Public Version

# California Water Service Company

## Water Supply and Facilities Master Plan

## Chico-Hamilton City District

## FINAL REPORT

## 2008

# TABLE OF CONTENTS

EXECUTIVE SUMMARY ..... ES-1
INTRODUCTION ..... ES-1
OVERVIEW OF CHICO-HAMILTON CITY DISTRICT SERVICE AREA ..... ES-1
EXISTING AND FUTURE WATER DEMANDS ..... ES-2
EXISTING AND FUTURE WATER SUPPLIES ..... ES-2
HYDRAULIC MODEL ..... ES-4
HYDRAULIC MODEL CALIBRATION ..... ES-4
Existing C-Factor Confirmation ..... ES-4
Hydraulic Model Verification ..... ES-4
RECOMMENDED FACILITIES RENEWAL AND REPLACEMENT PROGRAM ..... ES-5
Capital Improvement Projects ..... ES-5
R&R Projects ..... ES-5
SUMMARY OF RECOMMENDED IMPROVEMENTS FOR EXISTING POTABLE WATER SYSTEM ..... ES-6
Pipelines ..... ES-6
Pressure Zone 350 ..... ES-6
Hamilton City ..... ES-6
Pump Stations ..... ES-7
Chico ..... ES-7
Hamilton City ..... ES-7
Storage Facilities ..... ES-8
Chico ..... ES-8
Hamilton City ..... ES-8
Standby Generators ..... ES-8
Chico ..... ES-8
SUMMARY OF RECOMMENDED IMPROVEMENTS FOR BUILDOUT OF THE POTABLE WATER SYSTEM ..... ES-8
Pipelines ..... ES-9
Chico ..... ES-9
Pump Stations ..... ES-9
Chico ..... ES-9
Pressure Zone 350 ..... ES-9
Pressure Zone 400 ..... ES-9
Pressure Zone 570 ..... ES-9
Pressure Zone 635 ..... ES-10
Storage Facilities ..... ES-10
Chico ..... ES-10
Pressure Zone 350 ..... ES-10
Pressure Zone 400 ..... ES-10
Pressure Zone 475 ..... ES-10
Pressure Zone 570 ..... ES-10
Pressure Zone 635 ..... ES-10
Pressure Zone 795 ..... ES-11

Hamilton City ..... ES-11
Pressure Reducing Stations and Isolation Valves ..... ES-11
Chico ..... ES-11
Pressure Zone 570 ..... ES-11
Altitude Valves ..... ES-11
Chico ..... ES-11
RECOMMENDED CAPITAL IMPROVEMENT PROGRAM ..... ES-11

**CHAPTER 1. INTRODUCTION ..... 1-1**

MASTER PLAN PURPOSE ..... 1-1
MASTER PLAN OBJECTIVES ..... 1-1
AUTHORIZATION ..... 1-1
REPORT ORGANIZATION ..... 1-2
ACRONYMS AND ABBREVIATIONS ..... 1-3

**CHAPTER 2. EXISTING SYSTEM ..... 2-1**

EXISTING SERVICE AREA ..... 2-1
CHICO-HAMILTON CITY DISTRICT SERVICE CONNECTIONS AND POPULATION SERVED ..... 2-1
EXISTING WATER SUPPLIES ..... 2-2
EXISTING WATER SYSTEM FACILITIES ..... 2-2
Existing Well Facilities ..... 2-2
Existing Storage Facilities ..... 2-5
Existing Booster Pump Facilities ..... 2-5
Existing Distribution System and Pipelines ..... 2-6
Existing SCADA System ..... 2-8

**CHAPTER 3. WATER DEMANDS ..... 3-1**

DESCRIPTION OF THE CHICO-HAMILTON DISTRICT ..... 3-1
Historical Number of Services by Revenue Class ..... 3-1
Historical Population Served ..... 3-2
Historical Housing Density ..... 3-2
Population Served ..... 3-2
Existing and Projected Land Use by Revenue Class ..... 3-4
Estimated Timing of Future Development ..... 3-7
HISTORICAL WATER PRODUCTION AND CONSUMPTION ..... 3-7
Historical Water Production ..... 3-7
Unaccounted-for Water ..... 3-9
Historical Water Consumption ..... 3-9
Historical Per Capita Water Demand ..... 3-9
Water Conservation ..... 3-12
ADOPTED PEAKING FACTORS ..... 3-12
PROJECTED WATER DEMANDS ..... 3-14
Calculated Unit Demand Factors for those Areas with Only a Primary Designation ..... 3-14
Comparison Unit Demand Factors for those Areas with Only a Primary Designation ..... 3-16
Recommended Unit Demand Factors for Areas with a Primary and Secondary Designation ..... 3-16

Estimated Savings from Conversion of Residential–Flat Customers ..... 3-18
Projected Water Demands ..... 3-19
Timing of Projected Water Demands ..... 3-22
PROJECTED NUMBER OF SERVICES ..... 3-22
Service Based Unit Factors for Projecting Number of Services ..... 3-22
Service Based Residential Unit Factor ..... 3-22
Service Based Multiple Residences Unit Factor ..... 3-25
Service Based Commercial Unit Factor ..... 3-25
Service Based Industrial Unit Factor ..... 3-25
Service Based Government Unit Factor ..... 3-25
Service Based Non-Designated Development Unit Factor ..... 3-25
Future Service Connections ..... 3-26
PROJECTED POPULATION SERVED ..... 3-26
REFERENCES ..... 3-43

**CHAPTER 4. WATER SUPPLY ..... 4-1**

GROUNDWATER SUPPLY ..... 4-1
Groundwater Basin Description ..... 4-2
Groundwater Level Trends ..... 4-3
Criteria for Evaluating Historical Water Levels ..... 4-3
Groundwater Level Trends: Vina Sub-basin ..... 4-5
Groundwater Level Trends: West Butte Sub-basin ..... 4-6
Groundwater Level Trends: East Butte Sub-basin ..... 4-8
Groundwater Level Trends: Corning Sub-basin ..... 4-8
Summary of Groundwater Level Trends: Cal Water's Chico-Hamilton City District ..... 4-9
Groundwater Quality ..... 4-9
Water Quality from Bulletin 118 ..... 4-10
Regional Groundwater Plumes ..... 4-10
Active Groundwater Cases in the Area ..... 4-10
Historical Water Quality in Cal Water Wells ..... 4-13
Summary of Potential Water Quality Concerns ..... 4-14
Unit Cost of Providing Groundwater in the Future ..... 4-15
Cost of Maintaining Existing Groundwater Production Capacity ..... 4-15
Cost of Future Groundwater Production Requirements ..... 4-15
Total Unit Cost of Groundwater ..... 4-17
OTHER POTENTIAL WATER SUPPLY OPTIONS ..... 4-17
Potential Surface Water Supply Options ..... 4-18
State Water Project Contract Supplies ..... 4-18
Water Transfers ..... 4-19
New Water Right ..... 4-21
Conveyance/Wheeling ..... 4-21
Chico Surface Water Supply Options ..... 4-21
Option C-1, SWP Contract Supply: Contract with Butte County for SWP Water ..... 4-22
Option C-2, Water Transfer ..... 4-23
Option C-3, Water Right ..... 4-23

Hamilton City Water Supply Options ..... 4-23
Option HC-1, Water Transfer ..... 4-24
Option HC-2, Water Right ..... 4-24
Summary of Surface Water Supply Options ..... 4-24
Potential Recycled Water Supplies ..... 4-25
SUMMARY, RECOMMENDED WATER SUPPLY OPTION ..... 4-25
REFERENCES ..... 4-53

**CHAPTER 5. PLANNING AND DESIGN CRITERIA ..... 5-1**

FIRE FLOW REQUIREMENTS ..... 5-1
WATER SUPPLY CAPACITY DURING HIGH DEMAND PERIODS ..... 5-3
Maximum Day Demand plus Fire Flow ..... 5-3
Peak Hour Demand ..... 5-4
PUMPING FACILITY CAPACITY ..... 5-4
CRITICAL PUMPING FACILITY ..... 5-4
WATER STORAGE CAPACITY ..... 5-5
Operational Storage ..... 5-5
Fire Storage ..... 5-6
Emergency Storage ..... 5-6
Credits for Existing Groundwater Supply ..... 5-7
Total Storage Capacity ..... 5-7
WATER TRANSMISSION AND DISTRIBUTION PIPELINE SIZING ..... 5-8
Water Transmission System ..... 5-8
Average Day Demand ..... 5-8
Maximum Day Demand ..... 5-9
Peak Hour Demand ..... 5-9
Water Distribution System ..... 5-9
Average Day Demand ..... 5-9
Maximum Day Demand plus Fire Flow ..... 5-9
Peak Hour Demand ..... 5-9

**CHAPTER 6. HYDRAULIC MODEL ..... 6-1**

DEVELOPMENT OF THE HYDRAULIC MODEL ..... 6-1
Description of the Model and Element Definition ..... 6-2
Pipelines, Nodes, and Junctions Imported into $H_2$OMAP ..... 6-3
Roughness Factors Assigned in $H_2$OMAP ..... 6-3
Accounts Geocoded in GIS ..... 6-4
Water Demands Allocated in $H_2$OMAP ..... 6-5
Elevations Allocated in $H_2$OMAP ..... 6-7
Pipelines Skeletonized in $H_2$OMAP ..... 6-7
Incorporating Station Elements in $H_2$OMAP ..... 6-8
Naming Scheme Used in $H_2$OMAP ..... 6-8
HYDRAULIC MODEL CALIBRATION ..... 6-8
C-factor Test Results ..... 6-10
Diurnal Curve Development ..... 6-10
Chico Pressure Zone 350 ..... 6-11
Chico Pressure Zone 400 ..... 6-14

Chico Pressure Zone 475 ..... 6-14
Chico Pressure Zone 635 ..... 6-15
Chico Pressure Zone 795 ..... 6-15
Hamilton City Pressure Zone ..... 6-15
HYDRAULIC MODEL VERIFICATION ..... 6-15
Pressure Verification ..... 6-15
Verification Result ..... 6-16
Pressure Zone 350 ..... 6-16
Pressure Zone 400 ..... 6-17
Pressure Zone 475 ..... 6-17
Pressure Zone 635 ..... 6-18
Pressure Zone 795 ..... 6-18
Hamilton City ..... 6-18
Verification Findings and Conclusions ..... 6-18

**CHAPTER 7. INVENTORY AND ASSESSMENT OF FACILITIES CONDITIONS AND CAPACITY ..... 7-1**

SUMMARY OF KEY FINDINGS ..... 7-1
Booster Pump and Motors ..... 7-2
Wells ..... 7-2
Well Pump and Motors ..... 7-3
Tanks ..... 7-3
Auxiliary Power ..... 7-4
Disinfectant Storage ..... 7-4
Telemetry Systems ..... 7-4
Capital Considerations: ..... 7-5
Maintenance Considerations: ..... 7-5
ASSESSMENT PROCESS ..... 7-6
Asset Inventory ..... 7-6
Record Examination ..... 7-7
Staff Interview ..... 7-7
Visual Survey ..... 7-7
STATION ASSESSMENT ..... 7-7
Station 001 ..... 7-8
Station 004 ..... 7-9
Station 013 ..... 7-9
Station 016 ..... 7-10
Station 021 ..... 7-10
Station 024 ..... 7-11
Station 026 ..... 7-12
Station 031 ..... 7-12
Station 033 ..... 7-13
Station 040 ..... 7-14
Station 042 ..... 7-14
Station 044 ..... 7-15
Station 046 ..... 7-16
Station 053 ..... 7-16

Station 056 ..... 7-17
Station 058 ..... 7-18
Station 059 ..... 7-18
Station 061 ..... 7-19
Station 064 ..... 7-19
Station 066 ..... 7-20
Station 068 ..... 7-21
Station 071 ..... 7-22
RENEWAL AND REPLACEMENT SCHEDULE ..... 7-22

**CHAPTER 8. EVALUATION OF EXISTING WATER SYSTEM ..... 8-1**

EXISTING WATER DEMANDS ..... 8-1
EXISTING SYSTEM EVALUATION METHODOLOGY ..... 8-2
Water Storage Capacity Evaluation ..... 8-2
Pumping Capacity Evaluation ..... 8-2
Water Distribution System Analysis ..... 8-5
EVALUATION RESULTS ..... 8-7
Pressure Zone 350 ..... 8-7
Water Storage Capacity ..... 8-7
Pumping Capacity ..... 8-9
Water Distribution System ..... 8-10
Peak Hour ..... 8-10
Maximum Day plus Fire Flow Demand ..... 8-10
Pressure Zone 400 ..... 8-10
Water Storage Capacity ..... 8-10
Pumping Capacity ..... 8-11
Water Distribution System ..... 8-12
Peak Hour ..... 8-12
Maximum Day plus Fire Flow Demand ..... 8-13
Pressure Zone 475 ..... 8-13
Water Storage Capacity ..... 8-13
Pumping Capacity ..... 8-14
Water Distribution System ..... 8-15
Peak Hour ..... 8-15
Maximum Day plus Fire Flow Demand ..... 8-15
Pressure Zone 635 ..... 8-15
Water Storage Capacity ..... 8-15
Pumping Capacity ..... 8-16
Water Distribution System ..... 8-17
Peak Hour ..... 8-17
Maximum Day plus Fire Flow Demand ..... 8-17
Pressure Zone 795 ..... 8-17
Water Storage Capacity ..... 8-17
Pumping Capacity ..... 8-18
Water Distribution System ..... 8-18
Peak Hour ..... 18
Maximum Day plus Fire Flow Demand ..... 8-19

Hamilton City ..... 8-19
Water Storage Capacity ..... 8-19
Pumping Capacity ..... 8-20
Water Distribution System ..... 8-20
Peak Hour ..... 8-20
Maximum Day plus Fire Flow Demand ..... 8-21
SUMMARY OF RECOMMENDED IMPROVEMENTS FOR EXISTING POTABLE WATER SYSTEM ..... 8-22
Pipelines ..... 8-22
Pump Stations ..... 8-23
Storage Facilities ..... 8-23
Standby Generators ..... 8-24

**CHAPTER 9. EVALUATION OF FUTURE WATER SYSTEM ..... 9-1**

BUILDOUT WATER DEMANDS ..... 9-1
BUILDOUT SYSTEM EVALUATION METHODOLOGY ..... 9-2
Water Storage Capacity Evaluation ..... 9-2
Pumping Capacity Evaluation ..... 9-3
Water Distribution System Analysis ..... 9-6
EVALUATION RESULTS ..... 9-7
Pressure Zone 350 ..... 9-7
Water Storage Capacity ..... 9-7
Pumping Capacity ..... 9-9
Water Distribution System ..... 9-10
Peak Hour ..... 9-10
Maximum Day plus Fire Flow Demand ..... 9-11
Pressure Zone 400 ..... 9-12
Water Storage Capacity ..... 9-12
Pumping Capacity ..... 9-13
Water Distribution System ..... 9-14
Peak Hour ..... 9-14
Maximum Day plus Fire Flow Demand ..... 9-14
Pressure Zone 475 ..... 9-14
Water Storage Capacity ..... 9-14
Pumping Capacity ..... 9-15
Water Distribution System ..... 9-16
Peak Hour ..... 9-16
Maximum Day plus Fire Flow Demand ..... 9-16
Pressure Zone 570 ..... 9-16
Water Storage Capacity ..... 9-17
Pumping Capacity ..... 9-18
Water Distribution System ..... 9-18
Peak Hour ..... 9-18
Maximum Day plus Fire Flow Demand ..... 9-19
Pressure Zone 635 ..... 9-19
Water Storage Capacity ..... 9-19
Pumping Capacity ..... 9-20

Water Distribution System ..... 9-20
Peak Hour ..... 9-20
Maximum Day plus Fire Flow Demand ..... 9-21
Pressure Zone 795 ..... 9-21
Water Storage Capacity ..... 9-21
Pumping Capacity ..... 9-22
Water Distribution System ..... 9-22
Peak Hour ..... 9-22
Maximum Day plus Fire Flow Demand ..... 9-23
Hamilton City ..... 9-23
Water Storage Capacity ..... 9-23
Pumping Capacity ..... 9-24
Water Distribution System ..... 9-25
Peak Hour ..... 9-25
Maximum Day plus Fire Flow Demand ..... 9-25
SUMMARY OF RECOMMENDED IMPROVEMENTS FOR BUILDOUT OF THE POTABLE WATER SYSTEM ..... 9-25
Pipelines ..... 9-25
Pump Stations ..... 9-25
Pressure Zone 350 ..... 9-25
Pressure Zone 400 ..... 9-26
Pressure Zone 570 ..... 9-26
Pressure Zone 635 ..... 9-26
Storage Facilities ..... 9-26
Pressure Zone 350 ..... 9-26
Pressure Zone 400 ..... 9-26
Pressure Zone 475 ..... 9-27
Pressure Zone 570 ..... 9-27
Pressure Zone 635 ..... 9-27
Pressure Zone 795 ..... 9-27
Hamilton City ..... 9-27
Pressure Reducing Stations and Isolation Valves ..... 9-27
Pressure Zone 570 ..... 9-27
Altitude Valves ..... 9-27

**CHAPTER 10. RECOMMENDED CAPITAL IMPROVEMENT PROGRAM ..... 10-1**

RECOMMENDED CAPITAL IMPROVEMENT PROGRAM ..... 10-1
Existing Water System Improvements ..... 10-1
Existing Improvements ..... 10-1
Pressure Zone 350 ..... 10-1
Pressure Zone 400 ..... 10-2
Pressure Zone 795 ..... 10-2
Hamilton City ..... 10-2
Renewal and Replacement (0 to 5 Years) ..... 10-4

Buildout Water System Improvements ..... 10-4
Future Improvements ..... 10-5
Pressure Zone 350 ..... 10-5
Pressure Zone 400 ..... 10-5
Pressure Zone 475 ..... 10-5
Pressure Zone 570 ..... 10-5
Pressure Zone 635 ..... 10-6
Pressure Zone 795 ..... 10-6
Hamilton City ..... 10-6
Renewal & Replacement (5 to 25 Years) ..... 10-7
Recommended CIP Costs ..... 10-7
Recommended CIP by Project Types ..... 10-14
CAPITAL IMPROVEMENT PROGRAM IMPLEMENTATION ..... 10-15

**APPENDIX A: Chico-Hamilton City District Population Estimates**

**APPENDIX B: Conversion of Existing and Future Land Use Designations**

**APPENDIX C: Water Conservation Best Management Practices**

**APPENDIX D: Diurnal Curves for Chico-Hamilton City District Pressure Zones**

**APPENDIX E: Conversion of Demand Factors in the UWMP**

**APPENDIX F: Key Portions of Butte County Groundwater Inventory Analysis Including Plates 1 through 9**

**APPENDIX G: DWR Water Levels**

**APPENDIX H: Cal Water Levels**

**APPENDIX I: Water Quality for Key Cal Water Wells**

**APPENDIX J: SWRCB Sampling Results for Station 16**

**APPENDIX K: Detailed Cost Estimates for Groundwater Supply**

**APPENDIX L: Appendix 6-A. Hydraulic Model Calibration**

**APPENDIX M: Verification Results**

**APPENDIX N: Table 1. Recommended Renewal and Replacement (R&R) of System Facilities**
**Table 2. Asset Inventory Summary of District Facilities**
**Table 3. Summary of the Recommendations**

**APPENDIX O: Technical Memo for CWS SCADA System**

**APPENDIX P: Condition Assessment Forms**

**APPENDIX Q: Station Facility Photos from Site Visits**

**APPENDIX R: Cost Estimating Assumptions**

# LIST OF TABLES

Table ES-1. Projected Water Demands for Chico-Hamilton City District ..... ES-3
Table ES-2. Future Unit Costs of Existing Groundwater Capacity (In 2006 Dollars) ..... ES-4
Tables ES-3. Summary of Probable Construction Costs for Existing CIP ..... ES-13
Table ES-4. Summary of Probable Construction Costs for Buildout CIP ..... ES-14
Table 2-1. Existing (2005) Number of Service Connections By Revenue Class ..... 2-2
Table 2-2. Chico-Hamilton City District Well Facilities ..... 2-3
Table 2-3. Chico-Hamilton City District Storage Tank Facilities ..... 2-5
Table 2-4. Chico-Hamilton City District Active Booster Pump Facilities ..... 2-6
Table 2-5. Chico Pipeline Material Types ..... 2-7
Table 2-6. Hamilton City Pipeline Material Types ..... 2-8
Table 3-1. Historical Services By Revenue Class ..... 3-3
Table 3-2. Historical Population Served in the Chico-Hamilton City District ..... 3-5
Table 3-3. Existing and Projected Land Use By Revenue Class, Acres ..... 3-6
Table 3-4. Historical Water Production ..... 3-8
Table 3-5. Historical Water Consumption By Revenue Class ..... 3-10
Table 3-6. Historical Per Capita Demand ..... 3-11
Table 3-7. Historical Maximum Day Peaking Factors ..... 3-13
Table 3-8. Adopted Peaking Factors ..... 3-14
Table 3-9. Calculated Unit Demand Factors ..... 3-15
Table 3-10. Unit Demand Factors ..... 3-17
Table 3-11. Unit Factors Calculated for Areas With a Secondary Designation ..... 3-18
Table 3-12. Estimated Water Savings Due to Residential Metering Program ..... 3-20
Table 3-13. Projected Water Demands for the Chico-Hamilton City District ..... 3-21
Table 3-14. Timing of Projected Water Demands for the Chico-Hamilton City District ..... 3-23
Table 3-15. Revenue Class Conservation Factors for Projecting the Number of Services, Af/Service ..... 3-24
Table 3-16. Projected Number of Services for City of Chico ..... 3-27
Table 3-17. Projected Number of Services for Hamilton City ..... 3-28
Table 4-1. Characteristics of Groundwater Sub-Basins Underlying the Chico-Hamilton City District ..... 4-2
Table 4-2. Water-Bearing Formations Within Each Sub-Basin ..... 4-3

Table 4-3. Regional Groundwater Plumes ..... 4-11

Table 4-4. Potential Responsible Parties in the Chico-Hamilton City District with Known Groundwater Contamination ..... 4-12

Table 4-5. Cal Water Wells With Contaminants Above the MCL or 75 Percent of the MCL ..... 4-13

Table 4-6. Future Unit Costs of Existing Groundwater Capacity (In 2006 Dollars) ..... 4-15

Table 4-7. Unit Costs of Additional Groundwater Pumping Capacity (In 2006 Dollars) ..... 4-16

Table 4-8. Unit Costs of Additional Groundwater Pumping Capacity Required ..... 4-17

Table 4-9. Swp Average and Dry Year Table a Delivery From the Delta (Table 5-4) ..... 4-23

Table 4-10. Summary of Surface Water Supply Options ..... 4-24

Table 4-11. Projected Cost of the Recommended Water Supply Scenario ..... 4-26

Table 5-1. California Water Service Company's Chico-Hamilton City District Planning and Design Criteria ..... 5-2

Table 5-2. Fire Flow Requirements ..... 5-3

Table 6-1. Preliminary C-Factors Assigned in the Model ..... 6-4

Table 6-2. Geocoding Results for the City of Chico ..... 6-5

Table 6-3. Demand Allocation for Hamilton City ..... 6-6

Table 6-4. Revenue Class Assignment ..... 6-7

Table 6-5. Naming Scheme for Network Element ..... 6-9

Table 6-6. Demand Diurnal Dates ..... 6-11

Table 6-7. Available Scada Information From Cal Water Station ..... 6-12

Table 6-8. Available Scada Information From Cal Water Station ..... 6-13

Table 8-1. Existing Potable Demands for the Chico-Hamilton City District ..... 8-1

Table 8-2. Summary of Existing Storage Requirements ..... 8-3

Table 8-3. Summary of the Chico-Hamilton City District's Existing Pumping Facilities ..... 8-4

Table 8-4. Summary of Capacity Requirements of Existing Pumping Facilities ..... 8-6

Table 8-5. Chico-Hamilton City District Fire Flow Demand Requirements ..... 8-7

Table 8-6. Pressure Zone 350 Storage Requirements ..... 8-8

Table 8-7. Summary of Pressure Zone 350 Pumping Capacity ..... 8-9

Table 8-8. Pressure Zone 400 Storage Requirements ..... 8-11

Table 8-9. Summary of Pressure Zone 400 Pumping Capacity ..... 8-12

Table 8-10. Pressure Zone 475 Storage Requirements ..... 8-13

Table 8-11. Summary of Pressure Zone 475 Pumping Capacity ..... 8-14

Table 8-12. Pressure Zone 635 Storage Requirements ..... 8-16
Table 8-13. Summary of Pressure Zone 635 Pumping Capacity ..... 8-16
Table 8-14. Pressure Zone 795 Storage Requirements ..... 8-17
Table 8-15. Summary of Pressure Zone 795 Pumping Capacity ..... 8-18
Table 8-16. Hamilton City Storage Requirements ..... 8-19
Table 8-17. Summary of Hamilton City Pumping Capacity ..... 8-20
Table 9-1. Buildout Potable Demands for the Chico-Hamilton City District ..... 9-2
Table 9-2. Summary of Buildout Storage Requirements ..... 9-4
Table 9-3. Summary of Capacity Requirements of Pumping Facilities At Buildout ..... 9-5
Table 9-4. Chico-Hamilton City District Fire Flow Demand Requirements ..... 9-7
Table 9-5. Pressure Zone 350 Storage Requirements ..... 9-8
Table 9-6. Summary of Pressure Zone 350 Pumping Capacity ..... 9-9
Table 9-7. Pressure Zone 400 Storage Requirements ..... 9-12
Table 9-8. Summary of Pressure Zone 400 Pumping Capacity ..... 9-13
Table 9-9. Pressure Zone 475 Storage Requirements ..... 9-14
Table 9-10. Summary of Pressure Zone 475 Pumping Capacity ..... 9-15
Table 9-11. Pressure Zone 570 Storage Requirements ..... 9-17
Table 9-12. Summary of Pressure Zone 570 Pumping Capacity ..... 9-18
Table 9-13. Pressure Zone 635 Storage Requirements ..... 9-19
Table 9-14. Summary of Pressure Zone 635 Pumping Capacity ..... 9-20
Table 9-15. Pressure Zone 795 Storage Requirements ..... 9-21
Table 9-16. Summary of Pressure Zone 795 Pumping Capacity ..... 9-22
Table 9-17. Hamilton City Storage Requirements ..... 9-23
Table 9-18. Summary of Hamilton City Pumping Capacity ..... 9-24
Table 10-1. Recommended Pipeline CIP for Existing System to Meet Maximum Day Plus Fire Flow Demand Conditions ..... 10-3
Table 10-2. Recommended Pipelines CIP for Buildout System to Meet Maximum Day Plus Fire Flow Demands Conditions ..... 10-6
Table 10-3. Summary of Probable Construction Costs for Existing CIP ..... 10-8
Table 10-4. Summary of Probable Construction Costs for Renewal and Replacement CIP ..... 10-9
Table 10-5. Summary of Probable Construction Costs for Buildout CIP ..... 10-13
Table 10-6. Estimated Cost of Recommended CIP By Project Type and Location ..... 10-14

# LIST OF FIGURES

Figure ES-1. Service Area Location ..... ES-15
Figure ES-2. Groundwater Sub-Basins ..... ES-16
Figure ES-3. Hydrant Test Locations ..... ES-17
Figure ES-4. Preliminary and Renewal and Replacement Cost For Chico-Hamilton City District ..... ES-18
Figure ES-5. Existing Water System ..... ES-19
Figure ES-6. Buildout Water System ..... ES-20
Figure ES-7. Timing of Major Water Supply and Distribution Facilities ..... ES-21
Figure ES-8. Timing of Renewal andReplacement of Water Supply and Distribution Facilities ..... ES-22
Figure 2-1. Service Area Location ..... 2-9
Figure 2-2. Existing Potable Water Facilities ..... 2-10
Figure 2-3. Chico Schematic For Zone 350 ..... 2-11
Figure 2-4. Chico Schematic For Zone 350 ..... 2-12
Figure 2-5. Chico Schematic For Zone 350 ..... 2-13
Figure 2-6. Chico Schematic For Zone 350 ..... 2-14
Figure 2-7. Chico Schematic For Zones 400, 475, 635 and 795 ..... 2-15
Figure 2-8. Hamilton City Schematic ..... 2-16
Figure 2-9. Existing Water System ..... 2-17
Figure 3-1. Service Area Location ..... 3-29
Figure 3-2. Historical Density For Water Supply Planning ..... 3-30
Figure 3-3. Estimated Historical Population Served ..... 3-31
Figure 3-4. Existing Land Use ..... 3-32
Figure 3-5. Future Land Use ..... 3-33
Figure 3-6. Development Over Time ..... 3-34
Figure 3-7. Historical Water Production ..... 3-35
Figure 3-8. Comparison of Historical Per Capita Demand, Production & Population ..... 3-36
Figure 3-9. Estimated Water Savings From Conversion of Residential – Flat Accounts ..... 3-37
Figure 3-10. Projected Water Demands For The Chico District ..... 3-38
Figure 3-11. Unit Factor For Residentialand Multiple Residences ..... 3-39
Figure 3-12. Unit Factor For Commercialand Industrial ..... 3-40

Figure 3-13. Unit Factor For Governmentand Non-Designated Development ..... 3-41
Figure 3-14. Projected Population Served in The Chico-Hamilton City District ..... 3-42
Figure 4-2. Example of Overdraft Conditions in Bulletin 118 ..... 4-4
Figure 4-1. Groundwater Sub-Basins ..... 4-27
Figure 4-3. Vina Sub-Basin – Average Spring Groundwater Levels ..... 4-28
Figure 4-4. DWR Wells Evaluated ..... 4-29
Figure 4-5. Water Level Declines Greater Than 0.75 Ft/Year ..... 4-30
Figure 4-6. Station 033-01 – Spring Groundwater Level Hydrograph ..... 4-31
Figure 4-7. Station 034-01 – Spring Groundwater Level Hydrograph ..... 4-32
Figure 4-8. Cross-Section A-A': Well Construction Details ..... 4-33
Figure 4-9. Average Annual Groundwater Production: 2000 To 2006 ..... 4-34
Figure 4-10. Average Spring-Time Groundwater Production 2000 To 2006 ..... 4-35
Figure 4-11. West Butte Sub-Basin – Average Spring Groundwater Level Hydrograph ..... 4-36
Figure 4-12. Station 005-02 – Spring Groundwater Level Hydrograph ..... 4-37
Figure 4-13. Comparison of Well Construction Details: Stations 5, 11, 23, 35, 51 ..... 4-38
Figure 4-14. Average Annual Groundwater Production: 2000 To 2006 ..... 4-39
Figure 4-15. Average Spring-Time Groundwater Production: 2000 To 2006 ..... 4-40
Figure 4-16. Corning Sub-Basin - Average Spring Groundwater Level Hydrograph ..... 4-41
Figure 4-17. Known Regional Groundwater Plumes ..... 4-42
Figure 4-18. Known Point Sources of Pce & Tce Groundwater Contamination ..... 4-43
Figure 4-19. Known Point Sources of TPH, MTBE, & BTEX Groundwater Contamination ..... 4-44
Figure 4-20. Known Point Sources of PCP, TCP, PAH, Cyanideand Arsenic Groundwater Contamination ..... 4-45
Figure 4-21. Summary of Key Water Quality Results in Cal Water Wells ..... 4-46
Figure 4-22. Projected Number of New Wells Required ..... 4-47
Figure 4-23. Regional Surface Water Resources & Purveyors ..... 4-48
Figure 4-24. Location of Potential Recycled Water Supplyand Demand ..... 4-49
Figure 4-25. Comparison of Water Supply Demand ..... 4-50
Figure 4-26. Projected Max Day Demandsand Groundwater Production Capacity ..... 4-51
Figure 4-27. Projected Future Costs of Recommended Water Supply ..... 4-52
Figure 6-1. Geocoded Meters ..... 6-20
Figure 6-2. Hamilton City Demand Allocation ..... 6-21

Figure 6-3. Skeletonization ..... 6-22
Figure 6-4. Hydrant Test Locations ..... 6-23
Figure 6-5. Hydrant Pressure Recorder Locations ..... 6-24
Figure 6-6. Cal Water's Station Verification For Pressure Zone 350 Station 17 ..... 6-25
Figure 6-7. Cal Water's Station Verification For Pressure Zone 350 Station 26 ..... 6-26
Figure 6-8. Cal Water's Station Verification For Pressure Zone 350 Station 49 ..... 6-27
Figure 6-9. Cal Water's Station Verification For Pressure Zone 350 Station 68 ..... 6-28
Figure 6-10. Cal Water's Station Verification For Pressure Zone 350 Station 71 ..... 6-29
Figure 6-10a. Cal Water's Pressure Zone 350 Stations 48, 51, and 52 ..... 6-30
Figure 6-11. Pressure Comparison Between Field Recording and Model Simulation In Pressure Zone 350 ..... 6-31
Figure 6-12. Cal Water's Station Verification For Pressure Zone 400 Station 64 ..... 6-32
Figure 6-13. Cal Water's Station Verificationand Pressure Comparison Between Field Recordingand Model Simulation in Pressure Zone 400 ..... 6-33
Figure 6-14. Cal Water's Station Verification For Pressure Zone 475 Station 72 ..... 6-34
Figure 6-15. Cal Water's Station Verification For Pressure Zone 475 Station 67 ..... 6-35
Figure 6-16. Pressure Comparison Between Field Recordingand Model Simulation In Pressure Zone 475 ..... 6-36
Figure 6-17. Cal Water's Station Verification For Pressure Zone 635 ..... 6-37
Figure 6-18. Pressure Comparison Between Field Recordingand Model Simulation In Pressure Zone 635and 795 ..... 6-38
Figure 6-19. Cal Water's Station Verification For Pressure Zone 795 Station 66 C & D ..... 6-39
Figure 6-20. Cal Water's Station Verification For Hamilton City Station 1-01 ..... 6-40
Figure 6-21. Pressure Comparison Between Field Recordingand Model Simulation In Hamilton City ..... 6-41
Figure 7-1. Age Distribution For Chico-Hamilton City District Booster Pumps ..... 7-24
Figure 7-2. Age Distribution For Chico-Hamilton City District Booster Pump Motors ..... 7-25
Figure 7-3. Age Distribution For Chico-Hamilton City District Wells ..... 7-26
Figure 7-4. Age Distribution For Chico-Hamilton City District Well Pump ..... 7-27
Figure 7-5. Age Distribution For Chico-Hamilton City District Booster Pump Motors ..... 7-28
Figure 7-6. Age Distribution For Chico-Hamilton City District Steel Tanks ..... 7-29
Figure 7-7. Preliminary Renewaland Replacement Cost For Chico-Hamilton City District ..... 7-30
Figure 8-1. Existing Water System ..... 8-25
Figure 8-2. Existing Land Use ..... 8-26

Figure 8-3. Existing System Fire Flow Demands ..... 8-27
Figure 8-4. Pressure Zone 350 Peak Hour Analysis ..... 8-28
Figure 8-5. Pressure Zone 350 Recommendation ..... 8-29
Figure 8-6. Pressure Zone 400 Peak Hour Analysis ..... 8-30
Figure 8-7. Pressure Zone 475 Peak Hour Analysis ..... 8-31
Figure 8-8. Pressure Zone 635 Peak Hour Analysis ..... 8-32
Figure 8-9. Pressure Zone 795 Peak Hour Analysis ..... 8-33
Figure 8-10. Hamilton City Peak Hour Analysis ..... 8-34
Figure 8-11. Hamilton City Fire Flow Recommendation #1 ..... 8-35
Figure 8-12. Hamilton City Fire Flow Recommendation #2 ..... 8-36
Figure 8-13. Hamilton City Fire Flow Recommendation #3 ..... 8-37
Figure 8-14. Hamilton Fire Flow Recommendation #4 ..... 8-38
Figure 8-15. Hamilton City Fire Flow Recommendation #5 ..... 8-39
Figure 8-16. Recommended Existing Improvements ..... 8-40
Figure 9-1. Buildout Water System ..... 9-28
Figure 9-2. Future Landuse ..... 9-29
Figure 9-3. Fire Flow Demands ..... 9-30
Figure 9-4. Pressure Zone 350 Peak Hour Analysis ..... 9-31
Figure 9-5. Pressure Zone 350 Fire Flow Recommendation ..... 9-32
Figure 9-6. Pressure Zone 350 Fire Flow Recommendation ..... 9-33
Figure 9-7. Pressure Zone 400 Peak Hour Analysis ..... 9-34
Figure 9-8. Pressure Zone 400 Fire Flow Recommendation ..... 9-35
Figure 9-9. Pressure Zone 475 Peak Hour Analysis ..... 9-36
Figure 9-10. Pressure Zone 570 Peak Hour Analysis ..... 9-37
Figure 9-11. Pressure Zone 635 Peak Hour Analysis ..... 9-38
Figure 9-12. Pressure Zone 795 Peak Hour Analysis ..... 9-39
Figure 9-13. Hamilton City Peak Hour Analysis ..... 9-40
Figure 9-14. Recommended Buildout Improvements ..... 9-41
Figure 10-1. Existing Improvementsand 0 To 5 Years R&R ..... 10-16
Figure 10-2. Buildout Improvementsand 5 To 25 Years R&R ..... 10-17
Figure 10-3. Timing of Major Water Supplyand Distribution Facilities ..... 10-18
Figure 10-4. Timing of Renewaland Replacement of Water Supply and Distribution Facilities ..... 10-19

Public Version



# Executive Summary

## Future Water Supply Scenarios and Recommendations:

Chapter 4 of this Water Supply and Facilities Master Plan describes the quantity and reliability of groundwater pumped by Cal Water. This chapter also describes other potential future water supply concepts (surface water and recycled water) that Cal Water can further explore to increase supply reliability as demands increase in the future and if groundwater conditions change.

After identifying other potential water supplies for the Chico-Hamilton City District, this Chapter then presents the most plausible water supply scenario available to Cal Water, including a comparison of future water supply and demand. The cost of the recommended water supply scenario is also provided.

### Executive Summary Contents:


- Introduction
- Overview of Chico-Hamilton City District Service Area
- Existing and Future Water Demands
- Existing and Future Water Supplies
- Recommended Facilities Renewal and Replacement Program
- Recommended Capital Improvement Program


*Future Unit Costs of Existing Groundwater Capacity (in 2006 dollars):*

| Component | 2006 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|
| Annualized Capital Cost, $ | 4,825,650 | 4,412,250 | 4,804,300 | 5,120,750 | 5,230,550 | 4,818,475 |
| Groundwater, af | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 |
| Unit Capital Costs, $/af | 160 | 150 | 160 | 170 | 170 | 160 |

## Renewal and Replacement (R&R) Program:

A conditions assessment was performed for the Chico-Hamilton City District facilities to assess the existing condition of each station and make recommendations for required improvements. Recommended R&R activities include rehabilitation or replacement of existing wells and booster pumps, rehabilitation or replacement of redwood tanks, improvements to SCADA system components, painting of existing tanks and buildings, and other improvements. The recommended R&R activities are described by station in Chapter 7 of this Water Supply and Facilities Master Plan.

## Recommended CIP Components and Costs:

Recommended facilities to address identified existing system or buildout system deficiencies are discussed in Chapters 8 and 9 of this Water Supply and Facilities Master Plan. Costs for those recommended improvements are discussed in Chapter 10.

*Summary of CIP and R&R Costs:*

| Recommended Improvements | Existing System | Buildout System | Totals |
|---|---|---|---|
| Pipeline Improvements | $4.61 M | $89.89 M | $94.50 M |
| Pump Station Improvements | $15.71 M | $19.43 M | $35.14 M |
| Storage Improvements | $11.50 M | $29.51 M | $41.01 M |
| Emergency Generators | $0.83 M | -- | $0.83 M |
| Groundwater Well Improvements | $0 M | $39.51 M | $39.61 M |
| New Pressure Reducing Stations | $0 M | $0.06 M | $0.06 M |
| R&R Costs | $53.53 M | $31.71 M | $85.24 M |
| *Totals* | *$86.18 M* | *$210.21 M* | *$296.39 M* |

# EXECUTIVE SUMMARY

## INTRODUCTION

This Water Supply and Facilities Master Plan for the California Water Service Company's (Cal Water) Chico-Hamilton City District describes the Chico-Hamilton City District's water supply and distribution facilities, existing and projected future water demands, and existing and potential future water supplies. In order to evaluate the Chico-Hamilton City District's water system, West Yost Associates (WYA) developed a hydraulic water system model of the Chico-Hamilton City District system and conducted a condition assessment of the Chico-Hamilton City District's water facilities.

Three major work products resulted from this master planning effort. They are:

- An evaluation of potential future water supplies and economic feasibility analysis of potential future water supply scenarios;
- A recommended Renewal and Replacement (R&R) Program for the Chico-Hamilton City District's water system facilities; and
- A recommended Capital Improvement Program (CIP) for Chico-Hamilton City District's existing water system and future water system at buildout.

The associated analyses and assessments related to these issues and their recommendations are summarized below. Complete descriptions of the analyses and assessments are provided in the chapters and appendices of this Water Supply and Facilities Master Plan.

## OVERVIEW OF CHICO-HAMILTON CITY DISTRICT SERVICE AREA

Cal Water currently provides potable water service to the Cities of Chico and Hamilton City, which are located approximately 80 miles north of Sacramento. The Chico-Hamilton City District service area is approximately 16,599 acres, or 25.9 square miles. The location of the Chico-Hamilton City District is shown on Figure ES-1. As shown in Figure ES-1, the Chico-Hamilton City District service area serves all county islands within the Hamilton City and City of Chico city limits.

Cal Water tracks the number of services within the Chico-Hamilton District using six different revenue classes: Residential–Metered, Residential–Flat, Multiple Residences, Commercial, Industrial, Government, and Other. The Residential–Metered and Residential–Flat classes usually designate a service normally served by an individual meter, while the Multiple Residences class usually designates a service served by more than one meter.

Cal Water does not serve all of the schools, parks, or cemeteries within the Chico-Hamilton District; some users are served through private or individual wells on-site. The "Other" class includes all construction or "other" metered water uses that do not fit within the other five categories.

## EXISTING AND FUTURE WATER DEMANDS

As described in Chapter 3 of this Water Supply and Facilities Master Plan, existing water demands for the Chico-Hamilton City District were determined based on historical water production data, historical consumption data, and an estimation of unaccounted-for water. Peaking factors for maximum day demand and peak hour demand were estimated based on historical water consumption records.

Future water demands were projected through buildout of the Chico-Hamilton City District using a unit demand method based on land uses assigned to revenue classes. Table ES-1 summarizes projected water use in the Chico-Hamilton City District.

## EXISTING AND FUTURE WATER SUPPLIES

The Cal Water Chico-Hamilton City District currently relies solely on groundwater to meet the potable water demands of its existing customers.

The Chico-Hamilton City District overlies the Sacramento Valley groundwater basin, which has been divided into several smaller sub-basins using institutional boundaries established by the California Department of Water Resources (DWR). As shown on Figure ES-2, Cal Water's Chico-Hamilton City District currently overlies three sub-basins of the Sacramento Valley Groundwater Basin (the Vina, West Butte, and Corning sub-basins); however, the Chico-Hamilton City District will also eventually overlie the East Butte sub-basin at buildout. Cal Water is one of many groundwater pumpers that will continue to use groundwater from these sub-basins.

Cal Water operates 36 municipal supply wells within the Vina sub-basin, 21 municipal supply wells in the West Butte sub-basin, and 3 municipal supply wells in the Corning sub-basin. Cal Water also has 8 inactive wells due to water quality or low yield issues. As discussed in Chapter 3, during 2005 the Chico-Hamilton City District pumped approximately 28,900 af of groundwater for potable water consumption in the City of Chico and approximately 600 af of groundwater for potable water consumption in Hamilton City. A detailed description of the groundwater supply, including historic groundwater levels and groundwater quality, is provided in Chapter 4 of this Water Supply and Facilities Master Plan.

Table ES-2 presents the future unit cost of maintaining the existing groundwater pumping capacity assuming the replacement schedule and costs presented in Chapter 7 (Facility Assessment). The capital costs were annualized using the depreciation methodology adopted by Cal Water for its capital projects. The methodology, developed by Cal Water, accounts for depreciation over 40 years, and revenue requirements to cover debt, annual rate of return (13 percent), and taxes. The detailed tables used to develop the costs presented in Table ES-2 are included in Appendix K.

**Table ES-1. Projected Water Demands for the Chico-Hamilton City District**

| Location | Revenue Class[a] | Designation[b] | Additional Demand at Buildout: Future Development, acres[c] | Additional Demand at Buildout: Unit Demand Factor, af/ac/yr | Additional Demand at Buildout: Additional Water Demand, af | 2004/2005 Average Water Demand, af[d] | Savings due to Residential Metering | Total Projected Water Demand, af |
|---|---|---|---|---|---|---|---|---|
| City of Chico | Residential | Residential | 1,761 | 3.00 | 5,283 | 17,675 | (2,543) | 22,260 |
| | | Residential - Preserve | 1,212 | 1.50 | 1,818 | | | |
| | | Residential – Multiple Residences | 9 | 3.05 | 26 | | | |
| | Multiple Residences | Multiple Residences | 474 | 3.10 | 1,471 | 2,689 | 0 | 4,578 |
| | | Multiple Residences – Preserve | 270 | 1.55 | 419 | | | |
| | Commercial | Commercial | 423 | 3.80 | 1,607 | 5,641 | 0 | 7,644 |
| | | Commercial – Preserve | 200 | 1.90 | 380 | | | |
| | | Commercial – Multiple Residences | 5 | 3.45 | 16 | | | |
| | Industrial | Industrial | 738 | 2.20 | 1,623 | 413 | 0 | 2,680 |
| | | Industrial – Preserve | 575 | 1.12 | 644 | | | |
| | Government | Government | 408 | 1.70 | 693 | 1,004 | 0 | 1,696 |
| | Non-Designated Development | Non-Designated Development | 3,131 | 3.30 | 10,334 | 0 | 0 | 10,334 |
| | Other | | | | 0 | 82 | 0 | 82 |
| | Unaccounted-for Water | | | | 1,893 | 2,390 | 0 | 4,283 |
| | Subtotal | | | | 26,210 | 29,893 | (2,540) | 53,600 |
| Hamilton City | Residential | Residential | 19 | 3.00 | 56 | 413 | (27) | 442 |
| | Multiple Residences | Multiple Residences | 2 | 3.10 | 7 | 0 | 0 | 7 |
| | Commercial | Commercial | 5 | 3.80 | 21 | 109 | 0 | 129 |
| | Industrial | Industrial | 16 | 2.20 | 35 | 0 | 0 | 35 |
| | Government | Government | 0 | 1.70 | 0 | 65 | 0 | 65 |
| | Other | | | | 2 | 0 | 0 | 2 |
| | Unaccounted-for Water | | | | 8 | 51 | 0 | 59 |
| | Subtotal | | | | 130 | 638 | (30) | 740 |
| Total Production | | | | | 26,340 | 30,531 | (2,570) | 54,300 |

[a] Revenue Classes obtained from Cal Water's billing system.

[b] Water use for those areas with both a Primary and Secondary designation were aggregated according to its Primary designation (i.e., Revenue Class), which facilitated projection of future services and allocation of water demands into the hydraulic

[c] Acreage obtained from WYA's GIS system.

[d] 2005 water demand based on data provided by Cal Water.

Public Version

**Table ES-2. Future Unit Costs of Existing Groundwater Capacity (in 2006 dollars)**

| Component | 2006 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|
| Annualized Capital Cost, $ | 4,825,650 | 4,412,250 | 4,804,300 | 5,120,750 | 5,230,550 | 4,818,475 |
| Groundwater, af[(a)] | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 |
| Unit Capital Costs, $/af[(b)] | 160 | 150 | 160 | 170 | 170 | 160 |

(a) Actual 2005 pumpage was equal to 29,493. The pumpage was rounded to 30,000 af for planning purposes.
(b) Unit Capital Costs rounded to the nearest $10.

It is recommended that Cal Water staff plan on using groundwater to meet future water demands, but closely monitor groundwater levels to ensure increased annual demands do not induce overdraft conditions on a long-term basis. Although the planning horizon for this Water Supply and Facilities Master Plan is 2030, it will most likely require an update every 5 to 10 years.

## HYDRAULIC MODEL

Chapter 6 describes the development, calibration, and verification of the Cal Water's Chico-Hamilton City District water system hydraulic models.

## HYDRAULIC MODEL CALIBRATION

The hydraulic models for the District were calibrated to confirm that the computer simulation model can accurately represent the operation of the water distribution system under varying conditions. The hydraulic model calibration was separated into two steps. The first step was confirmation of existing C-factors and the second step was hydraulic model verification. These two calibration steps are discussed further in the following sections.

### Existing C-Factor Confirmation

After refining/enhancing Cal Water's hydraulic models, twenty-six locations were chosen in the City of Chico and two locations were chosen in Hamilton City for possible hydrant flow testing (see Figure ES-3). These tests were used to evaluate pipeline friction factors (C-factors) and to calibrate the models to ensure that both models closely represented actual observed pressure conditions in the field.

### Hydraulic Model Verification

Verifying that a model replicates field conditions requires thorough knowledge of how the system performs over a wide range of operating conditions. To ensure that the hydraulic model was correctly configured and capable of producing results that are consistent with those observed in the field, a verification process was carried out.

Overall, the results from the hydraulic model verification process validated the system configuration and demand allocation. However, based on the lack of accurate SCADA information from the District's facilities, it was impossible to refine the verification results. Pump station flow rate comparisons at each of Cal Water's operated facilities trended accurately for both SCADA and field readings. Comparisons of hydrant pressure record (HPR) and model-simulated data trended well. Most of the trends, though not exact, follow closely with the recorded HPR pressures. It is our recommendation that Cal Water continue to update/verify pipeline system configurations in the model as new facilities are constructed. It is also recommended to calibrate and confirm that the SCADA system is tracking good system information.

Based on the results of our verification, it can be concluded that the model provides an accurate operational representation of Cal Water's Chico-Hamilton City District water distribution system, and is more than adequate for use as a planning and operational tool.

## RECOMMENDED FACILITIES RENEWAL AND REPLACEMENT PROGRAM

As described in Chapter 7 of this Water Supply and Facilities Master Plan, WYA performed a conditions assessment of the Chico-Hamilton City District facilities in order to assess current condition and make recommendations for future renewal and replacement (R&R) activities. Most of the facilities were assessed via a "desktop assessment," whereby available data regarding each facility's original construction and maintenance activities were reviewed and evaluated. Twenty-two of the Chico-Hamilton City District stations were also visited with District operations staff for an "on-site assessment" to document and evaluate existing conditions at those stations.

