92**
41	RCP (Acorn)	1	3.0	27				110	339	0.04	735.49	19.19	741.61		
42	Acorn Manhole #2 Exit	1	3.0	27	0.7	0.01	1			0.01	735.49	0.00	741.62		
43	**Acorn Manhole #2 Inlet**	1	3.0	27	0.7	0.01	0.5			0.00	735.49	0.00	**741.62**	**747.50**	**5.88**

Data Source(s):
John A. Carollo Engineers. (1960). City of Riverside, California Sewage Treatment Plant Additions T5. Phoenix, Arizona.
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
Acorn/Arlanza Junction Box invert elevation and manhole elevation were found on C14 (Brown and Caldwell 1996).
Acorn manhole invert was estimated at 12 ft bgs based on a photograph of the inside of the manhole.
Acorn manhole elevation was determined using 2012 topographic survey.

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Arlanza Interceptor
Design Case: Ultimate Future Design Flow - AADF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Arlanza Flow Rate = 21.1 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Delta h (ft)					
	Acorn/Arlanza Combined Flow		*35.6*												
	Arlanza Flow		*32.6*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction												710.45		
3	**Inlet to Headworks Junction**	1	35.6	48	2.8	0.12	0.5			0.06	705.70		**710.51**	**713.70**	**3.19**
4	Reinforced Concrete Pipe (RCP, Headworks)	1	35.6	48				110	21	0.01	705.75	0.05	709.70		
5	90 Degree Bend	1	35.6	48	2.8	0.12	0.9			0.11	705.75	0.00	709.82		
6	Reinforced Concrete Pipe (RCP, Headworks)	1	35.6	48				110	79	0.05	705.94	0.19	710.06		
7	Meter Box Outlet	1	35.6	48	2.8	0.12	1			0.12	705.94	0.00	710.19		
8	**Meter Box Inlet**	1	35.6	48	2.8	0.12	0.5			0.06	705.96	0.02	**710.27**	**716.00**	**5.73**
9	Reinforced Concrete Pipe (RCP, Headworks)	1	35.6	48				110	491	0.34	707.10	1.14	711.75		
10	35 Degree Bend	1	35.6	48	2.8	0.12	0.4			0.05	707.10	0.00	711.80		
11	Reinforced Concrete Pipe (RCP, Headworks)	1	35.6	48				110	129	0.09	707.40	0.30	712.18		
12	Exit - Acorn/Arlanza Junction Box	1	35.6	48	2.8	0.12	1			0.12	707.40	0.00	712.31		
13	**Inlet - Acorn/Arlanza Junction Box**	2	17.8	48	1.4	0.03	0.5			0.02	707.40	0.00	**712.32**	**716.10**	**3.78**
14	Reinforced Concrete Pipe (RCP, Arlanza)	2	16.3	48				110	293	0.05	708.00	0.60	712.97		
15	Arlanza Junction Box Exit	2	16.3	48	1.3	0.03	1			0.03	708.00	0.00	713.00		
16	**Arlanza Junction Box Inlet**	1	32.6	51	2.3	0.08	0.5			0.04	708.00	0.00	**713.04**	**717.50**	**4.46**
17	Reinforced Concrete Pipe (RCP, Arlanza)	1	32.6	51				110	5	0.00	708.02	0.02	713.06		
18	30 Degree Bend	1	32.6	51	2.3	0.08	0.4			0.03	708.02	0.00	713.09		
19	Reinforced Concrete Pipe (RCP, Arlanza)	1	32.6	51				110	17	0.01	708.08	0.06	713.16		
20	20 Degree Bend	1	32.6	51	2.3	0.08	0.25			0.02	708.08	0.00	713.18		
21	Reinforced Concrete Pipe (RCP, Arlanza)	1	32.6	51				110	86	0.04	708.39	0.31	713.53		
22	Arlanza Manhole #1 Outlet	1	32.6	51	2.3	0.08	1			0.08	708.39	0.00	713.61		
23	**Arlanza Manhole #1 Inlet**	1	32.6	51	2.3	0.08	0.5			0.04	708.39	0.00	**713.65**	**724.80**	**11.15**
24	Reinforced Concrete Pipe (RCP, Arlanza)	1	32.6	51				110	161	0.07	708.97	0.58	714.30		
25	50 Degree Bend	1	32.6	51	2.3	0.08	0.7			0.06	708.97	0.00	714.36		
26	Reinforced Concrete Pipe (RCP, Arlanza)	1	32.6	51				110	24	0.01	709.05	0.09	714.45		
27	Arlanza Manhole #2 Outlet	1	32.6	51	2.3	0.08	1			0.08	709.05	0.00	714.53		
28	**Arlanza Manhole #2 Inlet**	1	32.6	51	2.3	0.08	0.5			0.04	709.05	0.00	**714.58**	**727.50**	**12.92**
29	Reinforced Concrete Pipe (RCP, Arlanza)	1	32.6	51				110	150	0.07	709.59	0.54	715.18		
30	Exit - Junction Box	1	32.6	51	2.3	0.08	1			0.08	709.59	0.00	715.26		
31	**Inlet - Junction Box**	1	32.6	51	2.3	0.08	0.5			0.04	709.59	0.00	**715.30**	**725.00**	**9.70**
32	Reinforced Concrete Pipe (RCP, Arlanza)	1	32.6	51				110	303	0.13	710.68	1.09	716.52		
33	20 Degree Bend	1	32.6	51	2.3	0.08	0.25			0.02	710.68	0.00	716.54		

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Arlanza Interceptor
Design Case: Ultimate Future Design Flow - AADF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Arlanza Flow Rate = 21.1 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Delta h (ft)					
34	Reinforced Concrete Pipe (RCP, Arlanza)	1	32.6	51				110	495	0.22	712.46	1.78	718.54		
35	Arlanza Manhole #3 Outlet	1	32.6	51	2.3	0.08	1			0.08	712.46	0.00	718.62		
36	**Arlanza Manhole #3 Inlet**	1	32.6	51	2.3	0.08	0.5			0.04	712.46	0.00	**718.66**	**724.00**	**5.34**
37	Reinforced Concrete Pipe (RCP, Arlanza)	1	32.6	51				110	428	0.19	713.32	0.86	719.70		
38	Arlanza Manhole #4 Outlet	1	32.6	51	2.3	0.08	1			0.08	713.32	0.00	719.79		
39	**Arlanza Manhole #4 Inlet**	1	32.6	51	2.3	0.08	0.5			0.04	713.32	0.00	**719.83**	**726.30**	**6.47**
40	Reinforced Concrete Pipe (RCP, Arlanza)	1	32.6	51				110	428	0.19	714.06	0.74	720.76		
41	Arlanza Manhole #5 Outlet	1	32.6	51	2.3	0.08	1			0.08	714.06	0.00	720.84		
42	**Arlanza Manhole #5 Inlet**	1	32.6	51	2.3	0.08	0.5			0.04	714.06	0.00	**720.88**	**725.60**	**4.72**
43	RCP (Arlanza)	1	32.6	51				110	21	0.01	715.67	1.61	722.50		
44	Tee from future Jurupa Run	1	32.6	51	2.3	0.08	0.6			0.05	715.67	0.00	722.55		
45	Tee from Bypass Run	1	32.6	51	2.3	0.08	0.6			0.05	715.67	0.00	722.60		
46	Outlet Gate	1	32.6	51	2.3	0.08	0.19			0.02	715.67	0.00	722.61		
47	Pipe Bend	1	32.6	36	4.6	0.33	0.2			0.07	712.67	-3.00	719.68		
48	New CCFRPM (Arlanza Meter Run)	1	32.6	36				155	45	0.06	712.67	0.00	719.73		
49	New WSP (Arlanza Meter Run)	1	32.6	36				140	16	0.02	712.67	0.00	719.76		
50	Inlet Structure Outlet	1	32.6	36	4.6	0.33	1			0.33	712.67	0.00	720.09		
51	Inlet Structure Losses	1	32.6	48	2.6	0.10	0.5			0.05	715.67	3.00	723.14		
52	Inlet Gate	1	32.6	48	2.6	0.10	0.19			0.02	715.67	0.00	723.16		
53	**Inlet Structure Inlet (Arlanza)**	1	32.6	48	2.6	0.10	0.5			0.05	715.67	0.00	**723.22**	**731.00**	**7.78**
54	RCP (Arlanza)	1	32.6	51				110	156	0.07	718.46	2.79	726.08		
55	Arlanza Manhole #6 Outlet	1	32.6	51	2.3	0.08	1			0.08	718.46	0.00	726.16		
56	**Arlanza Manhole #6 Inlet**	1	32.6	51	2.3	0.08	0.5			0.04	718.46	0.00	**726.20**	**730.00**	**3.80**

Data Source(s):
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.
Arlanza Pipeline: John Carollo Engineers. (1990). City of Riverside, CA Department of Public Works Water Quality Control Plant 1990 Tertiary Expansion. Phoenix, AZ.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
Acorn/Arlanza Junction Box invert elevation and manhole elevation were found on C14 (Brown and Caldwell 1996).
Arlanza Junction Box invert elevation and manhole elevation were determined on C15 (Brown and Caldwell 1996)
Arlanza Manhole #3 invert elevation was found on drawing Y-6 (John Carollo Engineers, 1990).
The average slope from the Arlanza junction box (708.0 ft invert elevation) and the Arlanza Manhole #3 (717.25 invert elevation) was determined to be 0.0074 ft/ft, using the length between the Arlanza junction box and the Arlanza Manhole #3.
Arlanza Manholes #1- #3 invert elevations were determined using a slc 0.00359 ft/ft and pipe lengths between each manhole.
The slope between Arlanza Manhole #3 and Arlanza Manhole #5 was determined 0.002 ft/ft
Arlanza Manhole #4 was determined using the slope between Arlanza Manhole #3 and Arlanza Manhole #5 and the pipe length between Arlanza Manhole #3 and Arlanza Manhole #4.

