Hydraulic Model Development
DRAFT

Sacramento Regional County Sanitation District

VERSION 2.0

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1.0 Introduction

The purpose of this technical memorandum (TM) is to define the model attributes and conventions used in creating and updating a model for the South County Agriculture and Habitat Wetlands Water Recycling Project (South County Ag). Included is a discussion of the modeling software, model elements, and design criteria assumptions.

2.0 Model Development

2.1 Background Data

During development of the Facilities Plan (RMC, 2017), preliminary layouts for proposed South County Ag transmission and distribution system facilities were developed. Preliminary sizing for transmission and distribution piping was based on demands developed as part of the facilities plan. These demands were based on parcel acreage and the type of crop grown, assuming a constant demand with no peaking factors.

As part of the Capital Program Management Office (C-PMO), a model was developed of the transmission and distribution facilities as described in the Basis of Design Report (BODR) (Sac Regional, 2020). The following components from the facilities plan were adjusted using the model:

- Demands. Demands developed for the facilities plan were updated based on data provided by growers to better refine demands and peaking factors. This task also included working with growers to identify the location of wells on their properties to correspond to more accurate locations for distribution system turnouts. Demands are discussed in more detail in the BODR (Sac Regional, 2020).

- Piping. Transmission and distribution pipe alignments initially developed for the facilities plan were modified to better serve customer demand locations. Pipe sizes were updated to handle the updated demands as discussed in Section 4.0.

2.2 GIS Interface

GIS layers created for the facilities plan were imported into a GIS geodatabase. The geodatabase contains feature datasets to organize the data layers and ensure that all data is in the same projection system (NAD 1983 State Plane California Zone 2 FIPS 0402 US Feet). The geodatabase contains the following feature datasets:

- Basemap. Reference features such as parcels, the service area boundary, and streets were added to this feature dataset.

- ModelData. Features used for hydraulic modeling such as transmission main alignments and parcels with demands were added to this feature dataset. Any exports from the hydraulic model should be saved in this feature dataset as well.

- Analysis. GIS analysis layers should be stored in this feature dataset.
- Archive. Intermediate feature classes used to develop analysis layers or older versions of model export feature classes should be stored in this feature dataset.

The C-PMO is developing and maintaining a Web GIS interface to track project information. As the layout of the transmission and distribution pipes are updated to reflect field investigation data, the model was updated to reflect these changes. Similarly, changes to the transmission and distribution pipes as a result of hydraulic analyses are reflected in the Web GIS.

2.3 Modeling Software

The model was developed in Innovyze's InfoWater Pro software and will be maintained in the latest version of InfoWater Pro. The InfoWater interface is operated as an extension within ESRI's ArcGIS Pro. The model will be updated and maintained by the C-PMO and will serve as an operational model following construction of recycled water infrastructure. The model includes three files/folders which must be kept in the same folder for the model to open and run properly. The three model files/folders include:

- **WaterModel.aprx –** This file is an ArcGIS Pro project file. The user opens this file to access the model. After the file is open, click the InfoWater Pro tab and then click the Initialize button to run the model.
- **WaterModel.IWDB** – This folder stores model specific data. It must have the same name as the .aprx file for InfoWater Pro to open the model.
- **WaterModel.OUT** – This folder is automatically generated when a model simulation is run. It is used to store output results. This folder can be deleted at any time and will be recreated when the model is run again.

3.0 Model Facilities and Assumptions

3.1 Asset Naming Convention

This section describes how model facility attributes were updated.

Table 1 describes model attributes that apply to all facilities. Section 3 describes model attributes assigned to each facility type.

Table 1. Common Attributes

Attribute	Value
ID	This field is the unique identifier (ID) for each facility. The numbering is alphanumeric, with a prefix and a unique identifier. The prefix indicates facility type and the unique identifier includes either text describing the facility or a unique number.

Table 1. Common Attributes				
Attribute	Value			
	Facility Type	Prefix	Unique Identifier	Sample ID
	Junction	J	A unique number, starting at 100, or a unique description	J-100
	Transmission Pipe	TM	A unique number, starting at 1000, or a unique description	TM-1-1000
	Distribution Pipe	DM	A unique number, starting at 1000, or a unique description	DM-1-1000
Elevation	Elevations are assigned to model nodes (junctions, valves, pumps, tanks). Elevations for junctions were interpolated (or will be interpolated for future facilities) from the USGS National Elevation Dataset. 1/3 arc (10-meter data horizonal accuracy, downloaded July 2020.			