Chico-Hamilton City District staff indicated that the following improvements would be helpful in the operation of the Chico-Hamilton City District system in the next five years.

### Capital Improvement Projects

- Drill wells for Stations 077 and 078 as needed for new development

### R&R Projects

- Reactivate the inactive Station 033 (in process)
- Install GAC system for Station 040 for reactivation of the station
- Rehabilitate Station 058 to remove odor, taste and color
- Complete interior painting for Tank 2 of Station 001 in the Chico system (in progress)
- Replace cathodic protection anodes for Tank 2 of Station 001 in the Chico system (by 2007)
- Paint the exterior of Tank 1 at Station 066 and the interior of Tank 3 at Station 008 in the Chico system (by 2007)
- Paint the interior of Tank 4 at Station 003 in the Chico system (by 2008)

- On an on-going basis, replace all oil lube type pumps to water lube type pumps with a mechanical seal
- On an on-going basis, continue to relocate disinfectant supplies and dosing equipment out of the pump facilities into a fiberglass shed or separate room in the pump buildings

A summary of the preliminary R&R schedule is provided in Table 1 of Appendix N in five-year increments. A preliminary R&R cost estimate in five-year increments is shown in Figure ES-4. The cost estimates for the first five years reflect the construction cost for the R&R projects and does not include land acquisition, engineering, legal, administrative costs, and construction contingencies.

## SUMMARY OF RECOMMENDED IMPROVEMENTS FOR EXISTING POTABLE WATER SYSTEM

Chapter 8 presents an overview evaluation of the Chico-Hamilton City District's existing water system (see Figure ES-5) and its ability to meet the Chico-Hamilton City District's recommended performance and planning criteria under existing demand conditions. The evaluation includes an analysis of water storage capacity, pumping capacity and the existing distribution system's ability to meet recommended operational and design criteria under maximum day demand plus fire flow and peak hour demand conditions. The evaluation was conducted by WYA using the updated hydraulic model. The evaluations, findings, and recommendations for addressing the identified existing water system deficiencies are organized by pressure zone. A description of the recommended CIP to implement the recommended improvements, including an estimate of probable construction costs, is provided in Chapter 10.

The recommended improvements needed to eliminate deficiencies identified in the analysis of the existing distribution systems are summarized below.

### Pipelines

<u>Pressure Zone 350</u>

- To alleviate head loss problems during maximum day demand plus fire flow in Pressure Zone 350, it is recommended various improvements described below.
  - Install 645 feet of a new 8-inch diameter pipeline along Eastwood Avenue
  - Upsize approximately 167 feet of an existing 2-inch diameter pipeline along Pine Street an 8-inch diameter pipeline

<u>Hamilton City</u>

- To alleviate head loss problems during maximum day demand plus fire flow in Hamilton City, it is recommended various improvements described below.
  - Upsize approximately 196 feet of an existing 6-inch diameter pipeline along 6$^{th}$ Street to a 12-inch diameter pipeline

- Upsize approximately 762 feet of an existing 6-inch diameter pipeline along 6th Street to an 8-inch diameter pipeline
- Upsize approximately 515 feet of an existing 6-inch diameter pipeline along 1st Street to an 8-inch diameter pipeline
- Install 2,892 feet of a new 12-inch diameter pipeline along Broadway Avenue
- Install 630 feet of a new 12-inch diameter pipeline along 2nd Street
- Upsize approximately 250 feet of an existing 6-inch diameter pipeline along 2nd Street to an 8-inch diameter pipeline
- Install 1,048 feet of a new 8-inch diameter pipeline along 5th Street
- Install 198 feet of a new 8-inch diameter pipeline along 2nd Street
- Install 208 feet of a new 8-inch diameter pipeline along 4th Street

**Pump Stations**

Chico

- A new 7.49 mgd booster pump station should be constructed to convey water from a new 2.7 MG storage tank located at Silver Dollar Way to increase storage in Pressure Zone 350.
- A new 3.24 mgd booster pump station should be constructed to convey water from a new 1.0 MG storage tank to be located at Mcintosh Avenue, west of Dayton Road to increase storage in Pressure Zone 350.
- A new 6.34 mgd booster pump station should be constructed to convey water from a new 1.0 MG storage tank to be located between Bruce Road and Potter Road to increase storage in Pressure Zone 350.
- A new 4.54 mgd booster pump station should be constructed to convey water from a new 1.0 MG storage tank to be located southwest of Highway 99 and Entler Avenue (west of Norfield Avenue) to increase storage in Pressure Zone 350.
- A new 6.84 mgd booster pump station should be constructed at Station 44 to provide maximum day plus fire flow demand in Pressure Zone 400.
- An additional 2.44 mgd of total pumping capacity should be provided at Station 66 to provide maximum day plus fire flow demand in Pressure Zone 795.

Hamilton City

- A new 6.93 mgd booster pump station should be constructed in Hamilton City to convey water from a new 1.0 MG storage tank located north of Broadway and 6th Street (future commercial land use parcel).

**Storage Facilities**

Chico

- To alleviate operational and fire flow storage deficiencies, an additional 5.7 MG of storage should be provided in Pressure Zone 350. These facilities should include the following:
  - 2.7 MG storage tank with a 7.49 mgd booster pump station to be located at Silver Dollar Way, northwest of the Cal Water Chico-Hamilton City District office
  - 1.0 MG storage tank with a 3.24 mgd booster pump station to be located at Mcintosh Avenue, west of Dayton Road
  - 1.0 MG storage tank with a 6.34 mgd booster pump station to be located between Bruce Road and Potter Road
  - 1.0 MG storage tank with a 4.54 mgd booster pump station to be located southwest of Highway 99 and Entler Avenue (west of Norfield Ave)
- To alleviate fire flow storage requirements in Pressure Zone 400, a new 1.0 MG storage tank should be constructed at Station 44 in Pressure Zone 400.

Hamilton City

- To alleviate fire flow storage requirements in Hamilton City, a new 1.0 MG storage tank with a 6.93 mgd booster pump should be constructed north of Broadway and 6th Street (future commercial land use parcel).

**Standby Generators**

Chico

- To increase the emergency storage credit in Pressure Zone 350, standby generators should be installed at Stations 54, 71, and 75.

## SUMMARY OF RECOMMENDED IMPROVEMENTS FOR BUILDOUT OF THE POTABLE WATER SYSTEM

Chapter 9 summarizes an evaluation of the Chico-Hamilton City District's water system at buildout and identifies the improvements to existing water system infrastructure.

The buildout system analysis was conducted by WYA using a model developed after the existing system deficiencies were identified (see Chapter 8) and improvements needed to eliminate these deficiencies were incorporated into the model.

The recommended improvements needed to eliminate deficiencies identified in the analysis of the buildout distribution systems are summarized below.

**Pipelines**

Chico

- To alleviate head loss and velocity problems in Pressure Zone 350 during maximum day demand plus fire flow, it is recommended to upsize the 8-inch diameter main (approximately 454 feet) along Thorntree Drive, west of Contractors Drive to a 12-inch diameter main and install a 12-inch diameter main (approximately 3,545 feet) along Mcintosh Avenue, from downstream of Dayton PRV/PSV station to Diamond Avenue.
- To alleviate head loss and velocity problems in Pressure Zone 400 during maximum day demand plus fire flow, it is recommended to upsize the 6-inch diameter main (approximately 289 feet) along Fortress Street, between Ryan Avenue and Crusader Court with an 8-inch diameter pipeline.

**Pump Stations**

Chico

*Pressure Zone 350*

- 9 new groundwater wells should be constructed to provide additional supply to Pressure Zone 350 to meet increasing demand under buildout conditions. The total capacity of each groundwater shall be 2.66 mgd (1,850 gpm).
- New 8.0 mgd booster pump stations (total capacity of 5,560 gpm; firm capacity of 4,170 gpm) should be constructed at each of the recommended new 3.0 MG storage tanks.

*Pressure Zone 400*

- The new pump station recommended for the existing system at Station 44 should be upsized from 6.84 mgd to 7.53 mgd (total capacity of 5,230 gpm; firm capacity of 3,920 gpm) to meet future pumping requirements during maximum day plus fire flow conditions.

*Pressure Zone 570*

- 8 new groundwater wells should be constructed to provide supply to the new Pressure Zone 570 located southeast of the Chico District. These groundwater wells include:
  - Six 2.38 mgd (1,650 gpm) groundwater wells
  - Two 1.87 mgd (1,300 gpm) groundwater wells
- New 7.5 mgd booster pump stations (total capacity of 5,205 gpm; firm capacity of 3,470 gpm) should be constructed at each of the recommended 2.5 MG storage tanks.

*Pressure Zone 635*

- A new 3.17 mgd booster pump station (total capacity of 2,200 gpm; firm capacity of 1,100 gpm) should be constructed to convey water from Pressure Zone 475 to Pressure Zone 635, and to fill the new 1.2 MG storage tank located in Pressure Zone 635.

**Storage Facilities**

Chico

*Pressure Zone 350*

- To meet future operational storage requirements in Pressure Zone 350, the following additional storage facilities should be constructed::
  - An additional 1.0 MG storage tank at Mcintosh Avenue, west of Dayton Road.
  - An additional 1.0 MG storage tank at Bruce Road and Potter Road..
  - An additional 1.0 MG storage tank southwest of Highway 99 and Entler Avenue
  - Two new 3.0 MG storage tanks in Pressure Zone 350 (one southeast of Forest Avenue and Baney Lane and one at Station 44 along Guynn Avenue)

*Pressure Zone 400*

- To meet future operational storage requirements in Pressure Zone 400, the new storage tank recommended for the existing system at Station 44 should be upsized from 1.0 MG to 1.2 MG.

*Pressure Zone 475*

- To serve new growth in Pressure Zone 475 and to provide the required storage capacity, a 2.1 MG storage tank should be constructed between Humboldt Road and Coyote Way.

*Pressure Zone 570*

- To serve new growth in Pressure Zone 570 and to provide the required storage capacity, two new 2.5 MG storage tanks should be constructed (one south of Skyway and one south of Nance Canyon).

*Pressure Zone 635*

- To serve new growth in Pressure Zone 635 and to provide the required storage capacity, a 1.2 MG storage tank should be constructed between Humboldt Road and Highway 32.

*Pressure Zone 795*

- To serve new growth in Pressure Zone 795 and to provide the required storage capacity, a 1.3 MG storage tank should be constructed on a future parcel at the southeast intersection of Shadowtree Lane and Whispering Winds Lane.

Hamilton City

- To meet future operational storage requirements in Hamilton City, the new storage tank recommended for the existing system should be upsized from 1.0 MG to 1.1 MG.

**Pressure Reducing Stations and Isolation Valves**

Chico

*Pressure Zone 570*

- Because of the wide range in elevations throughout Pressure Zone 570, three pressure reducing valves and one isolation valve should be constructed to eliminate excessive pressure in the lower elevations of Pressure Zone 570.

**Altitude Valves**

Chico

- Altitude valve should be installed at all new storage tanks to provide the ability to fill the tank when the pump station is not operating.

## RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

This chapter presents the recommended CIP for the Chico-Hamilton District's existing and buildout water system. Several recommendations for improvements to the existing and buildout water system were described previously in Chapters 8 and 9, respectively. This chapter provides descriptions of the recommended CIP program, along with estimates of probable construction costs.

Costs are presented in May 2008 dollars based on an Engineering News Record Construction Cost Index (ENR CCI) of 8141 (20 Cities Average). Total CIP costs include the following contingencies and project cost allowances:

- Construction Contingency: 20 percent
- Project Cost Allowances:
  - Design: 10 percent
  - Construction Management: 10 percent
  - Administration: 8 percent

A complete description of the assumptions used in developing the estimates of probable construction costs is provided in Appendix R.

Several improvement projects are recommended for the existing system and the buildout system. The recommended improvements for the existing system should be completed within the next five years. Figure ES-7 presents a five-year schedule starting in 2008 for the construction of the recommended capital improvement projects to eliminate deficiencies in the existing system.

The construction of the improvements for the buildout system should be coordinated with the proposed schedules of future development to ensure that the required infrastructure will be in place to serve future customers. However, they are based on addressing deficiency in fire flows, emergency storage, or reliability issues, and therefore should be completed in the next 10 years. As illustrated on Figures ES-7 and ES-8, all the required improvements are shown to be completed by end of 2030 (includes R&R recommendations).

For the pump station upgrades, probable construction costs have been estimated based on the ultimate, additional pumping capacity required. For each of the pump station upgrades, and the other recommended improvements, costs should be appropriately allocated to existing and/or future users, as shown in Tables ES-3 and ES-4.

Public Version

**Table ES-3. Summary of Probable Construction Costs for Existing CIP[a]**

| Pressure Zone | Improvement Type | Improvement Description | CIP ID | Quantity | 2008-2010 Estimated Construction Cost | 2008-2010 Total CIP Cost (including contingency and cost allowances) | 2011 - 2015 Estimated Construction Cost | 2011 - 2015 Total CIP Cost (including contingency and cost allowances) | 2016 - 2020 Estimated Construction Cost | 2016 - 2020 Total CIP Cost (including contingency and cost allowances) | 2021 - 2025 Estimated Construction Cost | 2021 - 2025 Total CIP Cost (including contingency and cost allowances) | 2026 - Buildout Estimated Construction Cost | 2026 - Buildout Total CIP Cost (including contingency and cost allowances) | Total Cost for Existing and Future CIP by Pressure Zone |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EXISTING CAPITAL IMPROVEMENTS** | | | | | | | | | | | | | | | |
| HC | Pipeline Improvement | 12-inch diameter, 196 lf | FF01 | 196 lf | $ 36,000 | $ 55,000 | | | | | | | | | |
| HC | Pipeline Improvement | 8-inch diameter, 762 lf | FF02 | 762 lf | $ 100,000 | $ 154,000 | | | | | | | | | |
| HC | Pipeline Improvement | 12-inch diameter, 515 lf | FF03 | 515 lf | $ 94,000 | $ 144,000 | | | | | | | | | |
| HC | Pipeline Improvement | 12-inch diameter, 2892 lf | FF04 | 2892 lf | $ 527,000 | $ 810,000 | | | | | | | | | |
| HC | Pipeline Improvement | 12-inch diameter, 630 lf | FF05 | 630 lf | $ 115,000 | $ 177,000 | | | | | | | | | |
| HC | Pipeline Improvement | 8-inch diameter, 250 lf | FF06 | 250 lf | $ 33,000 | $ 51,000 | | | | | | | | | $ 6,172,000 |
| HC | Pipeline Improvement | 8-inch diameter, 1048 lf | FF07 | 1048 lf | $ 138,000 | $ 212,000 | | | | | | | | | |
| HC | Pipeline Improvement | 8-inch diameter, 198 lf | FF08 | 198 lf | $ 26,000 | $ 40,000 | | | | | | | | | |
| HC | Pipeline Improvement | 8-inch diameter, 208 lf | FF09 | 208 lf | $ 27,000 | $ 41,000 | | | | | | | | | |
| HC | Pump Station | New 6.93 mgd Pump Station | CIPA | 6.93 mgd | $ 1,780,000 | $ 2,734,000 | | | | | | | | | |
| HC | Storage Tank | New 1.1 MG Storage Tank [b] | CIPA | 1.1 MG | $ 1,142,000 | $ 1,754,000 | | | | | | | | | |
| 350 | Pipeline Improvement | 8-inch diameter, 645 lf | FF10 | 645 lf | $ 85,000 | $ 131,000 | | | | | | | | | |
| 350 | Pipeline Improvement | 8-inch diameter, 167 lf | FF11 | 167 lf | $ 22,000 | $ 34,000 | | | | | | | | | |
| 350 | Pump Station | New 7.49 mgd Pump Station | CIP78 | 7.49 mgd | $ 1,907,000 | $ 2,929,000 | | | | | | | | | |
| 350 | Storage Tank | New 2.7 MG Storage Tank | CIP78 | 2.7 MG | $ 1,791,000 | $ 2,751,000 | | | | | | | | | |
| 350 | Pump Station | New 3.24 mgd Pump Station | CIP79 | 3.24 mgd | $ 978,000 | $ 1,502,000 | | | | | | | | | |
| 350 | Storage Tank | New 1.0 MG Storage Tank | CIP79 | 1.0 MG | $ 1,136,000 | $ 1,745,000 | | | | | | | | | |
| 350 | Pump Station | New 6.34 mgd Pump Station | CIP80 | 6.34 mgd | $ 1,646,000 | $ 2,528,000 | | | | | | | | | |
| 350 | Storage Tank | New 1.0 MG Storage Tank | CIP80 | 1.0 MG | $ 1,136,000 | $ 1,745,000 | | | | | | | | | $ 20,616,000 |
| 350 | New Pipeline Improvement | 8-inch diameter, 840 lf | CIP80 | 840 lf | $ 110,000 | $ 169,000 | | | | | | | | | |
| 350 | New Pipeline Improvement | 12-inch diameter, 1254 lf | CIP80 | 1254 lf | $ 228,000 | $ 350,000 | | | | | | | | | |
| 350 | Pump Station | New 4.54 mgd Pump Station | CIP81 | 4.54 mgd | $ 1,247,000 | $ 1,915,000 | | | | | | | | | |
| 350 | Storage Tank | New 1.0 MG Storage Tank | CIP81 | 1.0 MG | $ 1,136,000 | $ 1,745,000 | | | | | | | | | |
| 350 | New Pipeline Improvement | 12-inch diameter, 8004 lf | CIP81 | 8004 lf | $ 1,457,000 | $ 2,238,000 | | | | | | | | | |
| 350 | Auxiliary Power | Standby Generator at Stations 54, 71 and 75 | CIP108 | 3 | $ 543,000 | $ 834,000 | | | | | | | | | |
| 400 | Pump Station | New 7.53 mgd Pump Station [c] | CIP102 | 7.53 mgd | $ 1,916,000 | $ 2,943,000 | | | | | | | | | $ 4,706,000 |
| 400 | Storage Tank | New 1.2 MG Storage Tank [d] | CIP102 | 1.2 MG | $ 1,148,000 | $ 1,763,000 | | | | | | | | | |
| 795 | Upgrade Pump Station | Pump Station Upgrade | CIP66 | 2.44mgd | $ 755,000 | $ 1,160,000 | | | | | | | | | $ 1,160,000 |
| | | | **Totals** | | **$ 21,259,000** | **$ 32,654,000** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ 32,654,000** |
| | | | Construction Contingency (20%) | | $ 4,252,000 | | $ - | | $ - | | $ - | | $ - | | |
| | | | **Total Construction Cost** | | **$ 25,511,000** | | **$ -** | | **$ -** | | **$ -** | | **$ -** | | |
| | | | Engineering (10%) | | $ 2,551,000 | | $ - | | $ - | | $ - | | $ - | | |
| | | | Construction Management (10%) | | $ 2,551,000 | | $ - | | $ - | | $ - | | $ - | | |
| | | | Program Implementation (8%) | | $ 2,041,000 | | $ - | | $ - | | $ - | | $ - | | |
| | | | **Total CIP Cost** | | **$ 32,654,000** | | **$ -** | | **$ -** | | **$ -** | | **$ -** | | |

[a] Costs shown based on May 2008 dollars and an ENR CCI of 8,141 (20 Cities Average).

[b] 1.0 MG storage tank is required to meet the storage capacity under existing condition, and the remaining 0.1 MG storage tank is required to meet the storage capacity under buildout condition.

[c] 6.84 mgd pump station is required under existing condition, and additional 0.69 mgd (7.53 mgd - 6.84 mgd) pumping capacity is required under buildout condition.

[d] 1.0 MG storage tank is required to meet the storage capacity under existing condition, and the remaining 0.2 MG storage tank is required to meet the storage capacity under buildout condition.

Public Version

**Table ES-4. Summary of Probable Construction Costs for Buildout CIP[a]**

| Pressure Zone | Improvement Type[b] | Improvement Descriptior | CIP ID | Quantity | 2008-2010 Estimated Construction Cost | 2008-2010 Total CIP Cost (including contingency and cost allowances) | 2011 - 2015 Estimated Construction Cost | 2011 - 2015 Total CIP Cost (including contingency and cost allowances) | 2016 - 2020 Estimated Construction Cost | 2016 - 2020 Total CIP Cost (including contingency and cost allowances) | 2021 - 2025 Estimated Construction Cost | 2021 - 2025 Total CIP Cost (including contingency and cost allowances) | 2026 - Buildout Estimated Construction Cost | 2026 - Buildout Total CIP Cost (including contingency and cost allowances) | Total Cost for Existing and Future CIP by Pressure Zone |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BUILDOUT CAPITAL IMPROVEMENTS** | | | | | | | | | | | | | | | |
| 350 | Pipeline Improvement | 12-inch diameter, 454 lf | BFF01 | 454 lf | | $ - | | $ - | $ 68,900 | $ 106,000 | | $ - | | $ - | |
| 350 | Pipeline Improvement | 12-inch diameter, 3,545 lf | BFF02 | 3545 lf | | $ - | | $ - | $ 537,800 | $ 826,000 | | $ - | | $ - | |
| 350 | New Pipeline | 8-inch diameter, 29,365 lf | Group A | 29365 lf | | $ - | | $ - | $ 3,266,700 | $ 5,018,000 | | $ - | | $ - | |
| 350 | New Pipeline | 12-inch diameter, 36,708 lf | Group A | 36708 lf | | $ - | | $ - | $ 5,568,400 | $ 8,553,000 | | $ - | | $ - | |
| 350 | New Pipeline | 8-inch diameter, 27,285 lf | Group B | 27285 lf | | $ - | | $ - | | $ - | $ 3,035,300 | $ 4,662,000 | | $ - | |
| 350 | New Pipeline | 12-inch diameter, 41,403 lf | Group B | 41403 lf | | $ - | | $ - | | $ - | $ 6,280,700 | $ 9,647,000 | | $ - | |
| 350 | New Pipeline | 16-inch diameter, 6,588 lf | Group B | 6588 lf | | $ - | | $ - | | $ - | $ 1,265,900 | $ 1,944,000 | | $ - | |
| 350 | New Pipeline | 8-inch diameter, 1,174 lf | Group C | 1174 lf | | $ - | | $ - | $ 130,600 | $ 201,000 | | $ - | | $ - | |
| 350 | New Pipeline | 12-inch diameter, 10,758 lf | Group C | 10758 lf | | $ - | | $ - | $ 1,631,900 | $ 2,507,000 | | $ - | | $ - | |
| 350 | New Pipeline | 8-inch diameter, 2,709 lf | Group F | 2709 lf | | $ - | | $ - | $ 301,400 | $ 463,000 | | $ - | | $ - | |
| 350 | New Pipeline | 12-inch diameter, 13,004 lf | Group F | 13004 lf | | $ - | | $ - | $ 1,972,700 | $ 3,030,000 | | $ - | | $ - | |
| 350 | New Pipeline | 8-inch diameter, 12,901 lf | Group G | 12901 lf | | $ - | | $ - | $ 1,435,200 | $ 2,204,000 | | $ - | | $ - | |
| 350 | New Pipeline | 12-inch diameter, 7,815 lf | Group G | 7815 lf | | $ - | | $ - | $ 1,185,500 | $ 1,821,000 | | $ - | | $ - | |
| 350 | New Pipeline | 16-inch diameter, 67 lf | Group G | 67 lf | | $ - | | $ - | $ 12,900 | $ 20,000 | | $ - | | $ - | |
| 350 | New Pipeline | 12-inch diameter, 15,272 lf | Group H | 15272 lf | | $ - | | $ - | | $ - | | $ - | $ 2,316,700 | $ 3,558,000 | |
| 350 | New Pipeline | 12-inch diameter, 483 lf | Group I | 483 lf | | $ - | | $ - | | $ - | | $ - | $ 73,300 | $ 113,000 | $ 85,792,000 |
| 350 | New Pipeline | 8-inch diameter, 1,938 lf | Group J | 1938 lf | | $ - | | $ - | $ 215,600 | $ 331,000 | | $ - | | $ - | |
| 350 | New Pipeline | 12-inch diameter, 5,484 lf | Group J | 5484 lf | | $ - | | $ - | $ 831,900 | $ 1,278,000 | | $ - | | $ - | |
| 350 | Groundwater Well | 2.66 mgd Groundwater Well | BCIP89W | 2.66 mgd | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | | $ - | |
| 350 | Groundwater Well | 2.66 mgd Groundwater Well | BCIP86W | 2.66 mgd | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | | $ - | |
| 350 | Groundwater Well | 2.66 mgd Groundwater Well | BCIP90W | 2.66 mgd | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | | $ - | | $ - | |
| 350 | Groundwater Well | 2.66 mgd Groundwater Well | BCIP91W | 2.66 mgd | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | | $ - | | $ - | |
| 350 | Groundwater Well | 2.66 mgd Groundwater Well | BCIP92W | 2.66 mgd | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | | $ - | | $ - | |
| 350 | Groundwater Well | 2.66 mgd Groundwater Well | BCIP93W | 2.66 mgd | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | | $ - | | $ - | |
| 350 | Groundwater Well | 2.66 mgd Groundwater Well | BCIP94W | 2.66 mgd | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | | $ - | | $ - | |
| 350 | Groundwater Well | 2.66 mgd Groundwater Well | BCIP87W | 2.66 mgd | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | | $ - | |
| 350 | Groundwater Well | 2.66 mgd Groundwater Well | BCIP88W | 2.66 mgd | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | | $ - | |
| 350 | Storage Tank | New 1.0 MG Storage Tank | BCIP80 | 1.0 MG | | $ - | | $ - | $ 1,135,700 | $ 1,744,000 | | $ - | | $ - | |
| 350 | Storage Tank | New 1.0 MG Storage Tank | BCIP81 | 1.0 MG | | $ - | | $ - | | $ - | | $ - | $ 1,213,600 | $ 1,864,000 | |
| 350 | Storage Tank | New 1.0 MG Storage Tank | BCIP79 | 1.0 MG | | $ - | | $ - | $ 1,135,700 | $ 1,744,000 | | $ - | | $ - | |
| 350 | Storage Tank | New 3.0 MG Storage Tank | BCIP106 | 3.0 MG | | | | | | | $ 2,270,400 | $ 3,487,000 | | $ - | |
| 350 | Pump Station | New 8.0 mgd Pump Station | BCIP106 | 8.0 mgd | | | | | | | $ 2,022,800 | $ 3,107,000 | | $ - | |
| 350 | Storage Tank | New 3.0 MG Storage Tank | BCIP107 | 3.0 MG | | | | | | | | $ - | $ 2,270,400 | $ 3,487,000 | |
| 350 | Pump Station | New 8.0 mgd Pump Station | BCIP107 | 8.0 mgd | | | | | | | | $ - | $ 2,022,800 | $ 3,107,000 | |
| 400 | Pipeline Improvement | 8-inch diameter, 289 lf | BFF03 | 289 lf | | $ - | | $ - | $ 32,100 | $ 49,000 | | $ - | | $ - | $ 612,000 |
| 400 | New Pipeline | 12-inch diameter, 2,418 lf | Group B | 2418 lf | | $ - | | $ - | | $ - | $ 366,800 | $ 563,000 | | $ - | |
| 475 | New Pipeline | 12-inch diameter, 3,586 lf | Group C | 3586 lf | | $ - | | $ - | $ 544,000 | $ 836,000 | | $ - | | $ - | |
| 475 | New Pipeline | 12-inch diameter, 3,826 lf | Group D | 3826 lf | | $ - | | $ - | | $ - | | $ - | $ 580,400 | $ 891,000 | |
| 475 | New Pipeline | 8-inch diameter, 835 lf | Group E | 835 lf | | $ - | | $ - | | $ - | $ 92,900 | $ 143,000 | | $ - | |
| 475 | New Pipeline | 12-inch diameter, 21,563 lf | Group E | 21563 lf | | $ - | | $ - | | $ - | $ 3,271,000 | $ 5,024,000 | | $ - | |
| 475 | New Pipeline | 16-inch diameter, 6,702 lf | Group E | 6702 lf | | $ - | | $ - | | $ - | $ 1,287,800 | $ 1,978,000 | | $ - | $ 18,939,000 |
| 475 | New Pipeline | 8-inch diameter, 2,968 lf | Group F | 2968 lf | | $ - | | $ - | $ 330,200 | $ 507,000 | | $ - | | $ - | |
| 475 | New Pipeline | 12-inch diameter, 10,771 lf | Group F | 10771 lf | | $ - | | $ - | $ 1,633,900 | $ 2,510,000 | | $ - | | $ - | |
| 475 | New Pipeline | 8-inch diameter, 7,442 lf | Group G | 7442 lf | | $ - | | $ - | $ 827,900 | $ 1,272,000 | | $ - | | $ - | |
| 475 | New Pipeline | 12-inch diameter, 13,199 lf | Group G | 13199 lf | | $ - | | $ - | $ 2,002,200 | $ 3,075,000 | | $ - | | $ - | |
| 475 | Storage Tank | New 2.1 MG Storage Tank | BCIP82 | 2.1 MG | | $ - | | $ - | | $ - | $ 1,759,800 | $ 2,703,000 | | $ - | |
| 570 | New Pipeline | 12-inch diameter, 56,092 lf | Group I | 56092 lf | | $ - | | $ - | | $ - | | $ - | $ 8,508,900 | $ 13,070,000 | |
| 570 | New Pipeline | 16-inch diameter, 20,733 lf | Group I | 20733 lf | | $ - | | $ - | | $ - | | $ - | $ 3,983,800 | $ 6,119,000 | |
| 570 | Pressure Reducing Station | Pressure Reducing Station | | 3 | | $ - | | $ - | | $ - | | $ - | $ 38,800 | $ 60,000 | |
| 570 | Groundwater Well | 1.87 mgd Groundwater Well | BCIP95W | 1.87 mgd | | $ - | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | |
| 570 | Groundwater Well | 2.38 mgd Groundwater Well | BCIP96W | 2.38 mgd | | $ - | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | |
| 570 | Groundwater Well | 2.38 mgd Groundwater Well | BCIP100W | 2.38 mgd | | $ - | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | |
| 570 | Groundwater Well | 2.38 mgd Groundwater Well | BCIP101W | 2.38 mgd | | $ - | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | |
| 570 | Groundwater Well | 2.38 mgd Groundwater Well | BCIP97W | 2.38 mgd | | $ - | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | $ 60,561,000 |
| 570 | Groundwater Well | 2.38 mgd Groundwater Well | BCIP98W | 2.38 mgd | | $ - | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | |
| 570 | Groundwater Well | 2.38 mgd Groundwater Well | BCIP99W | 2.38 mgd | | $ - | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | |
| 570 | Groundwater Well | 1.87 mgd Groundwater Well | BCIP104W | 1.87 mgd | | $ - | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | |
| 570 | Storage Tank | New 2.5 MG Storage Tank | BCIP83A | 2.5 MG | | $ - | | $ - | $ 1,780,400 | $ 2,735,000 | | $ - | $ 1,780,400 | $ 2,735,000 | |
| 570 | Pump Station | New 7.5 mgd Pump Station | BCIP83APS | 7.5 mgd | | $ - | | $ - | $ 1,909,300 | $ 2,933,000 | | $ - | $ 1,909,300 | $ 2,933,000 | |
| 570 | Storage Tank | New 2.5 MG Storage Tank | BCIP83C | 2.5 MG | | $ - | | $ - | $ 1,780,400 | $ 2,735,000 | | $ - | $ 1,780,400 | $ 2,735,000 | |
| 570 | Pump Station | New 7.5 mgd Pump Station | BCIP83CPS | 7.5 mgd | | $ - | | $ - | $ 1,909,300 | $ 2,933,000 | | $ - | $ 1,909,300 | $ 2,933,000 | |
| 635 | New Pipeline | 8-inch diameter, 273 lf | Group D | 273 lf | | $ - | | $ - | | $ - | | $ - | $ 30,400 | $ 47,000 | |
| 635 | New Pipeline | 12-inch diameter, 5,039 lf | Group D | 5039 lf | | $ - | | $ - | | $ - | | $ - | $ 764,400 | $ 1,174,000 | |
| 635 | New Pipeline | 8-inch diameter, 9,686 lf | Group E | 9686 lf | | $ - | | $ - | | $ - | $ 1,077,500 | $ 1,655,000 | | $ - | $ 7,412,000 |
| 635 | New Pipeline | 12-inch diameter, 5,541 lf | Group E | 5541 lf | | $ - | | $ - | | $ - | $ 840,500 | $ 1,291,000 | | $ - | |
| 635 | Storage Tank | New 1.2 MG Storage Tank | BCIP84 | 1.2 MG | | $ - | | $ - | | $ - | $ 1,148,100 | $ 1,764,000 | | $ - | |
| 635 | Pump Station | New 3.17 mgd Pump Station | BCIP103PS | 3.17 mgd | | $ - | | $ - | | $ - | $ 963,500 | $ 1,481,000 | | $ - | |
| 795 | New Pipeline | 8-inch diameter, 4,654 lf | Group D | 4654 lf | | $ - | | $ - | | $ - | | $ - | $ 517,700 | $ 795,000 | |
| 795 | New Pipeline | 12-inch diameter, 10,733 lf | Group D | 10733 lf | | $ - | | $ - | | $ - | | $ - | $ 1,628,100 | $ 2,501,000 | $ 5,174,000 |
| 795 | New Pipeline | 16-inch diameter, 355 lf | Group D | 355 lf | | $ - | | $ - | | $ - | | $ - | $ 68,200 | $ 105,000 | |
| 795 | Storage Tank | New 1.3 MG Storage Tank | BCIP85 | 1.3 MG | | $ - | | $ - | | $ - | | $ - | $ 1,154,300 | $ 1,773,000 | |
| | | | **Totals** | | **$ -** | **$ -** | **$ -** | **$ -** | **$ 39,766,000** | **$ 61,081,000** | **$ 31,751,000** | **$ 48,769,000** | **$ 44,687,000** | **$ 68,640,000** | **$ 178,490,000** |
| | | | Construction Contingency (20%) | | $ - | | $ - | | $ 7,953,000 | | $ 6,350,000 | | $ 8,937,000 | | |
| | | | **Total Construction Cost** | | **$ -** | | **$ -** | | **$ 47,719,000** | | **$ 38,101,000** | | **$ 53,624,000** | | |
| | | | Engineering (10%) | | $ - | | $ - | | $ 4,772,000 | | $ 3,810,000 | | $ 5,362,000 | | |
| | | | Construction Management (10% | | $ - | | $ - | | $ 4,772,000 | | $ 3,810,000 | | $ 5,362,000 | | |
| | | | Program Implementation (8% | | $ - | | $ - | | $ 3,818,000 | | $ 3,048,000 | | $ 4,290,000 | | |
| | | | **Total CIP Cost** | | **$ -** | | **$ -** | | **$ 61,081,000** | | **$ 48,769,000** | | **$ 68,640,000** | | |

[a] Costs shown based on May 2008 dollars and an ENR CCI of 8141 (20 Cities Average).

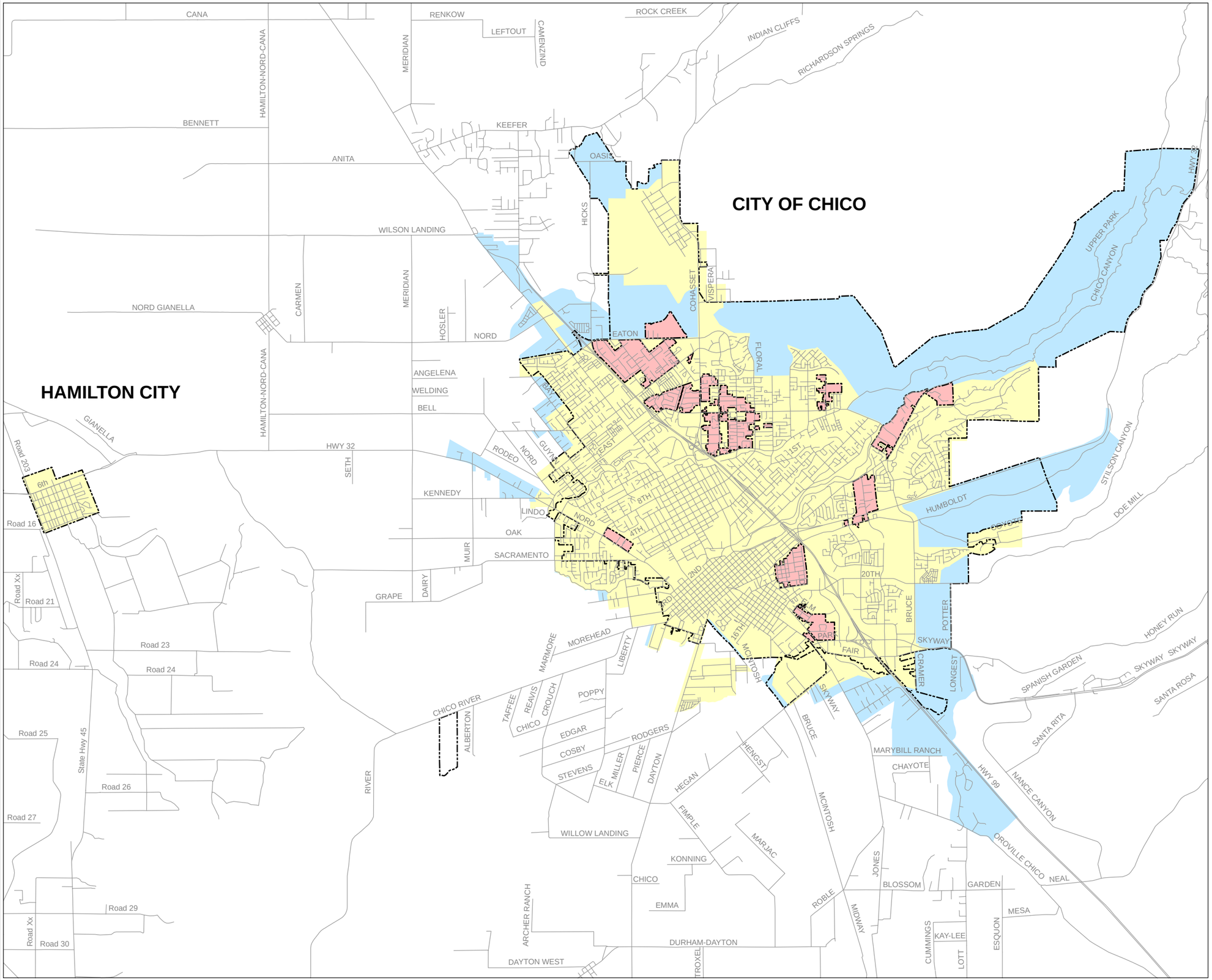
[b] Cal Water funds all supply related improvements. All other improvements are typically funded by development community.

Public Version

# FIGURE ES-1

## California Water Service Company Chico-Hamilton City District Water Supply and Facilities Master Plan

## SERVICE AREA LOCATION




NOTES:

LEGEND:

- Cal Water Service Area
- County Islands within City Limits
- City of Chico Sphere of Influence
- Street

o:\c\436\02-06-03\GIS\WMP\Ch ES\Figure ES-1 ServiceArea.mxd 05-01-07 11:13am isurosp

o:\c\436\020603\GIS\WMP\Ch ES\Figure ES-2_Basins.mxd

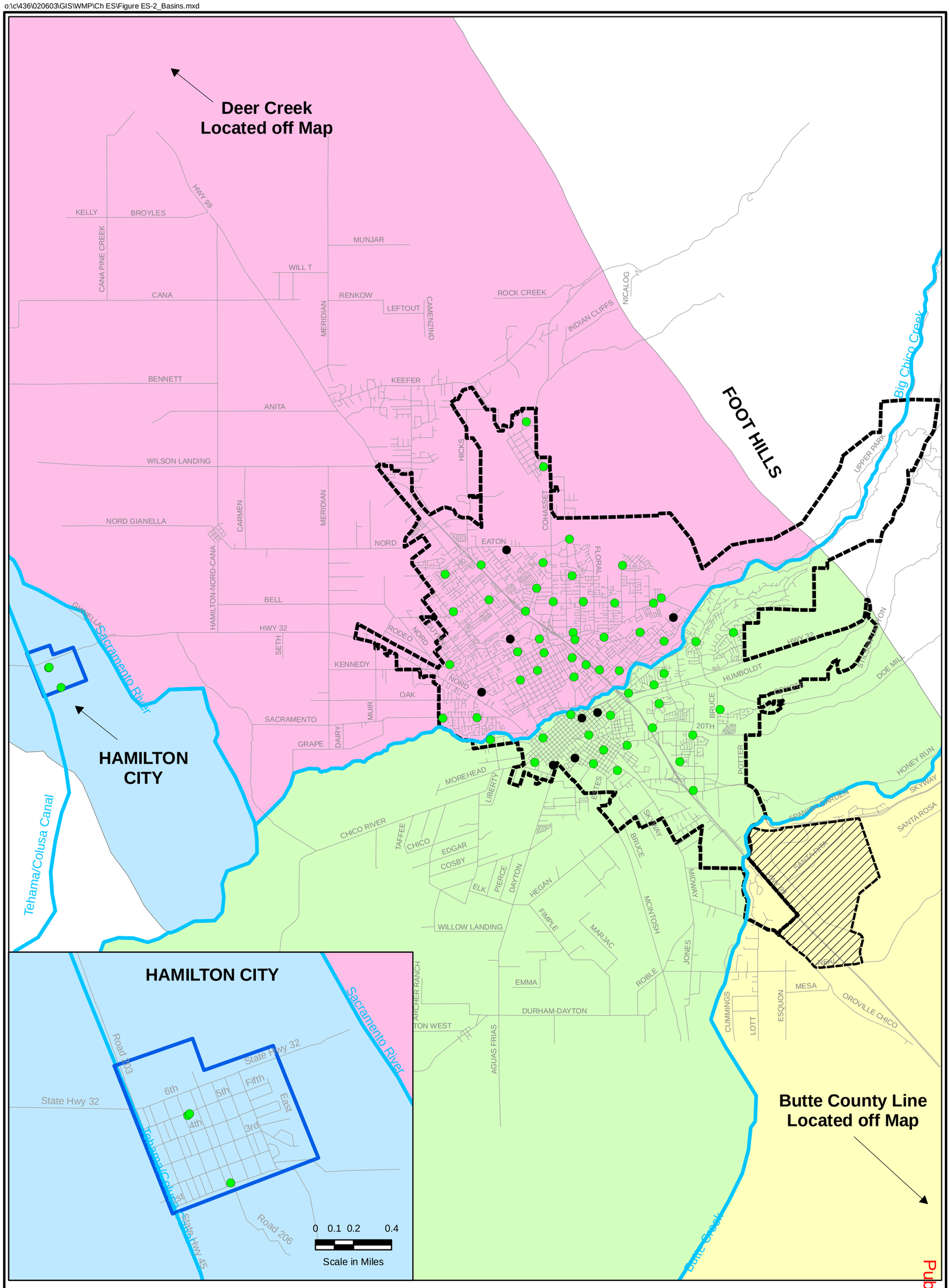



**FIGURE ES-2**

**California Water Service Company**
**Chico-Hamilton City District Water Supply and Facilities Master Plan**

**GROUNDWATER SUB-BASINS**

WEST YOST ASSOCIATES
Consulting Engineers

Public Version

***

Public Version

## FIGURE ES-3

**California Water Service Company**
**Chico - Hamilton City District Water Supply and Facilities Master Plan**

## HYDRANT TEST LOCATIONS

N

0 0.2 0.4 0.8

Scale in Miles

NOTES:

LEGEND:

- Stations
- Priority 1 Hydrant Test (14 Tests)
- Priority 2 Hydrant Test (5 Tests)
- Alternate (9 Tests)
- Street
- Cal Water Service Area

**PressureZones**

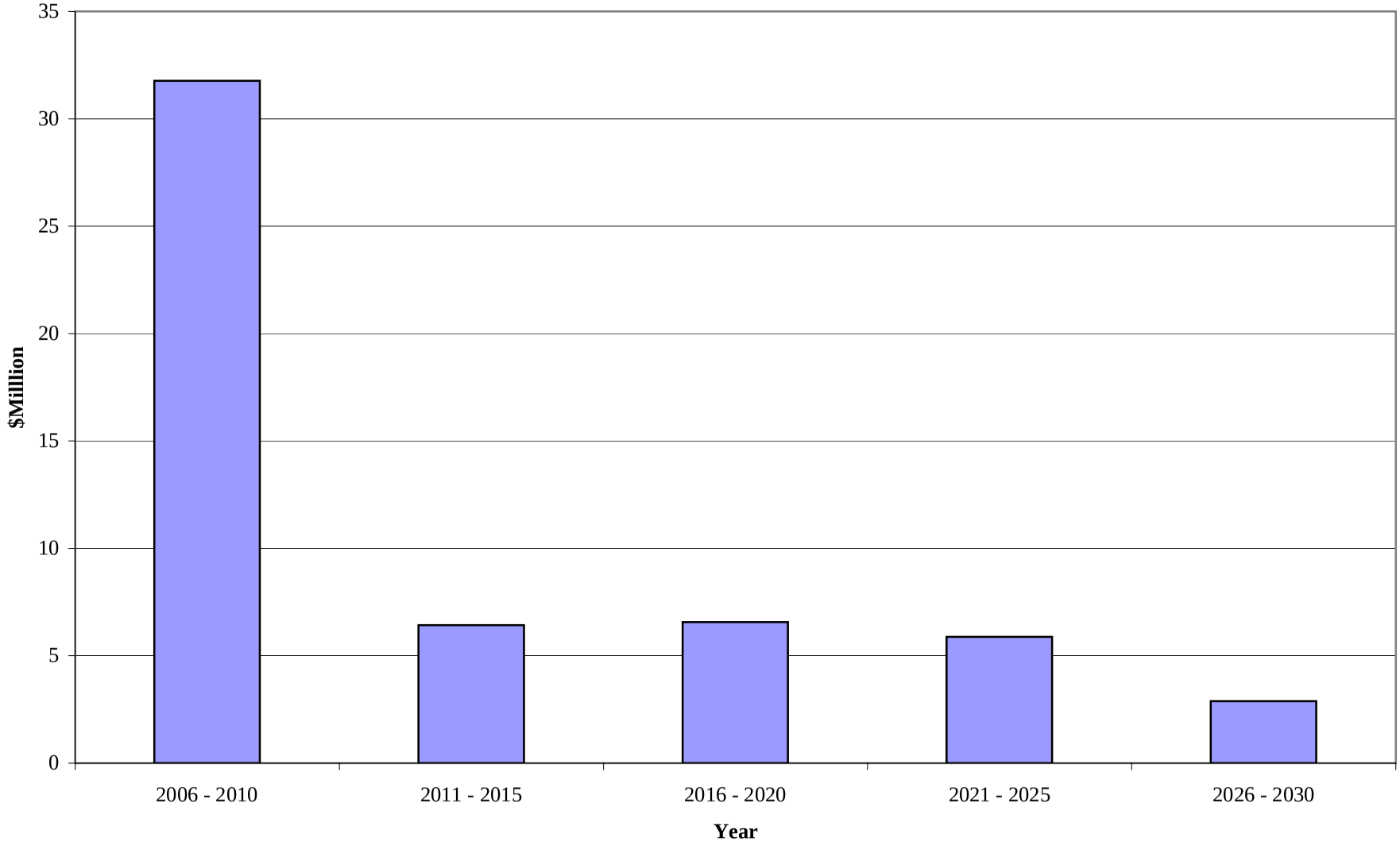
- 350
- 400
- 475
- 635

CALIFORNIA WATER SERVICE CO.

WEST YOST ASSOCIATES Consulting Engineers

D:\CL\26102-06-02\GIS\MXD\Ch6\Figure 6-4_C-Test Loc.mxd

**Figure ES-4 . Preliminary Renewal and Replacement Cost for Chico-Hamilton City District**




Public Version

West Yost Associates
o:\c\436\02-06-03\e\T3\inventory

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

***

Public Version

## FIGURE ES-5

**California Water Service Company**
**Chico - Hamilton City District Water Supply and Facilities Master Plan**

## EXISTING WATER SYSTEM

N

0 0.2 0.4 0.8

Scale in Miles

NOTES:

LEGEND:

- Station
- Cal Water Service Area
- Pipeline Diameter < 12-inch
- Pipeline Diameter ≥ 12-inch

**Pressure Zone**

- 350
- 400
- 475
- 635
- 795
- Street

CALIFORNIA WATER SERVICE CO.