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Santa Ana (Riverside/Hillside) Interceptor
Design Case: Ultimate Future Design Flow - AADF
Calculated by: NTC Date: 9/29/2014 **Santa Ana Flow Rate =** 21.9 MGD
Checked by: BCP Date: 9/30/2014

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Δh (ft)					
	Rubidoux, Jurupa, Santa Ana (Riverside/Hillside) Combined Flow		*46.0*												
	Santa Ana (Riverside/Hillside) Flow		*33.9*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction												710.45		
3	**Inlet to Headworks Junction**	2	23.0	42	2.4	0.09	0.5			0.04	705.70		**710.49**	**713.70**	**3.21**
4	Reinforced Concrete Pipe (RCP, Headworks)	2	23.0	42				125	28	0.01	705.87	0.17	710.68		
5	35 Degree Bend	2	23.0	42	2.4	0.09	0.4			0.04	705.87	0.00	710.71		
6	Reinforced Concrete Pipe (RCP, Headworks)	2	23.0	42				125	200	0.09	707.08	1.21	712.02		
7	35 Degree Bend	2	23.0	42	2.4	0.09	0.4			0.04	707.08	0.00	712.05		
8	Reinforced Concrete Pipe (RCP, Headworks)	2	23.0	42				125	16	0.01	707.18	0.10	712.16		
9	Exit from Junction	2	23.0	42	2.4	0.09	1			0.09	707.18	0.00	712.25		
10	**Inlet to Junction**	1	33.9	48	2.7	0.11	0.5			0.06	707.18	0.00	**712.30**	**717.00**	**4.70**
11	Reinforced Concrete Pipe (RCP, Headworks)	1	33.9	48				125	10	0.00	707.30	0.12	712.42		
12	CCFRPM Pipe (Santa Ana)	1	33.9	48				155	35	0.01	707.70	0.40	712.84		
13	Manhole #1 Exit	1	33.9	48	2.7	0.11	1			0.11	707.70	0.00	712.95		
14	**Manhole #1 Inlet**	1	33.9	48	2.7	0.11	0.5			0.06	707.70	0.00	**713.01**	**716.20**	**3.19**
15	New CCFRPM (Santa Ana)	1	33.9	36				155	12	0.02	707.99	0.29	713.32		
16	Tee from Bypass Run	1	33.9	36	4.8	0.36	0.6			0.21	707.99	0.00	713.53		
17	Outlet Gate	1	33.9	36	4.8	0.36	0.19			0.07	707.99	0.00	713.60		
18	Pipe Bend, vertical	1	33.9	36	4.8	0.36	0.2			0.07	704.99	-3.00	710.67		
19	New CCFRPM (Santa Ana Meter Run)	1	33.9	36				155	71	0.10	704.99	0.00	710.77		
20	New WSP (Santa Ana Meter Run)	1	33.9	36				140	38	0.06	704.99	0.00	710.83		
21	Inlet Structure Outlet	1	33.9	36	4.8	0.36	1			0.36	704.99	0.00	711.19		
22	Inlet Structure Losses	1	33.9	48	2.7	0.11	0.5			0.06	707.99	3.00	714.25		
23	Inlet Gate	1	33.9	48	2.7	0.11	0.19			0.02	707.99	0.00	714.27		
24	**Inlet Structure Inlet (Santa Ana)**	1	33.9	48	2.7	0.11	0.5			0.06	707.99	0.00	**714.33**	**717.80**	**3.47**
25	CCFRPM Pipe (Santa Ana)	1	33.9	48	2.7	0.11		155	31	0.01	708.06	0.07	714.40		
26	Manhole #2 Exit	1	33.9	48	2.7	0.11	1			0.11	708.06	0.00	714.51		
27	**Manhole #2 Inlet**	1	33.9	41	3.7	0.21	0.5			0.11	708.06	0.00	**714.62**	**714.60**	**-0.02**
28	CCFRPM Pipe (Santa Ana)	1	29.6	41				155	13	0.01	708.10	0.04	714.67		
29	Manhole #3 Exit	1	29.6	41	3.2	0.16	1			0.16	708.10	0.00	714.83		
30	**Manhole #3 Inlet**	1	29.6	41	3.2	0.16	0.5			0.08	708.10	0.00	**714.91**	**714.90**	**-0.01**
31	CCFRPM Pipe (Santa Ana)	1	29.6	41				155	95	0.05	708.26	0.16	715.12		
32	Manhole #4 Exit	1	29.6	41	3.2	0.16	1			0.16	708.26	0.00	715.28		
33	**Manhole #4 Inlet**	1	29.6	41	3.2	0.16	0.5			0.08	708.26	0.00	**715.36**	**715.50**	**0.14**
34	CCFRPM Pipe (Santa Ana)	1	29.6	41				155	13	0.01	708.29	0.03	715.40		
35	Manhole #5 Exit	1	29.6	41	3.2	0.16	1			0.16	708.29	0.00	715.56		

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Santa Ana (Riverside/Hillside) Interceptor
Design Case: Ultimate Future Design Flow - AADF
Calculated by: NTC Date: 9/29/2014 **Santa Ana Flow Rate =** 21.9 MGD
Checked by: BCP Date: 9/30/2014

36	**Manhole #5 Inlet**	1	33.9	48	2.7	0.11	0.5			0.06	708.29	0.00	**715.62**	**716.30**	**0.68**
37	CCFRPM Pipe (Santa Ana)	1	33.9	48				155	78	0.03	708.43	0.14	715.79		
38	Manhole #6 Exit	1	33.9	48	2.7	0.11	1			0.11	708.43	0.00	715.90		
39	**Manhole #6 Inlet**	1	33.9	48	2.7	0.11	0.5			0.06	708.43	0.00	**715.96**	**719.40**	**3.44**
40	CCFRPM Pipe (Santa Ana)	1	33.9	48				155	55	0.02	708.53	0.10	716.07		
41	Manhole #7 Exit	1	33.9	48	2.7	0.11	1			0.11	708.53	0.00	716.19		
42	**Manhole #7 Inlet**	1	33.9	48	2.7	0.11	0.5			0.06	708.53	0.00	**716.24**	**719.40**	**3.16**
43	CCFRPM Pipe (Santa Ana)	1	33.9	48				155	216	0.07	708.92	0.39	716.71		
44	Manhole #8 Exit	1	33.9	48	2.7	0.11	1			0.11	708.92	0.00	716.82		
45	**Manhole #8 Inlet**	1	33.9	48	2.7	0.11	0.5			0.06	708.92	0.00	**716.87**	**722.20**	**5.33**

Data Source(s):
Riverside/Hillside Pipeline: Brown and Caldwell. (2011). Riverside California Public Works Department Santa Ana River Trunk Sewer Replacement Project - Phase 1. San Diego, CA.
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
There is no junction elevation rise between 42" and 48" pipe based on S-2054 Sheet 6 of 33 (Brown & Caldwell 2011).
The length of pipes between the manholes were determined using S-2054 Sheet 6 of 33 (Brown and Caldwell 2011).
Invert elevations were determined using (Brown & Caldwell 1996, 2011).
The Riverside/Hillside CCFRPM pipeline was constructed in 2012; based on the pipe's age, a Hazen Williams coefficient of 155 was chosen.
The dual 42" RCPs to headworks were constructed in 1996; based on the pipe's age, a Hazen Williams coefficient of 125 was chosen.

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Flow for Rubidoux Interceptor (for use in Santa Ana hydraulic profile calculation)
Design Case: Ultimate Future Design Flow - PDWF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Rubidoux Flow Rate = 4.6 MGD