3.2 Junctions

Junctions were created in the model at changes in pipe diameter and material and at connections, intersections, and turnouts. Additional junctions were added where the GIS piping splits, such as at transitions between open-cut and trenchless installations. It is not necessary to split model piping to match GIS piping, but the model piping was set up to match GIS piping to the Web GIS and allow for similar pipe naming conventions to be used in the model and in distribution planning documentation and cost estimation. Table 2 lists the model's junction attributes.

Table 2. Junction Attributes	
Attribute	Value
Demand Type	1.
User Type	2.
Pattern	The water pattern for an individual user/farmer. Individual use patterns developed from farmers were developed based on irrigation schedules. Patterns are based on the demand type or crop and user type. The BODR provides additional detail on development of patterns. Demand Type: 1. Alfalfa 2. Almond 3. Pasture 4. Silage Corn 5. Vineyard 6. Walnut 7. Cherries User Type: 1. Single APN turnout/demand

Table 2. Junction Attributes	
Attribute	Value
	2. One connection for multiple APNs 3. Multiple connections per APN

A database separate from model demand files will be maintained outside of the model to track information collected from growers as the project progresses. The demand junctions in the model will be updated when new information on demands is received.

3.3 Pipes

The model includes both transmission and distribution facilities. Two transmission pipe alternatives are included in the model. Following selection of an alignment outside of the modeling effort, model scenarios will consider only the selected transmission main alternative.

Distribution facilities will be developed per Section 4.1. The model will include all proposed pipes, ending at grower property boundaries. Irrigation systems downstream of proposed meters are not included in the model. The distribution system will include all pipes up to proposed customer meters. Table 3 lists the model's pipe attributes.

Table 3. Pipe Attributes			
Attribute	Value		
Length	Calculated in the model based on the GIS length of the pipe.		
Diameter	The nominal diameter for the pipe segment. **This field will be updated with the actual inside diameter of the pipe after materials selection has been completed.**		
Material	Pipe material		
Hazen-Williams roughness (C-factor)	Material	C-factor	Source
	Welded Steel	140	Lindeburg (2014)
	High density polyethylene (HDPE)	140	AWWA (2012)
	Polyvinyl chloride (PVC)	140	AWWA (2012)
Minor loss	Set to 0. The C factor is more appropriate to account for losses due to bends and fittings because it accounts for losses based on the length of a pipe. One drawback of using this field is that if a minor loss is used, it causes the same head loss for short and long pipes.		

3.4 Pumps

Currently, the model includes the Harvest Water Pumping Station that will discharge into the transmission main. The pump station is currently modeled as a single pump with VFD controls to maintain a minimum of 15 psi of pressure in the distribution system. Additional detail on the

pump station will be added following completion of the Harvest Water Pump Station BODR to reflect the actual design of this facility.

Table 4 lists the model's pump attributes.

Table 4. Pump Attributes

Attribute	Value
Description	A brief description of the facility including the full name of the pump station and the pump number.
Type	The pump was modeled as a design point curve, for which a flow and head is defined.

The pump was modeled with a variable frequency drive. Specific pump curves and control points can be added into the model after pumps are selected and a control strategy is determined.

4.0 Distribution Piping Layout and Criteria

As mentioned in Section 2.1, the distribution piping alignments and sizing presented in the facilities plan have been revisited for this analysis. Because the new irrigation system will replace supply from existing groundwater wells, demands were added to the model at the same location of existing wells to identify where water is needed. The distribution system includes all piping to the location of the proposed meter. The location of customer demands within a property (i.e. the existing well location) identifies the location on the property boundary where water service will be provided and the meter will be located. Table 5 presents Transmission and distribution pipe criteria. The criteria may be revised as further information about demands and farmer needs are developed. Distribution pipe sizing and alignments will be adjusted as additional grower demand information is developed.

Table 5. Distribution Piping Criteria

Item	Description	Value	Source / Notes
Diameter	Determined based on velocity criteria at peak hour demand, minimum of 12 inches		
Pipe Alignment	Within public right of way where possible. Piping will be laid out to minimize the length of pipe required to reach the grower's property.		
Pressure	Minimum	15 psi	
	Maximum	50 psi	
Velocity	Maximum	7 ft/second	

5.0 References

AWWA, *Computer Modeling of Water Distribution Systems, M32*, Third Edition, 2012, American Water Works Association, pp. 23.

Michael R. Lindeburg, PE. Civil Engineering Reference Manual for the PE Exam, Fourteenth Edition, 2014, Professional Publications, Inc., Appendix 17.A.

RMC, *South Sacramento County Agriculture & Habitat Lands Recycled Water Program Facilities Plan*, 2017.

Sacramento Regional County Sanitation District, *Harvest Water Transmission Main and Distribution Pipelines Basis of Design Report*, 2020.