WEST YOST ASSOCIATES Consulting Engineers

o:\c436\02-06-03\GIS\WMP\Ch ES\Figure ES-5_CWSExSys.mxd

***

Public Version

# FIGURE ES-6

## California Water Service Company Chico - Hamilton City District Water Supply and Facilities Master Plan

## BUILDOUT WATER SYSTEM

N

0 0.25 0.5 1

Scale in Miles

NOTES:

LEGEND:

- Station
- Recommended Facilities
- New Closed Gate Valve
- New Pressure Reducing Station
- Cal Water Service Area
- Existing Pipes
- Buildout Pipes

**Existing Pressure Zone**

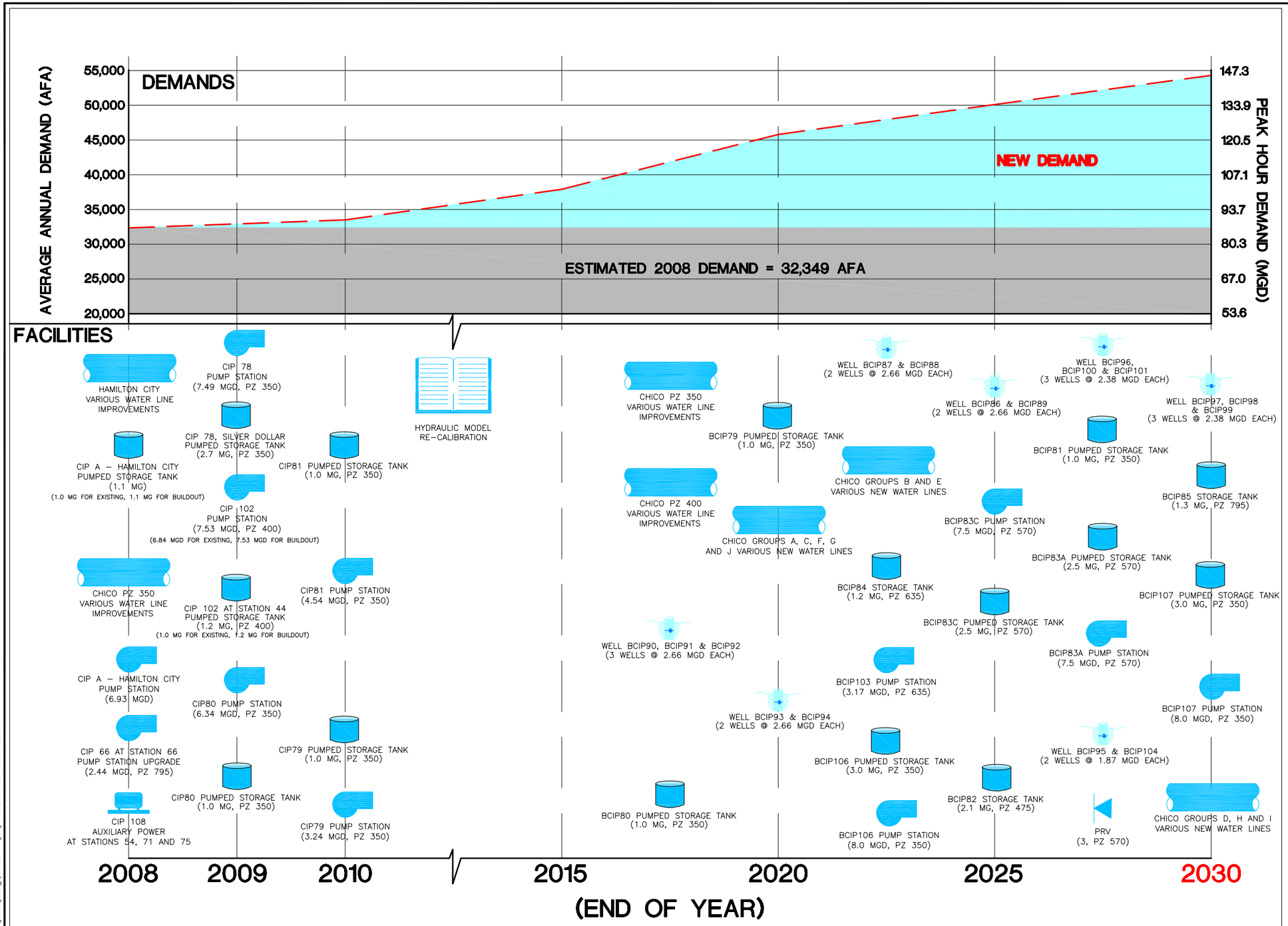
- 350
- 400
- 475
- 635
- 795
- Street

CALIFORNIA WATER SERVICE CO.

WEST YOST ASSOCIATES Consulting Engineers

o:\c436\02-06-03\GIS\WMP\ES\Figure ES-6_CWS2030BuildoutSys.mxd

Public Version




# FIGURE ES-7

**California Water Service Company**
**Chico-Hamilton City District Water Supply and Facilities Master Plan**

## TIMING OF MAJOR WATER SUPPLY AND DISTRIBUTION FACILITIES

N

0 – –
NO SCALE

NOTES:

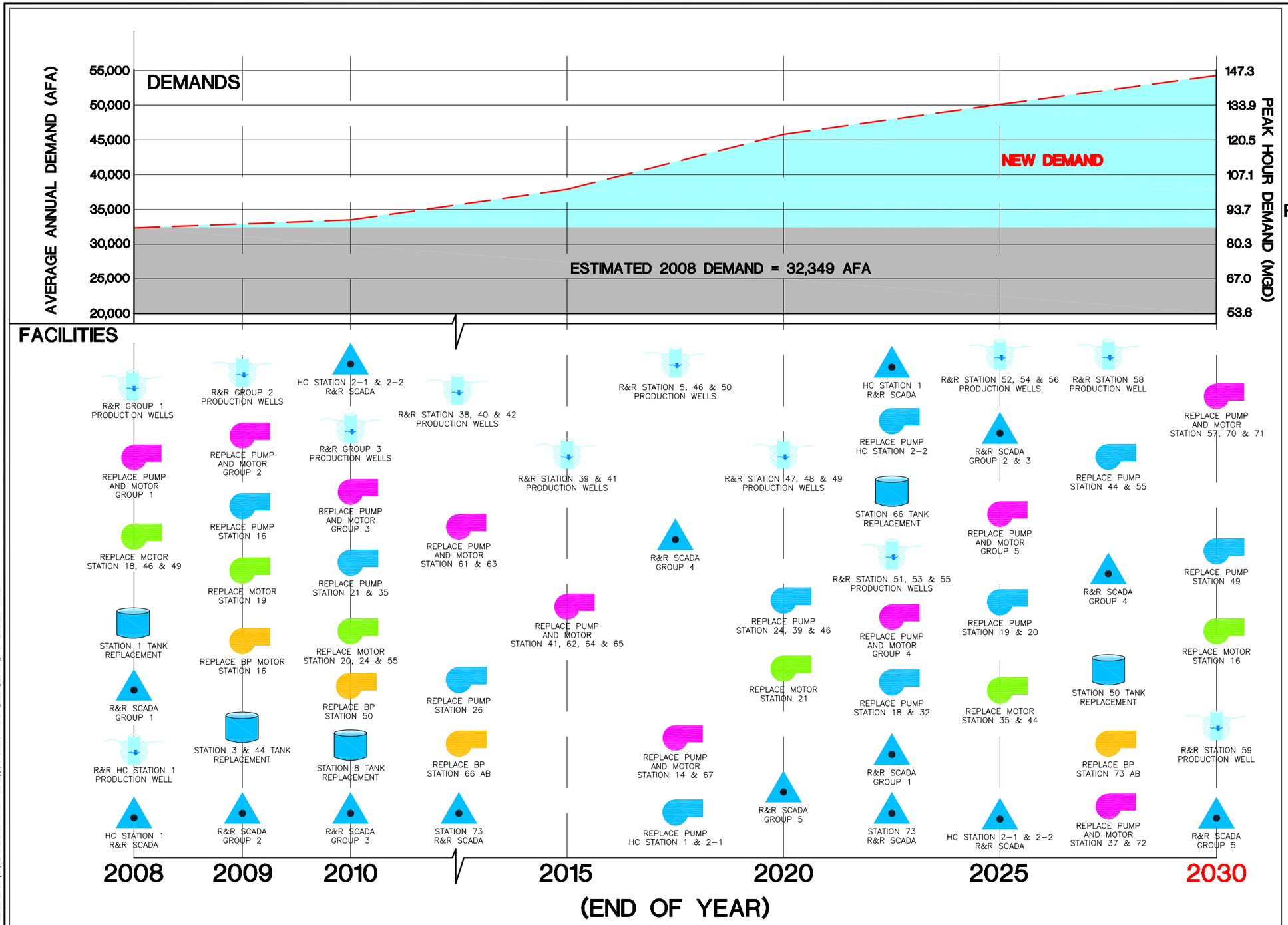
LEGEND:

CALIFORNIA WATER SERVICE CO.

WEST YOST ASSOCIATES
Consulting Engineers

CAD FILE: I:\0\C436\02-06-03\CAD\Figures\Fig ES-7_SystemCIPTiming.dwg DATE: 05-15-08 11:12 am lsuroso

Public Version




# FIGURE ES-8

**California Water Service Company**
**Chico-Hamilton City District Water Supply and Facilities Master Plan**

## TIMING OF RENEWAL AND REPLACEMENT OF WATER SUPPLY AND DISTRIBUTION FACILITIES

N

0 NO SCALE

NOTES:

1. Replace Well:
   Group 1:
   - Stations 1, 7, 12, 15, 18, 22, 25, 28, 31, 33, 34
   Group 2:
   - Stations 3, 9, 13, 16, 19, 23, 26, 29, 32, 44
   Group 3:
   - Stations 4, 8, 11, 14, 17, 20, 21, 24, 27, 30, 35
2. Replace Pump and Motor:
   Group 1:
   - Stations 1, 22, 25, 33, 52
   Group 2:
   - Stations 5, 23, 29, 40, 47, 53, 56
   Group 3:
   - Stations 4, 8, 11, 27, 30, 42, 50, 51, 54, 58
   Group 4:
   - Stations 3, 9, 15, 28, 34, 48, 68
   Group 5:
   - Stations 7, 12, 17, 31, 38, 59, 69
3. R&R SCADA:
   Group 1:
   - Stations 33, 49, 64, 66D
   Group 2:
   - Stations 44, 53, 65, 67, 68, 70
   Group 3:
   - Stations 24, 69, 71, 72
   Group 4:
   - Stations 1, 4, 7, 9, 12, 14, 16, 18, 20, 22, 25, 27, 29, 31, 34, 37, 39, 41, 45, 47, 51, 54, 56, 58, 61, 63
   Group 5:
   - Stations 3, 5, 8, 11, 13, 15, 17, 19, 21, 23, 26, 28, 30, 32, 35, 38, 40, 42, 46, 48, 50, 52, 55, 57, 59, 62

CALIFORNIA WATER SERVICE CO.

WEST YOST ASSOCIATES
Consulting Engineers

CAD FILE: Cir/Clients/436 California Water Service Company/02-06-03 Chico-Hamilton Water Supply & Facilities MP/CAD/Figures/Fig ES-8.dwg DATE: 09-12-07 11:10 am

Public Version



# Chapter 1: Introduction

*Chapter Contents:*


- Master Plan Purpose
- Master Plan Objectives
- Authorization
- Report Organization
- Acronyms & Abbreviations


## *Chapter Highlights:*

### *Master Plan Purpose:*

The purpose of this Water Supply and Facilities Master Plan is to identify existing system deficiencies and required system improvements, based on updated demand estimates and system evaluations, and to formulate a comprehensive Capital Improvement Program which meets the needs of existing and future customers.

### *Master Plan Objectives:*

- Develop operational and design criteria under which the existing system will be analyzed and future facilities will be formulated.
- Evaluate existing water demands and project future water demands.
- Analysis of the existing capacity and operation of existing facilities and pressure zone configurations.
- Identify potential new water storage facilities
- Evaluate future water service areas.
- Evaluate the effect of operating limitations placed on several wells.
- Evaluate new supply delivery points.
- Address the question: "What triggers the timing of construction of specific infrastructure improvements?"

## *Master Plan Organization:*

- Chapter 2: Existing Water Distribution System
- Chapter 3: Water Demands
- Chapter 4: Water Supply
- Chapter 5: Planning and Design Criteria
- Chapter 6: Hydraulic Model Development
- Chapter 7: Inventory and Assessment of Facilities Conditions and Capacity
- Chapter 8: Evaluation of Existing Water System
- Chapter 9: Evaluation of Future Water System
- Chapter 10: Recommended Capital Improvement Program

# CHAPTER 1. INTRODUCTION

## MASTER PLAN PURPOSE

California Water Service Company (Cal Water) has an ongoing capital improvement program to upgrade the Chico-Hamilton City District's water distribution system. However, with the recent development, calibration and verification of a hydraulic model of the Chico-Hamilton City District water system, Cal Water has the perfect opportunity to refine, further define, and prioritize a plan for capital improvement projects for the next 20 years. The intent of this Water Supply and Facilities Master Plan is to identify existing system deficiencies and required system improvements, based on updated demand estimates and system evaluations, and to formulate a comprehensive Capital Improvement Program (CIP) which meets the needs of existing and future customers.

## MASTER PLAN OBJECTIVES

The objectives of this Water Supply and Facilities Master Plan are to:

- Develop operational and design criteria under which the existing system will be analyzed and future facilities will be formulated,
- Evaluate existing water demands and project future water demands,
- Analyze the existing capacity and operation of existing pump stations, water storage facilities and pressure zone configurations to meet existing and 2025 water demands,
- Identify potential new water storage facilities,
- Evaluate water service to new development areas,
- Evaluate the effect of operating limitations placed on several wells (due to water quality issues)
- Evaluate potential new supply delivery points (both wells and turnouts)
- Address the question: "What triggers the timing of construction of specific infrastructure improvements?"

## AUTHORIZATION

West Yost Associates (WYA) was authorized to prepare this Water Supply and Facilities Master Plan by Cal Water on February 23, 2006.

## REPORT ORGANIZATION

This Water Supply and Facilities Master Plan is organized into the following chapters:

- Chapter 2: Existing Water Distribution System
- Chapter 3: Water Demands
- Chapter 4: Water Supply
- Chapter 5: Planning and Design Criteria
- Chapter 6: Hydraulic Model Development
- Chapter 7: Inventory and Assessment of Facilities Conditions and Capacity
- Chapter 8: Evaluation of Existing Water System
- Chapter 9: Evaluation of Future Water System
- Chapter 10: Recommended Capital Improvement Program

The following appendices to this Water Supply and Facilities Master Plan contain additional technical information and assumptions:

- Appendix A. Chico-Hamilton City District Population Estimates
- Appendix B. Conversion of Existing and Future Land Use Designations
- Appendix C. Water Conservation Best Management Practices
- Appendix D. Diurnal Curves for Chico-Hamilton City District Pressure Zones
- Appendix E. Conversion of Demand Factors in the UWMP
- Appendix F. Key Portions of Butte County Groundwater Inventory Analysis Including Plates 1 through 9
- Appendix G. DWR Water Levels
- Appendix H. Cal Water Levels
- Appendix I. Water Quality for Key Cal Water Wells
- Appendix J. SWRCB Sampling Results for Station 16
- Appendix K. Detailed Cost Estimates for Groundwater Supply
- Appendix L. Appendix 6-A. Hydraulic Model Calibration
- Appendix M. Verification Results
- Appendix N. Table 1. Recommended Renewal and Replacement (R&R) of System Facilities

  Table 2. Asset Inventory Summary of District Facilities

  Table 3. Summary of the Recommendations

- Appendix O. Technical Memo for CWS SCADA System
- Appendix P. Condition Assessment Forms
- Appendix Q. Station Facility Photos from Site Visits
- Appendix R. Cost Estimating Assumptions

## ACRONYMS AND ABBREVIATIONS

The following acronyms and abbreviations have been used throughout this Water Supply and Facilities Master Plan to improve document clarity and readability.

| | |
|---|---|
| AC | Asbestos Cement |
| af | Acre-Feet |
| af/ac/yr | Acre-Feet Per Acre Per Year |
| af/service/yr | Acre-Feet Per Service Per Year |
| AWWA | American Water Works Association |
| BCWRC | Butte County Department of Water Resources and Conservation |
| BMPs | Best Management Practices |
| BPS | Booster Pump Stations |
| BTEX | Benzene, Toluene, Ethylbenzene, Xylenes |
| Cal Water | California Water Service Company |
| CCI | Construction Cost Index |
| CDOF | California Department of Finance |
| C-factor | Roughness Factor |
| CFC | California Fire Code |
| CI | Cast Iron |
| CICL | Cast Iron Cement Lined |
| CIP | Capital Improvement Program |
| CL&C | Cement Mortar Lined & Cement Mortar Coated |
| CMU | Concrete Masonry Unit |
| COA | Coordinated Operations Agreement |
| COP | Copper |
| CUWCC | California Urban Water Conservation Council |
| D&W | Coated Steel |
| DHS | Department of Health Services |
| DI | Ductile Iron |
| DTSC | Department of Toxic Substances Control |
| DWR | Department of Water Resources |
| ENR | Engineering News Record |
| EPS | Extended Period Simulation |
| fps | Feet Per Second |
| ft | Feet |
| ft/kft | Feet Per Thousand Feet |
| ft/year | Feet Per Year |
| GAC | Granular Activated Carbon |

| | |
|---|---|
| GIS | Geographical Information System |
| gpcd | Gallons Per Capita Per Day |
| gpm | Gallons Per Minute |
| HCCSD | Hamilton City Community Services District |
| HGL | Hydraulic Grade Line |
| HPR | Hydrant Pressure Recorders |
| ID | Inside Diameter |
| LUFT | Leaking Underground Fuel Tank |
| MCL | Maximum Contaminant Levels |
| MG | Million Gallons |
| mg/L | Milligrams Per Liter |
| mgd | Million Gallons Per Day |
| MOU | Memorandum of Understanding |
| MTBE | Methyl Tertiary-butyl Ether |
| NFPA | National Fire Protection Association |
| O&M | Operations and Maintenance |
| OD | Outer Diameter |
| PAHs | Polycyclic Aromatic Hydrocarbon |
| PCE | Tetrachloroethylene |
| PG&E | Pacific Gas & Electric |
| PRV | Pressure Reducing Valves |
| psi | Pounds Per Square Inch |
| PVC | Polyvinyl Chloride |
| R&R | Replacement and Renewal |
| RTU | Remote Telemetry Units |
| SCADA | Supervisory Control and Data Acquisition |
| SLIC List | Spills, Leaks, Investigation, and Cleanup List |
| SS/STD STL | Standard Steel |
| STL | Steel |
| STL CL | Cement Mortar Lined Steel |
| STL CL&C | Cement Lined & Coated Steel Pipe |
| SWP | State Water Project |
| SWRCD | State Water Resources Control Board |
| TAC | Technical Advisor Committee |
| TCE | Trichloroethylene |
| TDH | Total Dynamic Head |
| TDS | Total Dissolved Solids |
| TPH | Total Petroleum Hydrocarbons |
| TRANS | Transite |
| UAFW | Unaccounted-for Water |
| UFC | Uniform Fire Code |
| USBR | U.S. Bureau of Reclamation |
| UWMP | Urban Water Management Plan |
| VOC | Volatile Organic Chemical |

| | |
|---|---|
| WAC | Water Advisory Committee |
| WI | Wrought Iron |
| WPCP | Water Pollution Control Plant |
| WYA | West Yost Associates |
| YEL | Yellow Mine |

Public Version



# Chapter 2: Existing System

*Chapter Contents:*


- Existing Service Area
- Chico-Hamilton City District Service Connections and Population Served
- Existing Water Supplies
- Existing Water System Facilities


*Chapter Highlights:*

The Cal Water Chico-Hamilton City District water distribution service area is located in Butte and Glenn Counties, located approximately 80 miles north of Sacramento. The Chico-Hamilton City District service area is approximately 16,599 acres, or 25.9 square miles. Chico-Hamilton City District service area serves all county islands within the Hamilton City and City of Chico city limits. The Chico-Hamilton City District's water distribution system currently serves approximately 17,640 customers (service connections) comprising a population of 52,726 as of January 1, 2006.
The purpose of this chapter is to describe the Cal Water Chico-Hamilton City District's existing (2006) water distribution system. System information was obtained through the review of previous reports, maps, plans, operating records, and other available data provided to WYA by Cal Water. Existing facilities were also visited and Cal Water staff were consulted on existing system conditions, any operational problems, and planned improvements.

# CHAPTER 2. EXISTING SYSTEM

The purpose of this chapter is to describe Cal Water's Chico-Hamilton City District's existing (2006) water distribution system. System information was obtained through the review of previous reports, maps, plans, operating records, and other available data provided to WYA by Cal Water. The following sections of this chapter describe the components of the Cal Water's Chico-Hamilton City District existing water distribution system:

- Existing Service Area
- Chico-Hamilton City District Service Connections and Population served Existing Water Supplies
- Existing Water System Facilities
  - Wells
  - Storage Facilities
  - Booster Pump Stations
  - Distribution Pipelines
  - SCADA System

## EXISTING SERVICE AREA

Cal Water currently provides potable water service to the Cities of Chico and Hamilton City, which are located approximately 80 miles north of Sacramento. The Chico-Hamilton City District service area is approximately 16,599 acres, or 25.9 square miles. The location of the Chico-Hamilton City District is shown on Figure 2-1. As shown in Figure 2-1 the Chico-Hamilton City District service area serves all county islands within the Hamilton City and City of Chico city limits.

## CHICO-HAMILTON CITY DISTRICT SERVICE CONNECTIONS AND POPULATION SERVED

The Chico-Hamilton City District currently has six different revenue classes which make up its 25,830 service connections. A breakdown of the number of connections by revenue class is provided in Table 2-1. As shown, over 80 percent of the Chico-Hamilton City District's (i.e., both the City of Chico and Hamilton City) connections are residential (flat and metered).

As mentioned previously, the Chico-Hamilton City District serves both county islands located within the City of Chico and Hamilton City; therefore, normal sources of historical population data do not apply to the Chico-Hamilton City District. Thus, the population estimates served by the Chico-Hamilton City District were determined based on housing densities (i.e., people per dwelling unit) and the number of dwelling units.

A more complete description of the population estimation methodology, and how it was used to estimate population to be served in the future, is provided in Chapter 3 Water Demands.

**Table 2-1. Existing (2005) Number of Service Connections by Revenue Class[(a)]**

| Revenue Class | Number of Connections in 2005 | Percent of Total Connections |
|---|---|---|
| Residential - Metered | 10,579 | 41.0 |
| Residential – Flat | 11,182 | 43.3 |
| Multiple Residences | 426 | 1.6 |
| Commercial | 3,216 | 12.5 |
| Industrial | 35 | 0.1 |
| Government | 342 | 1.3 |
| Other | 50 | 0.2 |
| Total | 25,830 | 100.0 |

Data provided by Cal Water (serv and sales.xls)

## EXISTING WATER SUPPLIES

Cal Water's Chico-Hamilton City District relies exclusively on groundwater to meet the water demands of its customers. The Chico-Hamilton City District does not have any surface water supply available to meet its potable needs. A complete description of the District's groundwater supply is provided in Chapter 4.

## EXISTING WATER SYSTEM FACILITIES

The Chico-Hamilton City District's water system facilities (including wells, storage facilities and booster pump stations) are located at numbered "stations" throughout the service area. Figure 2-2 shows the locations of the stations. A schematic of the pressure zones the stations serve is shown on Figures 2-3 through 2-8.

Facility assessments are discussed in Chapter 7 of this report. The evaluation of facility capacities and ability to meet existing and future demands is described in Chapters 8 and 9.

### Existing Well Facilities

The Chico-Hamilton City District currently has 50 active groundwater wells, 1 well under repair, and 8 inactive wells. Table 2-2 presents a summary of the well facilities, their status, and key characteristics. Figure 2-2 shows the locations of the Chico-Hamilton City District wells.

The current pumping capacity of the District's active wells is approximately 51,250 gallons per minute (gpm), or 73.8 million gallons per day (mgd).

**Table 2-2. Chico-Hamilton City District Well Facilities[a]**

| Well Number (Station Number) | Current Status | Year Constructed | Total Depth, feet | Flow Capacity, gpm[b] |
|---|---|---|---|---|
| Chico | | | | |
| 01-04 | Active | 1909 | 499 | 500 |
| 03-03 | Active | 1909 | 607 | 400 |
| 04-02 | Inactive | 1960 | 766 | 1000 |
| 05-02 | Active | 1971 | 507 | 1200 |
| 07-04 | Active | 1946 | 502 | 880 |
| 08-01 | Active | 1929 | 777 | 900 |
| 09-02 | Inactive | 1939 | 572 | 900 |
| 11-01 | Active | 1944 | 475 | 600 |
| 12-01 | Active | 1945 | 550 | 600 |
| 13-01 | Inactive | 1948 | 500 | NA |
| 14-01 | Active | 1948 | 500 | 550 |
| 15-01 | Inactive | 1949 | 652 | 750 |
| 16-01 | Active | 1949 | 550 | 900 |
| 17-01 | Active | 1950 | 612 | 900 |
| 18-01 | Active | 1951 | 578 | 900 |
| 19-01 | Active | 1951 | 597 | 700 |
| 20-01 | Active | 1952 | 635 | 900 |
| 21-01 | Active | 1953 | 630 | 850 |
| 22-01 | Active | 1954 | 600 | 800 |
| 23-01 | Active | 1955 | 689 | 1350 |
| 24-01 | Active | 1955 | 601 | 750 |
| 25-01 | Active | 1956 | 616 | 1000 |
| 26-01 | Active | 1959 | 775 | 850 |
| 27-01 | Active | 1957 | 661 | 1000 |
| 28-01 | Active | 1957 | 746 | 800 |
| 29-01 | Active | 1958 | 632 | 1000 |
| 30-01 | Active | 1963 | 764 | 1000 |
| 31-01 | Active | 1960 | 678 | 950 |
| 32-01 | Active | 1962 | 832 | 950 |
| 33-01 | Under Repair | 1961 | 740 | 100 |
| 34-01 | Active | 1965 | 718 | 1200 |
| 35-01 | Active | 1963 | 924 | 1000 |
| 37-01 | Active | 2003 | 0 | 900 |
| 38-01 | Active | 1967 | 784 | 850 |
| 39-01 | Active | 1967 | 757 | 1000 |
| 40-01 | Inactive | 1968 | 500 | 825 |
| 41-01 | Active | 1966 | 590 | 1100 |
| 42-01 | Active | 1970 | 520 | 850 |
| 44-01 | Active | 1942 | 428 | 700 |
| 45-01 | Abandoned | (c) | (c) | (c) |
| 46-01 | Active | 1972 | 470 | 500 |
| 47-01 | Active | 1973 | 524 | 740 |
| 48-01 | Active | 1973 | 500 | 900 |
| 49-01 | Active | 1973 | 500 | 900 |
| 50-01 | Active | 1973 | 590 | 850 |
| 51-01 | Active | 1976 | 528 | 1100 |
| 52-01 | Active | 1976 | 500 | 1100 |
| 53-01 | Active | 1977 | 500 | 1100 |
| 54-01 | Active | 1977 | 500 | 1770 |
| 55-01 | Inactive | 1978 | 521 | 1100 |
| 56-01 | Active | 1978 | 504 | 900 |
| 57-01 | Active | 2003 | (c) | 1000 |
| 58-01 | Inactive | 1981 | 560 | 1000 |
| 59-01 | Active | 1981 | 520 | 1100 |

Public Version

| Well Number (Station Number) | Current Status | Year Constructed | Total Depth, feet | Flow Capacity, gpm[(b)] |
|---|---|---|---|---|
| 61-01 | Active | 1989 | 560 | 1100 |
| 62-01 | Active | 1986 | 600 | 1000 |
| 63-01 | Active | 1988 | 590 | 1050 |
| 64-01 | Active | 1988 | 560 | 850 |
| 65-01 | Active | 1990 | 540 | 1150 |
| 67-01 | Active | 1995 | 600 | 1200 |
| 68-01 | Active | 1998 | 610 | 1200 |
| 69-01 | Active | 1998 | 640 | 1000 |
| 70-01 | Active | 2000 | 570 | 950 |
| 71-01 | Active | 2001 | 570 | 1500 |
| 72-01 | Active | 2002 | 530 | 1000 |
| Hamilton City | | | | |
| 001-01 | Active | 1951 | 342 | 600 |
| 002-01 | Active | 1968 | 228 | 850 |
| 002-02 | Active | 2000 | 220 | 550 |

(a) Data sources: Cal Water "CH Wells 3 2006.xls".
(b) Flow capacity for wells based on Cal Water "CH Wells 3 2006.xls".
(c) ND = No data

Public Version

Wellhead treatment is provided at the District's active wells and consists of wellhead disinfection (chlorination). Some of the wells also have a Granular Activated Carbon (GAC) treatment system.

**Existing Storage Facilities**

The Chico-Hamilton City District currently operates seven storage tank facilities (all welded steel). Table 2-3 presents a summary of the storage facilities, ages, and capacities. As shown, the Chico-Hamilton City District currently has a total storage capacity of 2.37 million gallons (MG). The locations of the District's storage facilities are shown on Figure 2-2.

**Table 2-3. Chico-Hamilton City District Storage Tank Facilities**

| Storage Facility Name/Number | Station Number | Storage Type | Material | Year Constructed | Storage Capacity, MG |
|---|---|---|---|---|---|
| Chico | | | | | |
| Reservoir 1 | 001-T1 | Elevated tank | Steel | 1905 | 0.10 |
| Reservoir 2 | 001-T2 | Elevated tank | Steel | 1913 | 0.15 |
| Reservoir 3 | 003-T4 | Elevated tank | Steel | 1950 | 0.30 |
| Reservoir 4 | 008-T3 | Elevated tank | Steel | 1945 | 0.30 |
| Reservoir 5 | 066-T1 | Ground level reservoir | Welded Steel | 1974 | 0.50 |
| Reservoir 6 | 066-T2 | Ground level reservoir | Welded Steel | 2003 | 0.50 |
| Reservoir 7 | 074-T1 | Ground level reservoir | Welded Steel | 2003 | 0.50 |
| Chico Storage Capacity, MG | | | | | 2.35 |
| Hamilton City | | | | | |
| Reservoir 1 | T1-01 | Elevated tank | Steel | - | 0.02 |
| Hamilton City Storage Capacity, MG | | | | | 0.02 |
| Chico-Hamilton City District Total Storage Capacity, MG | | | | | 2.37 |

**Existing Booster Pump Facilities**

The Chico-Hamilton City District currently operates six active booster pump stations. Each of the booster pumps is used to feed the water tanks or meet peak hour demands during the morning and afternoon hours. Table 2-4 presents a summary of the booster pump stations (including age, rated capacity, and number of pumps at each station).

**Table 2-4. Chico-Hamilton City District Active Booster Pump Facilities**

| Booster Pump Station Number | Corresponding Tank/Pressure Zone | Year Constructed[(a)] | Rated Capacity, gpm | Number of Pumps |
|---|---|---|---|---|
| Chico | | | | |
| Station 16[(b)] | Pressure Zone 350 | 2000 | 900 | 1 |
| Station 50[(c)] | Station 50 Hydropneumatic Tank 1 | 1979 | 250 | 1 |
| Station 66 A & B | Pressure Zone 635 | 1990 | 500 | 2 |
| Station 66 C & D | Pressure Zone 795 | 2001 | 400 | 2 |
| Station 73 A & B | Pressure Zone 475 | 2001 | 500 | 2 |
| Hamilton City | | | | |
| None | - | - | - | - |

Pump installation date.

(b) Station 16 is not currently operated.

(c) Station 50 is currently inactive.

### Existing Distribution System and Pipelines

The Chico-Hamilton City District distribution system is divided into five separate services or pressure zones. Figure 2-2 presents the different pressure zones within the Chico-Hamilton City District. There are approximately 352 miles of pipeline in the Chico-Hamilton City District's service area. Pipelines in Cal Water's water distribution system range from 1 to 14 inches in diameter. Pipeline materials consist of asbestos cement (AC), cast iron (CI), cast iron cement lined (CICL), cement mortar coated steel pipe (CL&C), Copper (COP), Coated Steel (D&W), ductile iron (DI), galvanized (GALV), polyvinyl chloride (PVC), Transite (TRANS), wrought iron (WI), PVC Yellow Mine (YEL) standard steel (SS or STD STL), steel (STL), cement mortar lined steel (STL CL), cement lined and coated steel pipe (STL CL&C), and steel pipe classified by inside diameter (ID) or outer diameter (OD). Tables 2-5 and 2-6 provide a summary of pipeline material types within the district service area for Chico and Hamilton City respectively, as found in the hydraulic water model.

**Table 2-5. Chico Pipeline Material Types[a]**

| Material Designation | Length of Pipelines, feet (ft) | Percent in Water System |
|---|---|---|
| Asbestos Cement | 908,930 | 49.92 |
| Cast Iron | 150,945 | 8.29 |
| Cast Iron Cement Lined | 46,699 | 2.56 |
| Cement Mortar Coated Steel Pipe | 7,630 | 0.42 |
| Copper | 198 | 0.01 |
| Coated Steel | 14,948 | 0.82 |
| Ductile Iron | 268,933 | 14.77 |
| Galvanized | 339 | 0.02 |
| Polyvinyl Chloride | 306,233 | 16.82 |
| Transite | 15,690 | 0.86 |
| Wrought Iron | 9,051 | 0.50 |
| Yellow Mind (PVC) | 516 | 0.03 |
| Standard Steel | 21,924 | 1.20 |
| Steel | 52,334 | 2.87 |
| Cement Mortar Lined Steel | 16,017 | 0.88 |
| Cement Lined and Coated Steel | 44 | 0.00 |
| Steel Inside/Outside Diameter | 319 | 0.02 |
| Unknown | 72 | 0.00 |
| Total | 1,820,822 | 100.00 |

[a] Material types and lengths obtained from hydraulic model.

**Table 2-6. Hamilton City Pipeline Material Types[a]**

| Material Designation | Length of Pipelines, ft | Percent in Water System |
|---|---|---|
| Asbestos Cement | 20,451 | 56.59 |
| Cement Mortar Coated Steel Pipe | 176 | 0.49 |
| Ductile Iron | 1,602 | 4.43 |
| Polyvinyl Chloride | 5,786 | 16.01 |
| Standard Steel | 8,054 | 22.28 |
| Steel | 31 | 0.09 |
| Unknown | 41 | 0.11 |
| Total | 36,141 | 100.00 |

[a] Material types and lengths obtained from hydraulic model.

Figure 2-9 provides a layout of the Chico-Hamilton City District distribution system.

**Existing SCADA System**

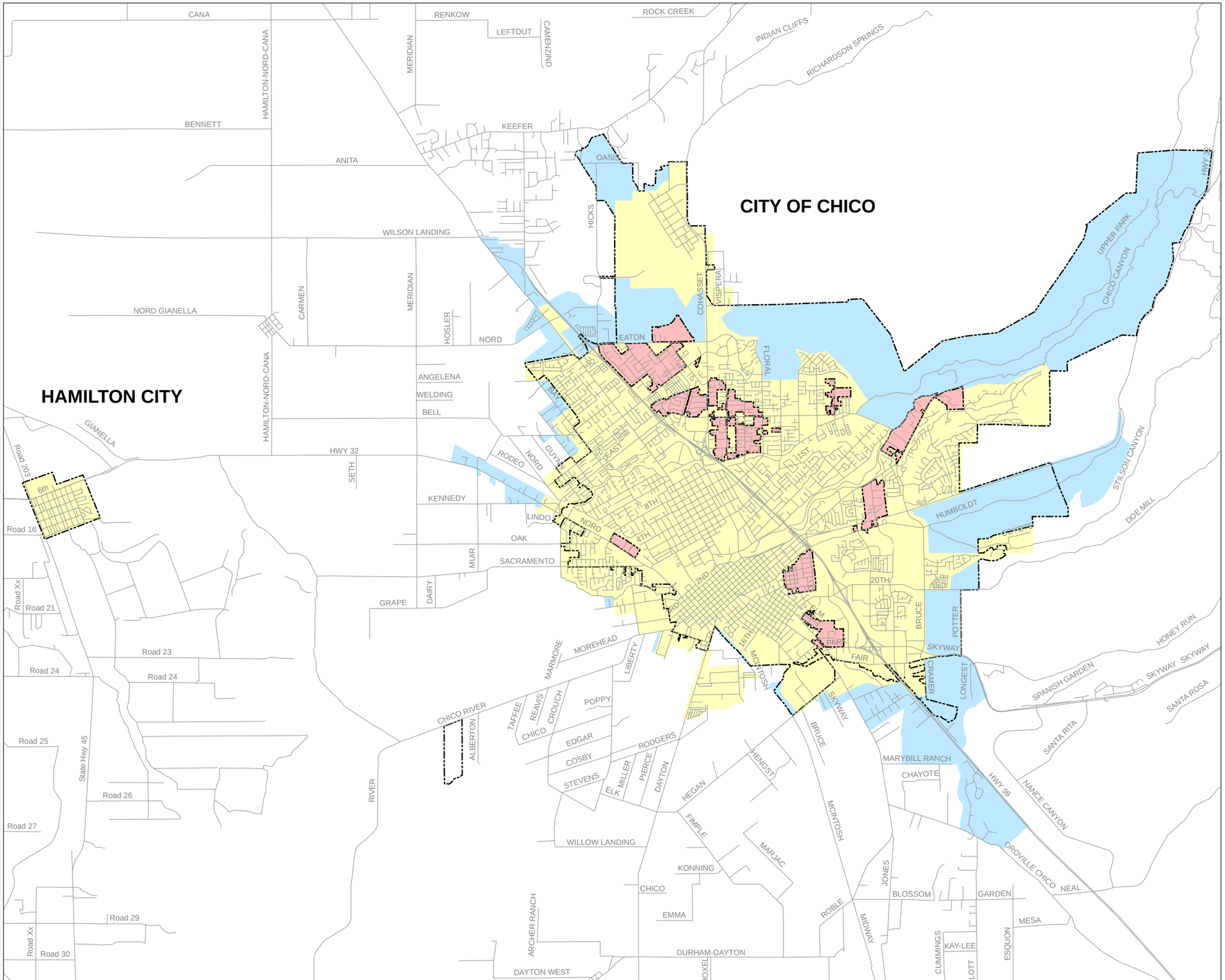
Cal Water utilizes a Supervisory Control and Data Acquisition (SCADA) system to provide for remote operation and monitoring of its facilities. Approximately half of the District's active wells currently have SCADA installed. Further discussion of the Chico-Hamilton City Districts' SCADA system is provided in Chapter 7 Inventory and Assessment of Facilities Conditions and Capacity.

Public Version

# FIGURE 2-1

## California Water Service Company Chico-Hamilton City District Water Supply and Facilities Master Plan

## SERVICE AREA LOCATION




NOTES:

LEGEND:

- Cal Water Service Area
- County Islands within City Limits
- City of Chico Sphere of Influence
- Street

o:\c\436\02-06-03\GIS\WMP\Ch2\Figure 2-1 ServiceArea.mxd 05-01-07 11:13am isuroso

***

Public Version

# FIGURE 2-2

**California Water Service Company**
**Chico - Hamilton City District Water Supply and Facilities Master Plan**

## EXISTING WATER FACILITIES

N

0 0.2 0.4 0.8

Scale in Miles

NOTES:

LEGEND:

- Station - BPS Only
- Station - Tank Only
- Station - Tank and BPS
- Station - Well
- Station - Tank and Well
- Street
- Cal Water Service Area

**Pressure Zone**

- 350
- 400
- 475
- 635
- 795

CALIFORNIA WATER SERVICE CO.

WEST YOST ASSOCIATES
Consulting Engineers

o:\c436\02-06-03\GIS\WMP\Ch2\Figure 2-2_CWSStation.mxd 05-01-07 11:26am isuroso

***

Public Version

## LEGEND

- WELL
- TANK
- PRESSURE TANK
- ELEVATED TANK
- PUMP
- PRESSURE CONTROL
- ALTITUDE VALVE
- CARBON FILTER
- SAND TRAP

**FIGURE 2-3**

**California Water Service Company**
**CHICO SCHEMATIC**
**FOR ZONE 350**

WEST YOST ASSOCIATES
Consulting Engineers

O:\Clients\436 California Water Service Company\02-06-03 Chico - Hamilton City Facilities Plan\CAD\Figures\HGL 053006cn1.dwg 9-13-07 10:02:41 AM akwong

***

Public Version

## LEGEND

- WELL
- TANK
- PRESSURE TANK
- ELEVATED TANK
- PUMP
- PRESSURE CONTROL
- ALTITUDE VALVE
- CARBON FILTER
- SAND TRAP

**FIGURE 2-4**

**California Water Service Company**
**CHICO SCHEMATIC**
**FOR ZONE 350**

WEST YOST ASSOCIATES
Consulting Engineers

O:\Clients\436 California Water Service Company\02-06-03 Chico - Hamilton City Facilities Plan\CAD\Figures\HGL 053006cn1.dwg 9-13-07 10:05:46 AM akwong

***

Public Version

## LEGEND

- WELL
- TANK
- PRESSURE TANK
- ELEVATED TANK
- PUMP
- PRESSURE CONTROL
- ALTITUDE VALVE
- CARBON FILTER
- SAND TRAP

**FIGURE 2-5**

**California Water Service Company**
**CHICO SCHEMATIC**
**FOR ZONE 350**

WEST YOST ASSOCIATES
Consulting Engineers

O:\Clients\436 California Water Service Company\02-06-03 Chico - Hamilton City Facilities Plan\CAD\Figures\HGL 053006cn1.dwg 9-13-07 10:07:37 AM akwong

***

Public Version

## LEGEND

- WELL
- TANK
- PRESSURE TANK
- ELEVATED TANK
- PUMP
- PRESSURE CONTROL
- ALTITUDE VALVE
- CARBON FILTER
- SAND TRAP

**FIGURE 2-6**

**California Water Service Company**
**CHICO SCHEMATIC**
**FOR ZONE 350**

WEST YOST ASSOCIATES
Consulting Engineers

O:\Clients\436 California Water Service Company\02-06-03 Chico - Hamilton City Facilities Plan\CAD\Figures\HGL 053006cn1.dwg 9-13-07 10:09:15 AM akwong

***

Public Version

## LEGEND

- WELL
- TANK
- PRESSURE TANK
- ELEVATED TANK
- PUMP
- PRESSURE CONTROL
- ALTITUDE VALVE
- CARBON FILTER
- SAND TRAP

**FIGURE 2-7**

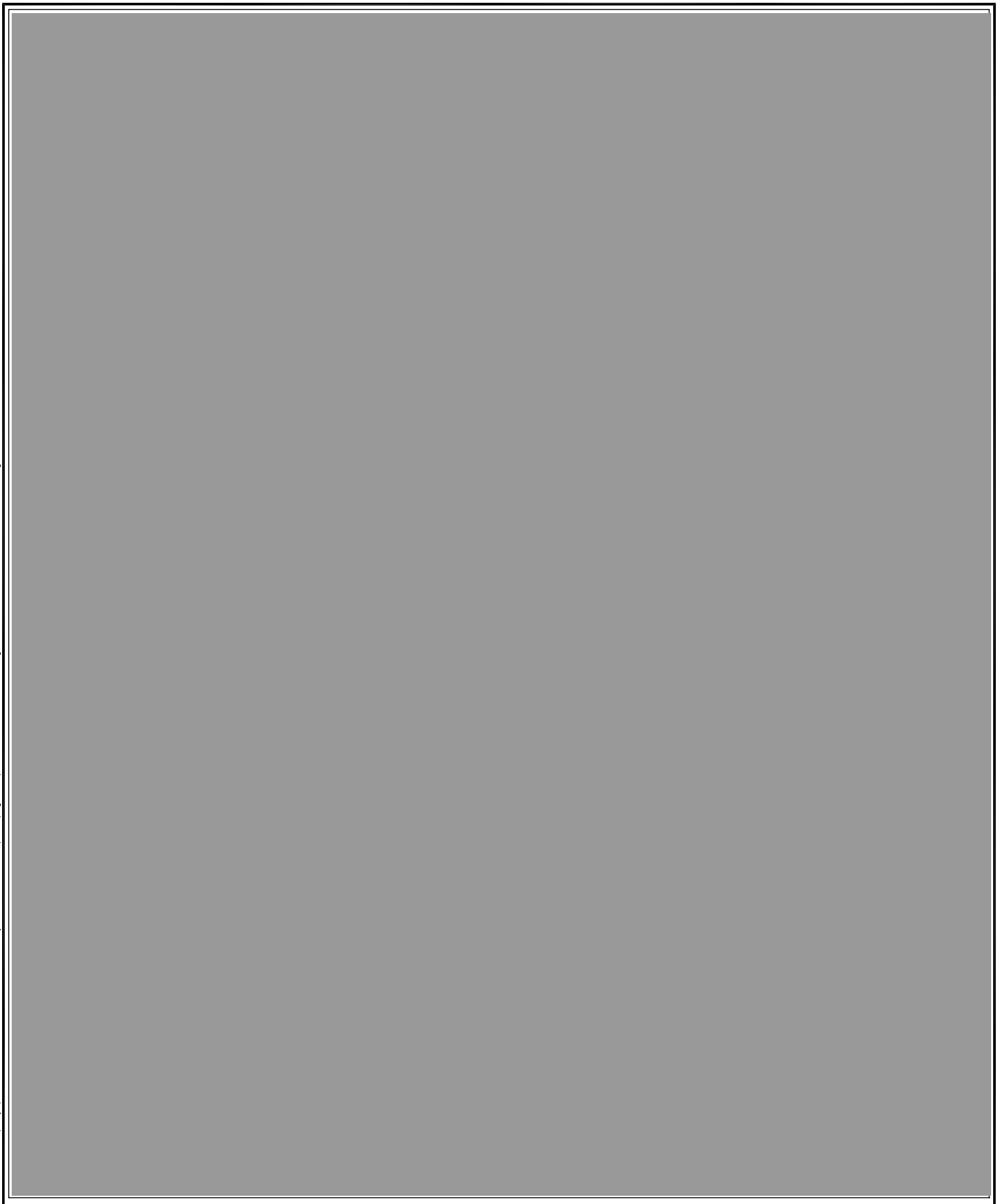
**California Water Service Company**
**CHICO SCHEMATIC**
**FOR ZONES 400, 475, 635, AND 795**

WEST YOST ASSOCIATES
Consulting Engineers

O:\Clients\436 California Water Service Company\02-06-03 Chico - Hamilton City Facilities Plan\CAD\Figures\HG_053006n1.dwg 9-13-07 10:10:50 AM akwong

***

Public Version



## LEGEND

- WELL
- PRESSURE TANK
- ELEVATED TANK
- ALTITUDE VALVE

**FIGURE 2-8**

**California Water Service Company**

**HAMILTON CITY SCHEMATIC**

WEST YOST ASSOCIATES
Consulting Engineers

O:\Clients\436 California Water Service Company\02-06-03 Chico - Hamilton City Facilities Plan\CAD\Figures\HC HGL 112106ak1.dwg 9-13-07 10:00:43 AM akwong

***

Public Version

**FIGURE 2-9**

**California Water Service Company Chico - Hamilton City District Water Supply and Facilities Master Plan**

## EXISTING WATER SYSTEM

N

0 0.2 0.4 0.8

Scale in Miles

NOTES:

LEGEND:

- Station
- Cal Water Service Area
- Pipeline Diameter < 12-inch
- Pipeline Diameter ≥ 12-inch
- Street

CALIFORNIA WATER SERVICE CO.

WEST YOST ASSOCIATES Consulting Engineers

o:\c\436\02-06-03\GIS\WMP\Ch2\Figure 2-9_CWSExSys.mxd

Public Version



# Chapter 3: Water Demands

*Chapter Contents:*

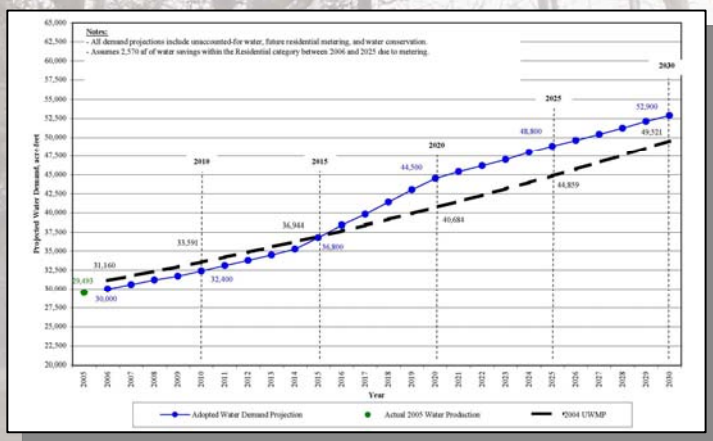
- Description of Chico-Hamilton City District
- Historical Water Production and Consumption
- Adopted Peaking Factors
- Projected Water Demands
- Projected Number of Services
- Projected Population Served

*Chapter Highlights:*

The purpose of this chapter is to present the current and projected water demands served by Cal Water in its Chico-Hamilton City District. Accurate and detailed water demand estimates are required to develop and calibrate the water system hydraulic model, help identify deficiencies in the existing water system, and assist in the assessment of future system capacity and future CIP based on planned development. Future water demand projections also play a key role in helping Cal Water identify and secure sufficient water supplies to serve their Chico-Hamilton City District customers under various hydrologic conditions.

*Current and Projected Future Water Demands for Chico-Hamilton City District:*

| Revenue Class | 2006 Demand, af | Buildout Demand, af |
|---|---|---|
| Residential, Metered | 6,527 | 22,730 |
| Multiple Residences | 2,688 | 4,585 |
| Commercial | 5,714 | 7,774 |
| Industrial | 411 | 2,715 |
| Government | 1,110 | 1,762 |
| Other | 59 | 82 |
| Non-Designated Development | 0 | 10,334 |
| Unaccounted-for Water | 2,394 | 4,319 |
| Totals | 29,930 | 54,300 |



# CHAPTER 3. WATER DEMANDS

The purpose of this chapter is to present the current and projected potable water demands served by Cal Water in its Chico-Hamilton City District. Accurate and detailed potable water demand estimates are required to develop and calibrate the potable water system hydraulic model, help identify deficiencies in the existing potable water system, and assist in the assessment of future system capacity and future CIP's based on planned development. Future water demand projections also play a key role in helping Cal Water identify and secure sufficient water supplies to serve customers in the Chico-Hamilton District under various hydrologic conditions.

The following sections of this chapter describe the data and methodology utilized to determine the District's potable water system demands:

- Description of the Chico-Hamilton District
- Historical Water Production and Consumption
- Adopted Peaking Factors
- Projected Potable Water Demands
- Projected Number of Services
- Projected Population Served

## DESCRIPTION OF THE CHICO-HAMILTON DISTRICT

Cal Water currently provides potable water service to the City of Chico and Hamilton-City, located approximately 80 miles north of the City of Sacramento. The City of Chico is located in Butte County, along Highway 99, while Hamilton City is located in Glenn County, approximately 10 miles east of the City of Chico, along Highway 32.

Figure 3-1 presents the location of the Chico-Hamilton District. As shown in Figure 3-1, Cal Water serves both the City of Chico and county islands within the City limits.

Subsequent sections describe the historical number of services by revenue class, estimated population served, and the existing and projected land uses within the Chico-Hamilton District.

### Historical Number of Services by Revenue Class

Cal Water tracks the number of services within the Chico-Hamilton District using six different revenue classes: Residential–Metered, Residential–Flat, Multiple Residences, Commercial, Industrial, Government, and Other. The Residential–Metered and Residential–Flat classes usually designate a service normally served by an individual meter, while the Multiple Residences class usually designates a service served by more than one meter.

The commercial and industrial classes designate typical commercial and industrial uses, such as a retail store for commercial or a manufacturing company for industrial. The Government class

includes all uses operated by a governing body (e.g., City Hall). The Other class includes all construction or "other" metered water uses that do not fit within the other five categories.

Table 3-1 summarizes the historical number of services within the Chico-Hamilton District (i.e., both the City of Chico and Hamilton-City), by revenue class, over the past 27 years. As shown in Table 3-1, all user classes, except Residential–Flat and Industrial, have experienced increases greater than 35 percent over the past 27 years.