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Acorn Interceptor
Design Case: Ultimate Future Design Flow - PDWF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Acorn Flow Rate = 2.9 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Δh (ft)					
	Acorn/Arlanza Combined Flow		*53.4*												
	Acorn Flow		*4.4*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction Box												710.45		
3	**Inlet to Headworks Junction Box**	1	53.4	48	4.2	0.28	0.5			0.14	705.70		**710.59**	**713.70**	**3.11**
4	Reinforced Concrete Pipe (RCP, Headworks)	1	53.4	48				110	21	0.03	705.75	0.05	710.67		
5	90 Degree Bend	1	53.4	48	4.2	0.28	0.9			0.25	705.75	0.00	710.92		
6	Reinforced Concrete Pipe (RCP, Headworks)	1	53.4	48				110	79	0.11	705.94	0.19	711.23		
7	Meter Box Outlet	1	53.4	48	4.2	0.28	1			0.28	705.94	0.00	711.51		
8	**Meter Box Inlet**	1	53.4	48	4.2	0.28	0.5			0.14	705.96	0.02	**711.67**	**715.90**	**4.23**
9	Reinforced Concrete Pipe (RCP, Headworks)	1	53.4	48				110	491	0.71	707.10	1.14	713.52		
10	35 Degree Bend	1	53.4	48	4.2	0.28	0.4			0.11	707.10	0.00	713.63		
11	Reinforced Concrete Pipe (RCP, Headworks)	1	53.4	48				110	129	0.19	707.40	0.30	714.12		
12	Exit - Acorn/Arlanza Junction Box	1	53.4	48	4.2	0.28	1			0.28	707.40	0.00	714.40		
13	**Inlet - Acorn/Arlanza Junction Box**	1	4.4	48	0.4	0.00	0.5			0.00	707.40	0.00	**714.40**	**716.10**	**1.70**
14	RCP (Acorn)	1	4.4	36				110	109	0.01	711.29	3.89	718.30		
15	RCP (Acorn)	1	4.4	27				110	39	0.01	712.36	1.07	719.38		
16	New MH AC-3 Outlet	1	4.4	27	1.1	0.02	1			0.02	712.36	0.00	719.40		
17	45 Degree Bend	1	4.4	24	1.4	0.03	0.42			0.01	712.36	0.00	719.41		
18	**New MH AC-3 Inlet**	1	4.4	24	1.4	0.03	0.5			0.02	712.36	0.00	**719.43**	**720.70**	**1.27**
19	New RCP (Acorn)	1	4.4	24				140	28	0.01	712.93	0.57	720.00		
20	45 Degree Bend	1	4.4	24	1.4	0.03	0.42			0.01	714.24	1.31	721.33		
21	Tee from Bypass Run	1	4.4	24	1.4	0.03	0.6			0.02	714.24	0.00	721.34		
22	Outlet Gate	1	4.4	16	3.2	0.16	0.19			0.03	714.24	0.00	721.37		
23	Pipe Bend	1	4.4	16	3.2	0.16	0.2			0.03	712.74	-1.50	719.91		
24	New CCFRPM (Acorn Meter Run)	1	4.4	16				155	23	0.04	712.74	0.00	719.94		
25	New WSP (Acorn Meter Run)	1	4.4	16				140	17	0.03	712.74	0.00	719.98		
26	Inlet Structure Outlet	1	4.4	16	3.2	0.16	1			0.16	712.74	0.00	720.13		
27	Inlet Structure Losses	1	4.4	16	3.2	0.16	0.5			0.08	714.24	1.50	721.71		
28	Inlet Gate	1	4.4	16	3.2	0.16	0.19			0.03	714.24	0.00	721.74		
29	**Inlet Structure Inlet (Acorn)**	1	4.4	24	1.4	0.03	0.5			0.02	714.74	0.50	**722.26**	**724.00**	**1.74**
30	New RCP (Acorn)	1	4.4	24				140	12	0.00	714.98	0.24	722.50		
31	New MH AC-2 Outlet	1	4.4	24	1.4	0.03	1			0.03	714.98	0.00	722.53		
32	45 Degree Bend	1	4.4	24	1.4	0.03	0.42			0.01	714.98	0.00	722.54		
33	**New MH AC-2 Inlet**	1	4.4	24	1.4	0.03	0.5			0.02	714.98	0.00	**722.56**	**725.90**	**3.34**

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Acorn Interceptor
Design Case: Ultimate Future Design Flow - PDWF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Acorn Flow Rate = 2.9 MGD

34	New RCP (Acorn)	1	4.4	24				140	31	0.01	715.60	0.62	723.19		
35	New MH AC-1 Outlet	1	4.4	24	1.4	0.03	1			0.03	715.60	0.00	723.22		
36	45 Degree Bend	1	4.4	24	1.4	0.03	0.42			0.01	715.60	0.00	723.23		
37	**New MH AC-1 Inlet**	1	4.4	27	1.1	0.02	0.5			0.01	715.60	0.00	**723.24**	**726.60**	**3.36**
38	RCP (Acorn)	1	4.4	27				110	25	0.01	716.30	0.70	723.95		
39	Acorn Manhole #1 Outlet	1	4.4	27	1.1	0.02	1			0.02	716.30	0.00	723.97		
40	**Acorn Manhole #1 Inlet**	1	4.4	27	1.1	0.02	0.5			0.01	716.30	0.00	**723.98**	**728.30**	**4.32**
41	RCP (Acorn)	1	4.4	27				110	339	0.08	735.49	19.19	743.25		
42	Acorn Manhole #2 Exit	1	4.4	27	1.1	0.02	1			0.02	735.49	0.00	743.27		
43	**Acorn Manhole #2 Inlet**	1	4.4	27	1.1	0.02	0.5			0.01	735.49	0.00	**743.28**	**747.50**	**4.22**

Data Source(s):
John A. Carollo Engineers. (1960). City of Riverside, California Sewage Treatment Plant Additions T5. Phoenix, Arizona.
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
Acorn/Arlanza Junction Box invert elevation and manhole elevation were found on C14 (Brown and Caldwell 1996).
Acorn manhole invert was estimated at 12 ft bgs based on a photograph of the inside of the manhole.
Acorn manhole elevation was determined using 2012 topographic survey.

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Arlanza Interceptor
Design Case: Ultimate Future Design Flow - PDWF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Arlanza Flow Rate = 31.7 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Delta h (ft)					
	Acorn/Arlanza Combined Flow		*53.4*												
	Arlanza Flow		*49.0*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction												710.45		
3	**Inlet to Headworks Junction**	1	53.4	48	4.2	0.28	0.5			0.14	705.70		**710.59**	**713.70**	**3.11**
4	Reinforced Concrete Pipe (RCP, Headworks)	1	53.4	48				110	21	0.03	705.75	0.05	709.72		
5	90 Degree Bend	1	53.4	48	4.2	0.28	0.9			0.25	705.75	0.00	709.97		
6	Reinforced Concrete Pipe (RCP, Headworks)	1	53.4	48				110	79	0.11	705.94	0.19	710.28		
7	Meter Box Outlet	1	53.4	48	4.2	0.28	1			0.28	705.94	0.00	710.56		
8	**Meter Box Inlet**	1	53.4	48	4.2	0.28	0.5			0.14	705.96	0.02	**710.72**	**716.00**	**5.28**
9	Reinforced Concrete Pipe (RCP, Headworks)	1	53.4	48				110	491	0.71	707.10	1.14	712.57		
10	35 Degree Bend	1	53.4	48	4.2	0.28	0.4			0.11	707.10	0.00	712.68		
11	Reinforced Concrete Pipe (RCP, Headworks)	1	53.4	48				110	129	0.19	707.40	0.30	713.17		
12	Exit - Acorn/Arlanza Junction Box	1	53.4	48	4.2	0.28	1			0.28	707.40	0.00	713.45		
13	**Inlet - Acorn/Arlanza Junction Box**	2	26.7	48	2.1	0.07	0.5			0.04	707.40	0.00	**713.49**	**716.10**	**2.61**
14	Reinforced Concrete Pipe (RCP, Arlanza)	2	24.5	48				110	293	0.10	708.00	0.60	714.19		
15	Arlanza Junction Box Exit	2	24.5	48	1.9	0.06	1			0.06	708.00	0.00	714.25		
16	**Arlanza Junction Box Inlet**	1	49.0	51	3.5	0.18	0.5			0.09	708.00	0.00	**714.34**	**717.50**	**3.16**
17	Reinforced Concrete Pipe (RCP, Arlanza)	1	49.0	51				110	5	0.00	708.02	0.02	714.36		
18	30 Degree Bend	1	49.0	51	3.5	0.18	0.4			0.07	708.02	0.00	714.43		
19	Reinforced Concrete Pipe (RCP, Arlanza)	1	49.0	51				110	17	0.02	708.08	0.06	714.51		
20	20 Degree Bend	1	49.0	51	3.5	0.18	0.25			0.05	708.08	0.00	714.56		
21	Reinforced Concrete Pipe (RCP, Arlanza)	1	49.0	51				110	86	0.08	708.39	0.31	714.95		
22	Arlanza Manhole #1 Outlet	1	49.0	51	3.5	0.18	1			0.18	708.39	0.00	715.13		
23	**Arlanza Manhole #1 Inlet**	1	49.0	51	3.5	0.18	0.5			0.09	708.39	0.00	**715.22**	**724.80**	**9.58**
24	Reinforced Concrete Pipe (RCP, Arlanza)	1	49.0	51				110	161	0.15	708.97	0.58	715.95		
25	50 Degree Bend	1	49.0	51	3.5	0.18	0.7			0.13	708.97	0.00	716.08		
26	Reinforced Concrete Pipe (RCP, Arlanza)	1	49.0	51				110	24	0.02	709.05	0.09	716.19		
27	Arlanza Manhole #2 Outlet	1	49.0	51	3.5	0.18	1			0.18	709.05	0.00	716.37		
28	**Arlanza Manhole #2 Inlet**	1	49.0	51	3.5	0.18	0.5			0.09	709.05	0.00	**716.47**	**727.50**	**11.03**
29	Reinforced Concrete Pipe (RCP, Arlanza)	1	49.0	51				110	150	0.14	709.59	0.54	717.14		
30	Exit - Junction Box	1	49.0	51	3.5	0.18	1			0.18	709.59	0.00	717.33		
31	**Inlet - Junction Box**	1	49.0	51	3.5	0.18	0.5			0.09	709.59	0.00	**717.42**	**725.00**	**7.58**
32	Reinforced Concrete Pipe (RCP, Arlanza)	1	49.0	51				110	303	0.28	710.68	1.09	718.79		
33	20 Degree Bend	1	49.0	51	3.5	0.18	0.25			0.05	710.68	0.00	718.83		

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Arlanza Interceptor
Design Case: Ultimate Future Design Flow - PDWF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Arlanza Flow Rate = 31.7 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Delta h (ft)					
34	Reinforced Concrete Pipe (RCP, Arlanza)	1	49.0	51				110	495	0.46	712.46	1.78	721.07		
35	Arlanza Manhole #3 Outlet	1	49.0	51	3.5	0.18	1			0.18	712.46	0.00	721.25		
36	**Arlanza Manhole #3 Inlet**	1	49.0	51	3.5	0.18	0.5			0.09	712.46	0.00	**721.35**	**724.00**	**2.65**
37	Reinforced Concrete Pipe (RCP, Arlanza)	1	49.0	51				110	428	0.39	713.32	0.86	722.60		
38	Arlanza Manhole #4 Outlet	1	49.0	51	3.5	0.18	1			0.18	713.32	0.00	722.78		
39	**Arlanza Manhole #4 Inlet**	1	49.0	51	3.5	0.18	0.5			0.09	713.32	0.00	**722.87**	**726.30**	**3.43**
40	Reinforced Concrete Pipe (RCP, Arlanza)	1	49.0	51				110	428	0.39	714.06	0.74	724.01		
41	Arlanza Manhole #5 Outlet	1	49.0	51	3.5	0.18	1			0.18	714.06	0.00	724.20		
42	**Arlanza Manhole #5 Inlet**	1	49.0	51	3.5	0.18	0.5			0.09	714.06	0.00	**724.29**	**725.60**	**1.31**
43	RCP (Arlanza)	1	49.0	51				110	21	0.02	715.67	1.61	725.92		
44	Tee from future Jurupa Run	1	49.0	51	3.5	0.18	0.6			0.11	715.67	0.00	726.03		
45	Tee from Bypass Run	1	49.0	51	3.5	0.18	0.6			0.11	715.67	0.00	726.14		
46	Outlet Gate	1	49.0	51	3.5	0.18	0.19			0.04	715.67	0.00	726.17		
47	Pipe Bend	1	49.0	36	6.9	0.75	0.2			0.15	712.67	-3.00	723.32		
48	New CCFRPM (Arlanza Meter Run)	1	49.0	36				155	45	0.12	712.67	0.00	723.44		
49	New WSP (Arlanza Meter Run)	1	49.0	36				140	16	0.05	712.67	0.00	723.49		
50	Inlet Structure Outlet	1	49.0	36	6.9	0.75	1			0.75	712.67	0.00	724.24		
51	Inlet Structure Losses	1	49.0	48	3.9	0.24	0.5			0.12	715.67	3.00	727.36		
52	Inlet Gate	1	49.0	48	3.9	0.24	0.19			0.04	715.67	0.00	727.40		
53	**Inlet Structure Inlet (Arlanza)**	1	49.0	48	3.9	0.24	0.5			0.12	715.67	0.00	**727.52**	**731.00**	**3.48**
54	RCP (Arlanza)	1	49.0	51				110	156	0.14	718.46	2.79	730.46		
55	Arlanza Manhole #6 Outlet	1	49.0	51	3.5	0.18	1			0.18	718.46	0.00	730.64		
56	**Arlanza Manhole #6 Inlet**	1	49.0	51	3.5	0.18	0.5			0.09	718.46	0.00	**730.73**	**730.00**	**-0.73**

Data Source(s):
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.
Arlanza Pipeline: John Carollo Engineers. (1990). City of Riverside, CA Department of Public Works Water Quality Control Plant 1990 Tertiary Expansion. Phoenix, AZ.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
Acorn/Arlanza Junction Box invert elevation and manhole elevation were found on C14 (Brown and Caldwell 1996).
Arlanza Junction Box invert elevation and manhole elevation were determined on C15 (Brown and Caldwell 1996)
Arlanza Manhole #3 invert elevation was found on drawing Y-6 (John Carollo Engineers, 1990).
The average slope from the Arlanza junction box (708.0 ft invert elevation) and the Arlanza Manhole #3 (717.25 invert elevation) was determined to be 0.0074 ft/ft, using the length between the Arlanza junction box and the Arlanza Manhole #3.
Arlanza Manholes #1- #3 invert elevations were determined using a slc 0.00359 ft/ft and pipe lengths between each manhole.
The slope between Arlanza Manhole #3 and Arlanza Manhole #5 was determined 0.002 ft/ft
Arlanza Manhole #4 was determined using the slope between Arlanza Manhole #3 and Arlanza Manhole #5 and the pipe length between Arlanza Manhole #3 and Arlanza Manhole #4.

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Santa Ana (Riverside/Hillside) Interceptor
Design Case: Ultimate Future Design Flow - PDWF
Calculated by: NTC Date: 9/29/2014 **Santa Ana Flow Rate =** 32.9 MGD
Checked by: BCP Date: 9/30/2014

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Δh (ft)					
	Rubidoux, Jurupa, Santa Ana (Riverside/Hillside) Combined Flow		*65.3*												
	Santa Ana (Riverside/Hillside) Flow		*50.9*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction												710.45		
3	**Inlet to Headworks Junction**	2	32.6	42	3.4	0.18	0.5			0.09	705.70		**710.54**	**713.70**	**3.16**
4	Reinforced Concrete Pipe (RCP, Headworks)	2	32.6	42				125	28	0.02	705.87	0.17	710.73		
5	35 Degree Bend	2	32.6	42	3.4	0.18	0.4			0.07	705.87	0.00	710.81		
6	Reinforced Concrete Pipe (RCP, Headworks)	2	32.6	42				125	200	0.18	707.08	1.21	712.20		
7	35 Degree Bend	2	32.6	42	3.4	0.18	0.4			0.07	707.08	0.00	712.27		
8	Reinforced Concrete Pipe (RCP, Headworks)	2	32.6	42				125	16	0.01	707.18	0.10	712.38		
9	Exit from Junction	2	32.6	42	3.4	0.18	1			0.18	707.18	0.00	712.56		
10	**Inlet to Junction**	1	50.9	48	4.0	0.25	0.5			0.13	707.18	0.00	**712.68**	**717.00**	**4.32**
11	Reinforced Concrete Pipe (RCP, Headworks)	1	50.9	48				125	10	0.01	707.30	0.12	712.81		
12	CCFRPM Pipe (Santa Ana)	1	50.9	48				155	35	0.02	707.70	0.40	713.24		
13	Manhole #1 Exit	1	50.9	48	4.0	0.25	1			0.25	707.70	0.00	713.49		
14	**Manhole #1 Inlet**	1	50.9	48	4.0	0.25	0.5			0.13	707.70	0.00	**713.62**	**716.20**	**2.58**
15	New CCFRPM (Santa Ana)	1	50.9	36				155	12	0.03	707.99	0.29	713.95		
16	Tee from Bypass Run	1	50.9	36	7.2	0.80	0.6			0.48	707.99	0.00	714.43		
17	Outlet Gate	1	50.9	36	7.2	0.80	0.19			0.15	707.99	0.00	714.59		
18	Pipe Bend, vertical	1	50.9	36	7.2	0.80	0.2			0.16	704.99	-3.00	711.75		
19	New CCFRPM (Santa Ana Meter Run)	1	50.9	36				155	71	0.20	704.99	0.00	711.95		
20	New WSP (Santa Ana Meter Run)	1	50.9	36				140	38	0.13	704.99	0.00	712.08		
21	Inlet Structure Outlet	1	50.9	36	7.2	0.80	1			0.80	704.99	0.00	712.89		
22	Inlet Structure Losses	1	50.9	48	4.0	0.25	0.5			0.13	707.99	3.00	716.01		
23	Inlet Gate	1	50.9	48	4.0	0.25	0.19			0.05	707.99	0.00	716.06		
24	**Inlet Structure Inlet (Santa Ana)**	1	50.9	48	4.0	0.25	0.5			0.13	707.99	0.00	**716.19**	**717.80**	**1.61**
25	CCFRPM Pipe (Santa Ana)	1	50.9	48	4.0	0.25		155	31	0.02	708.06	0.07	716.28		
26	Manhole #2 Exit	1	50.9	48	4.0	0.25	1			0.25	708.06	0.00	716.53		
27	**Manhole #2 Inlet**	1	50.9	41	5.6	0.48	0.5			0.24	708.06	0.00	**716.77**	**714.60**	**-2.17**
28	CCFRPM Pipe (Santa Ana)	1	44.3	41				155	13	0.02	708.10	0.04	716.83		
29	Manhole #3 Exit	1	44.3	41	4.8	0.36	1			0.36	708.10	0.00	717.19		
30	**Manhole #3 Inlet**	1	44.3	41	4.8	0.36	0.5			0.18	708.10	0.00	**717.37**	**714.90**	**-2.47**
31	CCFRPM Pipe (Santa Ana)	1	44.3	41				155	95	0.11	708.26	0.16	717.64		
32	Manhole #4 Exit	1	44.3	41	4.8	0.36	1			0.36	708.26	0.00	718.01		
33	**Manhole #4 Inlet**	1	44.3	41	4.8	0.36	0.5			0.18	708.26	0.00	**718.19**	**715.50**	**-2.69**
34	CCFRPM Pipe (Santa Ana)	1	44.3	41				155	13	0.02	708.29	0.03	718.23		
35	Manhole #5 Exit	1	44.3	41	4.8	0.36	1			0.36	708.29	0.00	718.60		