The Residential–Flat revenue class increased between 1980 and 1992, and then slowly decreased between 1992 and 2006. Residential–Flat accounts did not increase beyond 1992 because California State law passed in 1992 required Cal Water to meter all new residential homes; the number of Residential Flat accounts likely decreased as homes were converted to Residential–Metered accounts. The number of Industrial services has remained relatively stable.

**Historical Population Served**

As discussed previously, Cal Water's Chico-Hamilton District serves both county islands located within the City of Chico and Hamilton City; therefore, the normal sources for historical population data (e.g., the California Department of Finance (CDOF)) do not apply to the Chico-Hamilton District. Consequently, the population served by the Chico-Hamilton District was estimated using housing densities (i.e., people per dwelling unit) and the number of dwelling units, and then calibrated using 2000 Census block data provided by Cal Water staff.

Historical Housing Density

The City of Chico Planning Department (Planning) estimates historical housing densities for the City of Chico. The Chico-Hamilton District serves the City of Chico and therefore, the Planning estimates provide a good approximation of the housing density within the Chico-Hamilton District.

Historical housing densities from 1970 to 2005 were downloaded from the Planning Department's website[1] and plotted on Figure 3-2. As shown on Figure 3-2, the housing density estimates show that the City's housing density has been relatively stable, at around 2.5 people per dwelling unit, since around 1975.

Population Served

The housing density based population for Cal Water's Chico-Hamilton District was calculated by multiplying the historical housing density previously presented in Figure 3-2 by the historical number of dwelling units (provided by Cal Water Staff). Additionally, Cal Water staff was able to estimate the population served for calendar year 2000 using GIS Census Block Data for the 2000 Census and the location of its water service area. Appendix A presents the Census Block data used by Cal Water.

[1] Densities for the City of Chico were downloaded from a report entitled, "General City of Chico Budget Information" (http://www.ci.chico.ca.us/common/_mod_resource.asp?p=179&f=122) on May 5, 2006.

**Table 3-1. Historical Services by Revenue Class[a]**

| Year | Residential Metered | Residential Flat | Total Residential | Multiple Residences | Commercial | Industrial | Government | Other | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1980 | 1,122 | 9,929 | 11,051 | 205 | 1,837 | 29 | 198 | 11 | 13,331 |
| 1981 | 1,282 | 10,035 | 11,317 | 229 | 1,927 | 31 | 199 | 14 | 13,717 |
| 1982 | 1,408 | 10,101 | 11,509 | 237 | 2,010 | 32 | 197 | 14 | 13,999 |
| 1983 | 1,602 | 10,027 | 11,629 | 250 | 2,084 | 32 | 202 | 10 | 14,207 |
| 1984 | 1,850 | 10,032 | 11,882 | 275 | 2,232 | 33 | 210 | 12 | 14,644 |
| 1985 | 2,023 | 10,150 | 12,173 | 305 | 2,339 | 35 | 215 | 11 | 15,078 |
| 1986 | 2,141 | 10,320 | 12,461 | 326 | 2,437 | 35 | 218 | 12 | 15,489 |
| 1987 | 2,272 | 10,533 | 12,805 | 332 | 2,540 | 35 | 221 | 19 | 15,952 |
| 1988 | 2,457 | 10,849 | 13,306 | 343 | 2,552 | 38 | 225 | 26 | 16,490 |
| 1989 | 2,768 | 11,316 | 14,084 | 347 | 2,604 | 40 | 233 | 25 | 17,333 |
| 1990 | 3,063 | 11,646 | 14,709 | 361 | 2,644 | 41 | 250 | 47 | 18,052 |
| 1991 | 3,380 | 11,913 | 15,293 | 407 | 2,684 | 41 | 250 | 35 | 18,710 |
| 1992 | 3,810 | 11,983 | 15,793 | 419 | 2,706 | 39 | 268 | 30 | 19,255 |
| 1993 | 4,316 | 11,898 | 16,214 | 421 | 2,748 | 38 | 271 | 29 | 19,721 |
| 1994 | 4,878 | 11,821 | 16,699 | 421 | 2,811 | 39 | 272 | 29 | 20,271 |
| 1995 | 5,275 | 11,729 | 17,004 | 419 | 2,830 | 38 | 268 | 26 | 20,585 |
| 1996 | 5,661 | 11,633 | 17,294 | 417 | 2,860 | 37 | 269 | 26 | 20,903 |
| 1997 | 6,033 | 11,567 | 17,600 | 417 | 2,875 | 37 | 278 | 29 | 21,236 |
| 1998 | 6,448 | 11,508 | 17,956 | 420 | 2,902 | 38 | 278 | 30 | 21,624 |
| 1999 | 6,984 | 11,468 | 18,452 | 419 | 2,933 | 37 | 277 | 33 | 22,151 |
| 2000 | 7,603 | 11,431 | 19,034 | 419 | 2,974 | 37 | 294 | 33 | 22,791 |
| 2001 | 8,046 | 11,408 | 19,454 | 422 | 2,960 | 35 | 344 | 36 | 23,251 |
| 2002[b] | 8,586 | 11,431 | 20,017 | 428 | 3,016 | 35 | 344 | 36 | 23,876 |
| 2003 | 9,167 | 11,330 | 20,497 | 428 | 3,074 | 36 | 344 | 42 | 24,421 |
| 2004 | 9,978 | 11,234 | 21,212 | 426 | 3,135 | 36 | 340 | 47 | 25,196 |
| 2005 | 10,579 | 11,182 | 21,761 | 426 | 3,216 | 35 | 342 | 50 | 25,830 |
| 2006 | 11,104 | 11,078 | 22,182 | 424 | 3,260 | 36 | 341 | 50 | 26,293 |
| Historical Average | 4,957 | 11,095 | 16,051 | 368 | 2,674 | 36 | 265 | 28 | 19,422 |
| 20-Year Average | 6,120 | 11,448 | 17,568 | 406 | 2,866 | 37 | 285 | 34 | 21,197 |
| 10-Year Average | 8,453 | 11,364 | 19,817 | 423 | 3,035 | 36 | 318 | 39 | 23,667 |
| 5-Year Average | 9,883 | 11,251 | 21,134 | 426 | 3,140 | 36 | 342 | 45 | 25,123 |

[a] All data provided by Cal Water (serv and sales.xls) on 4/28/06 and (serv and sales2.xls) on 08/01/07.

[b] Number of services in 2002 differs slightly from the 2004 UWMP because the data was corrected by Cal Water staff since the UWMP was published.

Public Version

A comparison of the estimated population for 2000 presented in Table 3-2 (68,621) and the 2000 population estimated using census block data (85,071) indicates that the 2000 Census based estimate is approximately 21 percent higher. The estimated population served using 2000 Census data is generally considered more accurate than population estimated using a housing density; census data is based on actual population counts.

Consequently, all population estimates for years 1980 through 1999 were calibrated to the 2000 census data by increasing all housing density based population projections by 21 percent. Population estimates for 2001 through 2003 were estimated by interpolating between estimates in 2000 and 2004. Table 3-2 presents the number of dwelling units, housing density, the calculated population served, and the calculated population calibrated to Census data. Figure 3-3 illustrates the calibrated population estimates.

As shown in Table 3-2 and Figure 3-3, the population served by the Chico-Hamilton District increased at relatively similar rates between 1980 and 1988 (approximately 22 percent over 8 years) and between 1995 and 2006 (approximately 26 percent over 10 years). The period between 1989 and 1994 shows a dramatic increase, leveling, and then a slight decrease.

**Existing and Projected Land Use by Revenue Class**

WYA obtained existing and future land use data from the City of Chico's GIS department, which used land use designations adopted in their 1999 General Plan. Land use data for Hamilton-City was based on information from Glenn County's GIS department and a site visit on March 30, 2006. For consistency with Cal Water's other documents (e.g., the Urban Water Management Plan) and in preparation for projecting future services by revenue class, all land use designations were assigned to one of Cal Water's existing Revenue Classes.

The assignment was completed by first assigning each land use category to a Revenue Class, as presented in Appendix B, then verified and adjusted using geocoded meter data allocated as part of the hydraulic model development. Additionally, a new class (Non-Designated Development) was created to track changes associated with known future development without specifically defined land uses (i.e., areas that City officials knew would develop in the future, but had no land use map).

Moreover, Planning (i.e, City staff) indicated that some areas within the City of Chico have two land use designations: a primary and secondary. The primary designation is the main land use designation for the area (i.e., residential); however, due to political or other pressures, these areas were also assigned a secondary designation (i.e., preserve).

Planning also indicated that the adopted General Plan assumed that any areas with two designations would develop at 50 percent of each designation. Consequently, for planning purposes, it was assumed that water demands allocated to those areas would consist of 50 percent of the primary and 50 percent of the secondary designation.

Figures 3-4 and 3-5 present the existing and projected land use by revenue class, respectively. A comparison of Figures 3-4 and 3-5 indicates that there will be extensive growth within the City of Chico and a small amount of growth within Hamilton City. Table 3-3 summarizes existing and

**Table 3-2. Historical Population Served in the Chico-Hamilton City District[a]**

| Year | Estimate of Dwelling Units | | | | | Housing Density[c] | Population Calculated from Housing Density[d] | Population Calibrated to 2000 Census Data[e] |
|---|---|---|---|---|---|---|---|---|
| | Residential Units (Metered)[b] | Residential Units (Flat)[b] | Total Residential Units[b] | Multiple-Family Units | Total Units | | | |
| 1980 | 1,122 | 9,929 | 11,051 | 4,602 | 15,653 | 2.53 | 39,619 | 49,116 |
| 1981 | 1,282 | 10,035 | 11,317 | 4,981 | 16,298 | 2.50 | 40,745 | 50,512 |
| 1982 | 1,408 | 10,101 | 11,509 | 5,090 | 16,599 | 2.50 | 41,498 | 51,445 |
| 1983 | 1,602 | 10,027 | 11,629 | 5,132 | 16,761 | 2.50 | 41,903 | 51,947 |
| 1984 | 1,850 | 10,032 | 11,882 | 5,550 | 17,432 | 2.50 | 43,580 | 54,027 |
| 1985 | 2,023 | 10,150 | 12,173 | 6,156 | 18,329 | 2.42 | 44,420 | 55,068 |
| 1986 | 2,141 | 10,320 | 12,461 | 6,452 | 18,913 | 2.39 | 45,150 | 55,974 |
| 1987 | 2,272 | 10,533 | 12,805 | 6,627 | 19,432 | 2.42 | 47,006 | 58,275 |
| 1988 | 2,457 | 10,849 | 13,306 | 6,915 | 20,221 | 2.40 | 48,594 | 60,243 |
| 1989 | 2,768 | 11,316 | 14,084 | 7,062 | 21,146 | 2.44 | 51,537 | 63,891 |
| 1990 | 3,063 | 11,646 | 14,709 | 7,484 | 22,193 | 2.48 | 54,986 | 68,167 |
| 1991 | 3,380 | 11,913 | 15,293 | 8,557 | 23,850 | 2.52 | 60,191 | 74,619 |
| 1992 | 3,810 | 11,983 | 15,793 | 8,040 | 23,833 | 2.53 | 60,252 | 74,695 |
| 1993 | 4,316 | 11,898 | 16,214 | 8,081 | 24,295 | 2.53 | 61,537 | 76,289 |
| 1994 | 4,878 | 11,821 | 16,699 | 8,065 | 24,764 | 2.56 | 63,444 | 78,652 |
| 1995 | 5,275 | 11,729 | 17,004 | 8,098 | 25,102 | 2.47 | 62,096 | 76,981 |
| 1996 | 5,661 | 11,633 | 17,294 | 8,103 | 25,397 | 2.47 | 62,712 | 77,745 |
| 1997 | 6,033 | 11,567 | 17,600 | 8,114 | 25,714 | 2.48 | 63,714 | 78,987 |
| 1998 | 6,448 | 11,508 | 17,956 | 8,222 | 26,178 | 2.48 | 65,047 | 80,640 |
| 1999 | 6,984 | 11,468 | 18,452 | 8,180 | 26,632 | 2.45 | 65,151 | 80,768 |
| 2000 | 7,603 | 11,431 | 19,034 | 8,264 | 27,298 | 2.51 | 68,621 | 85,071 |
| 2001 | 8,046 | 11,408 | 19,454 | 8,396 | 27,850 | 2.51 | 70,010 | 86,792 |
| 2002 | 8,586 | 11,431 | 20,017 | 8,759 | 28,776 | 2.51 | 72,339 | 89,680 |
| 2003 | 9,167 | 11,330 | 20,497 | 8,648 | 29,145 | 2.51 | 73,265 | 90,828 |
| 2004 | 9,978 | 11,234 | 21,212 | 8,648 | 29,860 | 2.50 | 74,753 | 92,672 |
| 2005 | 10,579 | 11,182 | 21,761 | 8,693 | 30,454 | 2.50 | 76,150 | 94,404 |
| 2006 | 11,104 | 11,078 | 22,182 | 8,910 | 31,092 | 2.50 | 77,746 | 96,383 |

[a] Data provided by Cal Water and includes both the City of Chico and Hamilton City.

[b] Residential is the revenue class used by Cal Water to track Single Family Homes, and does not include Multiple Family.

[c] Density between 1980 and 1985 were assumed equal to the adopted density (2.5 people per dwelling unit); other densitites were based on the density in that year.

[d] Population served was calculated by multiplying the housing density by the total units.

[e] Year 2000 is based on a 2000 census block analysis conducted by Cal Water staff; remaining years were calibrated to year 2000.

Public Version

**Table 3-3. Existing and Projected Land Use by Revenue Class, acres[a]**

| Type | Designation | Existing Development | | | Buildout of the General Plan (2030) | | |
|---|---|---|---|---|---|---|---|
| | | City of Chico | Hamilton City | Total | City of Chico | Hamilton City | Total |
| Primary | Residential[b] | 5,639 | 132 | 5,771 | 7,400 | 150 | 7,551 |
| | Multiple Residences | 824 | 0 | 824 | 1,299 | 2 | 1,301 |
| | Commercial | 1,490 | 27 | 1,518 | 1,913 | 33 | 1,946 |
| | Industrial | 182 | 0 | 182 | 919 | 16 | 935 |
| | Government | 695 | 37 | 731 | 1,102 | 37 | 1,139 |
| | Non-Designated Development[d] | 0 | 0 | 0 | 3,131 | 0 | 3,131 |
| Primary & Secondary | Residential–Preserve[c] | 0 | 0 | 0 | 1,212 | 0 | 1,212 |
| | Residential–Multiple Residences[c] | 0 | 0 | 0 | 9 | 0 | 9 |
| | Multiple Residences–Preserve[c] | 0 | 0 | 0 | 270 | 0 | 270 |
| | Commercial–Preserve[c] | 0 | 0 | 0 | 200 | 0 | 200 |
| | Commercial–Multiple Residences[c] | 0 | 0 | 0 | 5 | 0 | 5 |
| | Industrial - Preserve[c] | 0 | 0 | 0 | 575 | 0 | 575 |
| Total | | 8,830 | 200 | 9,030 | 18,040 | 240 | 18,270 |
| % Developed | | 49% | 83% | 49% | 100% | 100% | 100% |

[a] Data obtained from WYA's GIS system and does not include open space, streets, or highways.

[b] Residential is representative of Single Family, and does not include Multiple Family.

[c] Designations with two parts (e.g., Residential - Preserve) were used for areas of Cal Water's service area with two general plan designations.

[d] A new category "Non-Designated Development" was used to describe areas the City of Chico Planning department knew future development would occur, but did have specific land uses.

Public Version

projected land use by revenue class within the Chico-Hamilton District. As shown in Table 3-3, the Chico-Hamilton District is approximately 50 percent developed.

Estimated Timing of Future Development

On March 30, 2006, WYA staff met with Planning and the Hamilton City Community Services District (HCCSD) to discuss the timing of future development in the City of Chico and Hamilton City. Figure 3-6 illustrates the estimated start year for future development within the Chico-Hamilton District based on information provided by Planning and HCCSD.

As shown in Figure 3-6, developments were categorized as starting in 2006, 2010, or 2015. Figure 3-6 also indicates that most of the development in 2006 is scattered throughout the Cal Water's service area, most of the development starting in 2010 is located on the northern, eastern, and southern borders of Cal Water's service area, and that most of the development starting in 2015 is located in the southeastern portion of Cal Water's service area.

Additionally, for planning purposes in this water supply and facilities master plan, it was assumed that developments would take 14 to 15 years to complete once started. For example, any development starting in 2006 would finish in 2020, any development starting in 2010 would finish in 2025, and any development starting in 2015 would finish by 2030 (buildout of the City of Chico's General Plan).

The start year illustrated on Figure 3-6 and assumed timing is based on the most recent and readily available information provided by the City of Chico, and represent projections that were used for planning future water system infrastructure. Actual timing of developments may change as political, environmental, or other conditions change.

## HISTORICAL WATER PRODUCTION AND CONSUMPTION

Water production is the combined quantity of water produced by Cal Water's groundwater wells, while water consumption is the quantity of water actually consumed or used by its customers. As will be discussed later, the difference between production and consumption is unaccounted-for water (UAFW).

Cal Water currently tracks all of the water produced by its wells, and with the exception of the Residential–Flat revenue class, meters all of its customers within the Chico-Hamilton District. Consequently, Cal Water tracks water use in two ways: production records and meter (consumption) records. Both are discussed in more detail below, along with a discussion on UAFW.

### Historical Water Production

Cal Water meets its customers water demands within the Chico-Hamilton District with groundwater pumped from its own groundwater wells; the Chico-Hamilton District does not have an existing surface water supply used to meet potable water demands. Table 3-4 presents the historical water production from 1980 to 2006.

**Table 3-4. Historical Water Production[a]**

| Year | City of Chico, af | Hamilton City, af | Total, af[c] | % City of Chico | % Hamilton City |
|---|---|---|---|---|---|
| 1980 | 16,235 | 398 | 16,634 | 97.6% | 2.4% |
| 1981 | 17,584 | 420 | 18,004 | 97.7% | 2.3% |
| 1982 | 16,074 | 390 | 16,464 | 97.6% | 2.4% |
| 1983 | 16,479 | 401 | 16,880 | 97.6% | 2.4% |
| 1984 | 18,943 | 447 | 19,390 | 97.7% | 2.3% |
| 1985 | 19,962 | 426 | 20,387 | 97.9% | 2.1% |
| 1986 | 19,966 | 462 | 20,427 | 97.7% | 2.3% |
| 1987 | 22,057 | 538 | 22,595 | 97.6% | 2.4% |
| 1988 | 22,463 | 540 | 23,002 | 97.7% | 2.3% |
| 1989 | 21,114 | 499 | 21,613 | 97.7% | 2.3% |
| 1990 | 23,568 | 550 | 24,118 | 97.7% | 2.3% |
| 1991 | 22,502 | 543 | 23,044 | 97.6% | 2.4% |
| 1992 | 23,421 | 568 | 23,989 | 97.6% | 2.4% |
| 1993 | 22,630 | 526 | 23,156 | 97.7% | 2.3% |
| 1994 | 24,813 | 621 | 25,434 | 97.6% | 2.4% |
| 1995 | 23,514 | 564 | 24,078 | 97.7% | 2.3% |
| 1996 | 24,759 | 581 | 25,340 | 97.7% | 2.3% |
| 1997 | 25,391 | 591 | 25,982 | 97.7% | 2.3% |
| 1998 | 22,472 | 462 | 22,933 | 98.0% | 2.0% |
| 1999 | 25,708 | 563 | 26,271 | 97.9% | 2.1% |
| 2000 | 26,708 | 596 | 27,303 | 97.8% | 2.2% |
| 2001 | 28,057 | 634 | 28,691 | 97.8% | 2.2% |
| 2002[b] | 28,993 | 670 | 29,663 | 97.7% | 2.3% |
| 2003 | 28,069 | 602 | 28,670 | 97.9% | 2.1% |
| 2004 | 30,875 | 656 | 31,531 | 97.9% | 2.1% |
| 2005 | 28,873 | 620 | 29,493 | 97.9% | 2.1% |
| 2006 | 29,286 | 613 | 29,899 | 97.9% | 2.1% |
| Average | | | | 97.7% | 2.3% |

[a] Data obtained from Cal Water (ch wtrpr 3 2006.xls and hc wtrpr 3 2006.xls).

[b] Production in 2002 is different from the 2004 UWMP because the data was corrected by Cal Water staff since the UWMP was published.

[c] Production numbers vary slightly (1 to 2 af) from the 2004 UWMP due to method of converting units.

Public Version

As shown in Table 3-4, the City of Chico has historically comprised approximately 98 percent of all demands in the Chico-Hamilton District, while Hamilton City has only comprised approximately 2 percent. Table 3-4 also indicates that groundwater pumping has increased by approximately 80 percent (from 16,600 af in 1980 to 29,900 af in 2006) over the past 27 years. This trend indicates that as demands have increased within the Chico-Hamilton District, Cal Water has increased groundwater pumping to meet the potable water demands of its customers.

Figure 3-7 compares total historical water production and historical average annual rainfall. As shown in Figure 3-7, Chico-Hamilton District water demands increased at a relatively stable growth rate over the past 27 years, with only a few low demand periods in 1982 to 1983, 1998, and 2005, followed by a sharp decrease in 2005. The low demand periods (including the sharp decrease in 2005) appear to be the result of above average rainfall or regional water conservation efforts, of which, Cal Water has participated.

**Unaccounted-for Water**

UAFW in the Chico-Hamilton District is the difference between the recorded production from Cal Water's groundwater wells and metered consumption; however, because not all of the Residential revenue class is metered, the UAFW could not be determined.

UAFW includes many uses, such as hydrant testing, fires, system flushing, system leaks, and water main breaks. Construction water use is normally captured in the Other revenue class. For planning purposes in this water supply and facilities master plan, UAFW for the Chico-Hamilton District was assumed equal to 8 percent; an UAFW of 8 percent is consistent with Cal Water's 2004 Urban Water Management Plan (UWMP).

**Historical Water Consumption**

Historical water consumed between 1980 and 2006, within each of Cal Water's revenue classes, is summarized in Table 3-5. Water consumption for Residential–Flat customers was calculated based on 8 percent UAFW and the knowledge that all other revenue classes are metered.

As shown in Table 3-5, water consumption within every revenue class, except Residential–Flat has increased over the past 27 years. Table 3-5 also indicates that water consumption within the Residential–Flat revenue class has remained relatively stable.

**Historical Per Capita Water Demand**

Historical per capita water demands were calculated by dividing the total water production previously presented in Table 3-4 by the estimated historical population previously presented in Figure 3-3. Table 3-6 summarizes historical per capita water demands for the Chico-Hamilton District between 1980 and 2006. As shown in Table 3-6, the historical average per capita water demand has averaged approximately 287 gallons per capita per day (gpcd) over the past 5 years.

Figure 3-8 compares the historical per capita demand, historical production, and historical population. As shown in Figure 3-8, the historical population has increased at a relatively constant rate from 1995 to 2006, while the per capita demand has hovered at around 285 gpcd;

**Table 3-5. Historical Water Consumption by Revenue Class, acre-feet[a]**

| Year | Total Production[b] | Unaccounted-For Water[c] | Residential Metered[d] | Multiple Residences | Commercial | Industrial | Government | Other | Total Metered | Estimated Residential Flat[e] | Estimated Total Residential[d] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | 16,634 | 1,331 | 720 | 1,287 | 2,676 | 133 | 689 | 29 | 5,535 | 9,768 | 10,488 |
| 1981 | 18,004 | 1,440 | 841 | 1,448 | 2,973 | 165 | 782 | 36 | 6,245 | 10,319 | 11,160 |
| 1982 | 16,464 | 1,317 | 824 | 1,388 | 2,900 | 123 | 752 | 41 | 6,028 | 9,118 | 9,942 |
| 1983 | 16,880 | 1,350 | 895 | 1,393 | 3,127 | 123 | 716 | 39 | 6,293 | 9,237 | 10,131 |
| 1984 | 19,390 | 1,551 | 1,148 | 1,539 | 3,449 | 140 | 916 | 44 | 7,236 | 10,602 | 11,751 |
| 1985 | 20,387 | 1,631 | 1,232 | 1,758 | 3,699 | 122 | 1,005 | 28 | 7,844 | 10,912 | 12,144 |
| 1986 | 20,427 | 1,634 | 1,260 | 1,881 | 3,848 | 123 | 1,024 | 19 | 8,155 | 10,638 | 11,898 |
| 1987 | 22,595 | 1,808 | 1,417 | 2,053 | 4,122 | 111 | 1,005 | 38 | 8,745 | 12,042 | 13,459 |
| 1988 | 23,002 | 1,840 | 1,524 | 2,125 | 4,386 | 129 | 1,072 | 35 | 9,270 | 11,892 | 13,415 |
| 1989 | 21,613 | 1,729 | 1,533 | 2,015 | 4,311 | 130 | 1,081 | 58 | 9,128 | 10,756 | 12,288 |
| 1990 | 24,118 | 1,929 | 1,805 | 2,224 | 4,715 | 133 | 1,066 | 54 | 9,997 | 12,191 | 13,996 |
| 1991 | 23,044 | 1,844 | 1,864 | 2,277 | 4,591 | 138 | 956 | 61 | 9,887 | 11,314 | 13,178 |
| 1992 | 23,989 | 1,919 | 2,162 | 2,407 | 4,785 | 137 | 973 | 27 | 10,491 | 11,578 | 13,740 |
| 1993 | 23,156 | 1,852 | 2,412 | 2,401 | 4,701 | 153 | 939 | 47 | 10,654 | 10,649 | 13,062 |
| 1994 | 25,434 | 2,035 | 2,995 | 2,436 | 5,098 | 194 | 1,062 | 45 | 11,830 | 11,569 | 14,564 |
| 1995 | 24,078 | 1,926 | 3,098 | 2,346 | 5,121 | 205 | 944 | 32 | 11,747 | 10,405 | 13,503 |
| 1996 | 25,340 | 2,027 | 3,523 | 2,223 | 5,370 | 243 | 971 | 30 | 12,359 | 10,953 | 14,476 |
| 1997 | 25,982 | 2,079 | 3,851 | 2,496 | 5,460 | 281 | 1,050 | 35 | 13,173 | 10,731 | 14,582 |
| 1998 | 22,933 | 1,835 | 3,557 | 2,261 | 5,067 | 310 | 869 | 14 | 12,079 | 9,020 | 12,577 |
| 1999 | 26,271 | 2,102 | 4,483 | 2,411 | 5,526 | 349 | 1,009 | 83 | 13,862 | 10,307 | 14,791 |
| 2000 | 27,303 | 2,184 | 4,996 | 2,439 | 5,577 | 391 | 1,061 | 41 | 14,505 | 10,614 | 15,610 |
| 2001 | 28,691 | 2,295 | 5,436 | 2,582 | 5,664 | 406 | 1,275 | 57 | 15,420 | 10,976 | 16,411 |
| 2002 | 29,497 | 2,360 | 5,970 | 2,767 | 5,654 | 391 | 1,229 | 72 | 16,082 | 11,056 | 17,026 |
| 2003 | 28,670 | 2,294 | 6,013 | 2,629 | 5,544 | 390 | 1,120 | 36 | 15,732 | 10,645 | 16,658 |
| 2004 | 31,531 | 2,522 | 6,800 | 2,782 | 5,828 | 407 | 1,137 | 43 | 16,998 | 12,010 | 18,811 |
| 2005 | 29,493 | 2,359 | 6,667 | 2,595 | 5,672 | 419 | 1,000 | 82 | 16,436 | 10,697 | 17,365 |
| 2006 | 29,930 | 2,394 | 6,527 | 2,688 | 5,714 | 411 | 1,110 | 59 | 16,509 | 11,027 | 17,554 |
| Historical Average | | | 3,095 | 2,180 | 4,651 | 232 | 993 | 44 | 11,194 | 10,779 | 13,873 |
| 10-Year Average | | | 5,430 | 2,565 | 5,571 | 375 | 1,086 | 52 | 15,080 | 10,708 | 16,138 |
| 5-Year Average | | | 6,395 | 2,692 | 5,682 | 404 | 1,119 | 58 | 16,351 | 11,087 | 17,483 |

[a] All consumption data provided by Cal Water (serv and sales.xls, serv and sales2.xls), and includes City of Chico and Hamilton City.

[b] Production data provided by Cal Water (Ch wtrpr 3 2006 and HC wtrpr 3 2006.xls), and includes City of Chico and Hamilton City.

[c] Unaccounted-for water assumed equal to 8% of total production for consistency with Cal Water's Chico-Hamilton District UWMP.

[d] Residential is representative of a Single Family user class, and does not include multiple family water demands.

[e] Residential Flat was calculated by subtracting the unaccounted-for water and total metered water from the total production.

Public Version

**Table 3-6. Historical Per Capita Demand**

| Year | Production, MG | Estimated Population Served | Estimated Per Capita Demand, gpcd |
|---|---|---|---|
| 1980 | 5,420 | 49,116 | 302 |
| 1981 | 5,866 | 50,512 | 318 |
| 1982 | 5,364 | 51,445 | 286 |
| 1983 | 5,500 | 51,947 | 290 |
| 1984 | 6,318 | 54,027 | 320 |
| 1985 | 6,643 | 55,068 | 330 |
| 1986 | 6,656 | 55,974 | 326 |
| 1987 | 7,362 | 58,275 | 346 |
| 1988 | 7,495 | 60,243 | 341 |
| 1989 | 7,042 | 63,891 | 302 |
| 1990 | 7,858 | 68,167 | 316 |
| 1991 | 7,509 | 74,619 | 276 |
| 1992 | 7,816 | 74,695 | 287 |
| 1993 | 7,545 | 76,289 | 271 |
| 1994 | 8,287 | 78,652 | 289 |
| 1995 | 7,845 | 76,981 | 279 |
| 1996 | 8,256 | 77,745 | 291 |
| 1997 | 8,466 | 78,987 | 294 |
| 1998 | 7,472 | 80,640 | 254 |
| 1999 | 8,560 | 80,768 | 290 |
| 2000 | 8,896 | 85,071 | 287 |
| 2001 | 9,348 | 86,792 | 295 |
| 2002 | 9,665 | 89,680 | 295 |
| 2003 | 9,342 | 90,828 | 282 |
| 2004 | 10,274 | 92,672 | 304 |
| 2005 | 9,610 | 94,404 | 279 |
| 2006 | 9,742 | 96,383 | 277 |
| Historical Average | | | 297 |
| 10-Year Average | | | 286 |
| 5-Year Average | | | 287 |

gpcd - gallons per capita per day

Figure 3-8 also indicates a decrease in the pre-1992 average per capita demand of 313 gpcd to an average of only 285 gpcd between 1992 and 2006. This decrease is partly a result of installing water meters on all new homes constructed after 1992, and some existing Residential-Flat accounts voluntarily converting to a Residential-Metered account.

**Water Conservation**

Cal Water is committed to preserving California's water resources through water conservation, and is currently a signatory of the California Urban Water Conservation Council's (CUWCC) Memorandum of Understanding (MOU). As a signatory of the CUWCC MOU, Cal Water has agreed to implement the Best Management Practices (BMPs) defined in Exhibit 1 of the MOU that are cost beneficial, and submits a report to the CUWCC every two years describing BMP implementation. A list of each BMP is provided in Appendix C.

## ADOPTED PEAKING FACTORS

Peaking factors are used to calculate water demands expected under high demand conditions (i.e., Maximum Day and Peak Hour Demand). The resulting demand conditions for maximum day and peak hour periods are then used to evaluate and size transmission/distribution pipelines and storage facilities, and to define water supply needs and capacity requirements. This section describes the methodology used to develop the peaking factors for the maximum day and peak hour demand conditions within the Chico-Hamilton District.

Table 3-7 summarizes the historical maximum day and corresponding peaking factors, between 1980 and 2005. As shown in Table 3-7, the maximum day peaking factor for the Chico-Hamilton District has ranged from a low of 1.7 in 1991 and 2001, to a high of 2.3 in 1981. For planning purposes in this water supply and facilities master plan, a maximum day peaking factor of 2.0 was adopted. A peaking factor of 2.0 represents the average over the historical period from 1980 to 2005.

Insufficient data was available to determine a historical peak hour demand factor; however, as part of the recent hydraulic model development work completed for the Chico-Hamilton District, WYA used SCADA data, both in electronic and circular chart format, to develop diurnal curves for a peak day in July 2006. The diurnal curves from this work were used to estimate the peak hour demand in 2006 (see Appendix D).

The July 2006 peak hour demand in the system was 55,125 gpm; consequently, dividing the estimated peak hour demand (55,125 gpm or 79.4 mgd) by the average day demand (26.7 mgd), indicates that the peak hour peaking factor for the Chico-Hamilton District was approximately 3 in 2006. This peaking factor is consistent with peak hour factors observed for other work WYA has performed; hence, a peak hour peaking factor of 3.0 times the average day demand was adopted for this Water Supply and Facilities Master Plan.

Table 3-8 summarizes the maximum day and peak-hour peaking factors adopted for this Water Supply and Facilities Master Plan.

**Table 3-7. Historical Maximum Day Peaking Factors**

| Year | Average Day, mgd[a] | Maximum Day, mgd[a,b] | Average Day to Maximum Day Peaking Factor |
|---|---|---|---|
| 1980 | 15 | 31.8 | 2.1 |
| 1981 | 16 | 36.7 | 2.3 |
| 1982 | 15 | 30.8 | 2.1 |
| 1983 | 15 | 33.8 | 2.2 |
| 1984 | 17 | 37.5 | 2.2 |
| 1985 | 18 | 38.8 | 2.1 |
| 1986 | 18 | 38.2 | 2.1 |
| 1987 | 20 | 36.2 | 1.8 |
| 1988 | 21 | 39.7 | 1.9 |
| 1989 | 19 | 36.7 | 1.9 |
| 1990 | 22 | 39.2 | 1.8 |
| 1991 | 21 | 35.6 | 1.7 |
| 1992 | 21 | 37.8 | 1.8 |
| 1993 | 21 | 40.4 | 2.0 |
| 1994 | 23 | 42.7 | 1.9 |
| 1995 | 21 | 47.1 | 2.2 |
| 1996 | 23 | 42.8 | 1.9 |
| 1997 | 23 | 41.6 | 1.8 |
| 1998 | 20 | 42.3 | 2.1 |
| 1999 | 23 | 46.4 | 2.0 |
| 2000 | 24 | 47.3 | 1.9 |
| 2001 | 26 | 44.3 | 1.7 |
| 2002 | 26 | 49.6 | 1.9 |
| 2003 | 26 | 50.4 | 2.0 |
| 2004 | 28 | 50.4 | 1.8 |
| 2005 | 26 | 54.2 | 2.1 |
| 2006 | 27 | 50.9 | 1.9 |
| Average | | | 2.0 |
| 5-Year Average | | | 1.9 |

[a] Includes both the City of Chico and Hamilton City

[b] Maximum Day provided by Cal Water (Ch consolidated wtrpr 3 2006.xls)

**Table 3-8. Adopted Peaking Factors**

| Type of Factor | Adopted Factor |
|---|---|
| Average Day to Maximum Day Demand | 2.0 |
| Average Day to Peak Hour Demand | 3.0 |

## PROJECTED WATER DEMANDS

Water demands were projected through buildout of the Chico-Hamilton District using a unit demand method based on land uses assigned to revenue classes. A land use based methodology was used because per capita water demand projections uniformly distribute water use over the entire water service area and therefore, do not account for specific land uses and locations.

Additionally, as discussed previously, it was assumed that water demands allocated to those areas with two designations (Primary and Secondary) would consist of 50 percent of the primary and 50 percent of the secondary designation, which is consistent with planning assumptions used in the City's adopted General Plan. Consequently, unit demand factors were developed for those areas with only a Primary designation, and for those areas with a Primary and Secondary designation.

Subsequent sections describe the land use based methodology used, followed by a discussion of total projected water demands.

### Calculated Unit Demand Factors for those Areas with Only a Primary Designation

Unit demand factors by revenue class were developed for those areas with only a Primary designation by dividing existing water consumption by revenue class (see Table 3-5) by existing Primary land use designation (as assigned to each revenue class (see Figure 3-4)). Table 3-9 presents the unit demand factors calculated using 2005 water consumption.

As shown in Table 3-9, the calculated unit demand factor for Residential (3.0 acre-feet per acre per year (af/ac/yr)) appears to be on the higher end of the typical range (1.5 to 3.0 af/ac/yr) observed by WYA for other clients, which is likely due to a portion of this revenue class not being metered. Multiple Residences appears to be consistent with typical ranges; WYA has observed multiple residential factors that range from 2.5 to 3.5 af/ac/yr for other clients.

The unit demand factor for Commercial (3.7 af/ac/yr) is slightly outside the typical range observed (2.0 to 3.0 af/ac/yr), but is not significantly differently to cause concern, while the unit factor for industrial (2.3 af/ac/yr) appears to be consistent with typical ranges (1.5 to 3.0 af/ac/yr) observed for other WYA clients.

**Table 3-9. Calculated Unit Demand Factors**

| Revenue Class Designation[a] | Area Served within City of Chico, acres[b] | Area Served within Hamilton City, acres[b] | Total Area, acres | Consumption, af[c] | Calculated Unit Factor, af/acre[d] |
|---|---|---|---|---|---|
| Residential | 5,639 | 132 | 5,771 | 17,365 | 3.0 |
| Multiple Residences | 824 | 0 | 824.201 | 2,595 | 3.1 |
| Commercial | 1,490 | 27 | 1,518 | 5,672 | 3.7 |
| Industrial | 182 | 0 | 182 | 419 | 2.3 |
| Government | 695 | 37 | 731 | 1,000 | 1.4 |
| Total | 8,830 | 200 | 9,030 | 27,051 | 3.0 |

[a] Categories obtained from Cal Water's billing system, Commercial is representative of Business

[b] Acreage obtained from GIS shapefile of existing landuse provided by City of Chico

[c] Total water use obtained from Cal Water's billing system

[d] Unit factor calculated by dividing the total water use by the total area (does not include Other)

Public Version

However, the unit factor calculated for Government (1.4 af/ac/yr) does appear low (below a typical value of 1.5 to 2.5 af/ac/yr). The Government unit factor is likely low because Cal Water does not serve parks and schools within the City of Chico, which would typically be included within this revenue class.

**Comparison Unit Demand Factors for those Areas with Only a Primary Designation**

As previously illustrated on Figure 3-7, 2005 water use is slightly lower than water use in 2004; consequently, the calculated unit demand factors were compared to the historical minimum, maximum, and average unit factors used in the 2004 UWMP.

The 2004 UWMP factors were in units of gallons per year per service (or acre-feet per service per year (af/service/yr)), so they were converted to units of af/ac/yr using an estimate of service density (i.e., number of services per acre) that was calculated using the existing number of services and existing developed acreage. Appendix E presents the conversion of the 2004 UWMP factors.

Table 3-10 compares the calculated unit demand factors to the historical range of factors used in the 2004 UWMP and indicates the recommended factor for projecting water demands for those areas with only a Primary designation. As shown in Table 3-10, the calculated factors for Residential, Multiple Residences, and Commercial are within the historical range used in the 2004 UWMP; however, the calculated factor for Industrial is slightly higher and the calculated factor for Government is slightly lower than the range used in the 2004 UWMP.

The calculated factor of 3.0 and 3.1 af/ac/yr was adopted for Residential and Multiple Residences, respectively, because they fell within the historical range. The calculated factor of 3.8 af/ac/yr was adopted for Commercial because it is slightly larger than the historical average, while the calculated factor of 2.2 af/ac/yr was adopted for industrial because it is equal to the maximum, and nearly identical to the calculated factor. Industrial water use will be higher than the average due to the Sierra Nevada bottling plant, providing Cal Water with additional conservatism for planning purposes.

The calculated factor for Government falls below the minimum historical factor used in the 2004 UWMP; consequently, the average historical unit factor used in the 2004 UWMP (1.7 af/ac/yr) was adopted for Government.

**Recommended Unit Demand Factors for Areas with a Primary and Secondary Designation**

As discussed previously, some areas within the City of Chico have two designations (a primary and a secondary) due to political or other pressures. Unit factors were calculated for these areas by using averages of the factors developed for those areas with only a Primary designation. The average used assumes that these areas are developed at 50 percent of the Primary and 50 percent of the Secondary designation (i.e., (factor of Primary + factor of secondary)/2).

The Residential–Preserve factor was calculated by averaging the unit factor for Residential (3.0 af/ac/yr) and the unit factor for open space (0.0 af/ac/yr), or 1.5 af/ac/yr. The Residential–Multiple Residences factor was calculated by averaging the unit factor for Residential

**Table 3-10. Unit Demand Factors**

| Revenue Class Designation | Calculated Unit Factor, af/acre | Cal Water's Chico/Hamilton UWMP, af/acre[a] | | | **Adopted Unit Factor, af/acre[b]** |
|---|---|---|---|---|---|
| | | Min | Max | Average | |
| Residential | 3.0 | 2.6 | 4.0 | 3.3 | **3.0** |
| Multiple Residences | 3.1 | 2.8 | 3.3 | 3.0 | **3.1** |
| Commercial | 3.7 | 3.1 | 4.1 | 3.6 | **3.8** |
| Industrial | 2.3 | 0.6 | 2.2 | 1.4 | **2.2** |
| Government | 1.4 | 1.5 | 1.8 | 1.7 | **1.7** |
| Total | 3.0 | | | | **3.0** |

[a] UWMP factors are based on high/low factors used in the UWMP, converted to af/acre using calculated densities.

[b] Adopted unit demand factor as follows:

If the calculated factor was within range of the factors used in the UWMP, then the calculated factor was adopted.
If the calculated factor was less than the minimum used in the UWMP, then the average factor in the UWMP was adopted.
If the calcuated factor was greater than the maximum used in the UWMP, then the maximum factor in the UWMP was adopted.



Public Version

(3.0 af/ac/yr) and the unit factor for Multiple Residences (3.1 af/ac/yr), or 3.05 af/ac/yr. The Multiple Residences–Preserve factor was calculated by averaging the unit factor for Multiple Residences (3.1 af/ac/yr) and the unit factor for open space (0.0 af/ac/yr), or 1.55 af/ac/yr.

The Commercial–Preserve factor was calculated by averaging the unit factor for Commercial (3.8 af/ac/yr) and the unit factor for open space (0.0 af/ac/yr), or 1.90 af/ac/yr. The Commercial–Multiple Residences factor was calculated by averaging the unit factor for Commercial (3.8 af/ac/yr) and the unit factor for Multiple Residences (3.1 af/ac/yr), or 3.45 af/ac/yr. The Industrial–Preserve factor was calculated by averaging the unit factor for Industrial (2.2 af/ac/yr) and the unit factor for open space (0.0 af/ac/yr), or 1.12 af/ac/yr.

The Non-Designated development factor was calculated by averaging the unit factors Residential (3.0 af/ac/yr), Multiple Residences (3.1 af/ac/yr), and Commercial (3.8 af/ac/yr), or 3.3 af/ac/yr; any new development will likely consist of the Residential, Multiple Residences, and Commercial revenue classes. Table 3-11 summarizes the unit factors used in areas with a secondary designation.

**Table 3-11. Unit Factors Calculated for Areas with a Secondary Designation**

| Designation | Recommended Unit Factor, af/ac/yr |
|---|---|
| Residential–Preserve | 1.50 |
| Residential–Multiple Residences | 3.05 |
| Multiple Residences–Preserve | 1.55 |
| Commercial–Preserve | 1.90 |
| Commercial–Multiple Residences | 3.45 |
| Industrial Preserve | 1.12 |
| Non-Designated Development | 3.30 |

### Estimated Savings from Conversion of Residential–Flat Customers

California Water Code requires that all services be metered by the year 2025. Cal Water is currently developing a program to transition existing Residential–Flat services to a metered account; all new Residential services are metered. However, this program is still being developed and actual timelines have not been defined.

For planning purposes in this water supply and facilities master plan, it was assumed that starting in 2006, approximately 559 Residential–Flat accounts per year would be converted to a metered account. This assumption reduces the total number of existing Residential–Flat accounts from 11,182 in 2005 to zero by 2025.

Water savings associated with each converted account was estimated by comparing unit water use, in af/service/yr, between Residential–Flat and Residential–Metered accounts from 1980 to 2005. Figure 3-9 compares unit use water associated with Residential–Flat customers to unit water use associated with Residential–Metered customers from 1980 to 2005.

As shown in Figure 3-9, the Residential–Flat services have historically used more water than Residential–Metered services, and that savings can range from 0.23 af/year per service (difference between the minimum unit water use) to 0.36 af/year per service (difference between the average unit water use). For planning purposes in this water supply and facilities master plan, it was assumed that the water savings associated with each Residential–Flat account converted to a metered account would be equal to the difference between the minimum unit water use over the past 25-years. Unlike the difference between the average unit water use, using the minimum provides Cal Water with sufficient conservatism for water supply planning purposes (i.e., does not overly reduce demands or over predict potential savings).

Assuming that 559 Residential–Flat accounts are converted per year, then Cal Water can expect an annual water savings, due to metering, of approximately 129 acre-feet per year (0.23 af/service/yr times 559 accounts), or a total savings of approximately 2,570 acre-feet by 2025. The projected water savings due to metering (2,570 af) is approximately 15 percent of the estimated existing Residential water demand (17,365 af).

Table 3-12 summarizes the estimated cumulative water savings per year due to conversion of Residential–Flat services.

**Projected Water Demands**

Water demands for the Chico-Hamilton District were projected using the recommended unit demand factors presented in Tables 3-10 and 3-11, for those areas with only a Primary designation and those areas with both a Primary and Secondary designation (see Table 3-3), respectively.

Additionally, Cal Water tracks construction water and similar, temporary water use, under a revenue class labeled as Other. The Other revenue class is not captured in the land use maps discussed previously because it is not associated with permanent water use. However, Cal Water staff indicated a desire to provide additional system capacity for planning purposes; consequently, future water demands for customers in the Other revenue class were assumed equal to 2005 consumption, or 82 acre-feet.

Table 3-13 summarizes the projected water demand for the Chico-Hamilton District. As shown in Table 3-13, future water demands increase by approximately 84 percent (from 29,493 af to 54,300 af) over the next 25 years. Table 3-13 also indicates that water demands for those areas with both a Primary and Secondary designation were aggregated according to its Primary designation (i.e., Revenue Class), which facilitated projection of future services and allocation of water demands into the hydraulic model.

**Table 3-12. Estimated Water Savings Due to Residential Metering Program**

| Year | Residential Flat Services[a] | Number Converted Residential Flat Services | Expected Water Savings, acre-feet[b] | Cumulative Water Savings, acre-feet |
|---|---|---|---|---|
| 2005 | 11,182 | -- | -- | -- |
| 2006 | 10,623 | 559 | (129) | (130) |
| 2007 | 10,064 | 559 | (129) | (260) |
| 2008 | 9,505 | 559 | (129) | (390) |
| 2009 | 8,946 | 559 | (129) | (510) |
| 2010 | 8,387 | 559 | (129) | (640) |
| 2011 | 7,827 | 559 | (129) | (770) |
| 2012 | 7,268 | 559 | (129) | (900) |
| 2013 | 6,709 | 559 | (129) | (1,030) |
| 2014 | 6,150 | 559 | (129) | (1,160) |
| 2015 | 5,591 | 559 | (129) | (1,290) |
| 2016 | 5,032 | 559 | (129) | (1,410) |
| 2017 | 4,473 | 559 | (129) | (1,540) |
| 2018 | 3,914 | 559 | (129) | (1,670) |
| 2019 | 3,355 | 559 | (129) | (1,800) |
| 2020 | 2,796 | 559 | (129) | (1,930) |
| 2021 | 2,236 | 559 | (129) | (2,060) |
| 2022 | 1,677 | 559 | (129) | (2,190) |
| 2023 | 1,118 | 559 | (129) | (2,310) |
| 2024 | 559 | 559 | (129) | (2,440) |
| 2025 | 0 | 559 | (129) | (2,570) |

[a] California water code requires that all services be metered by 2025. Per discussion with Cal Water staff, conversion of Residential Flat to Residential Metered is based on interpolation.

[b] Assumes that each Residential Flat account uses 0.23 af less water after conversion.

Public Version

**Table 3-13. Projected Water Demands for the Chico-Hamilton City District**

| Location | Revenue Class[a] | Designation[b] | Additional Demand at Buildout: Future Development, acres[c] | Additional Demand at Buildout: Unit Demand Factor, af/ac/yr | Additional Demand at Buildout: Additional Water Demand, af | 2004/2005 Average Water Demand, af[d] | Savings due to Residential Metering | Total Projected Water Demand, af |
|---|---|---|---|---|---|---|---|---|
| City of Chico | Residential | Residential | 1,761 | 3.00 | 5,283 | 17,675 | (2,543) | 22,260 |
| | | Residential - Preserve | 1,212 | 1.50 | 1,818 | | | |
| | | Residential – Multiple Residences | 9 | 3.05 | 26 | | | |
| | Multiple Residences | Multiple Residences | 474 | 3.10 | 1,471 | 2,689 | 0 | 4,578 |
| | | Multiple Residences – Preserve | 270 | 1.55 | 419 | | | |
| | Commercial | Commercial | 423 | 3.80 | 1,607 | 5,641 | 0 | 7,644 |
| | | Commercial – Preserve | 200 | 1.90 | 380 | | | |
| | | Commercial – Multiple Residences | 5 | 3.45 | 16 | | | |
| | Industrial | Industrial | 738 | 2.20 | 1,623 | 413 | 0 | 2,680 |
| | | Industrial – Preserve | 575 | 1.12 | 644 | | | |
| | Government | Government | 408 | 1.70 | 693 | 1,004 | 0 | 1,696 |
| | Non-Designated Development | Non-Designated Development | 3,131 | 3.30 | 10,334 | 0 | 0 | 10,334 |
| | Other | | | | 0 | 82 | 0 | 82 |
| | Unaccounted-for Water | | | | 1,893 | 2,390 | 0 | 4,283 |
| | Subtotal | | | | 26,210 | 29,893 | (2,540) | 53,600 |
| Hamilton City | Residential | Residential | 19 | 3.00 | 56 | 413 | (27) | 442 |
| | Multiple Residences | Multiple Residences | 2 | 3.10 | 7 | 0 | 0 | 7 |
| | Commercial | Commercial | 5 | 3.80 | 21 | 109 | 0 | 129 |
| | Industrial | Industrial | 16 | 2.20 | 35 | 0 | 0 | 35 |
| | Government | Government | 0 | 1.70 | 0 | 65 | 0 | 65 |
| | Other | | | | 2 | 0 | 0 | 2 |
| | Unaccounted-for Water | | | | 8 | 51 | 0 | 59 |
| | Subtotal | | | | 130 | 638 | (30) | 740 |
| Total Production | | | | | 26,340 | 30,531 | (2,570) | 54,300 |

[a] Revenue Classes obtained from Cal Water's billing system.