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Santa Ana (Riverside/Hillside) Interceptor
Design Case: Ultimate Future Design Flow - PDWF
Calculated by: NTC Date: 9/29/2014 **Santa Ana Flow Rate =** 32.9 MGD
Checked by: BCP Date: 9/30/2014

36	**Manhole #5 Inlet**	1	50.9	48	4.0	0.25	0.5			0.13	708.29	0.00	**718.72**	**716.30**	**-2.42**
37	CCFRPM Pipe (Santa Ana)	1	50.9	48				155	78	0.05	708.43	0.14	718.92		
38	Manhole #6 Exit	1	50.9	48	4.0	0.25	1			0.25	708.43	0.00	719.17		
39	**Manhole #6 Inlet**	1	50.9	48	4.0	0.25	0.5			0.13	708.43	0.00	**719.30**	**719.40**	**0.10**
40	CCFRPM Pipe (Santa Ana)	1	50.9	48				155	55	0.04	708.53	0.10	719.44		
41	Manhole #7 Exit	1	50.9	48	4.0	0.25	1			0.25	708.53	0.00	719.69		
42	**Manhole #7 Inlet**	1	50.9	48	4.0	0.25	0.5			0.13	708.53	0.00	**719.82**	**719.40**	**-0.42**
43	CCFRPM Pipe (Santa Ana)	1	50.9	48				155	216	0.15	708.92	0.39	720.36		
44	Manhole #8 Exit	1	50.9	48	4.0	0.25	1			0.25	708.92	0.00	720.62		
45	**Manhole #8 Inlet**	1	50.9	48	4.0	0.25	0.5			0.13	708.92	0.00	**720.74**	**722.20**	**1.46**

Data Source(s):
Riverside/Hillside Pipeline: Brown and Caldwell. (2011). Riverside California Public Works Department Santa Ana River Trunk Sewer Replacement Project - Phase 1. San Diego, CA.
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
There is no junction elevation rise between 42" and 48" pipe based on S-2054 Sheet 6 of 33 (Brown & Caldwell 2011).
The length of pipes between the manholes were determined using S-2054 Sheet 6 of 33 (Brown and Caldwell 2011).
Invert elevations were determined using (Brown & Caldwell 1996, 2011).
The Riverside/Hillside CCFRPM pipeline was constructed in 2012; based on the pipe's age, a Hazen Williams coefficient of 155 was chosen.
The dual 42" RCPs to headworks were constructed in 1996; based on the pipe's age, a Hazen Williams coefficient of 125 was chosen.

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Flow for Rubidoux Interceptor (for use in Santa Ana hydraulic profile calculation)
Design Case: Ultimate Future Design Flow - PWWF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Rubidoux Flow Rate = 6.7 MGD

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Acorn Interceptor
Design Case: Ultimate Future Design Flow - PWWF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Acorn Flow Rate = 4.2 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Δh (ft)					
	Acorn/Arlanza Combined Flow		*78.3*												
	Acorn Flow		*6.5*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction Box												710.45		
3	**Inlet to Headworks Junction Box**	1	78.3	48	6.2	0.60	0.5			0.30	705.70		**710.75**	**713.70**	**2.95**
4	Reinforced Concrete Pipe (RCP, Headworks)	1	78.3	48				110	21	0.06	705.75	0.05	710.86		
5	90 Degree Bend	1	78.3	48	6.2	0.60	0.9			0.54	705.75	0.00	711.41		
6	Reinforced Concrete Pipe (RCP, Headworks)	1	78.3	48				110	79	0.23	705.94	0.19	711.83		
7	Meter Box Outlet	1	78.3	48	6.2	0.60	1			0.60	705.94	0.00	712.43		
8	**Meter Box Inlet**	1	78.3	48	6.2	0.60	0.5			0.30	705.96	0.02	**712.76**	**715.90**	**3.14**
9	Reinforced Concrete Pipe (RCP, Headworks)	1	78.3	48				110	491	1.45	707.10	1.14	715.34		
10	35 Degree Bend	1	78.3	48	6.2	0.60	0.4			0.24	707.10	0.00	715.58		
11	Reinforced Concrete Pipe (RCP, Headworks)	1	78.3	48				110	129	0.38	707.40	0.30	716.26		
12	Exit - Acorn/Arlanza Junction Box	1	78.3	48	6.2	0.60	1			0.60	707.40	0.00	716.87		
13	**Inlet - Acorn/Arlanza Junction Box**	1	6.5	48	0.5	0.00	0.5			0.00	707.40	0.00	**716.87**	**716.10**	**-0.77**
14	RCP (Acorn)	1	6.5	36				110	109	0.01	711.29	3.89	720.78		
15	RCP (Acorn)	1	6.5	27				110	39	0.02	712.36	1.07	721.87		
16	New MH AC-3 Outlet	1	6.5	27	1.6	0.04	1			0.04	712.36	0.00	721.91		
17	45 Degree Bend	1	6.5	24	2.1	0.07	0.42			0.03	712.36	0.00	721.93		
18	**New MH AC-3 Inlet**	1	6.5	24	2.1	0.07	0.5			0.03	712.36	0.00	**721.97**	**720.70**	**-1.27**
19	New RCP (Acorn)	1	6.5	24				140	28	0.02	712.93	0.57	722.55		
20	45 Degree Bend	1	6.5	24	2.1	0.07	0.42			0.03	714.24	1.31	723.89		
21	Tee from Bypass Run	1	6.5	24	2.1	0.07	0.6			0.04	714.24	0.00	723.93		
22	Outlet Gate	1	6.5	16	4.7	0.34	0.19			0.06	714.24	0.00	723.99		
23	Pipe Bend	1	6.5	16	4.7	0.34	0.2			0.07	712.74	-1.50	722.56		
24	New CCFRPM (Acorn Meter Run)	1	6.5	16				155	23	0.08	712.74	0.00	722.63		
25	New WSP (Acorn Meter Run)	1	6.5	16				140	17	0.07	712.74	0.00	722.70		
26	Inlet Structure Outlet	1	6.5	16	4.7	0.34	1			0.34	712.74	0.00	723.04		
27	Inlet Structure Losses	1	6.5	16	4.7	0.34	0.5			0.17	714.24	1.50	724.71		
28	Inlet Gate	1	6.5	16	4.7	0.34	0.19			0.06	714.24	0.00	724.77		
29	**Inlet Structure Inlet (Acorn)**	1	6.5	24	2.1	0.07	0.5			0.03	714.74	0.50	**725.30**	**724.00**	**-1.30**
30	New RCP (Acorn)	1	6.5	24				140	12	0.01	714.98	0.24	725.55		
31	New MH AC-2 Outlet	1	6.5	24	2.1	0.07	1			0.07	714.98	0.00	725.62		
32	45 Degree Bend	1	6.5	24	2.1	0.07	0.42			0.03	714.98	0.00	725.64		
33	**New MH AC-2 Inlet**	1	6.5	24	2.1	0.07	0.5			0.03	714.98	0.00	**725.68**	**725.90**	**0.22**

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Acorn Interceptor
Design Case: Ultimate Future Design Flow - PWWF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Acorn Flow Rate = 4.2 MGD

34	New RCP (Acorn)	1	6.5	24				140	31	0.02	715.60	0.62	726.31		
35	New MH AC-1 Outlet	1	6.5	24	2.1	0.07	1			0.07	715.60	0.00	726.38		
36	45 Degree Bend	1	6.5	24	2.1	0.07	0.42			0.03	715.60	0.00	726.41		
37	**New MH AC-1 Inlet**	1	6.5	27	1.6	0.04	0.5			0.02	715.60	0.00	**726.43**	**726.60**	**0.17**
38	RCP (Acorn)	1	6.5	27				110	25	0.01	716.30	0.70	727.14		
39	Acorn Manhole #1 Outlet	1	6.5	27	1.6	0.04	1			0.04	716.30	0.00	727.18		
40	**Acorn Manhole #1 Inlet**	1	6.5	27	1.6	0.04	0.5			0.02	716.30	0.00	**727.20**	**728.30**	**1.10**
41	RCP (Acorn)	1	6.5	27				110	339	0.16	735.49	19.19	746.56		
42	Acorn Manhole #2 Exit	1	6.5	27	1.6	0.04	1			0.04	735.49	0.00	746.60		
43	**Acorn Manhole #2 Inlet**	1	6.5	27	1.6	0.04	0.5			0.02	735.49	0.00	**746.62**	**747.50**	**0.88**

Data Source(s):
John A. Carollo Engineers. (1960). City of Riverside, California Sewage Treatment Plant Additions T5. Phoenix, Arizona.
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
Acorn/Arlanza Junction Box invert elevation and manhole elevation were found on C14 (Brown and Caldwell 1996).
Acorn manhole invert was estimated at 12 ft bgs based on a photograph of the inside of the manhole.
Acorn manhole elevation was determined using 2012 topographic survey.