[b] Water use for those areas with both a Primary and Secondary designation were aggregated according to its Primary designation (i.e., Revenue Class), which facilitated projection of future services and allocation of water demands into the hydraulic model.

[c] Acreage obtained from WYA's GIS system.

[d] 2005 water demand based on data provided by Cal Water.

Public Version

### Timing of Projected Water Demands

Projected water demands for the Chico-Hamilton District were then calculated on a yearly basis using the timing previously illustrated on Figure 3-6. Table 3-14 summarizes the total projected water demand by revenue class, including unaccounted for water, through the year 2030.

Figure 3-10 compares the projected water demands to the "Scenario 2" water demands projected in the 2004 UWMP. As shown in Figure 3-10, both demand projections vary from each other by less than 5 percent until 2015, and that the revised demand projections differ by as much as 14 percent between 2015 and 2030. The variation observed in water demand estimates is due to the timing assumptions previously presented in Figure 3-6.

## PROJECTED NUMBER OF SERVICES

This water supply and facilities master plan also provides an alternative methodology for projecting the number of future services by user class to help facilitate Cal Water staff in producing an UWMP for the Chico-Hamilton District. The methodology used involves developing a unit factor in af/service/yr that can then be used with the projected demand, by revenue class, to predict the number of service that can be served in a particular year.

Subsequent sections describe the development of each unit factor and the projected number of services.

### Service Based Unit Factors for Projecting Number of Services

Unit factors for each revenue class were calculated by dividing the historical water consumption (see Table 3-5) by the historical number of services (see Table 3-1). Historical factors in af/service/yr are summarized in Table 3-15, and illustrated on Figures 3-11, 3-12, and 3-13, respectively. Each factor is discussed in more detail below.

<u>Service Based Residential Unit Factor</u>

Table 3-15 indicates that the average factor over the past 25 years, 10 years, and 5 years is approximately 0.61 af/service/yr, 0.64 af/service/yr, and 0.65 af/service/yr, respectively, implying an increasing trend in water use per residential service. However, a review of Figure 3-11 indicates that the increasing trend is likely the result of the large increase in water use per residential service between 1999 and 2002; there is a decreasing trend between 2002 and 2006.

Adopting the 10-year average (0.64 af/service/yr) captures the fluctuation observed between 1999 and 2006, and provides additional conservatism (i.e., projects fewer services) than if the historical average (1980 to 2006) were adopted. Consequently, a 0.64 af/service/yr unit factor for Residential was adopted for projecting future services.

**Table 3-14. Timing of Projected Water Demands for the Chico-Hamilton City District, acre-feet**

| Year | Residential | Reduction for Metering Residential Flat | Total Residential | Multiple Residences | Commercial | Industrial | Government | Non-Designated Development | Other | UAFW | Total Production |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2005 | 18,088 | 0 | 18,088 | 2,689 | 5,750 | 413 | 1,069 | 0 | 82 | 2,359 | 30,450 |
| 2006 | 18,300 | (130) | 18,170 | 2,749 | 5,844 | 510 | 1,109 | 121 | 82 | 2,514 | 31,100 |
| 2007 | 18,500 | (260) | 18,240 | 2,810 | 5,937 | 608 | 1,149 | 242 | 82 | 2,531 | 31,600 |
| 2008 | 18,800 | (390) | 18,410 | 2,871 | 6,031 | 705 | 1,189 | 364 | 82 | 2,548 | 32,200 |
| 2009 | 19,000 | (510) | 18,490 | 2,932 | 6,124 | 802 | 1,230 | 485 | 82 | 2,655 | 32,800 |
| 2010 | 19,300 | (640) | 18,660 | 3,032 | 6,241 | 909 | 1,270 | 606 | 82 | 2,700 | 33,500 |
| 2011 | 19,600 | (770) | 18,830 | 3,132 | 6,358 | 1,016 | 1,310 | 727 | 82 | 2,744 | 34,200 |
| 2012 | 19,900 | (900) | 19,000 | 3,233 | 6,475 | 1,123 | 1,351 | 849 | 82 | 2,788 | 34,900 |
| 2013 | 20,300 | (1,030) | 19,270 | 3,333 | 6,592 | 1,230 | 1,391 | 970 | 82 | 2,833 | 35,700 |
| 2014 | 20,600 | (1,160) | 19,440 | 3,433 | 6,709 | 1,337 | 1,431 | 1,091 | 82 | 2,877 | 36,400 |
| 2015 | 21,000 | (1,290) | 19,710 | 3,555 | 6,841 | 1,486 | 1,477 | 1,745 | 82 | 3,003 | 37,900 |
| 2016 | 21,500 | (1,410) | 20,090 | 3,678 | 6,973 | 1,636 | 1,523 | 2,398 | 82 | 3,120 | 39,500 |
| 2017 | 22,000 | (1,540) | 20,460 | 3,800 | 7,106 | 1,786 | 1,569 | 3,051 | 82 | 3,246 | 41,100 |
| 2018 | 22,400 | (1,670) | 20,730 | 3,922 | 7,238 | 1,936 | 1,614 | 3,705 | 82 | 3,372 | 42,600 |
| 2019 | 22,900 | (1,800) | 21,100 | 4,045 | 7,370 | 2,086 | 1,660 | 4,358 | 82 | 3,498 | 44,200 |
| 2020 | 23,400 | (1,930) | 21,470 | 4,167 | 7,503 | 2,236 | 1,706 | 5,012 | 82 | 3,624 | 45,800 |
| 2021 | 23,600 | (2,060) | 21,540 | 4,228 | 7,542 | 2,289 | 1,712 | 5,544 | 82 | 3,764 | 46,700 |
| 2022 | 23,800 | (2,190) | 21,610 | 4,290 | 7,580 | 2,342 | 1,717 | 6,076 | 82 | 3,803 | 47,500 |
| 2023 | 24,100 | (2,310) | 21,790 | 4,351 | 7,619 | 2,394 | 1,723 | 6,608 | 82 | 3,832 | 48,400 |
| 2024 | 24,300 | (2,440) | 21,860 | 4,413 | 7,658 | 2,447 | 1,728 | 7,141 | 82 | 3,971 | 49,300 |
| 2025 | 24,500 | (2,570) | 21,930 | 4,474 | 7,697 | 2,500 | 1,734 | 7,673 | 82 | 4,010 | 50,100 |
| 2026 | 24,700 | (2,570) | 22,130 | 4,496 | 7,712 | 2,543 | 1,739 | 8,205 | 82 | 4,092 | 51,000 |
| 2027 | 24,800 | (2,570) | 22,230 | 4,518 | 7,728 | 2,586 | 1,745 | 8,737 | 82 | 4,174 | 51,800 |
| 2028 | 25,000 | (2,570) | 22,430 | 4,541 | 7,743 | 2,629 | 1,750 | 9,269 | 82 | 4,256 | 52,700 |
| 2029 | 25,100 | (2,570) | 22,530 | 4,563 | 7,759 | 2,672 | 1,756 | 9,802 | 82 | 4,237 | 53,400 |
| 2030 | 25,300 | (2,570) | 22,730 | 4,585 | 7,774 | 2,715 | 1,762 | 10,334 | 82 | 4,319 | 54,300 |

Public Version

**Table 3-15. Revenue Class Conversion Factors for Projecting the Number of Services, af/service[a]**

| Year | Residential Metered | Residential Flat | Multiple Residences | Commercial | Industrial | Government | Non-Designated Development |
|---|---|---|---|---|---|---|---|
| 1980 | 0.64 | 0.98 | 6.28 | 1.46 | 4.60 | 3.48 | 1.10 |
| 1981 | 0.66 | 1.03 | 6.32 | 1.54 | 5.31 | 3.93 | 1.16 |
| 1982 | 0.58 | 0.90 | 5.86 | 1.44 | 3.84 | 3.82 | 1.03 |
| 1983 | 0.56 | 0.92 | 5.57 | 1.50 | 3.83 | 3.54 | 1.05 |
| 1984 | 0.62 | 1.06 | 5.60 | 1.55 | 4.24 | 4.36 | 1.16 |
| 1985 | 0.61 | 1.08 | 5.76 | 1.58 | 3.47 | 4.68 | 1.19 |
| 1986 | 0.59 | 1.03 | 5.77 | 1.58 | 3.52 | 4.70 | 1.16 |
| 1987 | 0.62 | 1.14 | 6.18 | 1.62 | 3.17 | 4.55 | 1.25 |
| 1988 | 0.62 | 1.10 | 6.20 | 1.72 | 3.39 | 4.76 | 1.23 |
| 1989 | 0.55 | 0.95 | 5.81 | 1.66 | 3.25 | 4.64 | 1.09 |
| 1990 | 0.59 | 1.05 | 6.16 | 1.78 | 3.24 | 4.26 | 1.18 |
| 1991 | 0.55 | 0.95 | 5.59 | 1.71 | 3.37 | 3.82 | 1.09 |
| 1992 | 0.57 | 0.97 | 5.75 | 1.77 | 3.52 | 3.63 | 1.11 |
| 1993 | 0.56 | 0.90 | 5.70 | 1.71 | 4.03 | 3.47 | 1.04 |
| 1994 | 0.61 | 0.98 | 5.79 | 1.81 | 4.98 | 3.90 | 1.11 |
| 1995 | 0.59 | 0.89 | 5.60 | 1.81 | 5.40 | 3.52 | 1.04 |
| 1996 | 0.62 | 0.94 | 5.33 | 1.88 | 6.58 | 3.61 | 1.07 |
| 1997 | 0.64 | 0.93 | 5.99 | 1.90 | 7.58 | 3.78 | 1.08 |
| 1998 | 0.55 | 0.78 | 5.38 | 1.75 | 8.17 | 3.13 | 0.94 |
| 1999 | 0.64 | 0.90 | 5.76 | 1.88 | 9.42 | 3.64 | 1.04 |
| 2000 | 0.66 | 0.93 | 5.82 | 1.88 | 10.56 | 3.61 | 1.05 |
| 2001 | 0.68 | 0.96 | 6.12 | 1.91 | 11.61 | 3.71 | 1.08 |
| 2002 | 0.70 | 0.97 | 6.47 | 1.87 | 11.16 | 3.57 | 1.08 |
| 2003 | 0.66 | 0.94 | 6.14 | 1.80 | 10.82 | 3.26 | 1.03 |
| 2004 | 0.68 | 1.07 | 6.53 | 1.86 | 11.31 | 3.34 | 1.11 |
| 2005 | 0.63 | 0.96 | 6.09 | 1.76 | 11.98 | 2.92 | 0.99 |
| 2006 | 0.59 | 1.00 | 6.34 | 1.75 | 11.42 | 3.26 | 1.36 |
| Historical Average | 0.61 | 0.97 | 5.92 | 1.72 | 6.44 | 3.81 | 1.10 |
| 10-Year Average | 0.64 | 0.94 | 6.06 | 1.84 | 10.40 | 3.42 | 1.08 |
| 5-Year Average | 0.65 | 0.99 | 6.31 | 1.81 | 11.34 | 3.27 | 1.12 |

[a] Service conversion factor determined by dividing estimated sales by the number of services.



Public Version

Service Based Multiple Residences Unit Factor

Table 3-15 indicates that the historical average and average over the past 10 years is nearly identical, while the average over the past 5 years is larger, which implies that water use over the past five years has been larger than historical averages (1980 to 2006). However, a review of Figure 3-11 indicates that unit factors around the 5-year average (6.31 af/service/yr), from 2002 to 2006, have occurred several times in the past. Consequently, a 6.31 af/service/yr unit factor for Multiple Residences was adopted for projecting future services; this adopted factor provides additional conservatism (i.e., projects fewer services) than if the historical average (1980 to 2006) were adopted

Service Based Commercial Unit Factor

Table 3-15 indicates that the 10-year (1997 to 2006) and 5-year average (2002 to 2006) factors are nearly identical at 1.85 af/service/yr and 1.81 af/service/yr, respectively. A review of Figure 3-12 indicates that the unit factor for Commercial has been relatively stable since 1994; consequently, a 1.85 af/service/yr unit factor, which is equal to the 10-year average (1992 to 2006), was adopted for projecting future services.

Service Based Industrial Unit Factor

A comparison of the historical, 10-year (1997 to 2006), and 5-year average (2002 to 2006) on Table 3-15 clearly indicates that water use within the Industrial revenue class has increased significantly, while a review of Figure 3-12 indicates that this increasing trend started in 1993 and ended around 2001. Cal Water staff have indicated that this large increase is likely due to operation and expansion of the Sierra Nevada bottling plant. Consequently, an 11.34 af/service/yr unit factor was adopted for projecting future services because this factor more closely matches recent water use within this revenue class, and provides for potentially larger industrial water users.

Service Based Government Unit Factor

Table 3-15 indicates that there is a decreasing trend in the historical (1980 to 2006), 10-year average (1997 to 2006), and 5-year average (2002 to 2006) unit factor, which implies that overall water use per service is decreasing. A review of Figure 3-13 indicates that while there is an overall decrease in unit water use, the unit factor was relatively stable between 1993 and 2002. Adopting the 2005 unit factor would not provide ample conservatism for planning purposes; the unit factor in 2005 is a historical low, and using it would likely predict too many services. Consequently, a 3.42 af/service/yr unit factor, which is equal to the 10-year average (1997 to 2006), was adopted for projecting future services because this factor is not the historical low, yet it still captures the stability observed between 1999 and 2002.

Service Based Non-Designated Development Unit Factor

The unit factor for Non-Designated Development was determined by dividing the total water use for Residential, Multiple Residences, and Commercial by the total number of corresponding services. Table 3-15 indicates that the historical (1980 to 2006), 10-year average (1997 to 2006),

and the 5-year average (2002 to 2006) are very close, which illustrates the stability of the unit factor calculated for Non-Designated Development; a review of Figure 3-13 confirms this observation. Consequently, the historical average unit factor (1.10 af/service/yr) was adopted for projected future services.

**Future Service Connections**

Future services were projected by adding the incremental number of services due to an increase in water demand over the previous year's number of services. For example, the incremental increase in water use for the Multiple Residences revenue class between 2005 and 2006 is approximately 61 af (2,656 af in 2006 minus 2,595 af in 2005); hence, the projected number of additional services is 10 services (61 af/year divided by 6.27 af/service/yr), for a total of 436 services in 2006 after rounding.

The projected number of Residential services was based on projected water demand before subtracting water savings (due to metering) so that the projected number of services was not artificially lowered. Additionally, for planning purposes, the number of services for the Other revenue class was assumed equal to the number of services projected in the 2004 UWMP. Tables 3-16 and 3-17 summarize projected services by revenue class between 2006 and 2030.

## PROJECTED POPULATION SERVED

As discussed previously, Cal Water serves county islands within the City of Chico and Hamilton City; normal population projection sources do not apply to the Chico-Hamilton District. Consequently, future population served was estimated using a per capita demand factor and the total projected water demands.

Table 3-6 previously indicated that the average per capita water demand over the past 5-years is approximately 291 gpcd. This per capita demand is very close to the post-1992 average per capita demand previously illustrated on Figure 3-8. Consequently, a per capita demand factor of 291 gpcd was adopted to project the future population served within the Chico-Hamilton District.

The population was calculated by adding the incremental population due to an increase in water demand to the previous year's population. Figure 3-14 illustrates the total projected population based on a per capita demand of 291 gpcd. As shown on Figure 3-14, the population served by the Chico-Hamilton District is projected to increase from 94,404 people in 2005 to 170,500 people by 2030, or an increase of approximately 80 percent.

**Table 3-16. Projected Number of Services for City of Chico**

| Year | Residential | Multiple Residences | Commercial | Industrial | Government | Non-Designated Development | Other | Total |
|---|---|---|---|---|---|---|---|---|
| 2005 | 21,191 | 426 | 3,164 | 35 | 335 | 0 | 48 | 25,199 |
| 2006 | 21,550 | 436 | 3,215 | 44 | 347 | 110 | 79 | 25,781 |
| 2007 | 21,909 | 446 | 3,266 | 53 | 359 | 220 | 79 | 26,332 |
| 2008 | 22,268 | 456 | 3,317 | 62 | 371 | 330 | 79 | 26,883 |
| 2009 | 22,627 | 466 | 3,368 | 71 | 383 | 440 | 79 | 27,434 |
| 2010 | 23,115 | 482 | 3,431 | 80 | 395 | 550 | 79 | 28,132 |
| 2011 | 23,603 | 498 | 3,494 | 89 | 407 | 660 | 79 | 28,830 |
| 2012 | 24,091 | 514 | 3,557 | 98 | 419 | 770 | 79 | 29,528 |
| 2013 | 24,579 | 530 | 3,620 | 107 | 431 | 880 | 79 | 30,226 |
| 2014 | 25,067 | 546 | 3,683 | 116 | 443 | 990 | 79 | 30,924 |
| 2015 | 25,789 | 565 | 3,754 | 129 | 456 | 1,581 | 79 | 32,353 |
| 2016 | 26,511 | 584 | 3,825 | 142 | 469 | 2,172 | 79 | 33,782 |
| 2017 | 27,233 | 603 | 3,896 | 155 | 482 | 2,763 | 79 | 35,211 |
| 2018 | 27,955 | 622 | 3,967 | 168 | 495 | 3,354 | 79 | 36,640 |
| 2019 | 28,677 | 641 | 4,038 | 181 | 508 | 3,945 | 79 | 38,069 |
| 2020 | 29,399 | 660 | 4,109 | 194 | 521 | 4,536 | 79 | 39,498 |
| 2021 | 29,762 | 670 | 4,129 | 198 | 523 | 5,018 | 79 | 40,379 |
| 2022 | 30,125 | 680 | 4,149 | 202 | 525 | 5,500 | 79 | 41,260 |
| 2023 | 30,488 | 690 | 4,169 | 206 | 527 | 5,982 | 79 | 42,141 |
| 2024 | 30,851 | 700 | 4,189 | 210 | 529 | 6,464 | 79 | 43,022 |
| 2025 | 31,214 | 710 | 4,209 | 214 | 531 | 6,946 | 79 | 43,903 |
| 2026 | 31,448 | 713 | 4,217 | 218 | 533 | 7,428 | 79 | 44,636 |
| 2027 | 31,682 | 716 | 4,225 | 222 | 535 | 7,910 | 79 | 45,369 |
| 2028 | 31,916 | 719 | 4,233 | 226 | 537 | 8,392 | 79 | 46,102 |
| 2029 | 32,150 | 722 | 4,241 | 230 | 539 | 8,874 | 79 | 46,835 |
| 2030 | 32,384 | 725 | 4,249 | 234 | 541 | 9,356 | 79 | 47,568 |
| UWMP in 2030 | 38,170 | 447 | 4,155 | 34 | 362 | -- | 81 | 43,249 |

Public Version

**Table 3-17. Projected Number of Services for Hamilton City**

| Year | Residential | Multiple Residences | Commercial | Industrial | Government | Other | Total |
|---|---|---|---|---|---|---|---|
| 2005 | 570 | 0 | 52 | 0 | 7 | 2 | 631 |
| 2006 | 573 | 0 | 52 | 0 | 7 | 2 | 634 |
| 2007 | 576 | 0 | 52 | 0 | 7 | 2 | 637 |
| 2008 | 579 | 0 | 52 | 0 | 7 | 2 | 640 |
| 2009 | 582 | 0 | 52 | 0 | 7 | 2 | 643 |
| 2010 | 588 | 0 | 52 | 0 | 7 | 2 | 649 |
| 2011 | 594 | 0 | 52 | 0 | 7 | 2 | 655 |
| 2012 | 600 | 0 | 52 | 0 | 7 | 2 | 661 |
| 2013 | 606 | 0 | 52 | 0 | 7 | 2 | 667 |
| 2014 | 612 | 1 | 52 | 0 | 7 | 2 | 674 |
| 2015 | 618 | 1 | 53 | 0 | 7 | 2 | 681 |
| 2016 | 624 | 1 | 54 | 0 | 7 | 2 | 688 |
| 2017 | 630 | 1 | 55 | 1 | 7 | 2 | 695 |
| 2018 | 636 | 1 | 56 | 1 | 7 | 2 | 703 |
| 2019 | 642 | 1 | 57 | 1 | 7 | 2 | 710 |
| 2020 | 648 | 1 | 58 | 1 | 7 | 2 | 717 |
| 2021 | 651 | 1 | 59 | 1 | 7 | 2 | 721 |
| 2022 | 654 | 1 | 60 | 2 | 7 | 2 | 726 |
| 2023 | 657 | 1 | 61 | 2 | 7 | 2 | 730 |
| 2024 | 660 | 1 | 62 | 2 | 7 | 2 | 734 |
| 2025 | 663 | 1 | 63 | 2 | 7 | 2 | 738 |
| 2026 | 663 | 1 | 64 | 2 | 7 | 2 | 739 |
| 2027 | 663 | 1 | 65 | 3 | 7 | 2 | 741 |
| 2028 | 663 | 1 | 66 | 3 | 7 | 2 | 742 |
| 2029 | 663 | 1 | 67 | 3 | 7 | 2 | 743 |
| 2030 | 663 | 1 | 68 | 3 | 7 | 2 | 744 |
| UWMP in 2030 | -- | -- | -- | -- | -- | -- | 0 |

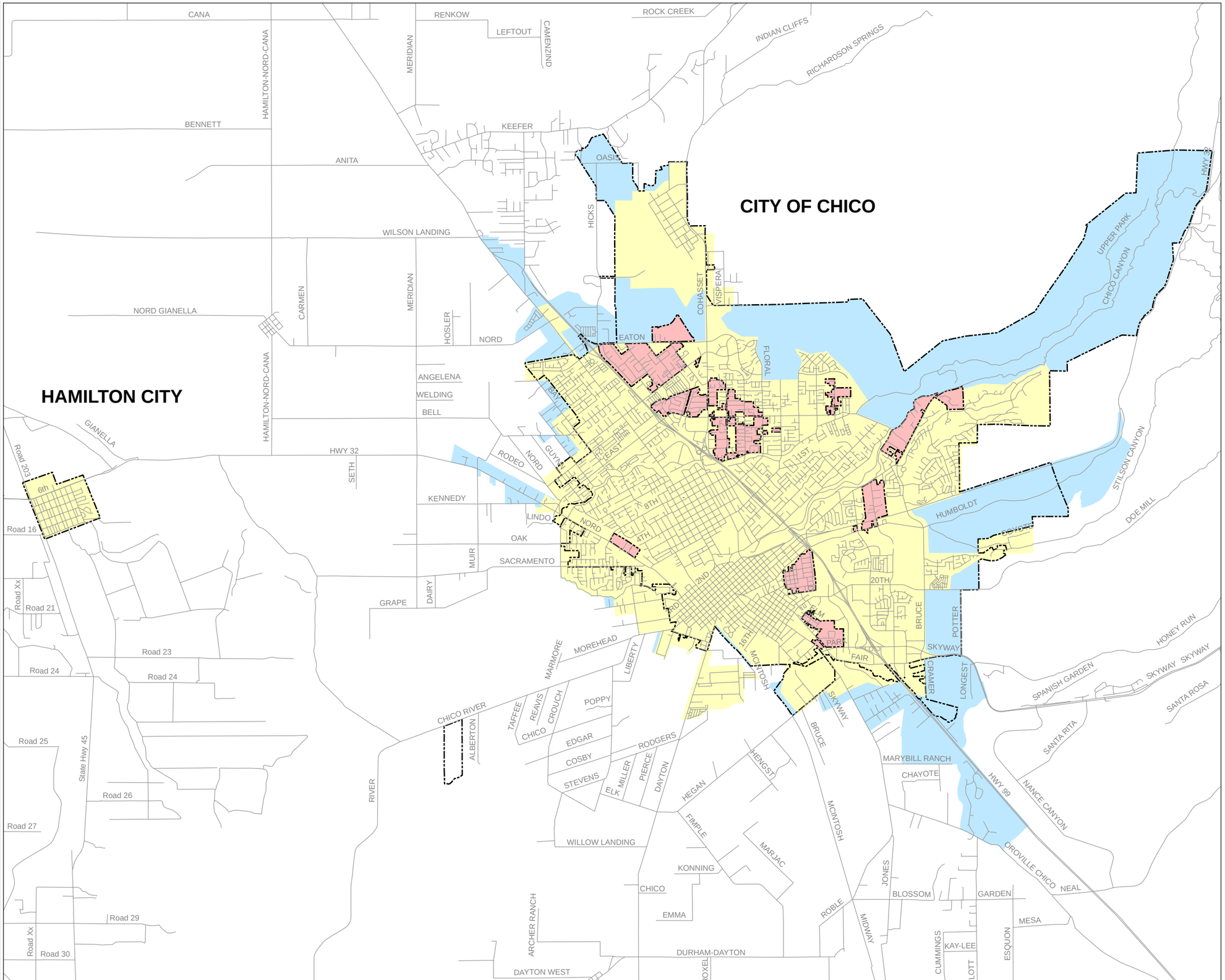
Public Version

Public Version

# FIGURE 3-1

## California Water Service Company Chico-Hamilton City District Water Supply and Facilities Master Plan

## SERVICE AREA LOCATION



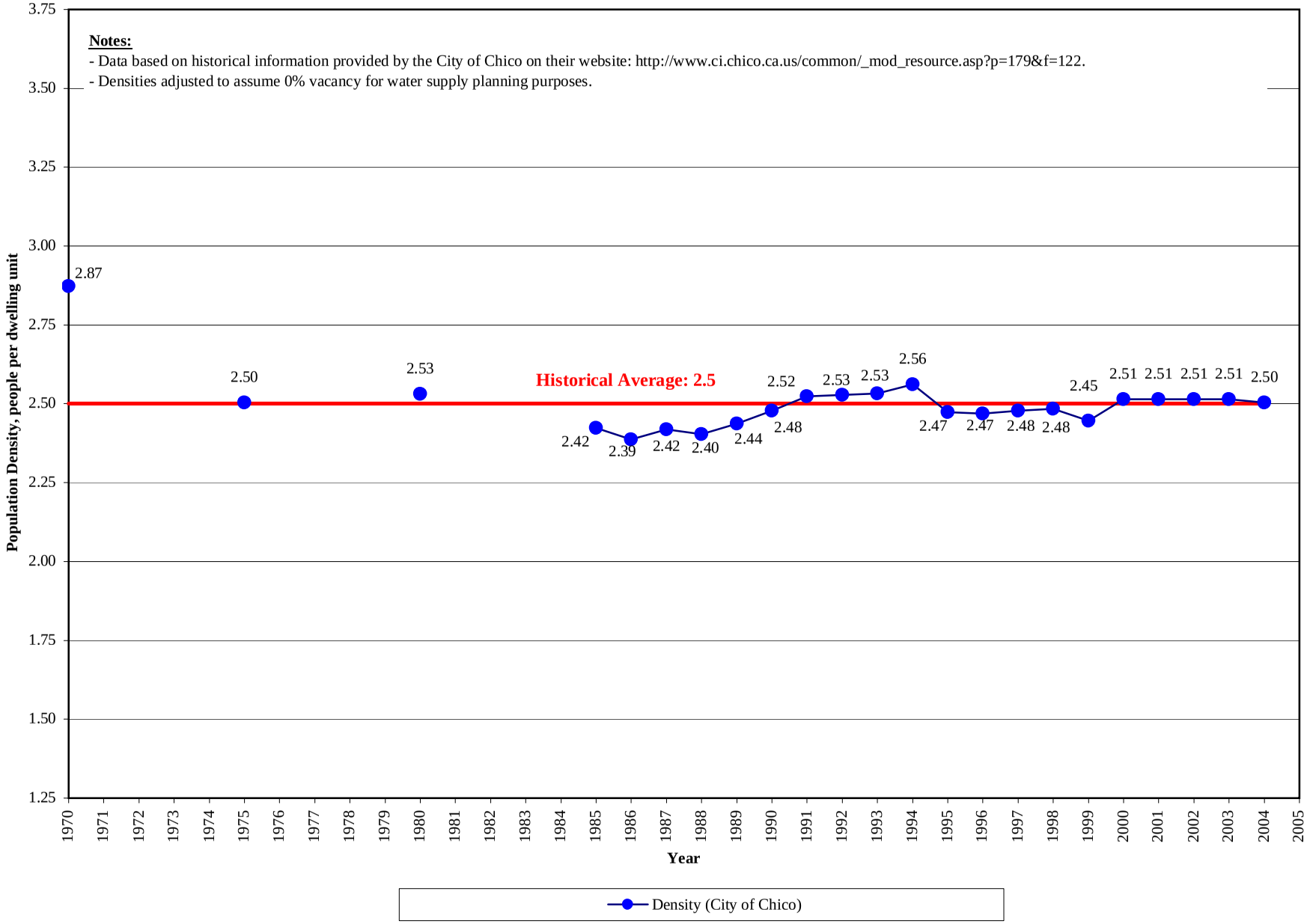

NOTES:

LEGEND:

- Cal Water Service Area
- County Islands within City Limits
- City of Chico Sphere of Influence
- Street

o:\c436\02-06-03\GIS\WMP\Ch3\Figure 3-1 ServiceArea.mxd 05-01-07 11:13am isuroso

# Figure 3-2. Historical Housing Density for Water Supply Planning

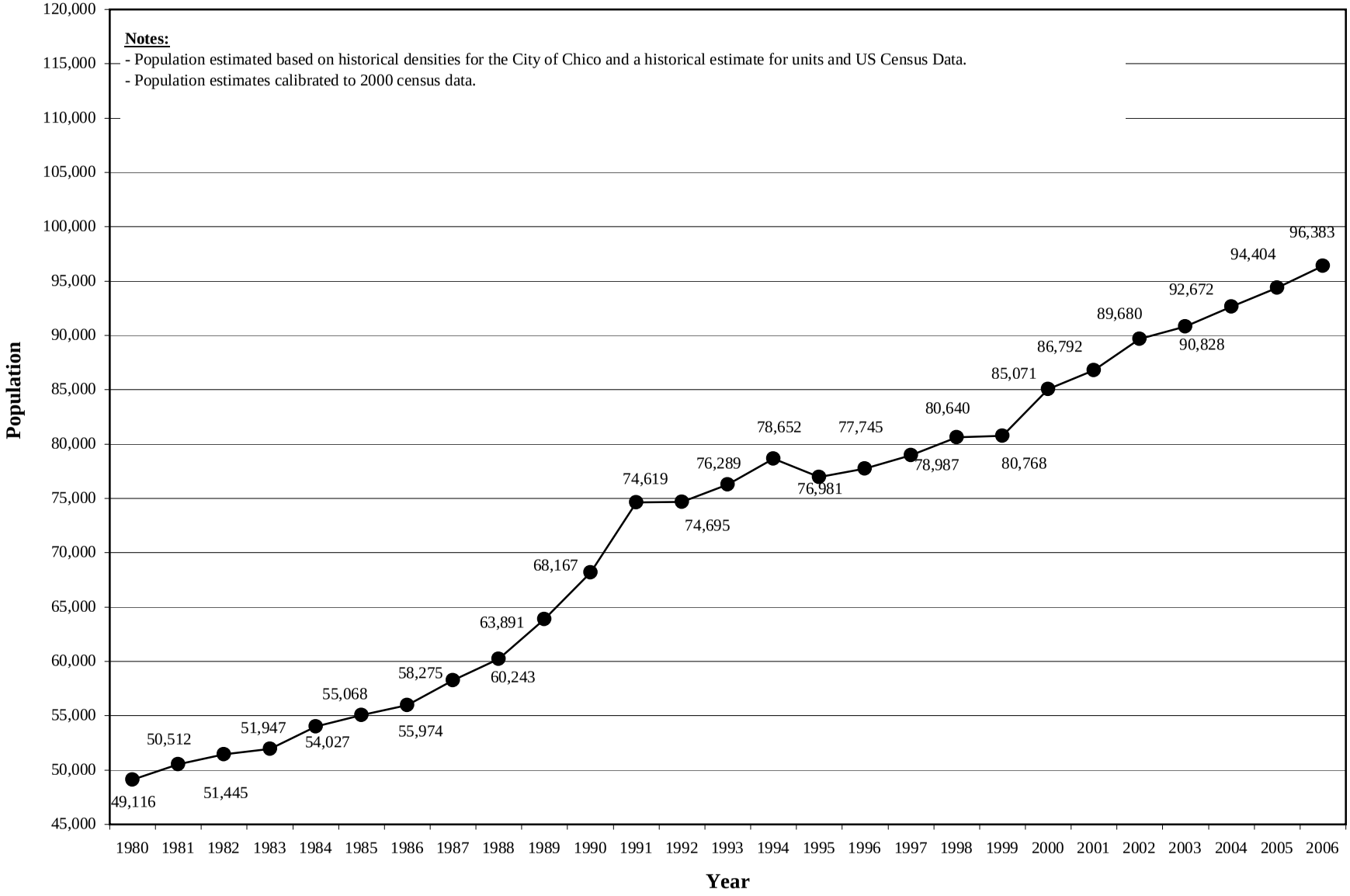



Public Version

West Yost Associates
o\c\436\020603\e\1\wd\chwtrp306
Last Revised: 5/30/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Figure 3-3. Estimated Historical Population Served




West Yost Associates
o\c\436\020603\e\1\wd\chwtrp306
Last Revised: 08/06/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

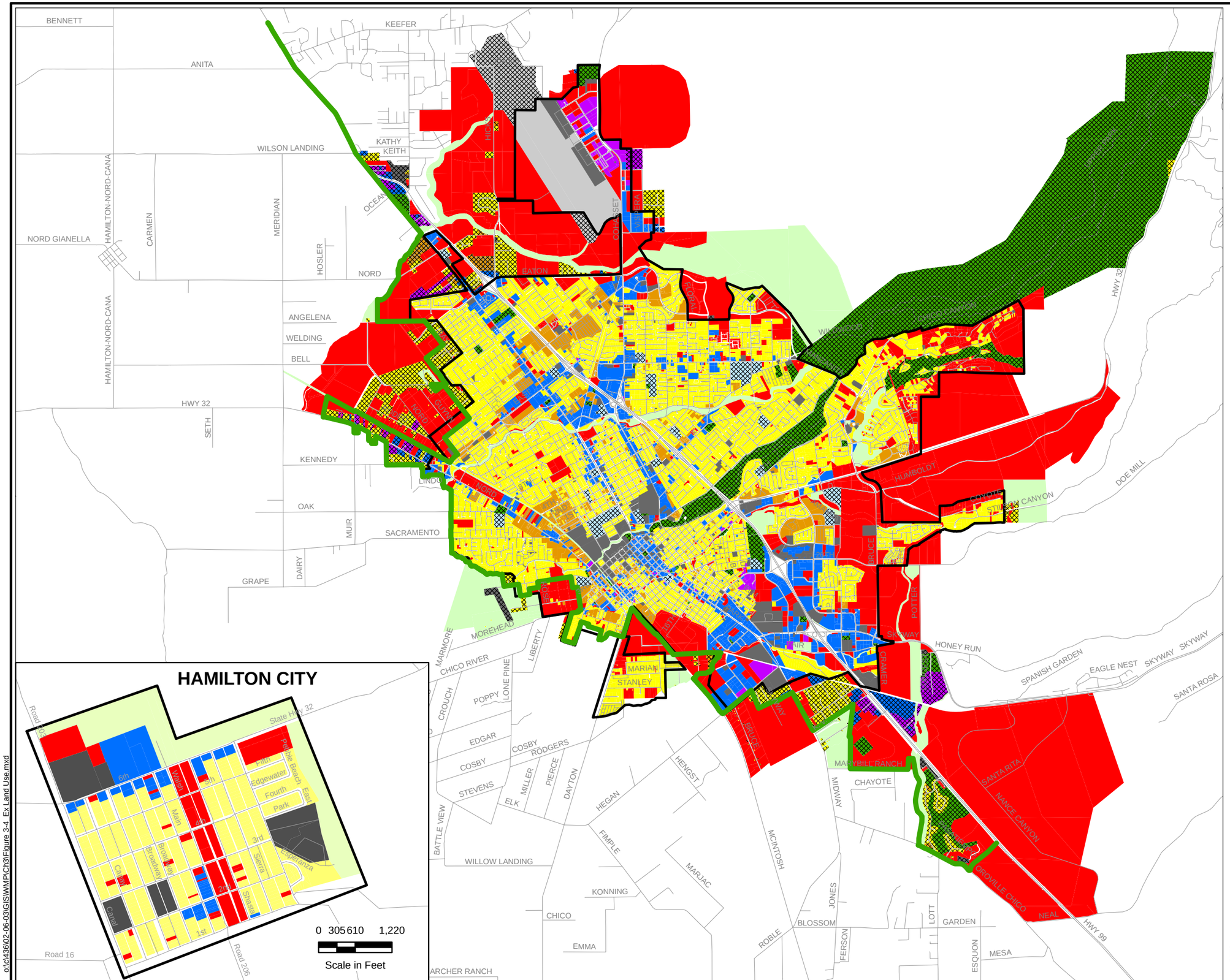
Public Version

Public Version

# FIGURE 3-4

## California Water Service Company Chico-Hamilton City District Water Supply and Facilities Master Plan

## EXISTING LAND USE




NOTES:

Greenline is an urban growth boundary adopted by Butte County in 1982.

LEGEND:

- Cal Water Service Area
- Assumed Served by Private Well
- Residential
- Multiple Residences
- Commercial
- Industrial
- Government
- Parks & Recreation
- School
- Open Space/Agriculture
- No Water Demand - Runway
- Vacant (to be developed)
- Greenline
- Street

CALIFORNIA WATER SERVICE CO.

WEST YOST ASSOCIATES Consulting Engineers

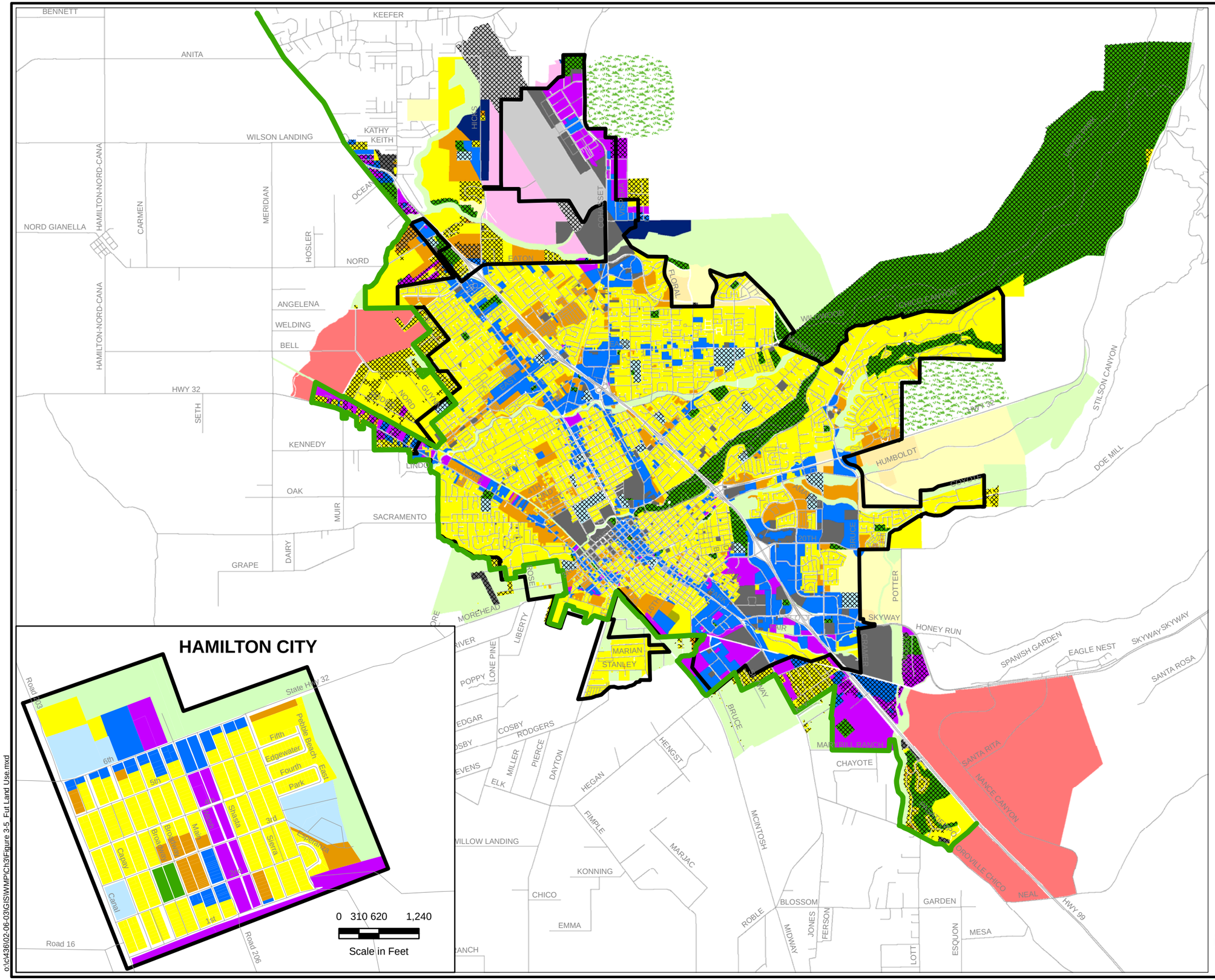
o:\c4436\02-06-03\GIS\WMP\Ch3\Figure 3-4 Ex Land Use.mxd

Public Version

# FIGURE 3-5

## California Water Service Company Chico-Hamilton City District Water Supply and Facilities Master Plan

## FUTURE LAND USE




0 0.5 1 2

Scale in Miles

NOTES:

Greenline is an urban growth boundary adopted by Butte County in 1982.

LEGEND:

- Cal Water Service Area
- Assumed Served by Private Well
- No Development Planned
- Residential
- Residential - Preserve
- Residential - Multiple Residences
- Multiple Residences
- Multiple Residences - Preserve
- Commercial
- Commercial - Preserve
- Commercial - Multiple Residences
- Industrial
- Industrial - Preserve
- Government
- Non-Designated Development
- Parks & Recreation
- School
- Open Space/Agriculture
- No Water Demand - Runway
- Greenline
- Street

CALIFORNIA WATER SERVICE CO.

WEST YOST ASSOCIATES Consulting Engineers

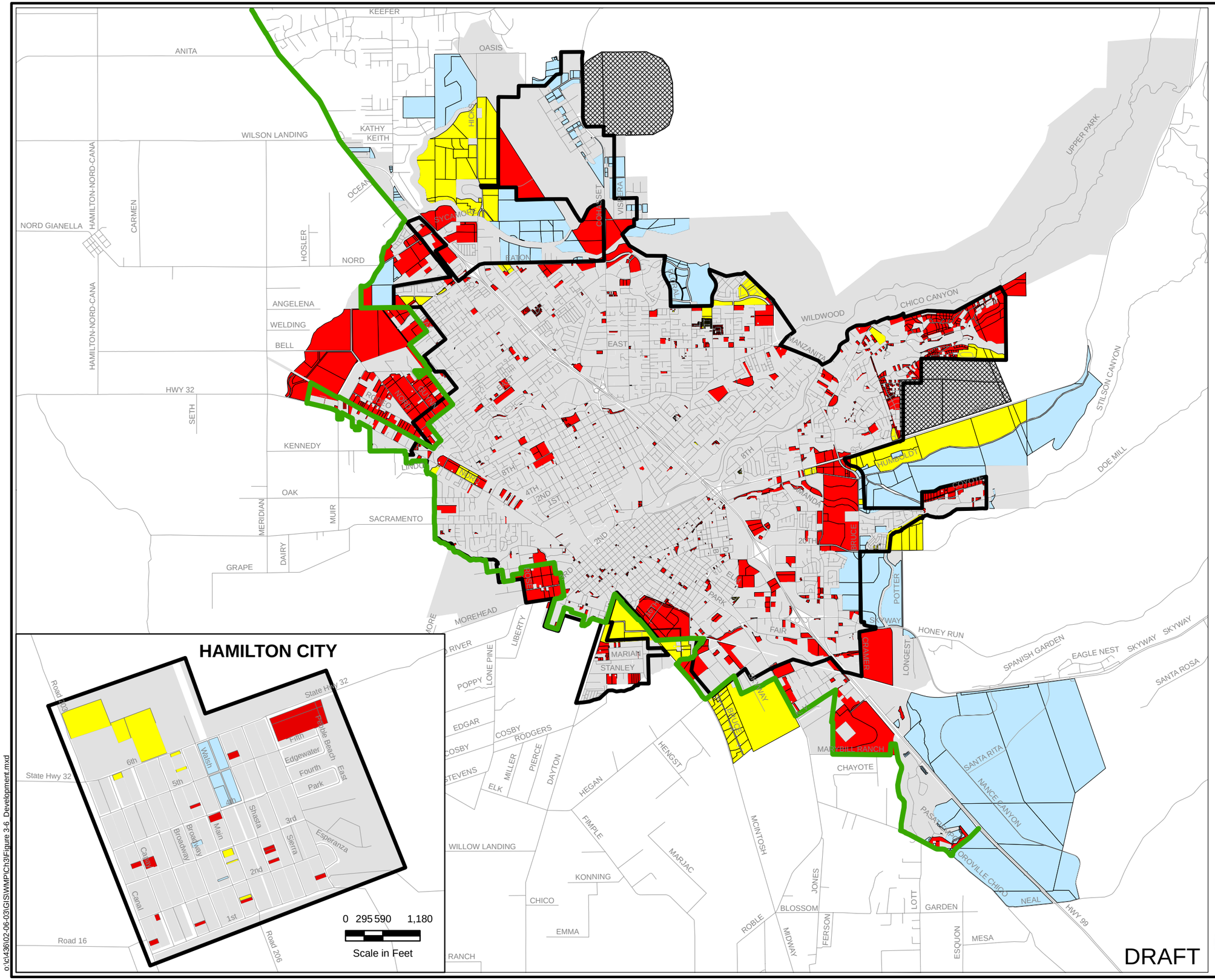
o:\c\436\02-06-03\GIS\WMP\Ch3\Figure 3-5 Fut Land Use.mxd

Public Version

# FIGURE 3-6

## California Water Service Company Chico-Hamilton City District Water Supply and Facilities Master Plan

## DEVELOPMENT OVER TIME




N

0 0.5 1 2

Scale in Miles

NOTES:

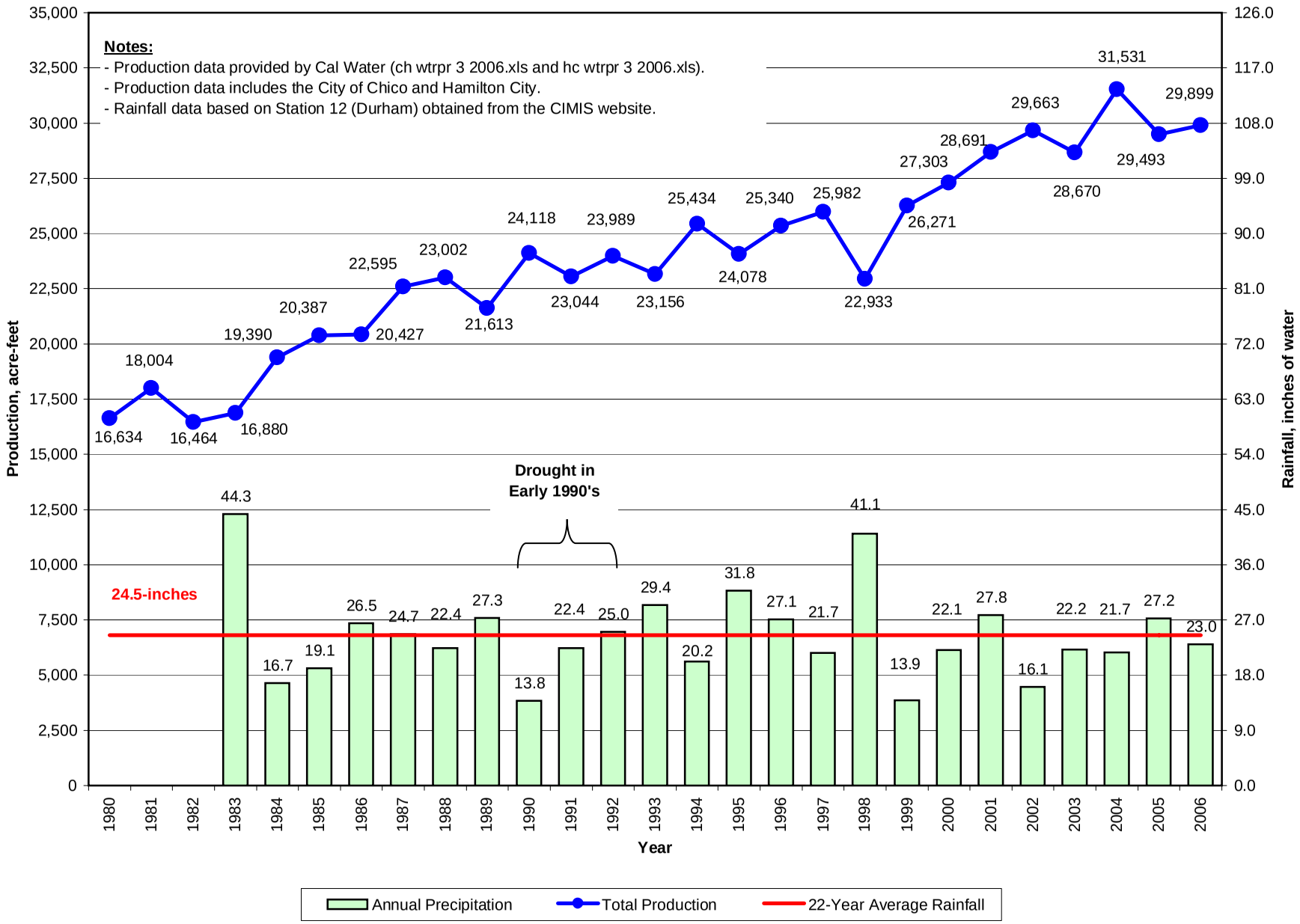
Greenline is an urban growth boundary adopted by Butte County in 1982.