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Arlanza Interceptor
Design Case: Ultimate Future Design Flow - PWWF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Arlanza Flow Rate = 46.4 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Delta h (ft)					
	Acorn/Arlanza Combined Flow		*78.3*												
	Arlanza Flow		*71.8*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction												710.45		
3	**Inlet to Headworks Junction**	1	78.3	48	6.2	0.60	0.5			0.30	705.70		**710.75**	**713.70**	**2.95**
4	Reinforced Concrete Pipe (RCP, Headworks)	1	78.3	48				110	21	0.06	705.75	0.05	709.75		
5	90 Degree Bend	1	78.3	48	6.2	0.60	0.9			0.54	705.75	0.00	710.30		
6	Reinforced Concrete Pipe (RCP, Headworks)	1	78.3	48				110	79	0.23	705.94	0.19	710.72		
7	Meter Box Outlet	1	78.3	48	6.2	0.60	1			0.60	705.94	0.00	711.32		
8	**Meter Box Inlet**	1	78.3	48	6.2	0.60	0.5			0.30	705.96	0.02	**711.65**	**716.00**	**4.35**
9	Reinforced Concrete Pipe (RCP, Headworks)	1	78.3	48				110	491	1.45	707.10	1.14	714.23		
10	35 Degree Bend	1	78.3	48	6.2	0.60	0.4			0.24	707.10	0.00	714.47		
11	Reinforced Concrete Pipe (RCP, Headworks)	1	78.3	48				110	129	0.38	707.40	0.30	715.15		
12	Exit - Acorn/Arlanza Junction Box	1	78.3	48	6.2	0.60	1			0.60	707.40	0.00	715.75		
13	**Inlet - Acorn/Arlanza Junction Box**	2	39.2	48	3.1	0.15	0.5			0.08	707.40	0.00	**715.83**	**716.10**	**0.27**
14	Reinforced Concrete Pipe (RCP, Arlanza)	2	35.9	48				110	293	0.20	708.00	0.60	716.63		
15	Arlanza Junction Box Exit	2	35.9	48	2.9	0.13	1			0.13	708.00	0.00	716.76		
16	**Arlanza Junction Box Inlet**	1	71.8	51	5.1	0.40	0.5			0.20	708.00	0.00	**716.96**	**717.50**	**0.54**
17	Reinforced Concrete Pipe (RCP, Arlanza)	1	71.8	51				110	5	0.01	708.02	0.02	716.99		
18	30 Degree Bend	1	71.8	51	5.1	0.40	0.4			0.16	708.02	0.00	717.15		
19	Reinforced Concrete Pipe (RCP, Arlanza)	1	71.8	51				110	17	0.03	708.08	0.06	717.24		
20	20 Degree Bend	1	71.8	51	5.1	0.40	0.25			0.10	708.08	0.00	717.34		
21	Reinforced Concrete Pipe (RCP, Arlanza)	1	71.8	51				110	86	0.16	708.39	0.31	717.81		
22	Arlanza Manhole #1 Outlet	1	71.8	51	5.1	0.40	1			0.40	708.39	0.00	718.21		
23	**Arlanza Manhole #1 Inlet**	1	71.8	51	5.1	0.40	0.5			0.20	708.39	0.00	**718.41**	**724.80**	**6.39**
24	Reinforced Concrete Pipe (RCP, Arlanza)	1	71.8	51				110	161	0.30	708.97	0.58	719.29		
25	50 Degree Bend	1	71.8	51	5.1	0.40	0.7			0.28	708.97	0.00	719.56		
26	Reinforced Concrete Pipe (RCP, Arlanza)	1	71.8	51				110	24	0.04	709.05	0.09	719.70		
27	Arlanza Manhole #2 Outlet	1	71.8	51	5.1	0.40	1			0.40	709.05	0.00	720.09		
28	**Arlanza Manhole #2 Inlet**	1	71.8	51	5.1	0.40	0.5			0.20	709.05	0.00	**720.29**	**727.50**	**7.21**
29	Reinforced Concrete Pipe (RCP, Arlanza)	1	71.8	51				110	150	0.28	709.59	0.54	721.11		
30	Exit - Junction Box	1	71.8	51	5.1	0.40	1			0.40	709.59	0.00	721.51		
31	**Inlet - Junction Box**	1	71.8	51	5.1	0.40	0.5			0.20	709.59	0.00	**721.71**	**725.00**	**3.29**
32	Reinforced Concrete Pipe (RCP, Arlanza)	1	71.8	51				110	303	0.57	710.68	1.09	723.36		
33	20 Degree Bend	1	71.8	51	5.1	0.40	0.25			0.10	710.68	0.00	723.46		

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Arlanza Interceptor
Design Case: Ultimate Future Design Flow - PWWF
Calculated by: NTC Date: 9/29/2014
Checked by: BCP Date: 9/30/2014

Arlanza Flow Rate = 46.4 MGD

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Delta h (ft)					
34	Reinforced Concrete Pipe (RCP, Arlanza)	1	71.8	51				110	495	0.93	712.46	1.78	726.17		
35	Arlanza Manhole #3 Outlet	1	71.8	51	5.1	0.40	1			0.40	712.46	0.00	726.57		
36	**Arlanza Manhole #3 Inlet**	1	71.8	51	5.1	0.40	0.5			0.20	712.46	0.00	**726.76**	**724.00**	**-2.76**
37	Reinforced Concrete Pipe (RCP, Arlanza)	1	71.8	51				110	428	0.80	713.32	0.86	728.42		
38	Arlanza Manhole #4 Outlet	1	71.8	51	5.1	0.40	1			0.40	713.32	0.00	728.82		
39	**Arlanza Manhole #4 Inlet**	1	71.8	51	5.1	0.40	0.5			0.20	713.32	0.00	**729.02**	**726.30**	**-2.72**
40	Reinforced Concrete Pipe (RCP, Arlanza)	1	71.8	51				110	428	0.80	714.06	0.74	730.56		
41	Arlanza Manhole #5 Outlet	1	71.8	51	5.1	0.40	1			0.40	714.06	0.00	730.96		
42	**Arlanza Manhole #5 Inlet**	1	71.8	51	5.1	0.40	0.5			0.20	714.06	0.00	**731.16**	**725.60**	**-5.56**
43	RCP (Arlanza)	1	71.8	51				110	21	0.04	715.67	1.61	732.81		
44	Tee from future Jurupa Run	1	71.8	51	5.1	0.40	0.6			0.24	715.67	0.00	733.04		
45	Tee from Bypass Run	1	71.8	51	5.1	0.40	0.6			0.24	715.67	0.00	733.28		
46	Outlet Gate	1	71.8	51	5.1	0.40	0.19			0.08	715.67	0.00	733.36		
47	Pipe Bend	1	71.8	36	10.2	1.60	0.2			0.32	712.67	-3.00	730.68		
48	New CCFRPM (Arlanza Meter Run)	1	71.8	36				155	45	0.24	712.67	0.00	730.92		
49	New WSP (Arlanza Meter Run)	1	71.8	36				140	16	0.10	712.67	0.00	731.03		
50	Inlet Structure Outlet	1	71.8	36	10.2	1.60	1			1.60	712.67	0.00	732.63		
51	Inlet Structure Losses	1	71.8	48	5.7	0.51	0.5			0.25	715.67	3.00	735.88		
52	Inlet Gate	1	71.8	48	5.7	0.51	0.19			0.10	715.67	0.00	735.98		
53	**Inlet Structure Inlet (Arlanza)**	1	71.8	48	5.7	0.51	0.5			0.25	715.67	0.00	**736.23**	**731.00**	**-5.23**
54	RCP (Arlanza)	1	71.8	51				110	156	0.29	718.46	2.79	739.32		
55	Arlanza Manhole #6 Outlet	1	71.8	51	5.1	0.40	1			0.40	718.46	0.00	739.72		
56	**Arlanza Manhole #6 Inlet**	1	71.8	51	5.1	0.40	0.5			0.20	718.46	0.00	**739.92**	**730.00**	**-9.92**

Data Source(s):
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.
Arlanza Pipeline: John Carollo Engineers. (1990). City of Riverside, CA Department of Public Works Water Quality Control Plant 1990 Tertiary Expansion. Phoenix, AZ.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
Acorn/Arlanza Junction Box invert elevation and manhole elevation were found on C14 (Brown and Caldwell 1996).
Arlanza Junction Box invert elevation and manhole elevation were determined on C15 (Brown and Caldwell 1996)
Arlanza Manhole #3 invert elevation was found on drawing Y-6 (John Carollo Engineers, 1990).
The average slope from the Arlanza junction box (708.0 ft invert elevation) and the Arlanza Manhole #3 (717.25 invert elevation) was determined to be 0.0074 ft/ft, using the length between the Arlanza junction box and the Arlanza Manhole #3.
Arlanza Manholes #1- #3 invert elevations were determined using a slc 0.00359 ft/ft and pipe lengths between each manhole.
The slope between Arlanza Manhole #3 and Arlanza Manhole #5 was determined 0.002 ft/ft
Arlanza Manhole #4 was determined using the slope between Arlanza Manhole #3 and Arlanza Manhole #5 and the pipe length between Arlanza Manhole #3 and Arlanza Manhole #4.