LEGEND:

- Cal Water Service Area
- Development Starting in 2006
- Development Starting in 2010
- Development Starting in 2015
- Existing Development
- No Development Planned
- Greenline
- Street

o:\c\436\02-06-03\GIS\WMP\Ch3\Figure 3-6_Development.mxd

# Figure 3-7. Historical Water Production

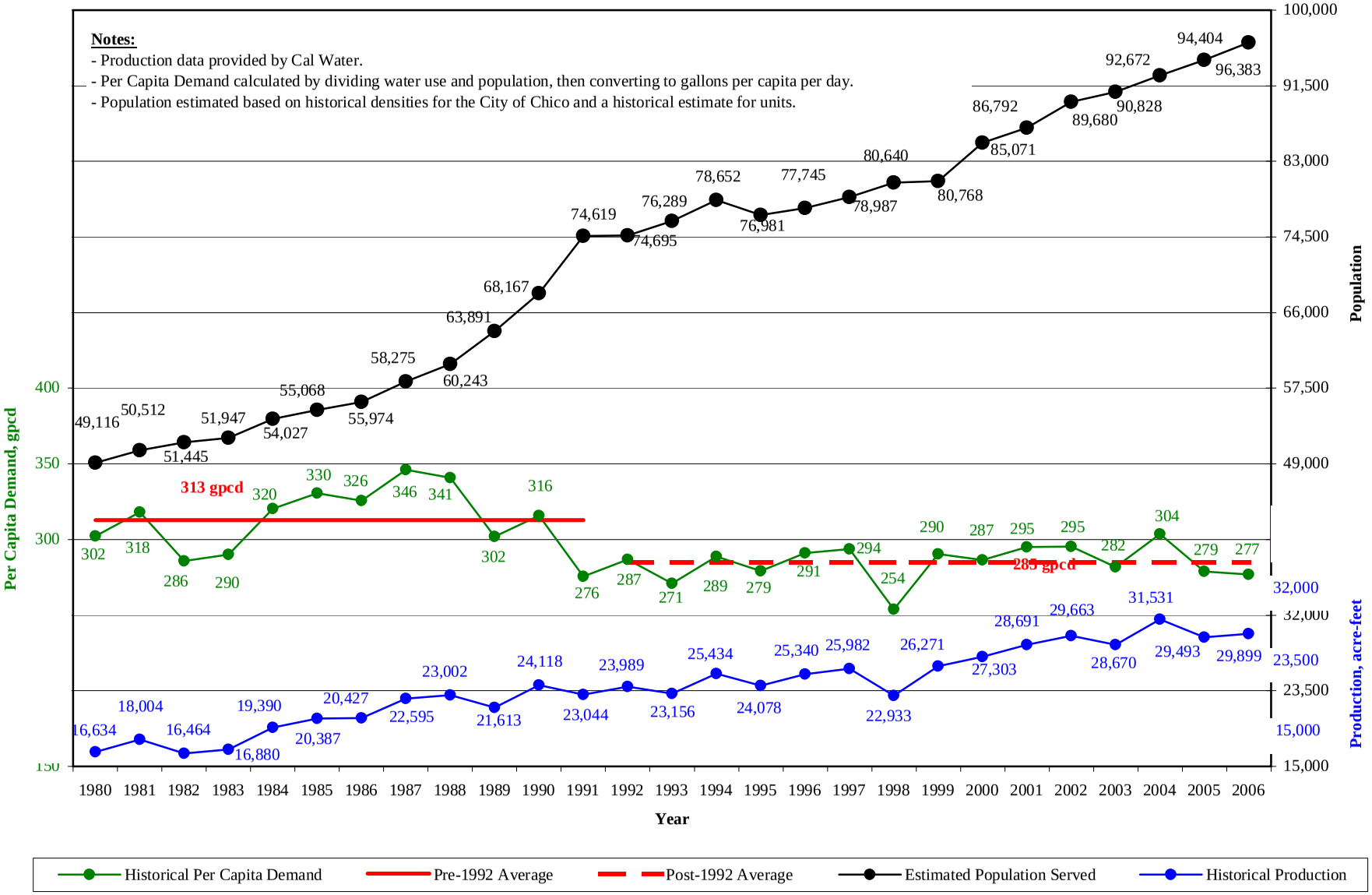



West Yost Associates
o\c\436\020603\e\1\wd\chwtrp306
Last Revised: 08/06/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

## Figure 3-8. Comparison of Historical Per Capita Demand, Production, & Population

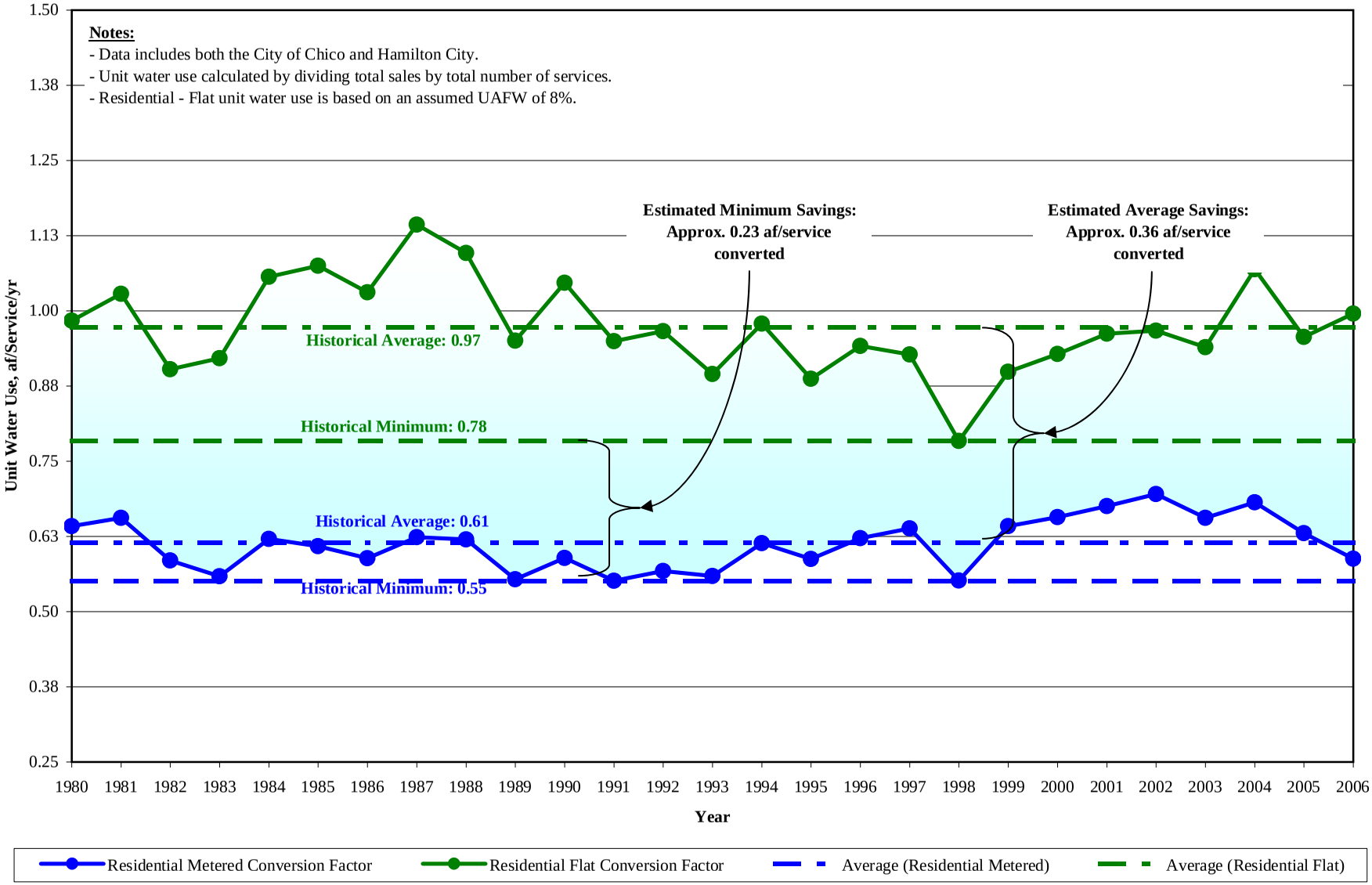



Public Version

West Yost Associates
o\c\436\020603\e\1\wd\chwtrp306
Last Revised: 07/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Figure 3-9. Estimated Water Savings from Conversion of Residential - Flat Accounts

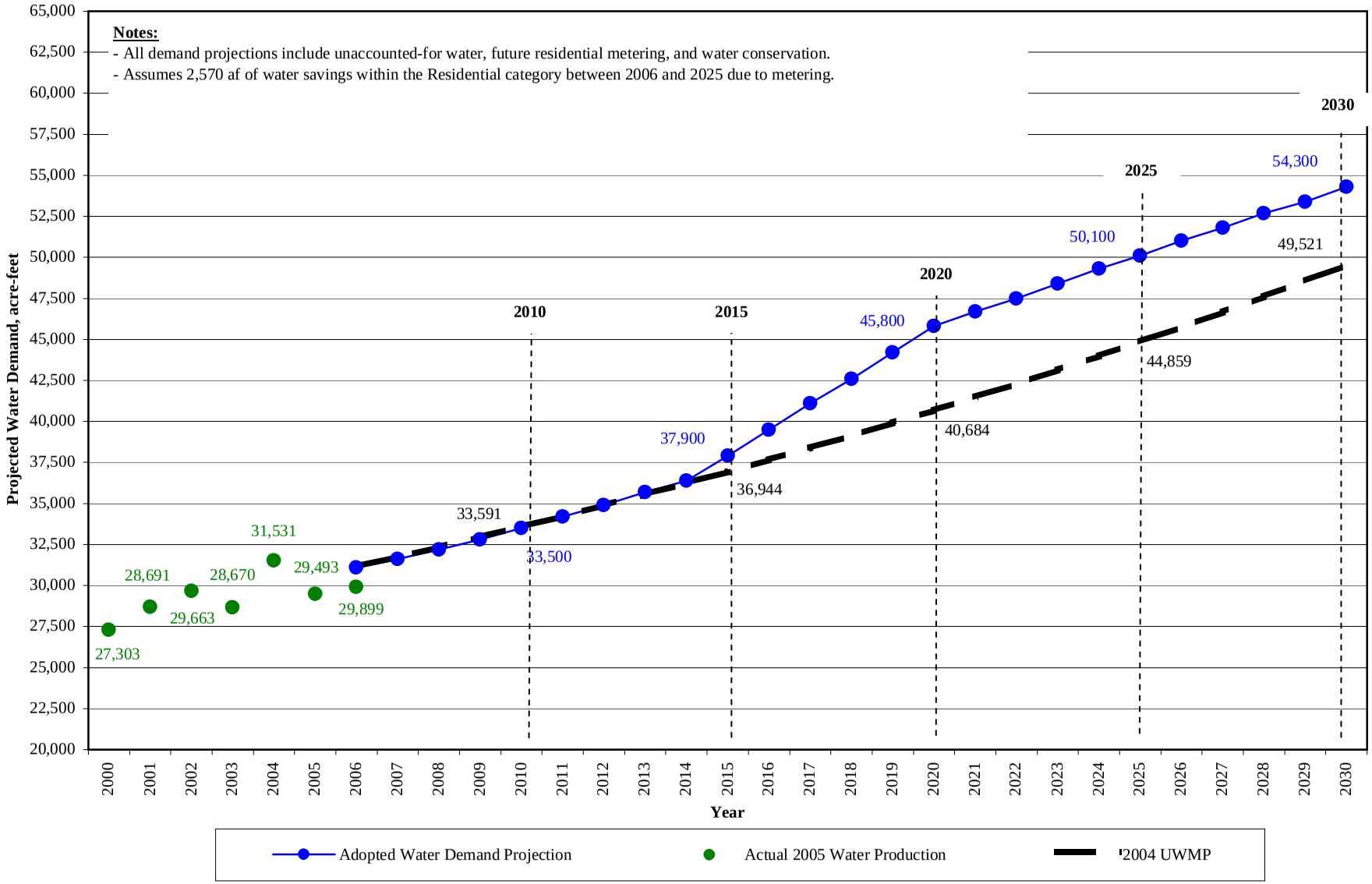



Public Version

West Yost Associates
o\c\436\020603\e\1\wd\servsales
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Figure 3-10. Projected Water Demands for the Chico District

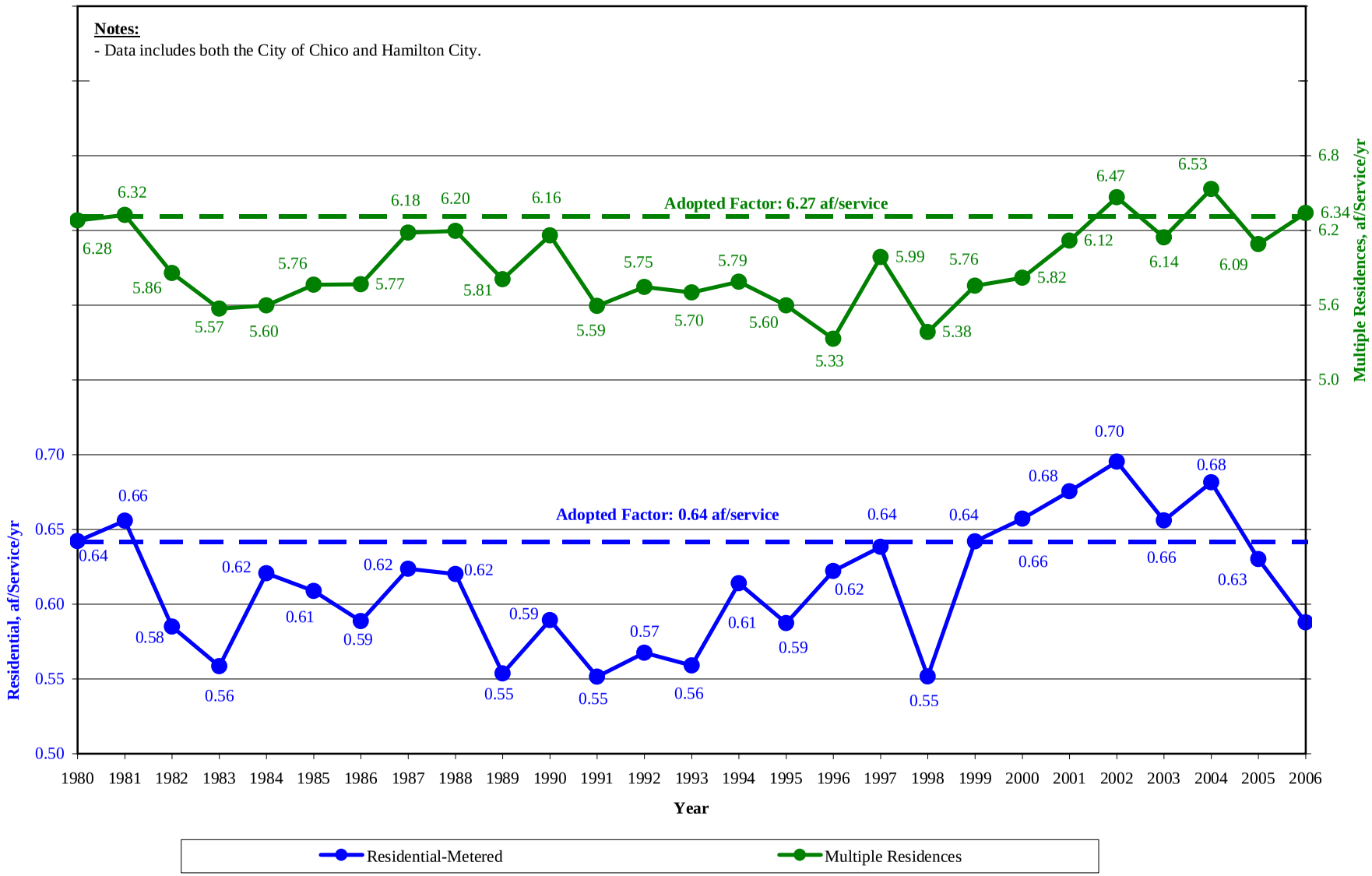



Public Version

West Yost Associates
o\c\436\02063\e\1\wtrdmds\06chicodemandprojections
Last Revised: 08/06/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Figure 3-11. Unit Factor for Residential and Multiple Residences

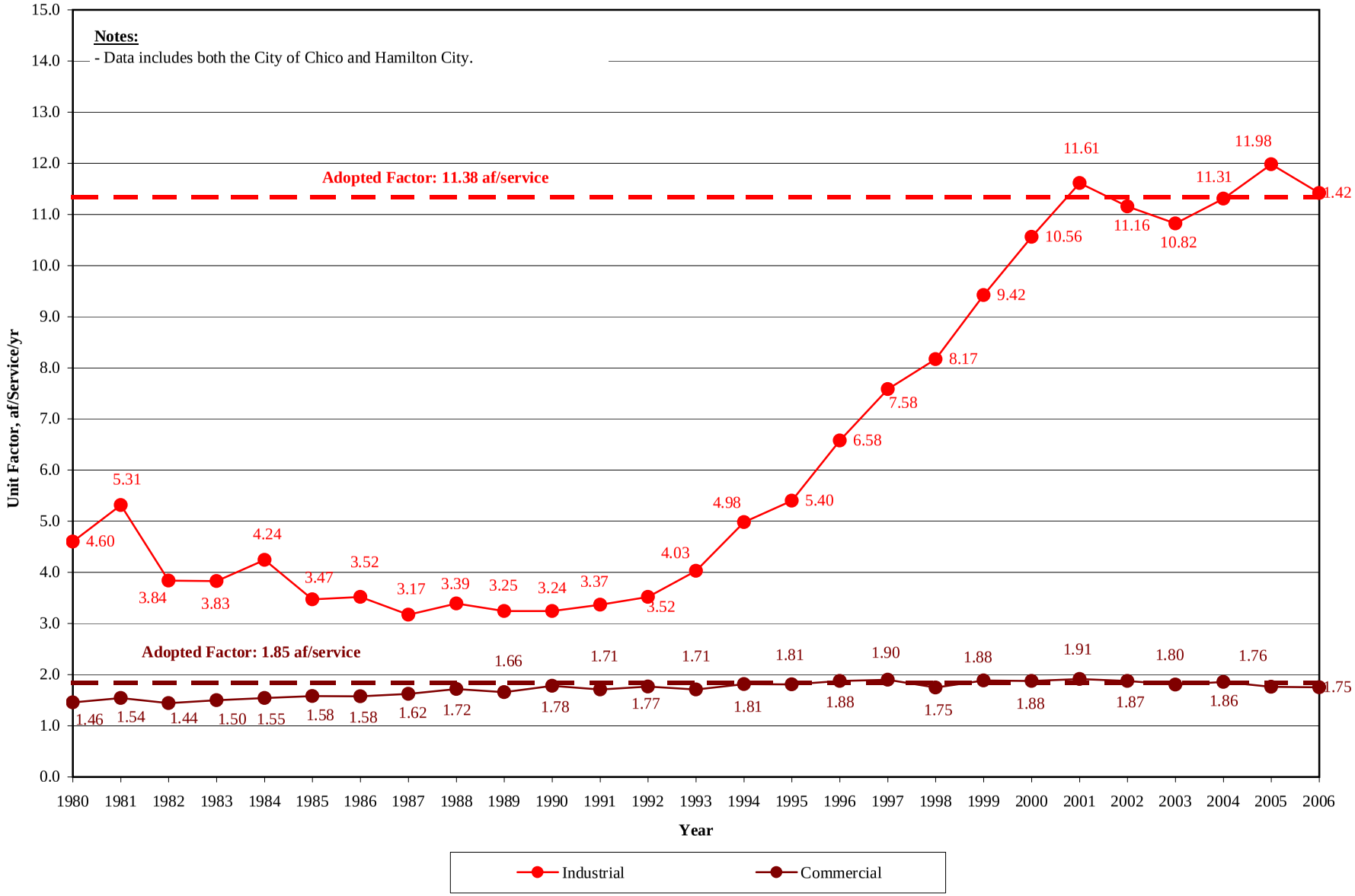



Public Version

West Yost Associates
o\c\436\020603\e\1\wd\servsales
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

# Figure 3-12. Unit Factor for Commercial and Industrial




West Yost Associates
o\c\436\020603\e\1\wd\servsales
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

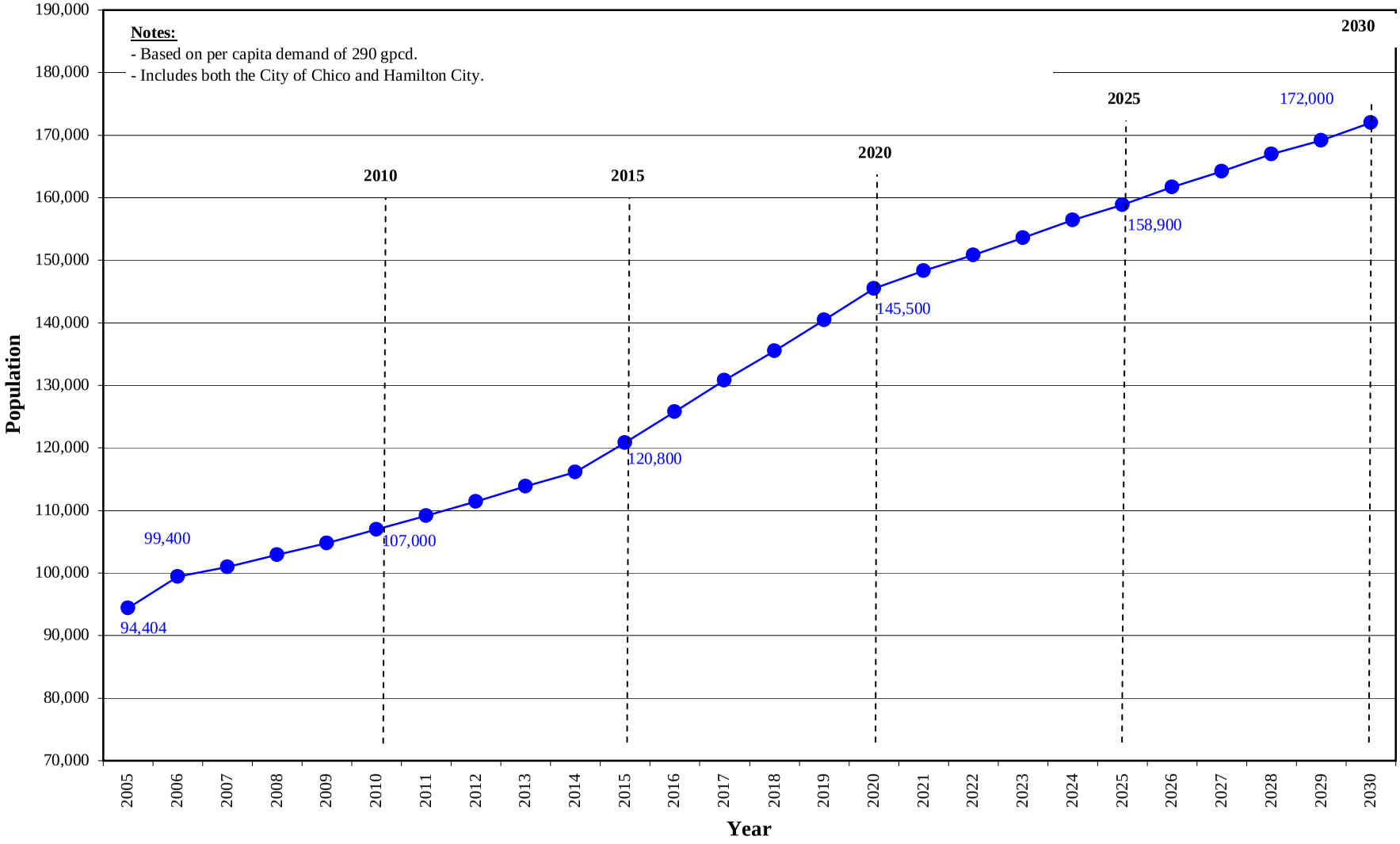
## Figure 3-13. Unit Factor for Government and Non-Designated Development

West Yost Associates
o\c\436\020603\e\1\wd\servsales
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

## Figure 3-14. Projected Population Served in the Chico-Hamilton City District




West Yost Associates
o:\c\436\02-06-03\e\01\waterdemands\2006chicodemandprojections
Last Revised: 05/31/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

## REFERENCES

Blaney Dyett, Michael Brandman Associates, Korve Engineering, Roma Design Group, Brown-Butin, 1999. City of Chico General Plan. February.

Cal Water, 2004. Urban Water Management Plan for the Chico-Hamilton District. June.

Heritage Partners, Budick and Company, Vail Engineering, 1995. North Chico Specific Plan. March 28.

Public Version



# Chapter 4: Water Supply

*Chapter Contents:*


- Groundwater Supply
- Other Potential Water Supply Options
- Summary Recommended Supply Option


*Chapter Highlights:*

The purpose of this Chapter is to describe the quantity and reliability of groundwater pumped by Cal Water. This chapter also describes other potential future water supply concepts (surface water and recycled water) that Cal Water can further explore to increase supply reliability as demands increase in the future and if groundwater conditions change.

After identifying other potential water supplies for the Chico-Hamilton City District, this Chapter then presents the most plausible water supply scenario available to Cal Water, including a comparison of future water supply and demand. The cost of the recommended water supply scenario is also provided.

# CHAPTER 4. WATER SUPPLY

Cal Water's Chico-Hamilton City District currently relies solely on groundwater to meet the potable water demands of its existing customers. The purpose of this Chapter is to describe the quantity and reliability of groundwater pumped by Cal Water. This chapter also describes other potential future water supply concepts (surface water and recycled water) that Cal Water can further explore to increase supply reliability as demands increase in the future and if groundwater conditions change.

After identifying other potential water supplies for the Chico-Hamilton City District, this Chapter then presents the most plausible water supply scenario available to Cal Water, including a comparison of future water supply and demand. The cost of the recommended water supply scenario is also provided.

The following sections describe the methodology used to develop the water supply options recommended for the Chico-Hamilton City District.

- Groundwater Supply
- Other Potential Water Supply Concepts
- Recommended Water Supply Option

## GROUNDWATER SUPPLY

The Chico-Hamilton City District overlies the Sacramento Valley groundwater basin, which has been divided into several smaller sub-basins using institutional boundaries established by the California Department of Water Resources (DWR). As shown on Figure 4-1, Cal Water's Chico-Hamilton City District currently overlies three sub-basins of the Sacramento Valley Groundwater Basin (the Vina, West Butte, and Corning sub-basins); however, the Chico-Hamilton City District will also eventually overlie the East Butte sub-basin at buildout. Cal Water is one of many groundwater pumpers that will continue to use groundwater from these sub-basins.

Characteristics of these groundwater sub-basins are provided in Table 4-1.

Figure 4-1 also indicates that Cal Water operates 36 municipal supply wells within the Vina sub-basin, 21 municipal supply wells in the West Butte sub-basin, and 3 municipal supply wells in the Corning sub-basin. Cal Water also has 8 inactive wells due to water quality or low yield problems. As discussed in Chapter 3, during 2005 the Chico-Hamilton City District pumped approximately 28,900 af of groundwater for potable water consumption in the City of Chico and approximately 600 af of groundwater for potable water consumption in Hamilton City.

The following groundwater basin descriptions were derived from DWR Bulletin 118 (last updated February 2004), with additional information obtained from the Butte County Groundwater Inventory Analysis completed in February 2005 by the Butte County Department of Water Resources and Conservation (BCWRC).

**Table 4-1. Characteristics of Groundwater Sub-basins Underlying the Chico-Hamilton City District[(a)]**

| Groundwater Basin Name | Sub-basin Name | Portion of Chico-Hamilton City District Served | DWR Basin Number | Surface Area |
|---|---|---|---|---|
| Sacramento Valley | Vina | City of Chico | 5-21.57 | 125,640 acres (195 square miles) |
| | West Butte | City of Chico | 5-21.58 | 181,560 acres (284 square miles) |
| | East Butte | City of Chico | 5-21.59 | 265,390 acres (415 square miles) |
| | Corning | Hamilton City | 5-21.51 | 205,640 acres (321 square miles) |

(a) Source: DWR Bulletin 118, Groundwater Basin Descriptions, updated February 27, 2004.

**Groundwater Basin Description**

The four groundwater sub-basins are within the Sacramento Valley Groundwater Basin, bounded by Red Bluff to the north, the Sacramento-San Joaquin Delta to the south, the Coast Ranges to the west, and the Cascade Range and Sierra Nevada to the east.[1] The Sacramento Valley Groundwater Basin covers an area of approximately 4,900 square miles.[2]

Figure 4-1 illustrates the location of all four sub-basins. The Vina sub-basin is bounded by Deer Creek to the north, the Sacramento River to the West, Big Chico Creek to the south, and the foothills to the east. The West Butte sub-basin is bounded by Big Chico Creek to the north, Butte Creek to the south, the Sacramento River to the west, and the foothills to the east. The East Butte sub-basin is bounded by Butte Creek to the north and west, Butte County line to the south, and the foothills to the east. The Corning sub-basin is bounded by Thomas Creek to the north, Sony Creek to the south, the Coast Ranges to the west, and the Sacramento River to the east.[3]

The principal hydrogeologic units within these groundwater sub-basins consist of Pliocene sedimentary deposits (e.g., Tuscan, Laguna, and Tehama formations) and Quaternary terrace deposits (e.g., Riverbank and Modesto formations).[4] The Tuscan, Laguna, Riverbank, and Modesto formations provide the majority of groundwater in the area.[5] Excerpts from the Butte County Groundwater Inventory Analysis describing these formations in greater detail (including key cross-sections) are provided in Appendix F.

Groundwater within the sub-basins occurs under both unconfined and confined conditions. Unconfined conditions exist in the surficial Quaternary deposits and Pliocene deposits exposed at the surface, while confined conditions usually exist at depths of 200 feet or greater. [6]The Tuscan formation is unconfined near the valley margin, but is confined at depth, and forms the largest aquifer system for Butte County.[7] Table 4-2 summarizes the major water-bearing formations within each sub-basin.

**Table 4-2. Water-Bearing Formations within Each Sub-basin[(a)]**

| Formation | Typical Thickness, feet | | | |
|---|---|---|---|---|
| | Vina | West Butte | East Butte | Corning |
| Holocene Stream Deposits | 1 to 80 | 1 to 80 | 1 to 80 | 1 to 80 |
| Holocene Basin Deposits | Up to 150 | 10 to 100 | Up to 150 | X |
| Pleistocene Modesto | 10 to 200 | 50 to 150 | 50 to 150 | 10 to 200 |
| Pleistocene Riverbank | 10 to 200 | 1 to 200 | 50 to 200 | 1 to 200 |
| Pleistocene Sutter Buttes Alluvium | X | X | Up to 600 | X |
| Pliocene Laguna | X | X | 180 to 1,000 | X |
| Pliocene Tehama | X | NR | X | Up to 2,000 |
| Pliocene Tuscan | Up to 1,250 | Up to 800 | Up to 800 | NR |

(a) Source: DWR Bulletin 118, Groundwater Basin Descriptions, updated February 27, 2004.
X = Not listed as being within the sub-basin.
NR = No range of thickness provided in literature reviewed.

### Groundwater Level Trends

At the time this water supply and facilities master plan was written, the groundwater model being developed by BCWRC was not complete, and therefore, could not be used to establish whether the portion of each sub-basin underlying Cal Water's Chico-Hamilton City District was in overdraft. Instead, historical water level trend data were used to evaluate the effects of Cal Water's pumping of groundwater supplies, including potential overdraft conditions.

The evaluation included a review of DWR Bulletin 118 to help define criteria necessary to evaluate water level data, analysis of water level data within each sub-basin (Vina, West Butte, and Corning) from which Cal Water currently extracts groundwater, and a summary of major conclusions for the Chico-Hamilton City District. This evaluation provides an estimate of the historical existing storage condition of the groundwater sub-basins, so that Cal Water can make a decision regarding whether or not to continue to rely solely on the groundwater basin for supply. Once completed, the groundwater model being developed by the BCWRC should be used to cross-check the results and recommendations of this evaluation.

<u>Criteria for Evaluating Historical Water Levels</u>

DWR Bulletin 118 defines overdraft as follows:

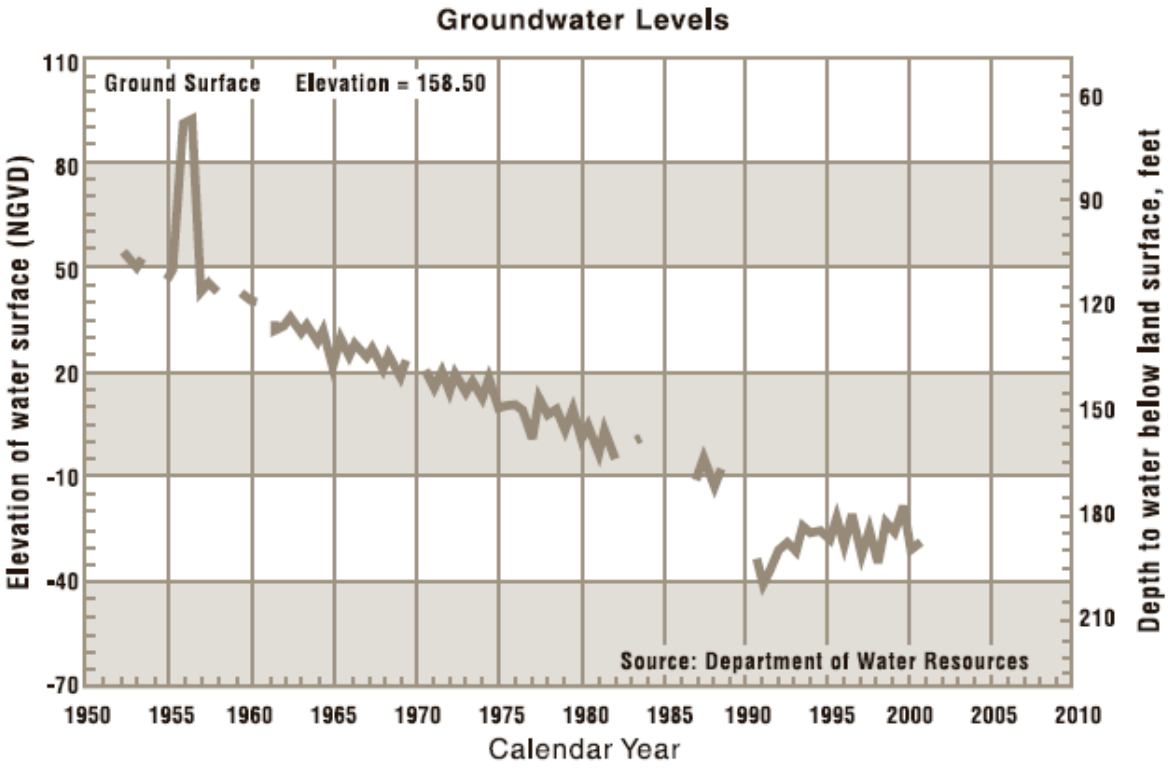
> *"Groundwater overdraft is defined as the condition of a groundwater basin or sub-basin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years, during which the water supply conditions approximate average conditions. Overdraft can be characterized by groundwater levels that decline over a period of years and never fully recover, even in wet years."*

This definition implies that overdraft conditions exist if pumping exceeds recharge, and that declining water levels over an unspecified but operationally representative period is an attribute of overdraft conditions. As shown in Figure 4-2, DWR Bulletin 118 also provides an example of overdraft conditions. This example reflects overdraft at a rate of about 2-1/2 feet per year (ft/year).

Historical annual water level trends fluctuate (declining or increasing by small amounts) depending on annual hydrologic conditions. These natural fluctuations do not necessarily indicate the presence of overdraft conditions; instead, the long-term trend over many years is more indicative of whether overdraft conditions exist or not. The geology, historical hydrologic conditions (e.g., dry or wet year), and historical management practices vary from sub-basin to sub-basin; consequently, the actual level of decline that would be indicative of overdraft conditions will also vary from sub-basin to sub-basin.

The rate of water level decline within the Chico-Hamilton City District that would be indicative of overdraft conditions would probably be more than 1 to 2 ft/year. For planning purposes in this Water Supply and Facilities Master Plan, this range (more than 1 to 2 ft/year) was used to evaluate historical water level trends within the portion of the sub-basin used by Cal Water.

**Figure 4-2. Example of Overdraft Conditions in Bulletin 118**
(Source: DWR Bulletin 118 (2003), Chapter 6, Figure 18, pg 97)



Groundwater Level Trends: Vina Sub-basin

The average groundwater elevation within the Vina sub-basin ranges from 130 feet above mean sea level (ft msl) in the southwest to about 200 ft msl in the northeast, and generally flows in a southwesterly direction.[8] Plate 7 of Appendix F illustrates regional groundwater flow in the Spring of 1997.

Figure 4-3 illustrates the average spring to spring water level trends for all of Cal Water's municipal supply wells operated in the Vina sub-basin, along with annual average rainfall. The average water level trend approximates the condition of the portion of the Vina sub-basin in which Cal Water operates.

As shown in Figure 4-3, the average water level decline for Cal Water wells in the Vina sub-basin is approximately 0.09 ft/year, and increases or decreases appear to be somewhat influenced by annual rainfall. This average water level decline is on the extreme lower end of the water level range (1 to 2 ft/year), and is not indicative of overdraft conditions (compare Figures 4-2 and 4-3).

The groundwater inventory analysis prepared by the BCWRC indicated that spring to spring groundwater levels within the northern portion of the Vina sub-basin have changed little since the 1950's and 60's.[9] However, the analysis also indicated that spring to spring water levels in the southern portion of the basin (near Cal Water) have dropped 10 to 15 feet since the 1950's.[10] This water level decline is on the order of 0.27 ft/year, and was based on one DWR well (22N/1E-09J002M). The hydrograph for well 22N/1E-09J002M is provided in Appendix G and the location of the well is illustrated on Figure 4-4.

Although well 22N/1E-09J002M indicated 0.27 ft/year declines, a review of hydrographs developed from three other DWR wells (22N/1W-05M01, 22N/1E-28J03M, 22N/1E-20K01M) near Cal Water's service area in the Vina sub-basin indicated that water level declines, over a 30 to 50 year period, were similar to the average decline observed in Cal Water's wells; on the extreme low end of the range. The water level decline observed in 22N/1E-09J02M may be a localized issue. The hydrographs for these wells are provided in Appendix G, while their location is illustrated on Figure 4-4.

Additionally, individual hydrographs were developed for all of Cal Water's municipal supply wells to determine if localized issues, similar to DWR well 22N/1E-09J002M, existed. All of the hydrographs developed for Cal Water's wells are provided in Appendix H. For planning purposes, we assumed that a potential problem existed if water level declines were greater than or equal to 0.75 ft/year. We believe this is a conservative rate for planning purposes.

Figure 4-5 illustrates the location of Cal Water wells within the Chico-Hamilton City District, and identifies those wells that have water levels declining at a rate greater than 0.75 ft/year. Only Stations 33 and 34 had water level declines greater than 0.75 ft/year within the Vina sub-basin. Figures 4-6 and 4-7 illustrate the hydrographs for Stations 33 and 34, respectively. We looked further into the details for both of these two wells to see if there was a plausible explanation for the observed water level declines.

An examination of the hydrograph for Station 33 on Figure 4-6 indicates that the water level measurements in 1988 and 1997 are suspect because they do not follow historical trends. Our statistical analysis indicates that the water level measurements in 1988 and 1997 are 2 and 3 standard deviations, respectively, larger than the mean. For planning purposes, these two measurements were considered outliers and removed from the analysis. If these two data outliers are removed from the data set and the analysis re-run, the average water level decline is reduced to only 0.34 ft/year (also illustrated on Figure 4-6).

The hydrograph for Station 34 on Figure 4-7 shows that the well has a steady decline of approximately 0.9 ft/year, and does not appear to have any data outliers. Consequently, a cross-section was drawn through Stations 14, 16, 34, 38, and 20 to evaluate the construction of the well. That cross-section is illustrated as Figure 4-8 (the plan view of the cross-section was previously illustrated on Figure 4-5).

As shown on Figure 4-8, it appears that every station along the cross-section, except Stations 34 and 38, have screened intervals in the upper water bearing zone. This additional screening may provide these wells with access to additional groundwater. A comparison of the hydrographs for Station 34 (Figure 4-7) and Station 38 (see Appendix H) indicates that water levels in Station 38 are not declining. Although both wells were constructed in the mid-1960's, Station 34 has a design capacity of 1,200 gpm, while Station 38 has a design capacity of 800 gpm. The difference in design capacity alone is not enough to account for the difference in water level decline.

Consequently, historical pumping records from 2000 to September 2006 for Stations 34 and 38 were compared. Figures 4-9 and 4-10 compare the annual average and spring time average pumpage from both wells. As shown on these figures, on average, Station 38 has pumped more groundwater than Station 34; hence, Cal Water's operational scheme is not likely a key factor contributing to declining water levels observed in Station 34.

Water levels at Station 34 are declining at a much higher rate than surrounding wells, and it appears that this rate of decline is not related to well construction or production. We therefore conclude that the decline appears to be an isolated, localized issue that may be influenced by private pumping activities near the site. We recommend that Cal Water staff visit Station 34 to evaluate the condition of the equipment and determine if private wells in the area may be influencing groundwater levels.

Groundwater Level Trends: West Butte Sub-basin

The average groundwater elevation within the West Butte sub-basin ranges from 90 ft above msl in the southwest to about 140 ft msl in the east, and generally flows in a south to southwesterly direction.[11] Plate 7 of Appendix F illustrates regional groundwater flow in the Spring of 1997.

Figure 4-11 illustrates the average spring to spring water level trends for all of Cal Water's municipal supply wells operated in the West Butte sub-basin, along with annual average rainfall. The average water level trend approximates the condition of the portion of the West Butte sub-basin in which Cal Water operates.

As shown in Figure 4-11, the average water level decline for Cal Water wells in the West Butte sub-basin is approximately 0.10 ft/year, with increases or decreases in water levels somewhat influenced by rainfall. Similar to the Vina sub-basin, this average water level decline is on the extreme lower end of the groundwater level range (1 to 2 ft/year), and does not indicate overdraft conditions.

The groundwater inventory analysis prepared by the BCWRC indicates that spring to spring groundwater levels near the Dayton "4-Corners" area (i.e., south of Cal Water's service area Well 21N/1E-27D01M) have changed little since the 1970's, but show a slight decline in groundwater levels since the late 1940's and early 1950's.[12] The analysis also indicates that groundwater levels near the Sacramento River, north of Old Ferry Road (Well 21N/1W-23J01M), have changed little since the early 1940's.[13] The hydrographs for these wells are provided in Appendix G, while their location is illustrated on Figure 4-4.

A review of hydrographs developed from two other DWR wells (21N/2E-07C01M and 22N/1E-29R01M) near Cal Water's service area in the West Butte sub-basin (see Figure 4-4) indicated that one well (21N/2E-07C01M) had a rate of decline of approximately 0.35 ft/year, while the other well (22N/1E-29R01M) had very stable water levels (see Appendix G). The groundwater decline in DWR well 21N/2E-07C01M is likely a localized issue on the fringe of the sub-basin, and may only be receiving limited recharge.

As shown on Figure 4-5, only Station 5 had water level declines greater than 0.75 ft/year within the West Butte sub-basin. Figures 4-12 provides the hydrograph for Station 5 indicating a steady decline of approximately 0.9 ft/year. A statistical analysis on water level data from calendar years 1994 and 2003, two potential outliers, indicates that the water level data for both years is two standard deviations lower than the mean. Even without these two points, the water level decline is 0.83 ft/year. Consequently, the well construction and historical pumpage for Station 5 were compared to Stations 11, 23, 35, and 51 (all four wells surround Station 5, as shown in Figure 4-5).

Figure 4-13 compares the construction of Station 5 to Stations 11, 23, 35, and 51. Stations 5 and 51 are shallower wells than Stations 11, 23, or 35. The additional depth could explain some of the reason Station 5 shows decreasing water levels; however, Station 51 is of similar depth and has increasing water levels. Additionally, Station 5 appears to be screened in a higher zone than Station 51, and both wells were constructed around the same time (1970s). Based on this information, it does not appear that well construction or major geologic features are a key factor contributing to the declining water levels observed at Station 5.

Figures 4-14 and 4-15 compare the annual average and spring-time groundwater production, respectively, from all five wells between 2000 and 2006. Station 5 has produced significantly less water than Stations 35 and 51, yet has a significantly larger rate of water level decline. Based on this information, it does not appear that historical pumping or Cal Water's operational scheme is a key factor contributing to the declining water levels observed at Station 5.

Water levels at Station 5 are declining at a much higher rate than surrounding wells, and it appears that this rate of decline is not related to well construction or production. Consequently, the decline appears to be an isolated, localized issue that may be influenced by private pumping activities near the site. We recommend that Cal Water staff visit Station 5 to evaluate the

condition of the equipment and determine if private wells in the area may be influencing groundwater levels.

Groundwater Level Trends: East Butte Sub-basin

Unlike the Vina and West Butte sub-basins, Cal Water is not currently pumping groundwater from the East Butte sub-basin. We reviewed general gradient information, data presented in the groundwater inventory analysis completed by the BCWRC, and water level trends from key DWR wells within the sub-basin to determine the potential for Cal Water to use groundwater from this sub-basin in the future.

The average groundwater elevation within the East Butte sub-basin ranges from 60 ft msl in the southwest to about 160 ft msl in the east, and generally flows in a south to southwesterly direction.[14] Plate 7 in Appendix F illustrates regional groundwater flow in the Spring of 1997.

The groundwater inventory analysis prepared by the BCWRC indicates that spring to spring groundwater levels between the Richvale and Gridley area (20 to 30 miles southeast of Cal Water's service area) have changed little since the mid-1940's.[15] The analysis also indicates that groundwater levels in the eastern portion of the basin, just south of Thermalito Forebay, have slightly increased since measurements began. This increase is attributed to surface water use in the area.[16]

A review of hydrographs developed from three DWR wells (21N/2E-26E02M, 21N/2E-26F01M, 20N/2E-28N01M) near Cal Water's service area in the East Butte sub-basin indicates that water levels in the portion of the sub-basin near the Chico-Hamilton City District appear to be increasing or only slightly declining, and this small rate of decline is not indicative of overdraft conditions. Appendix G contains the hydrographs developed for the three DWR wells. The location of these wells is illustrated on Figure 4-4.

Groundwater Level Trends: Corning Sub-basin

Plate 7 of Appendix F indicates that groundwater flow is generally east, toward the Sacramento River. According to DWR Bulletin 118, a review of spring to spring groundwater levels for wells within the Corning sub-basin indicate that there does not appear to be any decreasing or increasing trends in groundwater levels.[17]

Figure 4-16 illustrates the average spring to spring water level trends for all of Cal Water's municipal supply wells operated in the Corning sub-basin, along with annual average rainfall. The average water level trend approximates the condition of the portion of the Corning sub-basin in which Cal Water operates. The average water level change for Cal Water wells in the Corning sub-basin is approximately 0.33 ft/year increase, and annual increases or decreases in water levels appear to be influenced by rainfall.

Figure 4-4 indicates that none of the water levels in the three DWR wells reviewed (22N/2W-19E03M, 22N/1N-29K01M, 21N/1W-04N01M) were decreasing. On the contrary, groundwater levels in all of the DWR wells were either stable or increasing. Appendix G contains the hydrographs for the DWR wells, while Appendix H contains the hydrographs for Cal Water's wells.

Summary of Groundwater Level Trends: Cal Water's Chico-Hamilton City District

Groundwater wells within the Chico-Hamilton City District currently pump water from three groundwater sub-basins (Corning, Vina, and West Butte). Current plans are to also eventually pump groundwater from the East Butte sub-basin.

Only three wells are operated in the Corning sub-basin (Hamilton City). All of the wells evaluated in this study (both Cal Water and DWR) in or near Hamilton City have either stable or increasing groundwater levels. As discussed in Chapter 3, groundwater demands within Hamilton City are only projected to increase by approximately 130 af/yr. Consequently, additional groundwater pumpage by Cal Water is not likely to affect regional groundwater levels in the eastern portion of the Corning sub-basin.

Cal Water is currently operating 57 groundwater wells within the City of Chico (36 in the Vina sub-basin and 21 in the West Butte sub-basin). On average, water levels within the portion of the sub-basin used by Cal Water appear to be stable or only showing very minor water level declines in isolated wells.

Only two wells (Station 34 in the Vina sub-basin and Station 5 in the West Butte sub-basin) had water levels declining at an annual rate to cause concern (greater than 0.75 ft/year). However, these two wells appear to have isolated, localized issues that should be further investigated by conducting equipment inspections and site surveys of adjacent private pumpage.

Additionally, long-term water levels within the 11 DWR wells reviewed in the Chico area (4 in the Vina sub-basin, 4 in the West Butte sub-basin, and 3 in East Butte sub-basin), seem to support the water level stability trends observed in the Cal Water wells. Overdraft conditions are not likely present based on the data reviewed

As addressed in Chapter 3, water demands served by Cal Water in the City of Chico area are projected to increase by approximately 80 percent (from 29,900 to 54,300 af) over the next 25 years. Although historical water levels do not indicate the presence of overdraft conditions, increasing water demands by 80 percent, and continuing to use the groundwater basin to meet these demands, may have a dramatic affect on the sub-basins in the future.

Consequently, for planning purposes we recommend that Cal Water staff plan on using groundwater to meet future water demands, but closely monitor groundwater levels in its wells to see if increased demands cause additional groundwater level declines in the portions of the sub-basins in which they operate. Once completed, Cal Water staff should also use the groundwater model being developed by the BCWRC to confirm the recommendations provided in this chapter.

**Groundwater Quality**

The quality of groundwater underlying the Chico-Hamilton City District was evaluated by consulting DWR Bulletin 118, identifying known regional groundwater plumes in the area, locating active groundwater contamination cases in the area, and reviewing historical water quality data from each municipal well operated by Cal Water. As discussed below, most of the

concerns are already being addressed, and future problems can be avoided through careful site selection of new wells.

Water Quality from Bulletin 118

Groundwater within the Sacramento Valley Groundwater Basin, and the four sub-basins pertinent to Cal Water, consist predominately of calcium-magnesium bicarbonate and magnesium-calcium bicarbonate. Total dissolved solids (TDS) concentrations generally range from 48 to 676 milligrams per liter (mg/L).[18] TDS concentrations above 500 mg/L may start to cause taste and odor problems; however, the TDS concentrations reported by DWR Bulletin 118 will not likely limit Cal Water's ability to use groundwater in the area to meet demands.