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Santa Ana (Riverside/Hillside) Interceptor
Design Case: Ultimate Future Design Flow - PWWF
Calculated by: NTC Date: 9/29/2014 **Santa Ana Flow Rate =** 48.2 MGD
Checked by: BCP Date: 9/30/2014

Point No.	Item	Qty	Minor Losses					Pipe Friction		Head Loss	Invert Elevation (ft)	ΔElevation (ft)	Hydraulic Grade Line (ft)	Rim Elevation (ft)	Freeboard (ft)
			Flow, Q (cfs)	Diameter, D (in)	Velocity, V (ft/s)	$V^2/2g$ (ft)	K	C	L (ft)	Δh (ft)					
	Rubidoux, Jurupa, Santa Ana (Riverside/Hillside) Combined Flow		*92.4*												
	Santa Ana (Riverside/Hillside) Flow		*74.6*												
1	**Headworks Water Surface Elevation**												**709.64**	**713.70**	**4.06**
2	Exit from Headworks Junction												710.45		
3	**Inlet to Headworks Junction**	2	46.2	42	4.8	0.36	0.5			0.18	705.70		**710.63**	**713.70**	**3.07**
4	Reinforced Concrete Pipe (RCP, Headworks)	2	46.2	42				125	28	0.05	705.87	0.17	710.85		
5	35 Degree Bend	2	46.2	42	4.8	0.36	0.4			0.14	705.87	0.00	710.99		
6	Reinforced Concrete Pipe (RCP, Headworks)	2	46.2	42				125	200	0.34	707.08	1.21	712.54		
7	35 Degree Bend	2	46.2	42	4.8	0.36	0.4			0.14	707.08	0.00	712.68		
8	Reinforced Concrete Pipe (RCP, Headworks)	2	46.2	42				125	16	0.03	707.18	0.10	712.80		
9	Exit from Junction	2	46.2	42	4.8	0.36	1			0.36	707.18	0.00	713.16		
10	**Inlet to Junction**	1	74.6	48	5.9	0.55	0.5			0.27	707.18	0.00	**713.44**	**717.00**	**3.56**
11	Reinforced Concrete Pipe (RCP, Headworks)	1	74.6	48				125	10	0.02	707.30	0.12	713.57		
12	CCFRPM Pipe (Santa Ana)	1	74.6	48				155	35	0.05	707.70	0.40	714.03		
13	Manhole #1 Exit	1	74.6	48	5.9	0.55	1			0.55	707.70	0.00	714.58		
14	**Manhole #1 Inlet**	1	74.6	48	5.9	0.55	0.5			0.27	707.70	0.00	**714.85**	**716.20**	**1.35**
15	New CCFRPM (Santa Ana)	1	74.6	36				155	12	0.07	707.99	0.29	715.21		
16	Tee from Bypass Run	1	74.6	36	10.6	1.73	0.6			1.04	707.99	0.00	716.25		
17	Outlet Gate	1	74.6	36	10.6	1.73	0.19			0.33	707.99	0.00	716.58		
18	Pipe Bend, vertical	1	74.6	36	10.6	1.73	0.2			0.35	704.99	-3.00	713.93		
19	New CCFRPM (Santa Ana Meter Run)	1	74.6	36				155	71	0.41	704.99	0.00	714.34		
20	New WSP (Santa Ana Meter Run)	1	74.6	36				140	38	0.27	704.99	0.00	714.61		
21	Inlet Structure Outlet	1	74.6	36	10.6	1.73	1			1.73	704.99	0.00	716.34		
22	Inlet Structure Losses	1	74.6	48	5.9	0.55	0.5			0.27	707.99	3.00	719.61		
23	Inlet Gate	1	74.6	48	5.9	0.55	0.19			0.10	707.99	0.00	719.72		
24	**Inlet Structure Inlet (Santa Ana)**	1	74.6	48	5.9	0.55	0.5			0.27	707.99	0.00	**719.99**	**717.80**	**-2.19**
25	CCFRPM Pipe (Santa Ana)	1	74.6	48	5.9	0.55		155	31	0.05	708.06	0.07	720.10		
26	Manhole #2 Exit	1	74.6	48	5.9	0.55	1			0.55	708.06	0.00	720.65		
27	**Manhole #2 Inlet**	1	74.6	41	8.1	1.03	0.5			0.51	708.06	0.00	**721.16**	**714.60**	**-6.56**
28	CCFRPM Pipe (Santa Ana)	1	65.0	41				155	13	0.03	708.10	0.04	721.23		
29	Manhole #3 Exit	1	65.0	41	7.1	0.78	1			0.78	708.10	0.00	722.02		
30	**Manhole #3 Inlet**	1	65.0	41	7.1	0.78	0.5			0.39	708.10	0.00	**722.41**	**714.90**	**-7.51**
31	CCFRPM Pipe (Santa Ana)	1	65.0	41				155	95	0.23	708.26	0.16	722.79		
32	Manhole #4 Exit	1	65.0	41	7.1	0.78	1			0.78	708.26	0.00	723.57		
33	**Manhole #4 Inlet**	1	65.0	41	7.1	0.78	0.5			0.39	708.26	0.00	**723.97**	**715.50**	**-8.47**
34	CCFRPM Pipe (Santa Ana)	1	65.0	41				155	13	0.03	708.29	0.03	724.03		
35	Manhole #5 Exit	1	65.0	41	7.1	0.78	1			0.78	708.29	0.00	724.81		

URS

PROPOSED CONDITIONS

Project: City of Riverside Regional Water Quality Control Plant, Influent Flow Metering
Calculation: Hydraulic Profile for Santa Ana (Riverside/Hillside) Interceptor
Design Case: Ultimate Future Design Flow - PWWF
Calculated by: NTC Date: 9/29/2014 **Santa Ana Flow Rate =** 48.2 MGD
Checked by: BCP Date: 9/30/2014

36	**Manhole #5 Inlet**	1	74.6	48	5.9	0.55	0.5			0.27	708.29	0.00	**725.08**	**716.30**	**-8.78**
37	CCFRPM Pipe (Santa Ana)	1	74.6	48				155	78	0.11	708.43	0.14	725.33		
38	Manhole #6 Exit	1	74.6	48	5.9	0.55	1			0.55	708.43	0.00	725.88		
39	**Manhole #6 Inlet**	1	74.6	48	5.9	0.55	0.5			0.27	708.43	0.00	**726.15**	**719.40**	**-6.75**
40	CCFRPM Pipe (Santa Ana)	1	74.6	48				155	55	0.08	708.53	0.10	726.33		
41	Manhole #7 Exit	1	74.6	48	5.9	0.55	1			0.55	708.53	0.00	726.88		
42	**Manhole #7 Inlet**	1	74.6	48	5.9	0.55	0.5			0.27	708.53	0.00	**727.15**	**719.40**	**-7.75**
43	CCFRPM Pipe (Santa Ana)	1	74.6	48				155	216	0.31	708.92	0.39	727.85		
44	Manhole #8 Exit	1	74.6	48	5.9	0.55	1			0.55	708.92	0.00	728.40		
45	**Manhole #8 Inlet**	1	74.6	48	5.9	0.55	0.5			0.27	708.92	0.00	**728.67**	**722.20**	**-6.47**

Data Source(s):
Riverside/Hillside Pipeline: Brown and Caldwell. (2011). Riverside California Public Works Department Santa Ana River Trunk Sewer Replacement Project - Phase 1. San Diego, CA.
Headworks Pipeline: Brown and Caldwell. (1996). City of Riverside Regional Water Quality Control Plant Headworks Project. Irvine, CA.

Note(s):
Headworks WSEL based on 70 MGD of flow according to plant design hydraulic profile by Brown & Caldwell, 1996.
There is no junction elevation rise between 42" and 48" pipe based on S-2054 Sheet 6 of 33 (Brown & Caldwell 2011).
The length of pipes between the manholes were determined using S-2054 Sheet 6 of 33 (Brown and Caldwell 2011).
Invert elevations were determined using (Brown & Caldwell 1996, 2011).
The Riverside/Hillside CCFRPM pipeline was constructed in 2012; based on the pipe's age, a Hazen Williams coefficient of 155 was chosen.
The dual 42" RCPs to headworks were constructed in 1996; based on the pipe's age, a Hazen Williams coefficient of 125 was chosen.