Regional Groundwater Plumes

Discussions with staff of the California Department of Toxic Substances Control (DTSC) indicate that there are 8 regional groundwater contamination plumes located in the City of Chico. Half of the plumes are within the Vina sub-basin and half are within the West Butte sub-basin. No regional plumes near Cal Water's water distribution system could be identified in the East Butte sub-basin or in the Corning sub-basin (Hamilton City).

The 8 regional plumes, as labeled by DTSC, consist of the Central Plume, North Valley Cleaners, Louisiana Pacific, North Central Plume, Southwest Plume, Victor 20th Street Plume, Chico Municipal Airport/Victor Industries Plume, and the Skyway Homes Subdivision Plume. The potential source and status of each plume is summarized in Table 4-3, while Figure 4-17 illustrates the location of each plume relative to Cal Water's existing municipal supply wells.

As shown in Table 4-3, all of these plumes (with the exception of the Skyway Subdivisions plume) were discovered by the early 1990's, and are being addressed through site characterization or active remediation. None of these plumes, including Skyway Subdivisions, likely pose a threat to Cal Water's future groundwater supplies because their locations are identified and can be avoided by careful selection of future well sites.

Active Groundwater Cases in the Area

A review of the EnviroStor database managed by DTSC, and the GeoTracker database managed by the State Water Resources Control Board (SWRCB), indicate that, in addition to the 8 regional plumes located within the Chico-Hamilton City District, there are also 29 active unauthorized chemical releases that have impacted local groundwater. Two of these cases are located in Hamilton-City.

Table 4-4 identifies the sub-basin in which the active case is located, lists the type of case (LUFT, DTSC, SLIC), and summarizes the contaminants found. Figure 4-18 illustrates the location of sites consisting of chlorinated solvents (tetrachloroethylene (PCE) and trichloroethylene (TCE)), Figure 4-19 illustrates the location of sites consisting of petroleum hydrocarbons (total petroleum hydrocarbons (TPH), methyl tertiary-butyl ether (MTBE), and Benzene, Toluene, Ethylbenzene, Xylenes (BTEX)), and Figure 4-20 illustrates the location of sites consisting of other contaminants (e.g., polycyclic aromatic hydrocarbon (PAHs), cyanide,

arsenic). Some sites may be shown on more than one figure due to the presence of multiple contaminants.

**Table 4-3. Regional Groundwater Plumes[(a)]**

| Plume Name | Primary Contaminant | Year Detected | Potential Sources | Status |
|---|---|---|---|---|
| Central | PCE | 1986 | Typically used as a dry cleaning agent | Remediation is on-going, and a Chico High School irrigation well acted as conduit to spread contaminants to lower aquifer. |
| North Valley Cleaners | PCE | 1995 | North Valley Cleaners, via on-site septic tank | Currently undergoing remediation. |
| Louisiana Pacific | Arsenic, PCP, BTEX | 1991 | Louisiana Pacific – Wood Products Facility | Soil contamination remediation deemed complete, while groundwater is currently undergoing remediation. |
| North Central | PCE, 1,2-DCE | 1986 | PCE is typically used as a dry cleaning agent, while 1,2-DCE is likely a breakdown product | Groundwater is being treated via an air stripper located at Station 16. |
| Southwest | PCE | 1991 | Area dry-cleaners located upgradient | GAC installed at Station 46 is being used to treat groundwater. Responsible parties are investigating the shallow and deep groundwater. |
| Victor 20th Street | PCE/TCE | 1990 | Victor Industries – Former Metal Tube and Can facility, TCE used as a degreaser | Recent court settlement will provide DTSC with funding to continue site characterization, and construct a pump and treat system. |
| Chico Municipal Airport/Victor Industries | TCE | 1984 | Victor Industries | Responsible party in the process of installing GAC to treat TCE, and discharge treated water to Sycamore Creek. |
| Skyway Homes Subdivision | PCE, TCE | 2003 | Metal Manufacturing | DTSC is providing bottled water, and is trying to determine the responsible party. |

(a) Data obtained from DTSC staff, EnviroStor database, and the Chico Area Groundwater Plume Updates and Public Notice dated March 2004.

**Table 4-4. Potential Responsible Parties in the Chico-Hamilton City District with Known Groundwater Contamination**

| ID | SITE_NAME | Sub Basin | Type | PCE | TCE | TPH | MTBE | BTEX | PCP or TCP | PAH | CYANIDE | ARSENIC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 7-Eleven Store #14070 | West Butte | LUFT | | | | X | X | | | | |
| 02 | Beale Titan Site 1C | Vina | DTSC | X | X | | | | | | | |
| 03 | Cash Oil | Vina | LUFT | | | | X | | | | | |
| 04 | Chevron SS/One Stop Chico | Vina | LUFT | | | X | X | X | | | | |
| 05 | CSK/Former Grand Auto | West Butte | SLIC | | | X | | | | | | |
| 06 | Erics Cable Car Wash | Vina | LUFT | | | X | X | | | | | |
| 07 | Esplanade ARCO | Vina | LUFT | | | | X | | | | | |
| 08 | Esplanade Cleaners | Vina | DTSC | X | | | | | | | | |
| 09 | First Avenue Cleaners | Vina | DTSC | X | | | | | | | | |
| 10 | Flair Custom Cleaners | Vina | DTSC | X | | | | | | | | |
| 11 | Flowserve Corporation | West Butte | LUFT | | | | | | | | | |
| 12 | Flyers #50 | West Butte | LUFT | | | | | | | | | |
| 13 | Frost Oil SS Chico Case #2 | West Butte | LUFT | | | | X | | | | | |
| 14 | Gasamat #954 | Vina | LUFT | | | | X | | | | | |
| 15 | Holly Sugar - Hamilton City Plant | Corning | SLIC | | | X | X | | | | | |
| 16 | Jesse M. Lange Distributing | West Butte | LUFT | | | X | X | | | | | |
| 17 | Kinder Morgan | West Butte | LUFT/SLIC | | | | X | | | | | |
| 18 | Layland Residence | Vina | LUFT | | | | X | | | | | |
| 19 | Ledford Beacon SS | Vina | LUFT | | | X | X | | | | | |
| 20 | LP, Chico Remanufacturing Facility | West Butte | SLIC | | | | | | X | | | |
| 21 | Norge Village Cleaners | West Butte | DTSC | X | | | | | | | | |
| 22 | Peterson Traktor Company | West Butte | SLIC | | | X | | | | | | |
| 23 | PG&E Chico -1 | West Butte | DTSC | | | X | | | | X | X | X |
| 24 | PG&E Chico Former MGP | West Butte | SLIC | | | X | | X | | X | | |
| 25 | PG&E Fell Dehydrator Station | West Butte | SLIC | | | X | | X | | | | |
| 26 | Stony Creek Property | Corning | SLIC | | | X | | | | | | |
| 27 | TOSCO Bulk Plant #0089 | West Butte | SLIC | | | X | X | | | | | |
| 28 | Vanella Oil Company | Vina | LUFT | | | X | X | | | | | |
| 29 | Warner Petroleum | Vina | LUFT/SLIC | | | | X | | | | | |

[a] Data obtained from Geotracker, EnviroStor, and DTSC

LUFT = Leaking Underground Storage Tank
DTSC = Department of Toxic Substance Control
SLIC = Spills, Leaks, Investigation, and Cleanups
GW = Groundwater Contamination is Present
PCE - Tetrachloroethene
TCE - Trichloroethene
DCE - Dichloroethene (both *cis* and *trans* )
TPH - Total Petroleum Hydrocarbons
MTBE - Methyl Tertiary Butyl Ether
BTEX - Benzene, Toluene, Ethylbenzene, Xylene
PCP - Pentachlorophenol
TCP - Trichloropropane
PAH - Polycyclic Aromatic Hydrocarbons

Public Version

These cases have the potential of impacting Cal Water's municipal supply wells with a wide variety of contaminants; however, as shown in Figures 4-18 through 4-20, most of these cases are located in the south-southwestern portion of Cal Water's service area. With the exception of cyanide, all of the contaminants can be removed with conventional well head treatment technology (GAC, Membrane, or Air Stripping), if necessary.

Consequently, these sites can be avoided or the costs of treatment considered when selecting future groundwater well locations. The cyanide contamination location (Pacific Gas & Electric (PG&E) Chico-1, Figure 4-20) should be avoided in the future.

Historical Water Quality in Cal Water Wells

A review of historical water quality data provided by Cal Water indicates that within the past few years only six wells (Stations 16, 21, 33, 40, 46, and 55) had sampling results for various constituents that were above the maximum contaminant levels (MCL), only one well (Station 68) had sampling results above 75 percent of the MCL, and one well (Station 58) is inactive due to taste and odor issues. Wells with sampling results above 75 percent of the MCL were listed to indicate a potential to exceed MCLs in the near future.

Table 4-5 lists the wells and the corresponding contaminants, while Figure 4-21 illustrates the location of the wells relative to the regional groundwater contamination plumes. Appendix I contains historical water quality graphs for each of these wells and corresponding constituents.

**Table 4-5. Cal Water Wells with Contaminants above the MCL or 75 Percent of the MCL**

| Station | Status | PCE | cis-1,2-DCE | FE | NO3 | TDS | Taste & Odor |
|---|---|---|---|---|---|---|---|
| 16 | Active: WHT | > MCL | | | | | |
| 21 | Active: WHT | > MCL | | | | | |
| 33 | Inactive: Bacteria | | | > MCL | | | ✓ |
| 40 | Inactive | | > MCL | | | | |
| 46 | Active: WHT | > MCL | | | | | |
| 55 | Inactive: Nitrates T&O | | | | > MCL | | ✓ |
| 58 | Inactive | | | | | | ✓ |
| 68 | Active | | | | > 75% MCL | | |

WHT – Well Head Treatment Installed
PCE – Tetrachloroethylene
FE – Iron
NO3 – Nitrate as nitrate
TDS – Total Dissolved Solids
MCL – Maximum Contaminant Level

A brief summary of the status of each well follows, while more detailed discussion is provided in Chapter 7 (Facility Assessment):

- *Station 16:* Sampling data provided by Cal Water (mentioned above in Table 4-5 as having GAC to help manage the North Central Plume) did not indicate the presence of PCE greater than the MCL within the past three years. However, data collected by the SWRCB from the influent stream to the granular activated carbon unit did indicate that PCE concentrations were higher than the MCL. This data is provided in Appendix J.
- *Station 21:* Recent sampling results (past three years) indicated the presence of PCE above the MCL; however, Cal Water staff has installed wellhead treatment to remove the contaminant and allow the well to remain active.
- *Station 33:* This well is not currently operating due to microbial growth. Cal Water staff is in the process of rehabilitating the well to address these microbial issues, and expects to re-activate the well.
- *Station 40:* This well has been inactive for the past several years due to the presence of cis-1,2-DCE in concentrations above the MCL; however, Cal Water staff is planning to install wellhead treatment (GAC) to be able to bring this well back online.
- *Station 46:* Recent sampling results (past three years) indicated the presence of PCE above the MCL; however, Cal Water staff has installed wellhead treatment to remove the contaminant and allow the well to remain active.
- *Station 55:* Recent sampling results (past three years) indicated the presence of Nitrate (as NO3) above the MCL; however, Cal Water has deactivated this well, and is no longer using it to supply water.
- *Station 58:* This well has been inactive for the past several years due to taste and odor problems. As discussed in more detail in Chapter 7 (Facility Assessment), we recommend that this well be rehabilitated and re-activated.
- *Station 68:* Recent sampling results (past three years) indicated the presence of nitrates (NO3) above 75 percent of the MCL; however, as shown in Appendix I, these concentrations peaked in 2004 and are currently declining. Cal Water staff should continue to monitor this well to ensure that nitrate concentrations do not increase above the MCL.

Summary of Potential Water Quality Concerns

Although there are eight regional groundwater contamination plumes and 29 additional active, unauthorized chemical releases to groundwater within the Chico-Hamilton City District, they do not pose an immediate threat to Cal Water's existing groundwater supply. Most of the contaminant sources have been identified, and are currently being regulated by either the DTSC or SWRCB. In the future Cal Water can avoid these areas through careful site selection of future groundwater wells.

Of the 60 wells operated by Cal Water, only five wells (Stations 16, 21, 33, 46, and 55) had contaminant concentrations above their respective MCL, and only one well (Station 68) had concentrations above 75 percent of the MCL. Station 58 is an isolated case involving taste and odor issues. Despite the identification of wide-spread contaminants in the groundwater basin, less than 7 percent of Cal Water's wells have been impacted.

Consequently, regional groundwater contamination will not likely limit Cal Water's existing groundwater supplies or prevent Cal Water from relying on the groundwater basin in the future. Cal Water staff should continue to monitor nitrate concentrations at Station 68, and avoid placing wells near the PG&E Chico-1 site that has cyanide contamination.

**Unit Cost of Providing Groundwater in the Future**

The cost for Cal Water to provide groundwater in the future will consist of the cost to maintain its existing capacity and the cost to increase its groundwater production capacity as demands increase. Comparisons of supply and demand, along with the recommended water supply scenario, are discussed in subsequent sections of this Chapter.

Cost of Maintaining Existing Groundwater Production Capacity

Cal Water will need to replace older wells, construct new wells away from existing contamination, or install wellhead treatment, or blend to maintain its existing groundwater production capacity. A detailed discussion regarding schedule and costs to replace older wells or rehabilitate currently inactive wells is provided in Appendix N (Facility Assessment).

Table 4-6 presents the future unit cost of maintaining the existing groundwater pumping capacity assuming the replacement schedule and costs presented in Appendix N (Facility Assessment). The capital costs were annualized using the depreciation methodology adopted by Cal Water for its capital projects. The methodology, developed by Cal Water, accounts for depreciation over 40 years, and revenue requirement to cover debt, annual rate of return (13 percent), and taxes. The detailed tables used to develop the costs presented in Table 4-6 are included in Appendix K.

**Table 4-6. Future Unit Costs of Existing Groundwater Capacity (in 2006 dollars)**

| Component | 2006 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|
| Annualized Capital Cost, $ | 4,825,650 | 4,412,250 | 4,804,300 | 5,120,750 | 5,230,550 | 4,818,475 |
| Groundwater, af[(a)] | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 |
| Unit Capital Costs, $/af[(b)] | 160 | 150 | 160 | 170 | 170 | 160 |

(a) Actual 2005 pumpage was equal to 29,493. The pumpage was rounded to 30,000 af for planning purposes.
(b) Unit Capital Costs rounded to the nearest $10.

Cost of Future Groundwater Production Requirements

Although Cal Water does have a few storage tanks within the distribution system, it primarily relies on its groundwater wells to meet peak hour demands. Continuing to rely on groundwater wells in the future could require Cal Water to construct many new wells that will ultimately be

on stand-by for a majority of the year. This operational technique could add substantial operation and management (O&M) costs to the Chico-Hamilton City District.

Consequently, it was assumed that Cal Water would construct sufficient groundwater production capacity to meet projected maximum day demands, and that peak hour demands would be met with a combination of groundwater from wells and groundwater stored in above ground storage tanks. The maximum day demand was previously presented in Chapter 3 as 2.0 times the annual average day, or approximately 67,380 gpm (97.0 mgd).

Based on data provided by Cal Water, the existing design capacity of all the groundwater wells within the Chico-Hamilton City District is approximately 58,870 gpm. Assuming that 10 percent of Cal Water's groundwater production capacity could be out of service at any given time (i.e., maintenance, water quality or other issues), only 53,000 gpm should be considered as reliable firm capacity. Consequently, Cal Water will require an additional 14,400 gpm (67,380 gpm minus 53,000 gpm) of new reliable groundwater production capacity by 2030, or a total of approximately 15,800 gpm, after assuming that 10 percent additional capacity is required to account for new wells out of service for maintenance, water quality or other issues.

Data provided by Cal Water indicates that wells constructed within the past 30 years have an average design capacity of approximately 1,100 gpm. This implies that Cal Water will need to construct approximately 14 new wells (15,800 gpm divided by 1,100 gpm per well) by 2030.

Assuming an average cost of approximately $1.4 million per new well, Cal Water will expend approximately $19.6 million (1.4 x 14) in new well production capacity, not including the cost of land, between now and 2030.[1] Figure 4-22 illustrates the number of new wells required, by year, based on the timing of future water demands assumed in Chapter 3.

As shown on Figure 4-22, Cal Water will need to construct four wells between 2016 and 2020, five wells between 2021 and 2025, and five wells between 2026 and 2030. This timing was used to project the capital costs of additional groundwater pumping capacity required by 2030.

Table 4-7 presents the unit capital cost of providing additional groundwater pumping capacity to meet future water demands. The capital costs were annualized using the same depreciation methodology used for the existing groundwater costs (see Appendix K).

**Table 4-7. Unit Costs of Additional Groundwater Pumping Capacity (in 2006 dollars)**

| Component | 2006 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|
| Annualized Capital Cost, $ | 0 | 0 | 0 | 7,952,000 | 13,006,000 | 16,383,500 |
| Groundwater, af[(a)] | 1,100 | 3,500 | 7,900 | 15,800 | 20,100 | 24,300 |
| Unit Capital Costs, $/af[(b)] | 0 | 0 | 0 | 500 | 650 | 670 |

(a) Groundwater only includes the additional groundwater required to meet future demands.
(b) Unit capital costs rounded to the nearest $10.

[1] Costs of new wells provided by Cal Water staff.

Total Unit Cost of Groundwater

In addition to the capital costs associated with existing and future groundwater pumping capacity, Cal Water will also have associated O&M costs. Discussions with Cal Water staff in the Chico-Hamilton City District indicated that the current O&M cost is approximately $9,300,000 per year or approximately $310 per af based on 2005 pumpage of 30,000 af. This cost is the dollar value per acre-foot of groundwater delivered and therefore, includes pipeline repair, chemicals, power, and replacement of equipment.

In the future, O&M costs will likely increase due to inflation of material, labor, and equipment costs. Consequently, future O&M costs were projected assuming an increase of 4 percent per year (based on work completed in the Livermore District).

Table 4-8 summarizes the total unit cost of groundwater, which includes the capital costs associated with maintaining existing pumping capacity, capital costs associated with increasing pumping capacity, and O&M costs. As shown in Table 4-8, total costs of groundwater are expected to increase from $480 to $1,160 per af by the year 2030.

**Table 4-8. Unit Costs of Additional Groundwater Pumping Capacity Required**

| Component | 2006 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|
| Existing Capacity, $/af[(a)] | 160 | 150 | 160 | 170 | 170 | 160 |
| Future Capacity, $/af[(b)] | 0 | 0 | 100 | 170 | 180 | 170 |
| O&M Costs, $/af[(c)] | 320 | 380 | 460 | 560 | 680 | 830 |
| Total Unit Costs, $/af[(b)] | 480 | 530 | 720 | 900 | 1,030 | 1,160 |

(a) Obtained from Table 4-6.
(b) Obtained from Table 4-7.
(c) Based on $310/af, and then increased at a rate of 4% per year.

## OTHER POTENTIAL WATER SUPPLY OPTIONS

As discussed previously, this Water Supply and Facilities Master Plan is recommending that Cal Water staff plan on using groundwater to meet future water demands, but closely monitor groundwater levels to ensure increased annual demands do not induce overdraft conditions on a long-term basis. Although the planning horizon for this Water Supply and Facilities Master Plan is 2030, it will most likely require an update every 5 to 10 years.

Consequently, in the near term, Cal Water can rely on continued use of groundwater to meet existing and future projected water demands; however, we also recommend that Cal Water begin exploring the possibility of using other water supplies (e.g., surface water) in conjunction with groundwater. As regulations become stricter and regional water resources become scarcer, integration of other water supply sources may be desirable to assure adequate management and sustainability of groundwater resources, and provide Cal Water's Chico-Hamilton City District with additional supply reliability. Cal Water has recently requested additional water from Butte

County's Table-A Allocation from the State Water Project (SWP). In addition, in a letter dated March 14, 2007, Cal Water indicated that they have the potential to fully utilize all of Butte County's 27,500 af Table-A Allocation.

The purpose of this section is to present Cal Water staff with other potential water supply options that can be further explored. Integration of these other supplies (surface water and recycled water) would strengthen long-term management of groundwater resources and diversify Chico-Hamilton City District's water supply portfolio.

Identifying actual recharge areas and conveyance requirements is beyond the scope of this Water Supply and Facilities Master Plan. Cal Water should commission a separate, more focused feasibility study, which identifies permeable areas upstream of its groundwater extraction wells, and the conveyance facilities necessary to carry any potential water supplies to these areas.

**Potential Surface Water Supply Options**

Cal Water's Chico-Hamilton City District does not currently have surface water rights to support a conjunctive use program. In general, there are three potential sources of surface water for the Chico-Hamilton City District to consider: SWP contract supplies, water purchased from other users via water transfers, and application for a new water right.

The City of Chico and Hamilton City each has unique geography and proximity to surface water bodies, leading to different options for securing surface water rights. This section describes the general options for securing SWP contract supplies, acquiring water through a water transfer, and securing a new water right. This is followed by identification of specific options separately for both the City of Chico and Hamilton City.

State Water Project Contract Supplies

In the 1960s Butte County signed a long-term water supply contract with DWR for a portion of the supply developed by the SWP. The maximum amount in the contract is 27,500 acre-feet per year. The original contract had a buildup schedule to reach this maximum entitlement amount by 1990, but Butte County has worked with DWR to amend this buildup schedule a number of times. The current contract amount is 1,200 acre-feet per year, and is scheduled to jump to the full amount of 27,500 acre-feet per year in 2007.[19]

A working assumption is that the point of delivery, through potential wheeling agreements, is any location along Big Chico Creek, Butte Creek, and Feather River, allowing the use of this supply for implementation of a groundwater recharge project. Figure 4-23 illustrates the location of these water ways in relation to the Chico-Hamilton City District service area, along with other pertinent regional water resource features.

Identifying actual recharge areas and conveyance requirements is beyond the scope of this Water Supply and Facilities Master Plan, and it is recommended that Cal Water commission a separate, more focused feasibility study to address recharge location and conveyance.

The Butte County contract expires in 2035, along with all SWP contracts. Since the SWP serves more than 2.5 million acre-feet to urban water users throughout California, it is a reasonable assumption that these contracts will be extended after that date.

Like all SWP water contractors, Butte County pays an annual cost for the basic development of the water supply, and separately pays for the costs to deliver this water. The annual cost is the "Delta Water Charge", which is a calculated uniform annual "Delta Water Rate" multiplied by the annual amount of water under the contract. Consequently Butte County pays the same "rate" as all SWP water contractors, but pays a "charge" that is significantly less since it is one of the smallest SWP water contractors.

Cal Water will need to pay its proportional share of any portion of Butte County's SWP supplies assigned (not transferred) to Cal Water. The Delta Water Rate is calculated annually based on all financed costs to develop and maintain the water supply features of the SWP. The "rate" for 2005 was $24.48 per acre-foot (DWR Bulletin 132-04, Management of the California State Water Project, Table B-20A, November 2005). The "charge" (rate multiplied by contract amount) must be paid regardless of the amount actually delivered.

Although the SWP water supply contract has provisions for reductions in delivery when the SWP as a whole cannot meet all contract amounts, it is uncertain whether such deficiencies would necessarily be applied in the future to SWP water users upstream of the Delta. Based on the "area of origin" provisions in the California Water Code, a case could be made that SWP water supply deficiencies should not be applied to water users in the "area of origin" upstream of the Delta. If deficiencies are applied, they would be as set forth in DWR's periodic water supply reliability studies for the State Water Project. The most recent report of such studies was released in mid-summer 2006, and is dated April 2006.

More than 25,000 acre-feet per year of SWP contract supply is currently available for use within Butte County. Cost provisions are set forth in Butte County's SWP contract, with details updated in DWR's annual Bulletin 132. Securing a portion of this contract supply would require a separate agreement with the County of Butte.[2] As previously mentioned, Cal Water sent a letter, dated March 14, 2007, to the Butte County Department of Water and Resource Conservation. The letter was sent by Cal Water to indicate to Butte County that Cal Water has the potential to fully utilize all 27,500 af of Butte County's Table A-Allocation from the SWP.

Water Transfers

California has an active water transfers market, whereby one willing water user sells water to another willing water buyer under terms and conditions negotiated by the parties. California water law allows such transfers on both a short-term and a permanent basis. In general, water can be made available for transfer if there is a history of prior use, and the transfer is based on a decrease in use by the seller.

[2] October 4, 2006, conversation with Toccoy Dudley and Vickie Newlin from Butte County.

Based on experience developed in water marketing beginning with the 1991 State Drought Water Bank, DWR, the U.S. Bureau of Reclamation (USBR) and the SWRCB have both oversight and some regulatory role in approving transfers. Such roles and authorities depend on details of a specific proposed transfer.

Water made available by sellers for sale to others can be developed by:

- Selling surface water supplies and replacing with a like amount of additional ground water pumping (this could be supported by an ad hoc program developed in any year or a long-term conjunctive use program);
- Selling surface water supplies and foregoing irrigation that was supported by such supplies (historically described as land fallowing);
- Releasing previously stored water from reservoirs owned or controlled by the sellers;
- Implementing land use changes to reduce the net amount of water historically diverted and used (for example, shifting from a high water use crop to a low water use crop); and
- Pumping and selling ground water. Some of these potential sources are regulated or controlled in some form by local ordinances and State law, as well as by regulatory practice.

There is little or no history of permanent water transfers from agricultural to urban use in the Sacramento Valley, but there are several clear examples in southern California. The most recent example is the transfer of water from the Imperial Irrigation District to San Diego County Water Authority. However, Sacramento Valley transfers for urban use may be considered in the future as urban areas expand due to increases in population in the region.

Water transfers have occurred in the past from agricultural water districts in the Sacramento Valley. One group of potential sellers is irrigation districts along the Sacramento River that have water right settlement agreements with the USBR. Another group is the irrigation districts in Butte County that have water right settlement agreements with DWR. Both groups have sold water in the past on a temporary basis, and it is unknown whether any would be interested in selling water on a long-term basis. Figure 4-23 illustrates the location of other water purveyors (both urban and irrigation districts) near Cal Water's Chico-Hamilton City District service area.

Local ordinances in each county establish approval details and processes. For example, Butte County voters approved Measure G in 1996 **(Chapter 33 of the Butte County Code)** that requires specific findings to support any transfer that is based on the substitution of additional groundwater pumping to offset the sale of surface water.[20,21] In February 2000, the Glenn County Board of Supervisors approved Ordinance No. 1115, which established a Water Advisory Committee (WAC) and Technical Advisory Committee (TAC); these committees oversee regulation of water resources in Glenn County.[22]

Water transfers – whether short or long term – have generated a great deal of local interest and opposition. Any successful transfer will need to be accomplished within a local and regional

policy and political context, in addition to complying with environmental laws and regulatory processes.

New Water Right

Another option is to apply for a water right from the State Water Resources Control Board to divert unappropriated water from the Sacramento River. While a year-round supply cannot be acquired, it is possible to obtain a permit for urban use for much of the year. As indicated below, operations of DWR's State Water Project and the USBR's Central Valley Project control Sacramento River flows much of the year.

Water is available for appropriation except when these two water projects are releasing previously-stored water from their upstream reservoirs to meet flow and quality standards downstream in the Sacramento-San Joaquin Delta. In general, this means that water is available most of the year except for the period mid-June through mid-September, but this is administered on the basis of real-time flows and downstream requirements.

The City of Stockton recently received a water rights permit for a surface water diversion to operate in a conjunctive manner with its groundwater pumping facilities. Davis, Woodland and U.C. Davis are currently pursuing a water rights permit under similar conditions.

Conveyance/Wheeling

Delivery of surface water to the City of Chico or Hamilton City depends on the location of stream systems and/or existing or potential new canals or pipelines, and the location of potential recharge areas. As discussed previously, identifying actual recharge areas and conveyance requirements is beyond the scope of this Water Supply and Facilities Master Plan, and it is recommended that Cal Water commission a separate, more focused feasibility study, to address recharge location and conveyance.

In general, from a water transfers perspective, most or all potential sellers have water right settlement agreements with DWR or USBR. These agencies jointly manage water flows in the Sacramento River system to meet instream and downstream flow and water quality requirements and needs, and coordinate their water project operations through the 1986 Coordinated Operations Agreement (COA). Due to the institutional connections among various water users, DWR and USBR, it may be possible to reduce conveyance costs for some water transfers through exchange agreements that allow water from one stream system to be diverted from another.

Chico Surface Water Supply Options

While the City of Chico portion of Cal Water's Chico-Hamilton City District will continue to rely on groundwater, it can augment those supplies with surface water by securing water rights via any of the three surface water supply options discussed above. Constructing a new water treatment plant to treat and deliver any surface water supplies is likely cost prohibitive, and would not take advantage of Cal Water's existing distribution system; consequently, the most economical use of surface water would likely involve recharge of the groundwater basin through percolation ponds. Should constructing a new water treatment plant become a feasible alternative

for Cal Water's Chico-Hamilton City District, this will require construction of a water conveyance system from DWR's Thermalito Afterbay to this surface water treatment plant near or in the City of Chico. Figure 4-23 shows the proximity of Thermalito Afterbay and the City of Chico. A potential route of the conveyance system is along State Highway 99, which runs fairly directly from the Thermalito Afterbay to the City of Chico. Identifying the actual location of a proposed water treatment plant and conveyance requirements is beyond the scope of this Water Supply and Facilities Master Plan. If Cal Water has acquired a reliable surface water supply and the treatment of that supply is the preferred option, Cal Water should commission a separate, more focused feasibility study, to site the future water treatment plant, and the conveyance facilities necessary to carry any potential water supplies to the water treatment plant. Each water supply option is discussed below.

*Option C-1, SWP Contract Supply: Contract with Butte County for SWP Water*

Depending on the best location to take delivery of the water, a diversion facility would be needed. For example, Cal Water could develop a wheeling agreement where SWP water could be diverted off Big Chico Creek or Butte Creek into percolation ponds. Cal Water could also take delivery along the Feather River, south of Thermalito Afterbay, but that option would require a costly pump station and pipeline. Figure 4-23 shows the proximity of Big Chico Creek, Butte Creek, Thermalito Afterbay, the Feather River, and the City of Chico.

SWP contract supplies (referred to in the SWP contracts as "Table A Amounts" since they are listed in Table A of the individual contracts) are subject to deficiencies when there is not enough water to meet the cumulative demands. Deficiencies are determined on a year-to-year basis and depend on hydrology, carryover storage in SWP reservoirs, and conveyance limitations including pumping restrictions due to environmental conflicts. DWR began in the 1980s to refine its studies of potential future conditions. In 2003 such studies were formalized in the first complete report on SWP water supply reliability. An update to that report was distributed as final in mid-summer 2006 (DWR, The State Water Project Delivery Reliability Report, Public Review Draft, April 2006). That final report includes the following table (Table 4-9) on delivery reliability under a variety of assumptions from both the 2003 studies and 2005 draft studies:

Table 4-9 is based on SWP deliveries made from/or south of the Delta, and accounts for Delta pumping restrictions related to fisheries issues that would not be applicable to delivery of water to Butte County (located north of the Delta). Thus, these projected water delivery deficiencies understate the reliability (overstate the deficiencies) of Butte County's SWP contract supply.

There are at least three strategies that could be pursued in determining the quantity of SWP supply that should be acquired:

1. Contract for an amount of water to meet Chico's demands in a wet year, assuming an average supply of 77 percent and other reductions as set forth in the table above. This strategy will require use of groundwater in most years, and meeting 95 percent of demand with groundwater in a severe year like 1977.

2. Contract for a greater amount than this first strategy, such that an adequate supply is available on average, and more than needed in wet years. This will translate into less delivery reductions than indicated in the table. This strategy will require a lesser amount of groundwater use than the first strategy.
3. Work with Butte County to pursue a finding by DWR that Butte County SWP supplies should not be subject to a deficiency due to the County's position as an entity in the "area of origin".

**Table 4-9. SWP Average and Dry Year Table A Delivery from the Delta (Table 5-4)**

| Study | SWP Table A Delivery from the Delta (in percent of maximum Table A) | | | | | |
|---|---|---|---|---|---|---|
| | Average 1922-1994 | Single Dry Year 1977 | 2-Year Drought 1976-1977 | 4-Year Drought 1931-1934 | 6-Year Drought 1987-1992 | 6-Year Drought 1929-1934 |
| SWP Delivery Reliability Report (2003): | | | | | | |
| 1. 2001 Study | 72% | 19% | 48% | 37% | 41% | 40% |
| 2. 2021A Study | 75% | 20% | 44% | 39% | 40% | 41% |
| 3. 2021B Study | 76% | 20% | 44% | 39% | 40% | 41% |
| Updated Studies: | | | | | | |
| 4. 2005 Study | 68% | 4% | 41% | 32% | 42% | 37% |
| 5. 2025 Study | 77% | 5% | 40% | 33% | 42% | 38% |

*Option C-2, Water Transfer*

Regardless of the location of the seller, it is desirable from a cost standpoint to deliver surface water to Chico from either Big Chico Creek or Butte Creek. If water is purchased from water right settlement contractors on the Feather River or Sacramento River, a wheeling agreement will be necessary.

*Option C-3, Water Right*

A third potential option is to apply for a water right from the SWRCB to divert unappropriated water from the Sacramento River. This option would still require some sort of wheeling agreement so that water could be diverted off Big Chico Creek or Butte Creek.

<u>Hamilton City Water Supply Options</u>

Options for providing surface water to Hamilton City are limited to purchasing water from existing water users, or securing a permit to divert unappropriated water from the immediately adjacent Sacramento River. Each is discussed below.

*Option HC-1, Water Transfer*

Regardless of the location of the seller, it is desirable from a cost standpoint to deliver surface water to Hamilton City by direct diversion from the Sacramento River. If water were purchased from water right settlement contractors on the Feather River, an exchange agreement would be needed with both DWR and the USBR. The "exchange" would be the offset of additional flow in the Feather River by a like reduction in flow on the Sacramento River. An obvious option is to negotiate a transfer from the Glenn-Colusa Irrigation District, the largest water diverter on the Sacramento River. GCID serves water to 141,000 acres of irrigated farmland, and its diversion facilities are located four miles directly north of Hamilton City. These diversion facilities are fairly new, and utilize state-of-the-art fish screens.

A permanent water transfer could be developed to handle a variety of future conditions, depending on the degree to which Hamilton City water needs would be met by continued use of ground water.

*Option HC-2, Water Right*

A second potential option is to apply for a water right from the SWRCB to divert unappropriated water from the Sacramento River. This option would require construction of a diversion structure as well as a pipeline to convey the water to Hamilton City for treatment and distribution. Hamilton City is located within one mile of the Sacramento River. As indicated earlier, unappropriated water is not available year-round except in very wet years such as 2005 and 2006. Under most conditions, Hamilton City could acquire a water right to meet all its needs for most months with the exception of the period June – September. The State Water Resources Control Board will not likely issue a new water right permit unless it is assured that Hamilton City will have adequate supplies when surface water is not available. This will require continued reliance on ground water, although another option would be to negotiate a water transfer for this period.

Summary of Surface Water Supply Options

Future water supply options for Chico and Hamilton City to supplement ground water use are summarized in Table 4-10 below. We recommend that Cal Water conduct a feasibility level evaluation of each option to assess: supply option, available water quantities; required conveyance facilities; wheeling requirements, if needed; recharge locations, and other technical and institutional issues associated with each supply option.

**Table 4-10. Summary of Surface Water Supply Options**

| Option | Chico | Hamilton City |
|---|---|---|
| Contract for SWP supply | X | NA |
| New water right | X | X |
| Water transfer | X | X |

**Potential Recycled Water Supplies**

Recycled water projects normally arise due to a need to offset potable water use or dispose of wastewater that cannot be discharged through normal practices. Schools and parks are normally the first customers to use recycled water due to their landscape irrigation needs.

Some of the schools and parks within the City of Chico are served by private water wells and therefore, would not provide Cal Water with any direct potable water offset. At the time this Water Supply and Facilities Master Plan was completed, no wastewater disposal issues could be identified, and Cal Water is not responsible for the City of Chico's wastewater treatment and disposal system.

Additionally, the regional water pollution control plant (WPCP) is located approximately 4.5 miles southwest of the nearest potential customer, and all of the schools and parks are scattered throughout the City. Although any recycled water system would be cost prohibitive at the present time, it may not be in the future. For example, there is serious consideration being given in southern California to greater use of satellite wastewater treatment systems that would open the door for greater implementation of recycled water programs. Figure 4-24 illustrates the location of the regional wastewater treatment plant and potential future school and park customers.

Based on these conditions, a recycled water system in Chico is not justifiable at this time, and should only be considered if:

- Wastewater disposal and river discharge became an issue at the WPCP.
- Cal Water is unable to secure surface water supplies, and groundwater overdraft conditions occur.
- Cal Water needs to offset private pumping to secure long-term groundwater pumping rights.

Consequently, it is recommended that Cal Water not explore the use of recycled water until it has further evaluated the potential surface water supply options previously discussed in this chapter, needs to secure long-term groundwater pumping rights to offset future demands, or there are changes to wastewater treatment facilities and options that improve the economics for recycled water use.

## SUMMARY, RECOMMENDED WATER SUPPLY OPTION

In the near term, Cal Water can rely on continued use of groundwater to meet future projected water demands. We recommend that Cal Water begin exploring the possibility of using surface water supplies in conjunction with groundwater. As regulations become stricter and regional water resources become scarcer, integration of other water supply sources could be desirable to strengthen management and sustainability of the groundwater resources, and provide Cal Water's Chico-Hamilton City District with additional supply reliability.

Consequently, for planning purposes in this Water Supply and Facilities Master Plan, we assumed that Cal Water would meet all future demands with groundwater, and explore the feasibility of implementing a groundwater recharge program that uses surface water diverted from either Big Chico Creek or Butte Creek.

Figure 4-25 compares Cal Water's future water demands and existing water supply. As shown in Figure 4-25, all of Cal Water's future annual water demands can be met from the groundwater basin using existing wells. Additionally, unlike surface water supplies, groundwater supplies are inherently resistant to drought conditions due to the relatively large volume of water in basin storage. For planning purposes, it was assumed that the Chico-Hamilton City District's groundwater supplies would be available during all hydrologic water year types.

Figure 4-26 compares the projected maximum day demands to existing and future groundwater production capacity. As shown in Figure 4-26, the Chico-Hamilton City District will require additional groundwater production capacity by 2019, and will need to provide an additional 44 mgd of capacity by 2030 (provides 10 percent reserve capacity).

Additionally, as previously discussed, WYA recommends that Cal Water confirm our recommendation to continue to rely on the groundwater basin and investigate groundwater recharge using surface water supplies, using the calibrated groundwater model after it is completed by the BCWRC. In particular, Cal Water should review the scenario results to ensure that overdraft conditions will not occur if an additional 24,000 af/year of groundwater is extracted over the long-term (50 years).

Figure 4-27 illustrates the projected future costs of the recommended water supply scenario, including the cost to explore the feasibility of using surface water supplies under a conjunctive use program that emphasizes groundwater recharge. For planning purposes it was assumed that Cal Water would expend $350,000 on the study over two years (2007 and 2008).

The total cost of the recommended water supply scenario was determined by multiplying the total groundwater extracted (see Chapter 3) by the total unit cost of groundwater (see Table 4-8). Table 4-11 presents the future cost of the recommended scenario, while Figure 4-27 illustrates the costs over time. As shown in Table 4-11 and Figure 4-27, the total cost of meeting future water demands with groundwater and exploring the feasibility of securing a surface water supply is projected to reach approximately $63- milli by 2030.

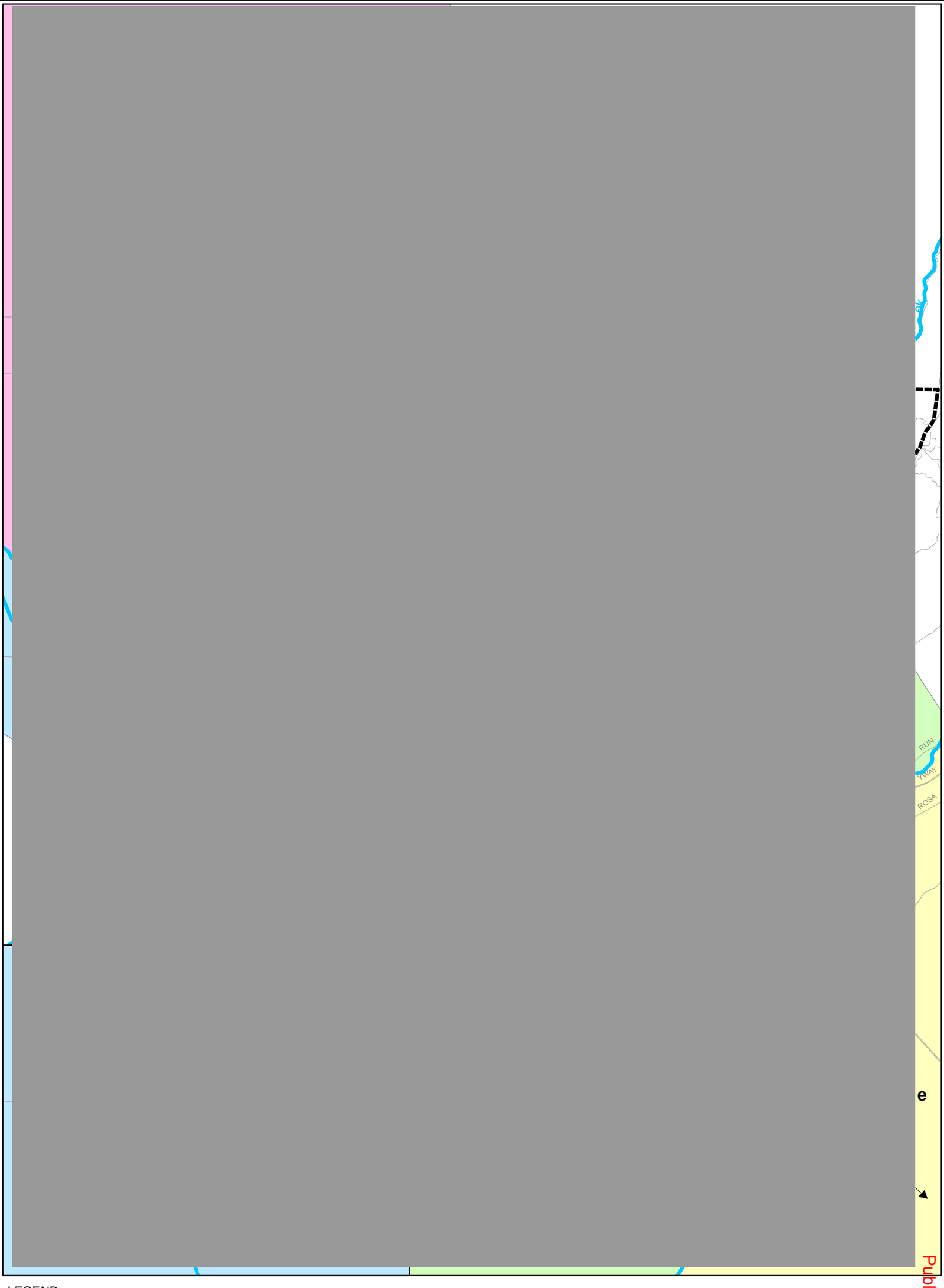
**Table 4-11. Projected Cost of the Recommended Water Supply Scenario**

| Component | 2006 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|
| Groundwater Extracted, af[(a)] | 31,100 | 33,500 | 37,900 | 45,800 | 50,100 | 54,300 |
| Unit Cost, $/af[(b)] | 480 | 530 | 720 | 900 | 1,030 | 1,160 |
| Total Cost, $ | 14,900,000 | 17,800,000 | 27,300,000 | 41,200,000 | 51,600,000 | 63,000,000 |

(a) Groundwater quantity obtained from Figure 4-25.
(b) Unit costs obtained from Table 4-8.