APPENDIX C – COST ESTIMATE

URS

ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COSTS
30% PRELIMINARY DESIGN LEVEL

Project: Riverside Regional Water Quality Control Plant Influent Flow Metering Project
Client : City of Riverside, Public Works Department, Water Quality Control Plant Engineering Section
Engineer : URS Corporation
Rev : October 6, 2014

Item	Description	Estimated Quantity	Unit	Unit Price	Total Price	Source
1	**General Contractor General Conditions**			**Subtotal:**	**$300,000**	
	Mobilization, Demobilization, Cleanup	1	LS	$100,000	$100,000	[8]
	Other General Conditions	1	LS	$200,000	$200,000	[8]
2	**Santa Ana (Riverside-Hillside) Metering System**			**Subtotal:**	**$806,100**	
	Bypass Pumping (30 days)	1	LS	$180,000	$180,000	[7]
	Demo and clearing including disposal and pipe	1	LS	$20,000	$20,000	[8]
	Excavation including hauling and shoring	1,900	CY	$30	$57,000	[8]
	Backfill	1,300	CY	$50	$65,000	[8]
	6-inch AC Pavement/class 2 base	500	SF	$8	$4,000	[8]
	48" CCFRPM Pipe and Fitting (Bypass Pipe)	110	LF	$400	$44,000	[1]
	36" CCFRPM Pipe and Fittings (Meter Pipe)	71	LF	$300	$21,300	[1]
	36" Steel Pipe and Fittings (Meter Pipe)	38	LF	$600	$22,800	[5]
	Inlet Vault and hatches	1	LS	$60,000	$60,000	[8]
	Meter vault and hatches	1	LS	$25,000	$25,000	[8]
	Outlet vault and hatches	1	LS	$20,000	$20,000	[8]
	T-lock lining for wet vaults	1	LS	$40,000	$40,000	[8]
	Fabricated 316SS sluice gates (48"x48")	1	LS	$30,000	$30,000	[4]
	Fabricated 316SS sluice gates (36"x36")	2	LS	$27,000	$54,000	[4]
	Misc. Metals	1	LS	$10,000	$10,000	[8]
	Painting and Coatings	1	LS	$15,000	$15,000	[8]
	Sump Pump (0.5 hp) and piping	1	LS	$5,000	$5,000	[6]
	18" x 18" sump catch basin and grate	1	LS	$1,000	$1,000	[8]
	Electrical	1	LS	$40,000	$40,000	[8]
	Ventilation	1	LS	$7,000	$7,000	[8]
	Instrumentation Including 36" Meter and SCADA	1	LS	$60,000	$60,000	[3] & [7]
	Miscellaneous appurtenances	1	LS	$25,000	$25,000	[8]
3	**Acorn Metering System**			**Subtotal:**	**$557,000**	
	Bypass Pumping (24 days)	1	LS	$45,000	$45,000	[7]
	Demo and clearing including disposal and pipe	1	LS	$15,000	$15,000	[8]
	Excavation including hauling and shoring	1,700	CY	$30	$51,000	[8]
	Backfill	1,200	CY	$50	$60,000	[8]
	6-inch AC Pavement/class 2 base	1,000	SF	$8	$8,000	[8]
	24" CCFRPM Pipe and Fitting (Bypass Pipe)	40	LF	$200	$8,000	[1]
	16" CCFRPM Pipe and Fittings (Meter Pipe)	23	LF	$140	$3,220	[1]
	16" Steel Pipe and Fittings (Meter Pipe)	17	LF	$300	$5,100	[2]
	24" RCP (New Pipe Alignment)	71	LF	$200	$14,200	[2]
	Sewer Manholes	3	LS	$7,000	$21,000	[8]
	Inlet Vault and hatches	1	LS	$50,000	$50,000	[8]
	Meter vault and hatches	1	LS	$30,000	$30,000	[8]
	Outlet vault and hatches	1	LS	$15,000	$15,000	[8]
	T-lock lining for wet vaults and sewer manholes	1	LS	$55,000	$55,000	[8]
	Fabricated 316SS sluice gates (36" x36")	1	LS	$27,000	$27,000	[4]
	Fabricated 316SS sluice gates (18" x18")	2	LS	$22,000	$44,000	[4]
	Misc. Metals	1	LS	$10,000	$10,000	[8]
	Painting and Coatings	1	LS	$13,000	$13,000	[8]
	Sump Pump (0.5 hp)	1	LS	$1,500	$1,500	[6]
	18" x 18" sump catch basin and grate	1	LS	$1,000	$1,000	[8]
	Electrical	1	LS	$30,000	$30,000	[8]
	Ventilation	1	LS	$5,000	$5,000	[8]
	Instrumentation Including 16" Meter and SCADA	1	LS	$30,000	$30,000	[3] & [8]
	Miscellaneous appurtenances	1	LS	$15,000	$15,000	[8]

Item	Description	Estimated Quantity	Unit	Unit Price	Total Price	Source
4	**Arlanza Metering System**			**Subtotal:**	**$805,600**	
	Bypass Pumping (30 days)	1	LS	$180,000	$180,000	[7]
	Demo and clearing including disposal and pipe	1	LS	$20,000	$20,000	[8]
	Excavation including hauling and shoring	1,900	CY	$30	$57,000	[8]
	Backfill	1,400	CY	$50	$70,000	[8]
	6-inch AC Pavement/class 2 base	2,000	SF	$8	$16,000	[8]
	48" CCFRPM Pipe and Fitting (Bypass Pipe)	65	LF	$400	$26,000	[1]
	36" CCFRPM Pipe and Fittings (Meter Pipe)	45	LF	$300	$13,500	[1]
	36" Steel Pipe and Fittings (Meter Pipe)	16	LF	$600	$9,600	[5]
	Inlet Vault and hatches	1	LS	$60,000	$60,000	[8]
	Meter vault and hatches	1	LS	$25,000	$25,000	[8]
	Outlet vault and hatches	1	LS	$40,000	$40,000	[8]
	T-lock lining for wet vaults	1	LS	$40,000	$40,000	[8]
	Fabricated 316SS sluice gates (48"x48")	1	LS	$30,000	$30,000	[4]
	Fabricated 316SS sluice gates (36"x36")	2	LS	$27,000	$54,000	[4]
	Misc. Metals	1	LS	$10,000	$10,000	[8]
	Painting and Coatings	1	LS	$15,000	$15,000	[8]
	Sump Pump (0.5 hp)	1	LS	$1,500	$1,500	[6]
	18" x 18" sump catch basin and grate	1	LS	$1,000	$1,000	[8]
	Electrical	1	LS	$40,000	$40,000	[8]
	Ventilation	1	LS	$7,000	$7,000	[8]
	Instrumentation Including 36" Meter and SCADA	1	LS	$60,000	$60,000	[8]
	Miscellaneous appurtenances	1	LS	$30,000	$30,000	[8]
5	**Start-up Testing and Training**			**Subtotal:**	**$20,000**	
		1	LS	$20,000	$20,000	[8]
6	**Prepare Operation and Maintenance Manuals**			**Subtotal:**	**$10,000**	
		1	LS	$10,000	$10,000	[8]
7	**Prepare and Maintain Record Drawings**			**Subtotal:**	**$10,000**	
		1	LS	$10,000	$10,000	[8]
				SUBTOTAL - DIRECT COSTS ONLY	**$2,508,700**	
8	**Bonding and All Risk Insurance**			2%	$50,200	
				Subtotal:	**$2,558,900**	
9	**Contingency**			30%	$752,700	
				Subtotal:	**$3,261,400**	
10	**General Contractor Overhead and Profit**			15%	$489,300	
				Subtotal:	**$3,750,700**	
11	**Escalation to Construction Midpoint**			3%	$112,600	
				Subtotal:	**$3,863,300**	
12	**Owner's Reserve for Change Orders**			10%	$386,400	
				TOTAL ESTIMATED CONSTRUCTION COST	**$4,249,700**	

Notes:
1. Minor discrepancies in subtotals are possible due to rounding.
2. This estimate is based on the Project Preliminary Design Report prepared by URS dated 10/06/2014.

Sources:
[1] Vendor quote, Hobas Pipe - CCFRPM (2013).
[2] Caltrans Contract Cost Data Book (2012).
[3] Vendor quote, Siemens (2013).
[4] Vendor quote, CS-AMSCO (2013).
[5] Vendor quote, Northwest Pipe (2013).
[6] Vendor quote, Pump Man/Pump Source USA (2013).
[7] Vendor quote, Rain for Rent (2013).
[8] Experience from previous projects.

Attachment B

DETAILED COST ESTIMATE

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CITY OF RIVERSIDE PUBLIC WORKS

UPDATED INTEGRATED MASTER PLAN FOR WASTEWATER COLLECTION AND TREATMENT FACILITIES PROJECT

TASK :	7 - CIP and Financial Plan and User Rates and Fees	**ESTIMATE PREPARATION DATE :**	3/1/2016
JOB # :	10495A.00	**PREPARED BY :**	TetraTech
LOCATION :	Riverside, CA	**REVIEWED BY :**	
TITLE :	Levee Rehabilitation Phase II		

ITEM NO.	DESCRIPTION	QTY	UNIT	UNIT COST	SUBTOTAL	TOTAL
1	**Mobilization**					
	Mobilization	1.0	LS	$85,654	$85,700	
	Total					$85,700
2	**Site Preparation**					
	Site Preparation	1	LS	$41,783	$41,800	
	Total					$41,800
3	**Earthwork**					
	Structural Excavation	81925	CY	$30	$2,457,800	
	Grouted Riprap	2102	CY	$200	$420,400	
	Total					$2,878,200
4	**Permitting**					
	Permitting	1.0	LS	$1,000,000	$1,000,000	
	Total					$1,000,000
	ITEM NO. 1,2,3,and 4 SUBTOTAL					**$4,119,121**
5	**Allowances**					
	Construction Difficulty	5	%		$205,956	
	Total					$206,000
	SUBTOTAL					**$4,325,121**
	Estimating Contingency	30	%			$1,298,000
	SUBTOTAL					**$5,623,121**
	General Conditions	10	%			$562,312
	SUBTOTAL					**$6,185,434**
	General Contractor Overhead & Profit	15	%			$646,659
	SUBTOTAL					**$6,269,780**
	Escalation to June 2018	3	%			$188,093
	SUBTOTAL					**$6,457,874**
	Sales Tax on 50% of Subtotal Above	8.75	%			$549,000
	CONSTRUCTION COST SUBTOTAL					**$6,818,780**
	Engineering, Management, and Legal	30	%			$2,046,000
	Phave II Preliminary Design Report Allowance					$250,000
	PROJECT COST					**$9,114,800**