***

o:\c\436\020603\GIS\WMP\Ch4\Figure 4-1_Basins.mxd




LEGEND

- Active Well
- Inactive Well
- Major Rivers
- Chico Sphere of Influence
- Hamilton City Service Area
- Future Blakely & Swartz Development
- Street
- East Butte Sub-Basin
- Vina Sub-Basin
- West Butte Sub-Basin
- Corning Sub-Basin

N

0 0.45 0.9 1.8

Scale in Miles

**FIGURE 4-1**

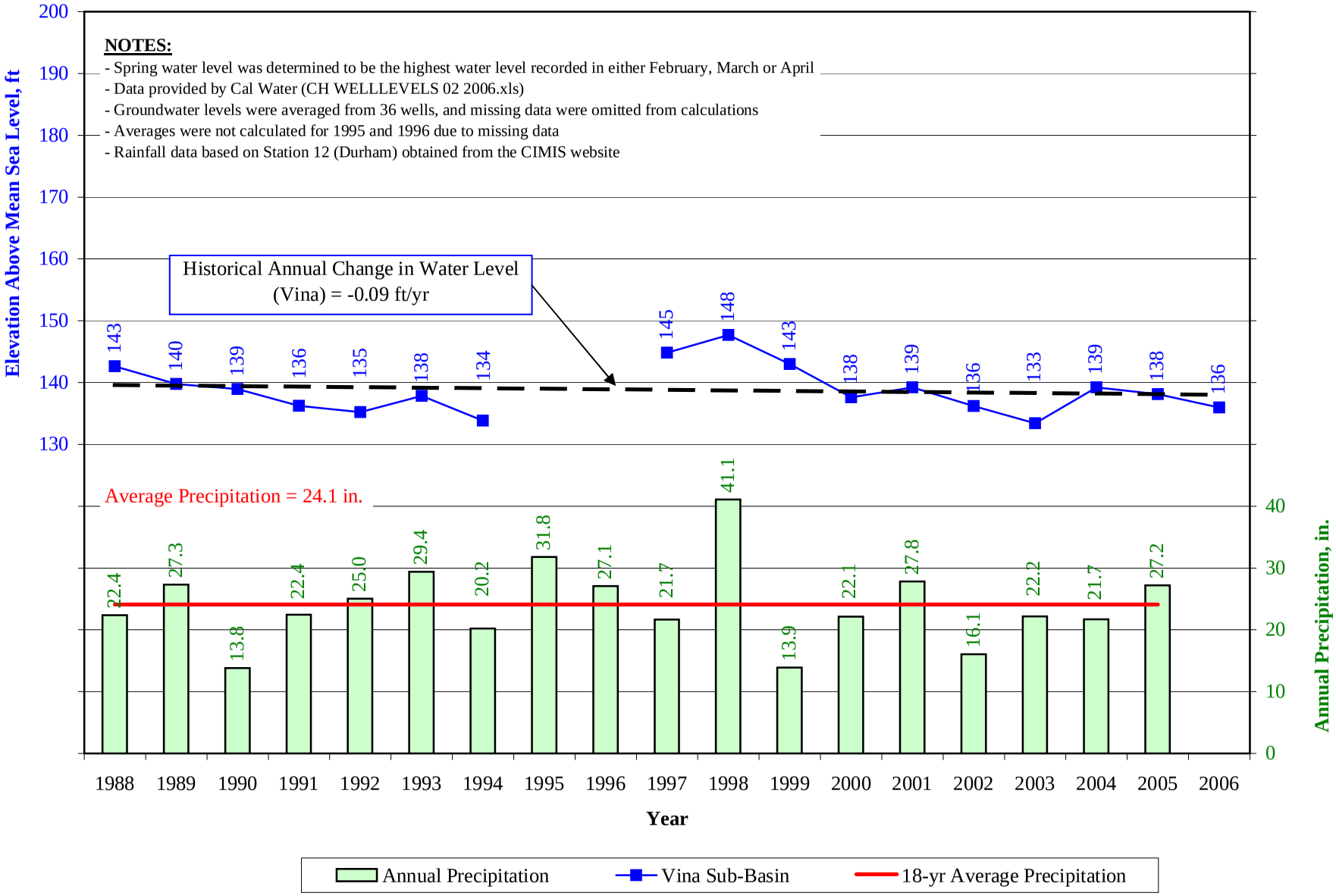
**California Water Service Company**
**Chico-Hamilton City District Water**
**Supply and Facilities Master Plan**

**GROUNDWATER SUB-BASINS**

WEST YOST ASSOCIATES
Consulting Engineers

Public Version

## Figure 4-3. Vina Sub-Basin - Average Spring Groundwater Levels

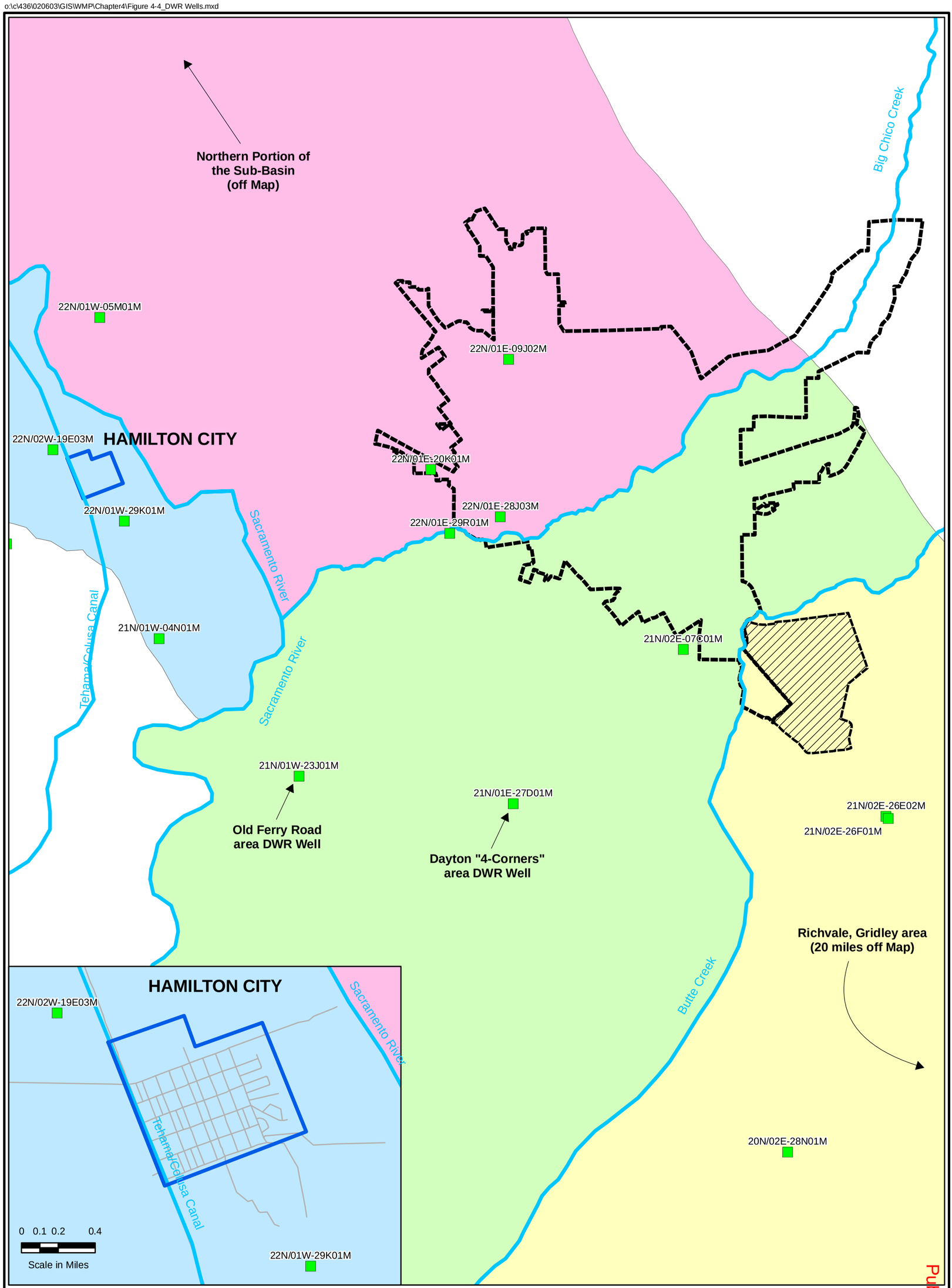



West Yost Associates
436\020603\2\gw\chhamsbdepthgw
Last Revised: 10/17/06

California Water Service District
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

o:\c\436\020603\GIS\WMP\Chapter4\Figure 4-4_DWR Wells.mxd




LEGEND

- DWR Well
- Major Rivers
- Chico Sphere of Influence
- Hamilton City Service Area
- Blakely & Swartz Development
- East Butte Sub-Basin
- Vina Sub-Basin
- West Butte Sub-Basin
- Corning Sub-Basin

N

0 0.5 1 2

Scale in Miles

**FIGURE 4-4**

**California Water Service Company**
**Chico-Hamilton City District Water Supply and Facilities Master Plan**

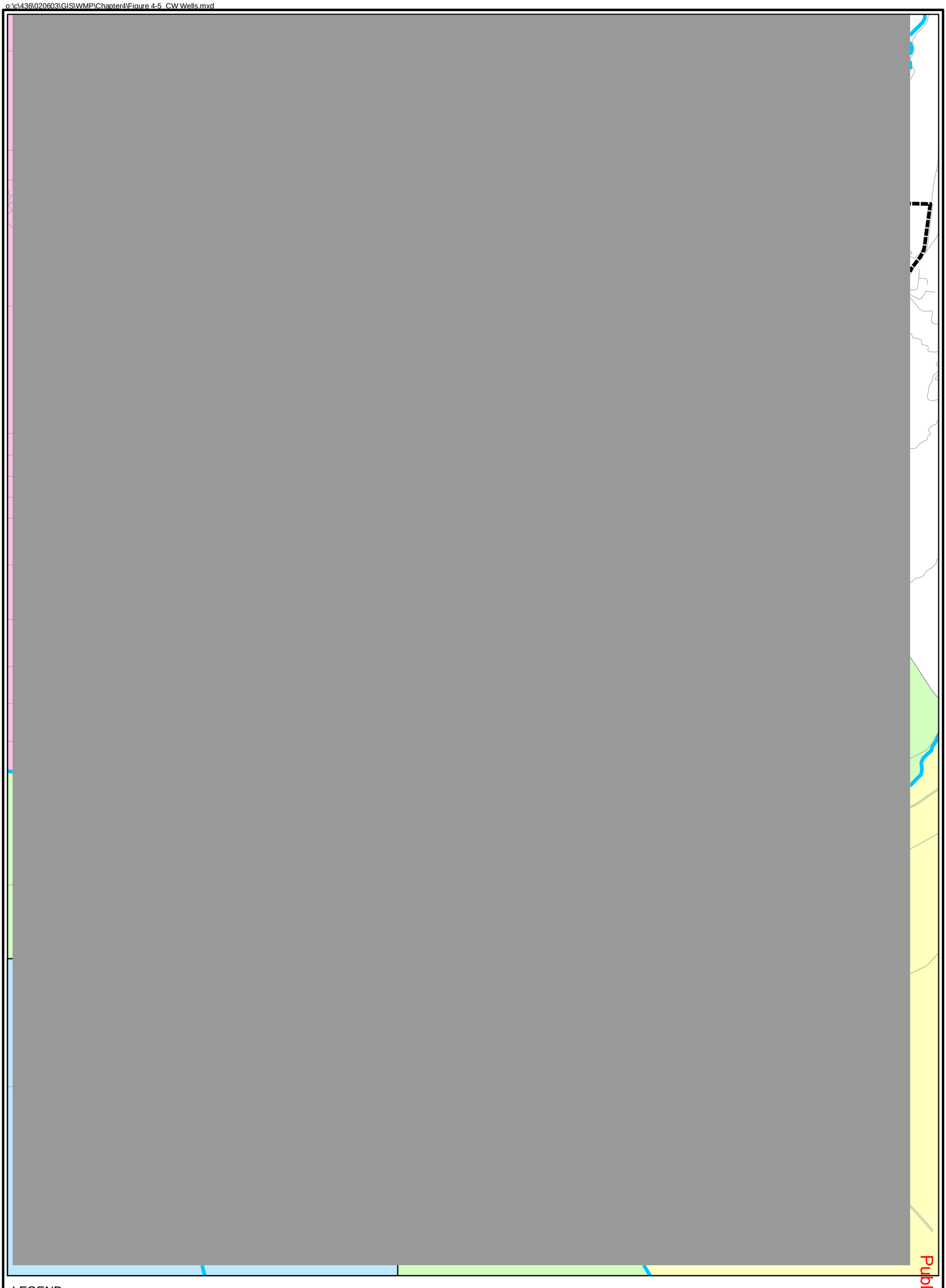
**DWR WELLS EVALUATED**

WEST YOST ASSOCIATES Consulting Engineers

Public Version

g:\c\436\020603\GIS\WMP\Chapter4\Figure 4-5_CW Wells.mxd

***



LEGEND

- Cal Water Well with Declines > 0.75 ft/year
- Other Cal Water Wells
- Major Rivers
- Chico Sphere of Influence
- Hamilton City Service Area
- Blakely & Swartz Development
- Street
- East Butte Sub-Basin
- Vina Sub-Basin
- West Butte Sub-Basin
- Corning Sub-Basin

N

0 0.3 0.6 1.2

Scale in Miles

**FIGURE 4-5**

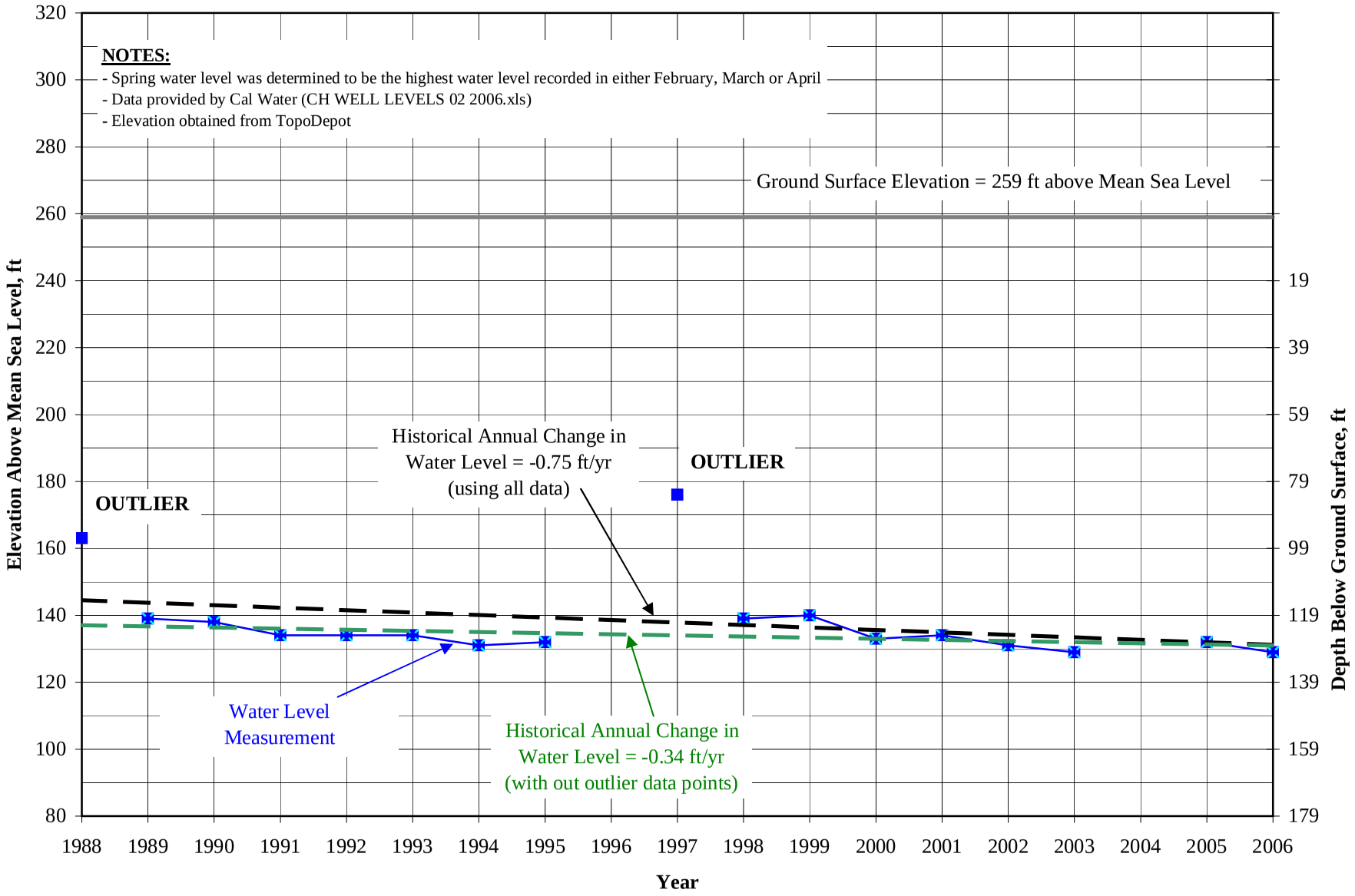
**California Water Service Company**
**Chico-Hamilton City District Water**
**Supply and Facilities Master Plan**

**WATER LEVEL DECLINES**
**GREATER THAN 0.75 ft/year**

WEST YOST ASSOCIATES
Consulting Engineers

Public Version

## Figure 4-6. Station 033-01 - Spring Groundwater Level Hydrograph

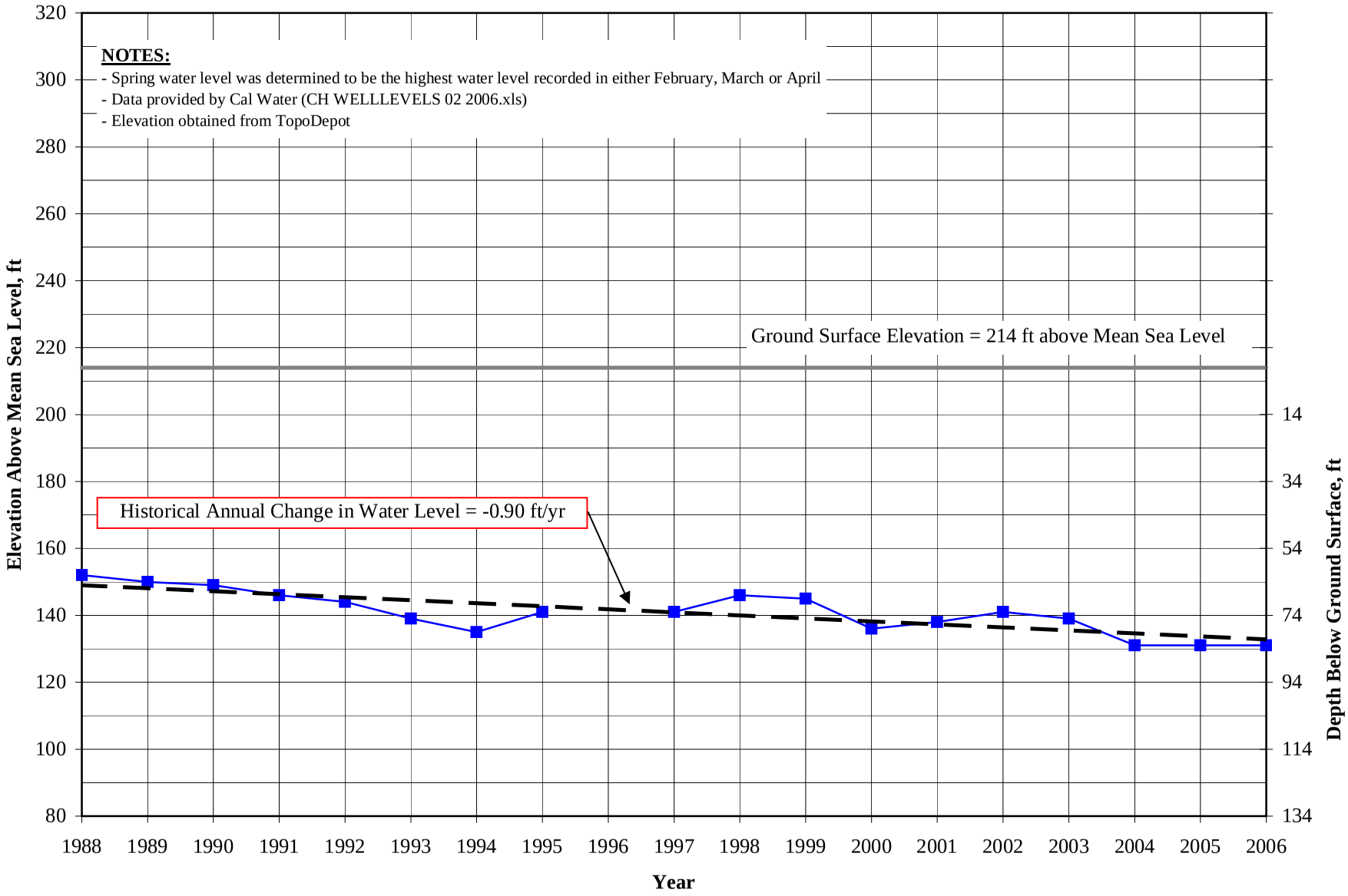



West Yost Associates
436\020603\e\2\gw\CHDepthGW1fig
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

## Figure 4-7. Station 034-01 - Spring Groundwater Level Hydrograph



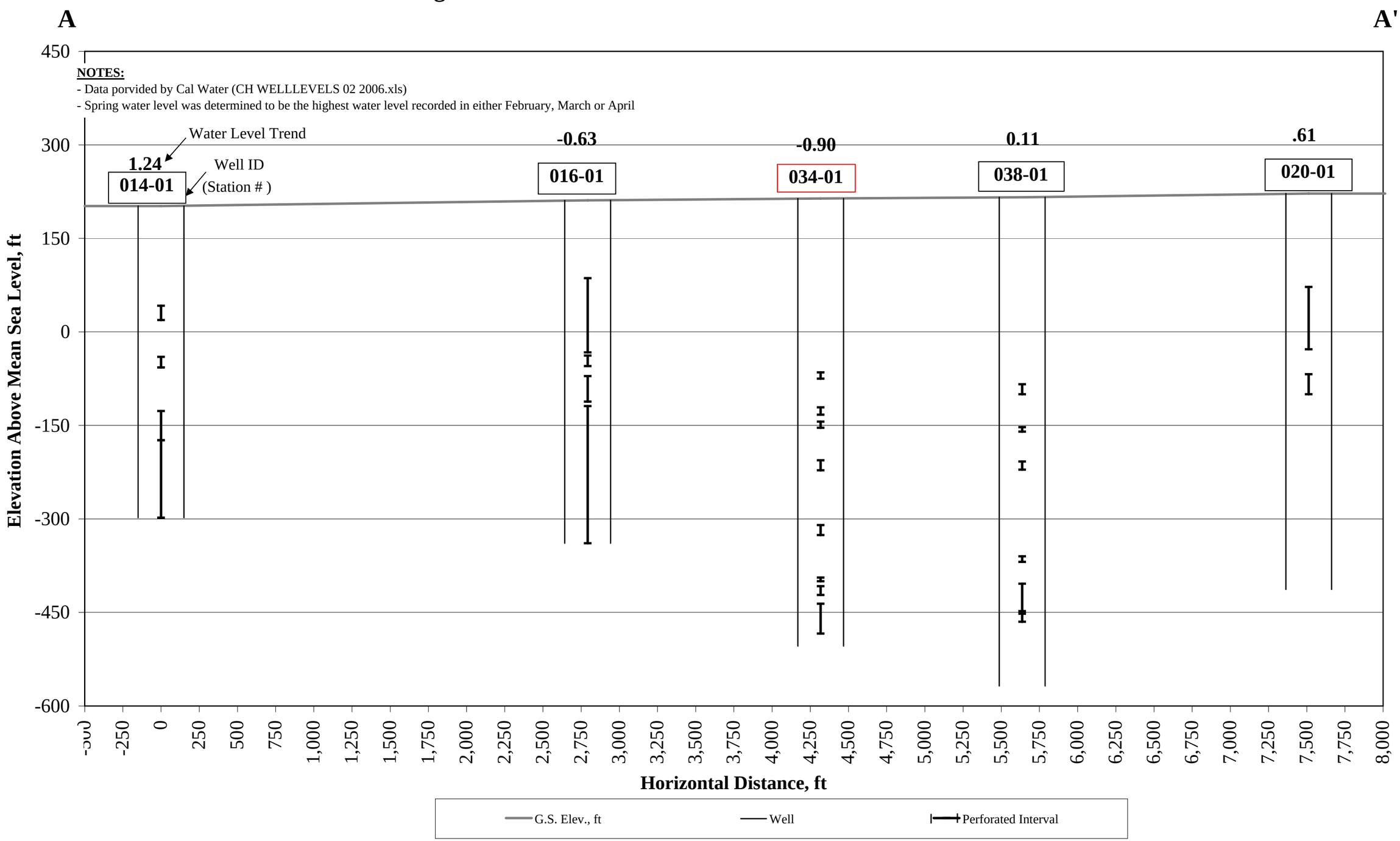

West Yost Associates
436\020603\e\2\gw\CHDepthGW1fig
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

Public Version

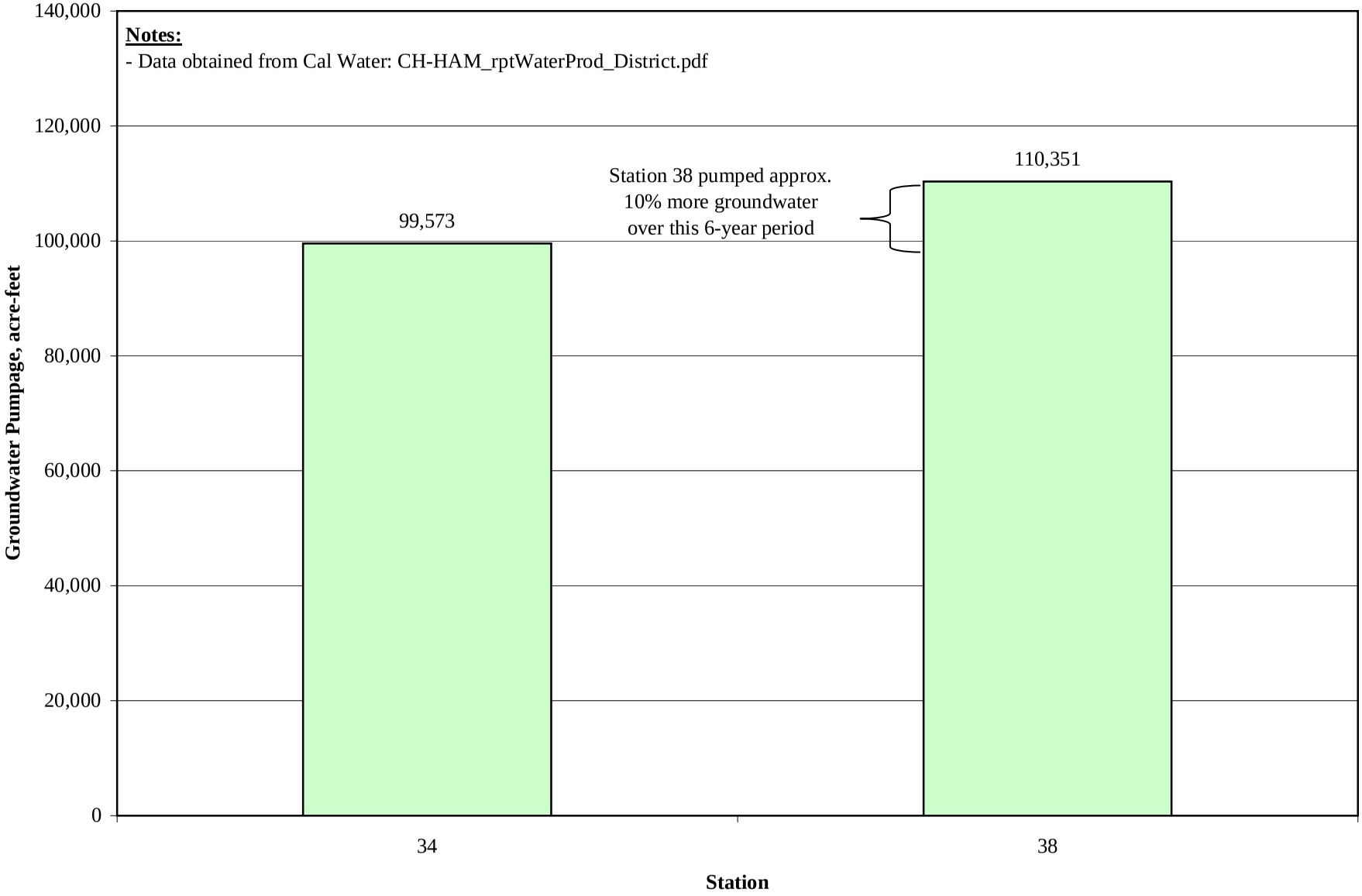
# Figure 4-8. Cross-Section A-A': Well Construction Details




West Yost Associates
436\020603\e\2\gw\chdeclinwells
Last Revised: 10/6/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

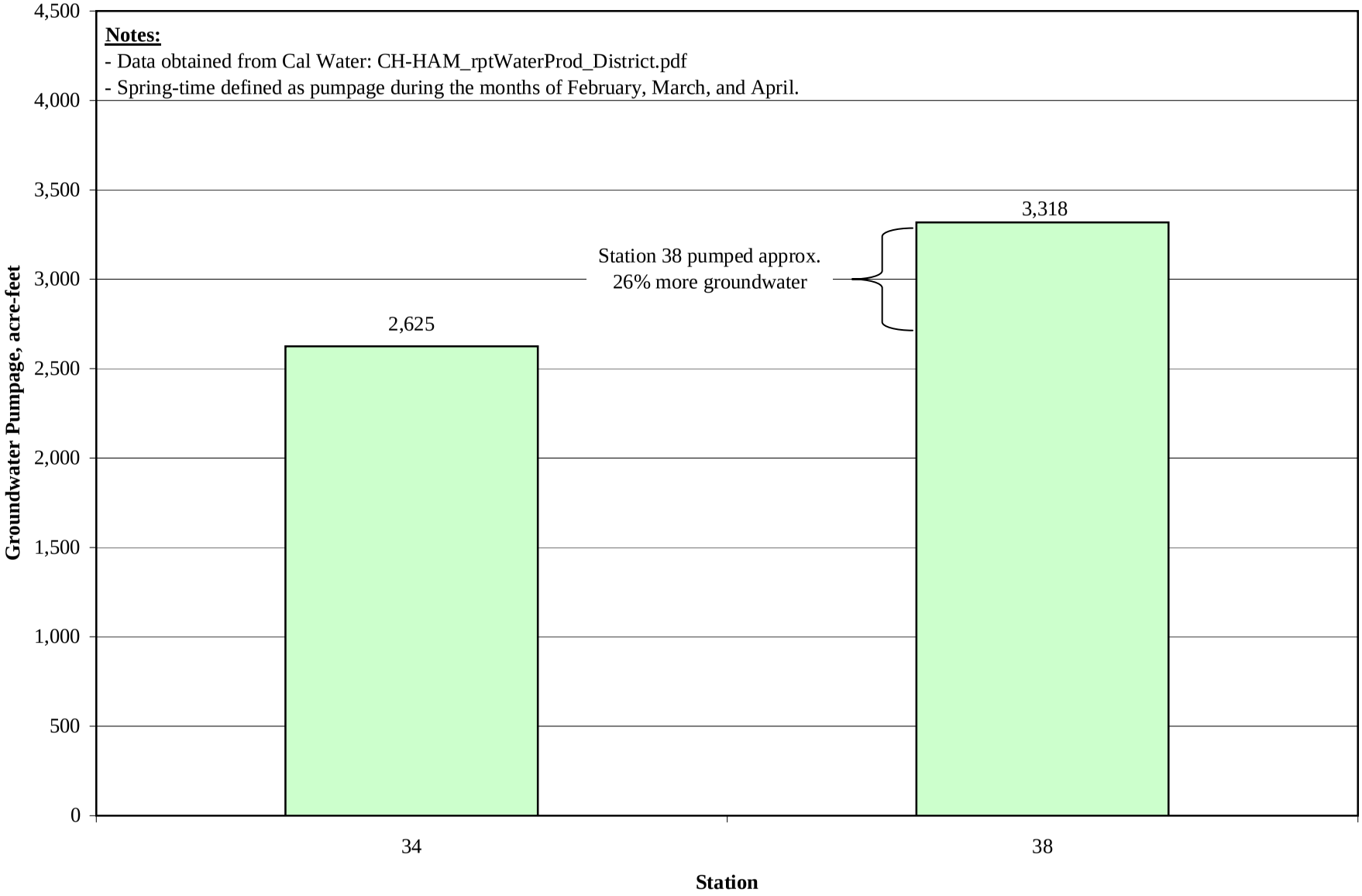
## Figure 4-9. Average Annual Groundwater Production: 2000 to 2006






Public Version

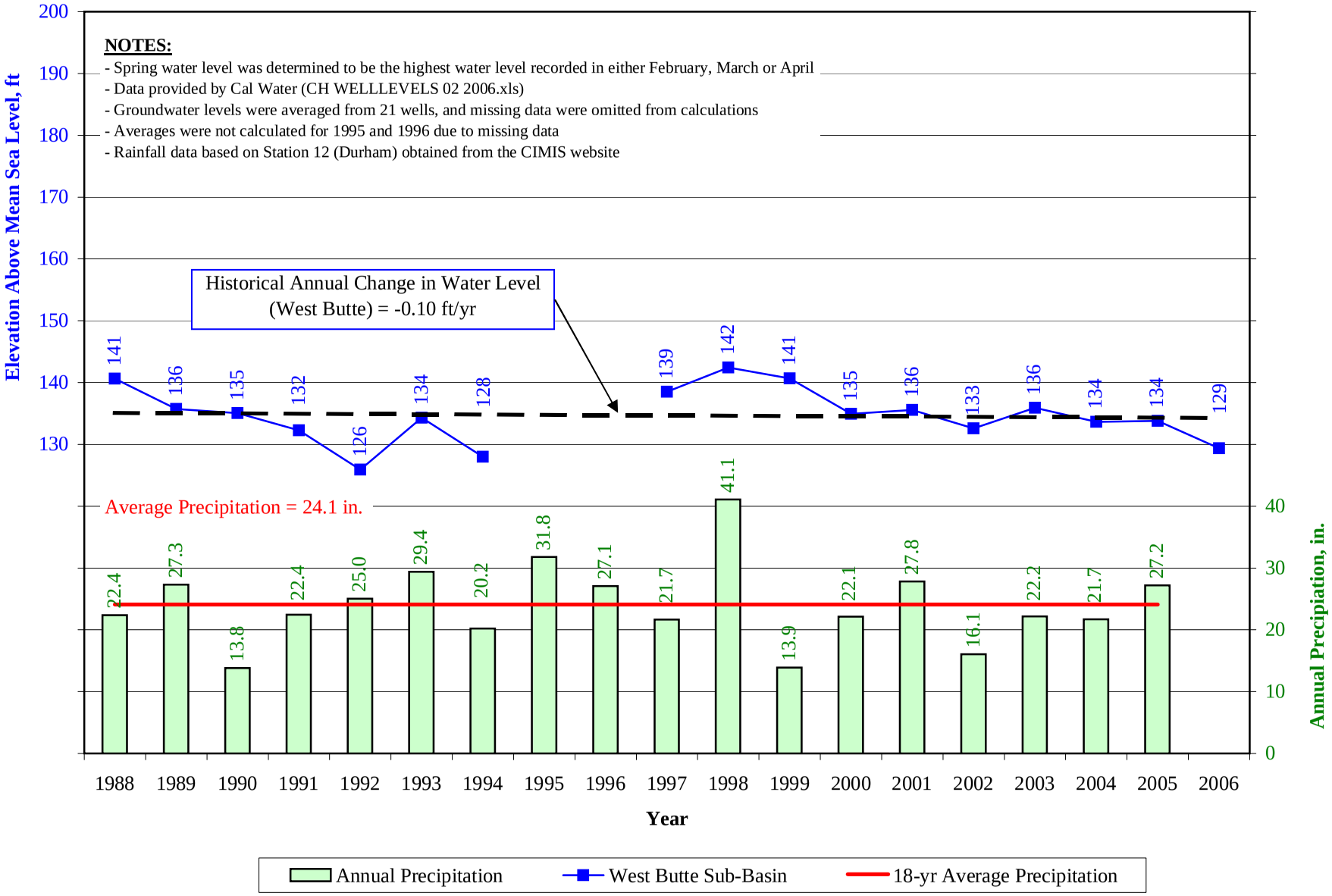
## Figure 4-10. Average Spring-time Groundwater Production: 2000 to 2006






Public Version

## Figure 4-11. West Butte Sub-Basin - Average Spring Groundwater Level Hydrograph

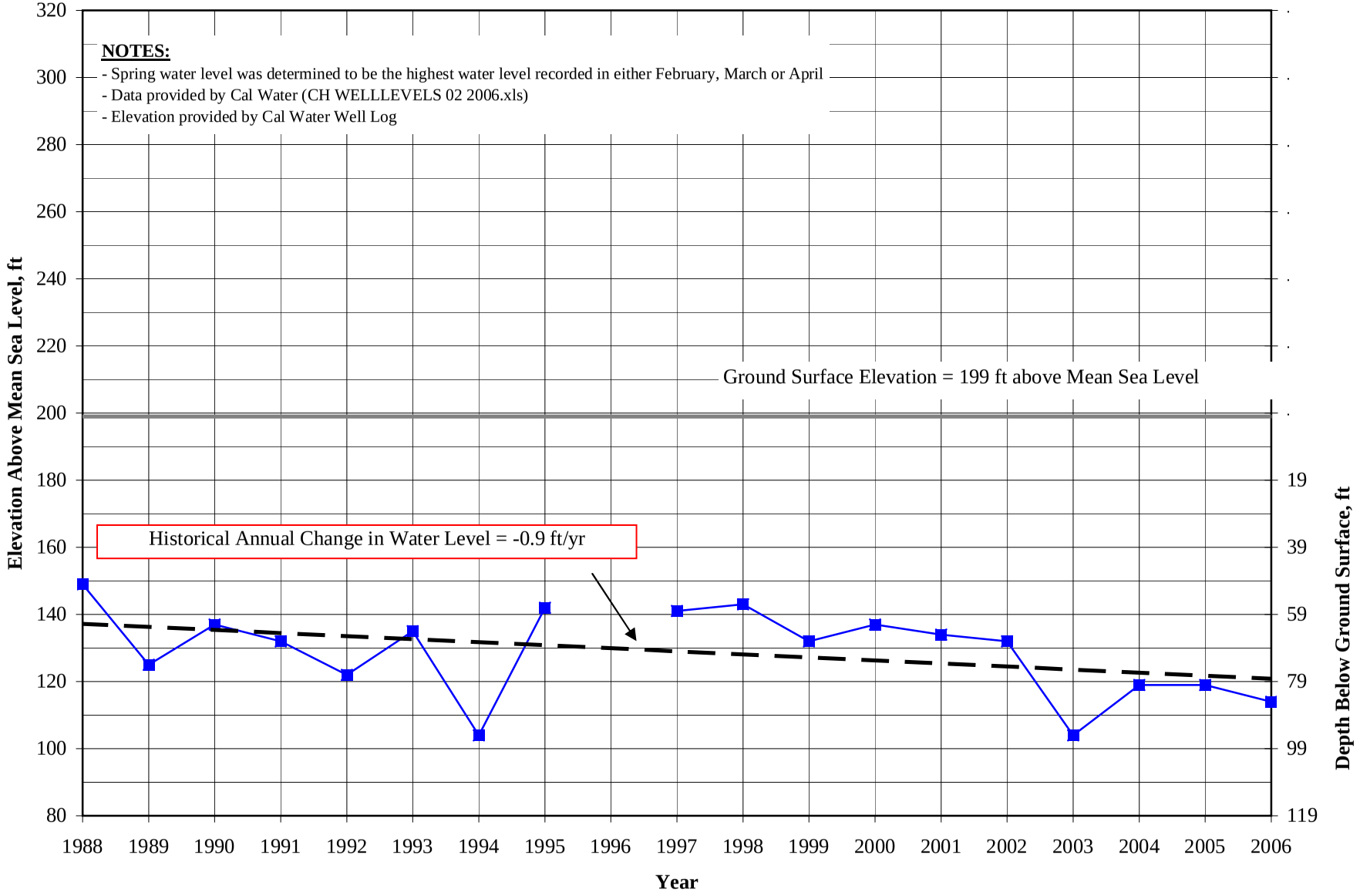



West Yost Associates
436\020603\2\gw\chhamsbdepthgw
Last Revised: 10/17/06

California Water Service District
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

## Figure 4-12. Station 005-02 - Spring Groundwater Level Hydrograph

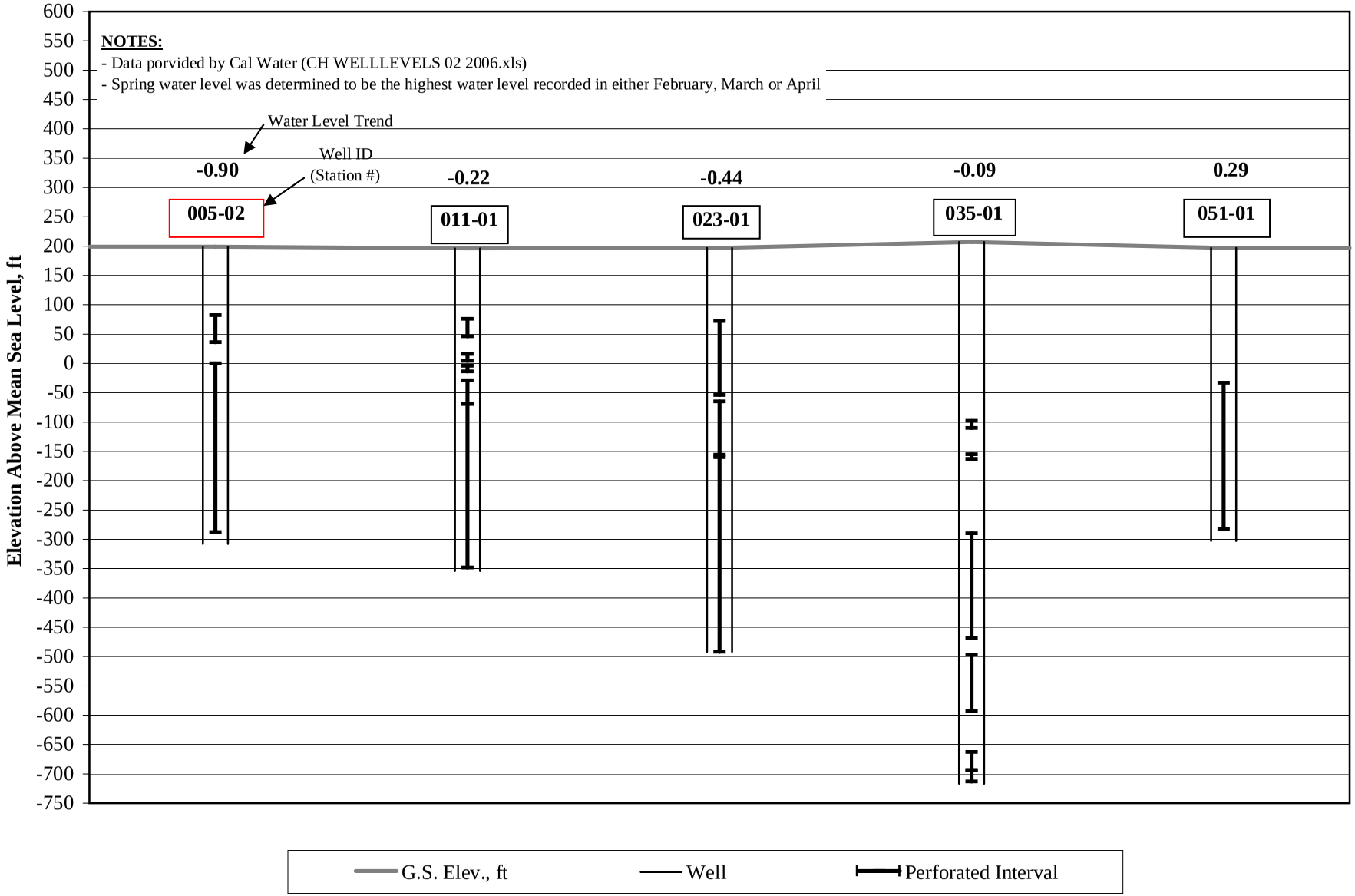



West Yost Associates
436\020603\e\2\gw\CHDepthGW1fig
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

## Figure 4-13. Comparison of Well Construction Details: Stations 5, 11, 23, 35, 51

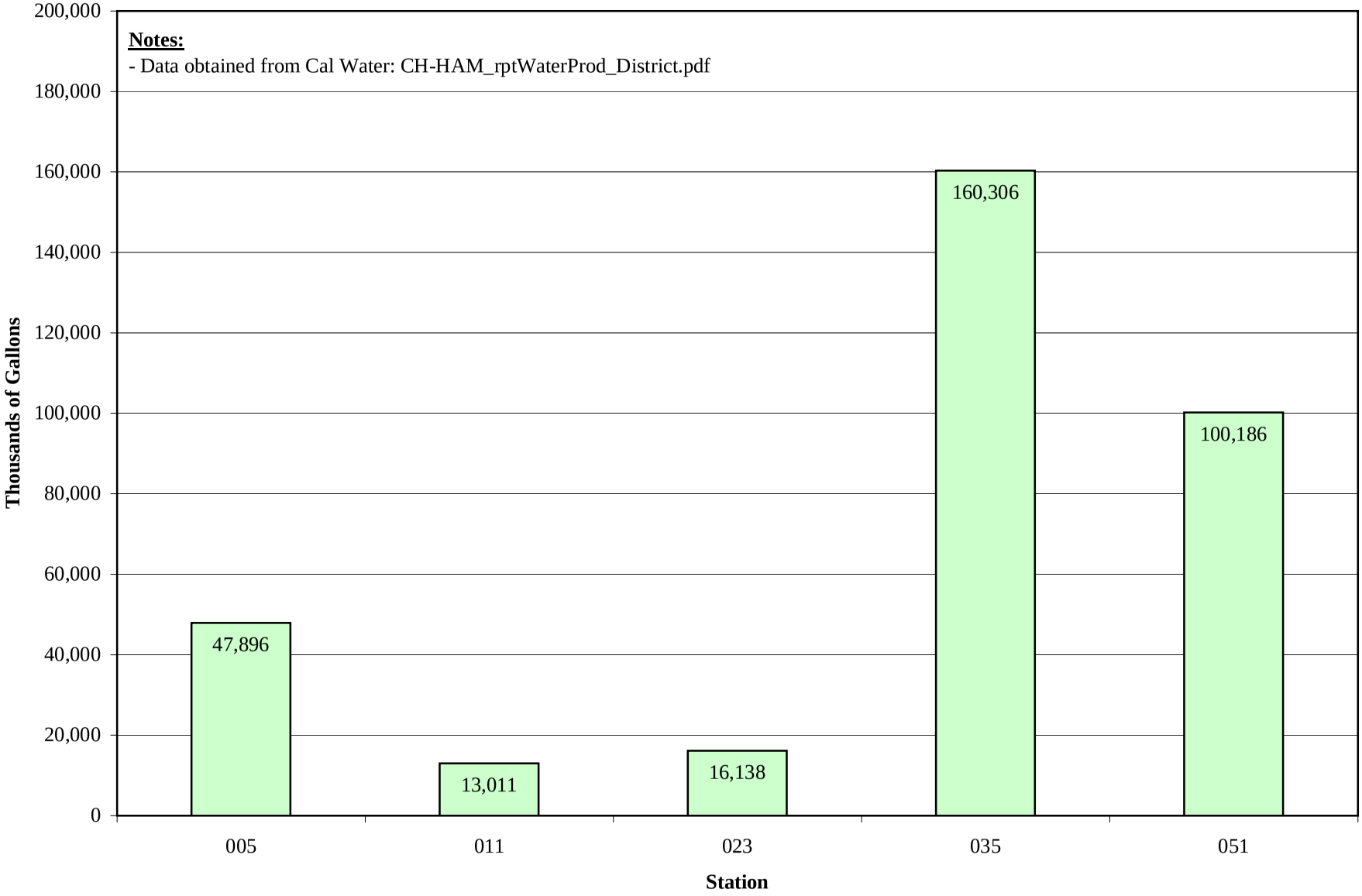



West Yost Associates
436\020603\e\2\g\chdeclinwells
Last Revised: 10/23/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

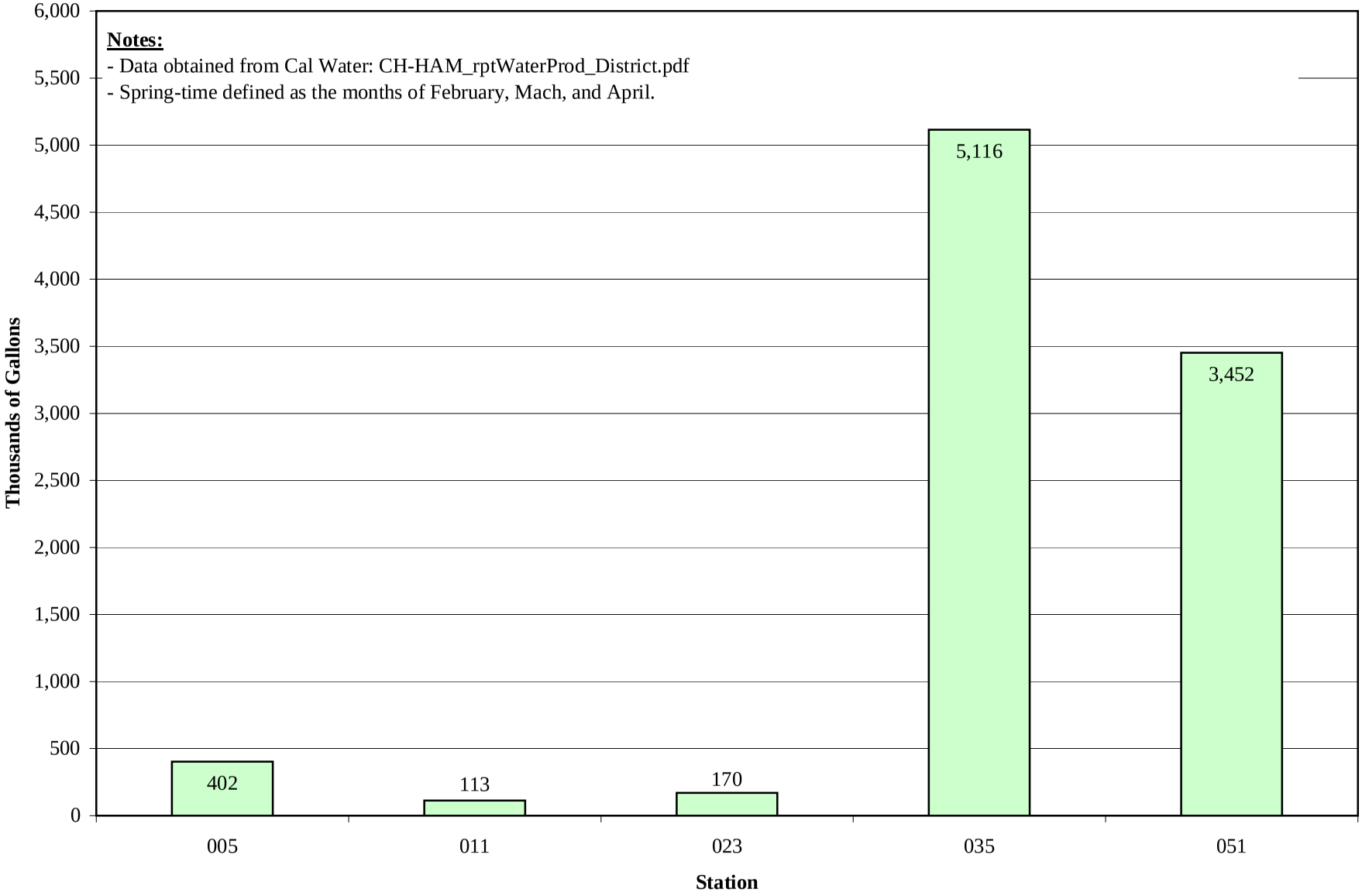
Public Version

## Figure 4-14. Average Annual Groundwater Production: 2000 to 2006




Public Version

## Figure 4-15. Average Spring-time Groundwater Production: 2000 to 2006

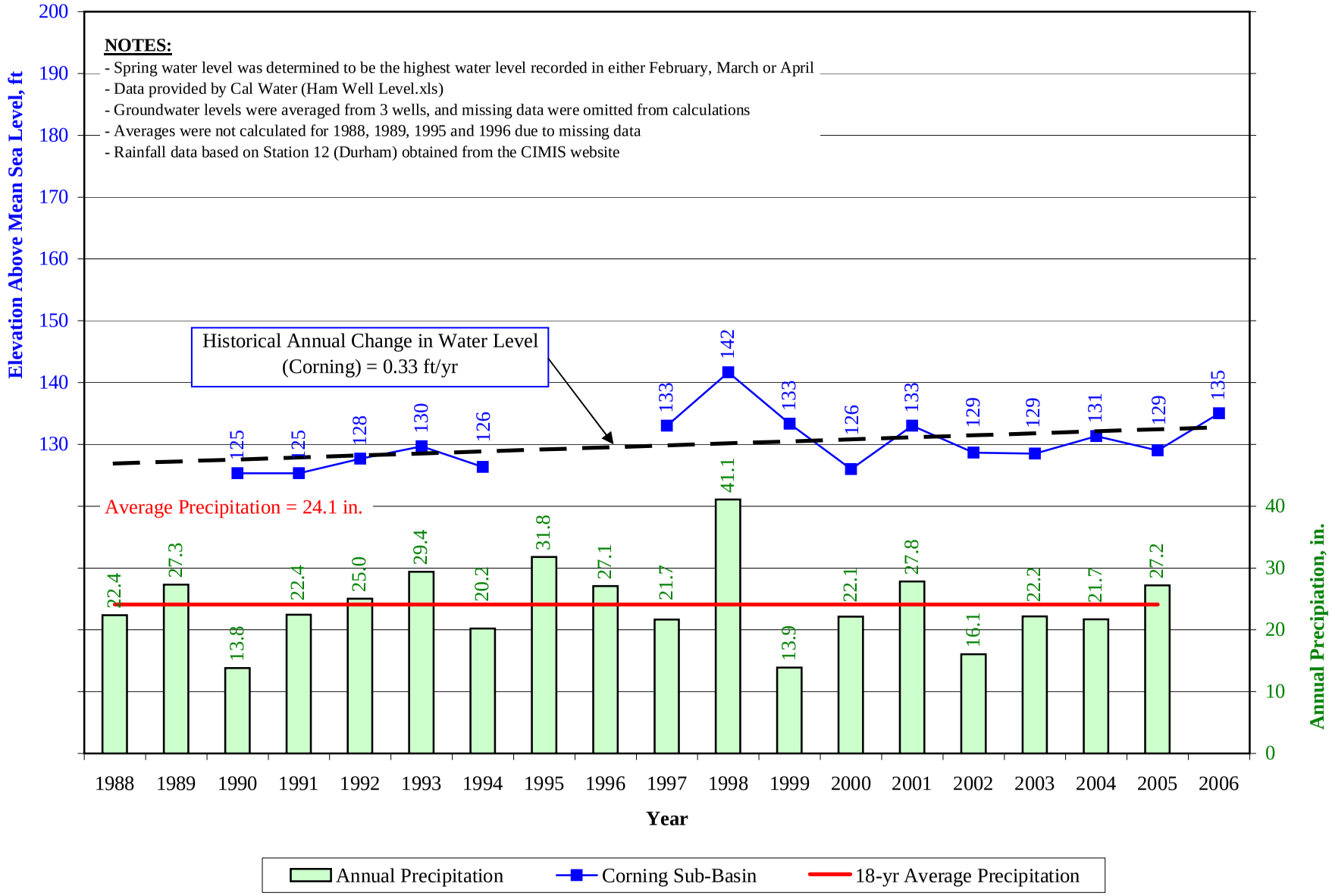



Public Version

West Yost Associates
o:\c\436\020603\e\2\westbuttecompareprod
Last Revised: 04/11/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Figure 4-16. Corning Sub-Basin - Average Spring Groundwater Level Hydrograph



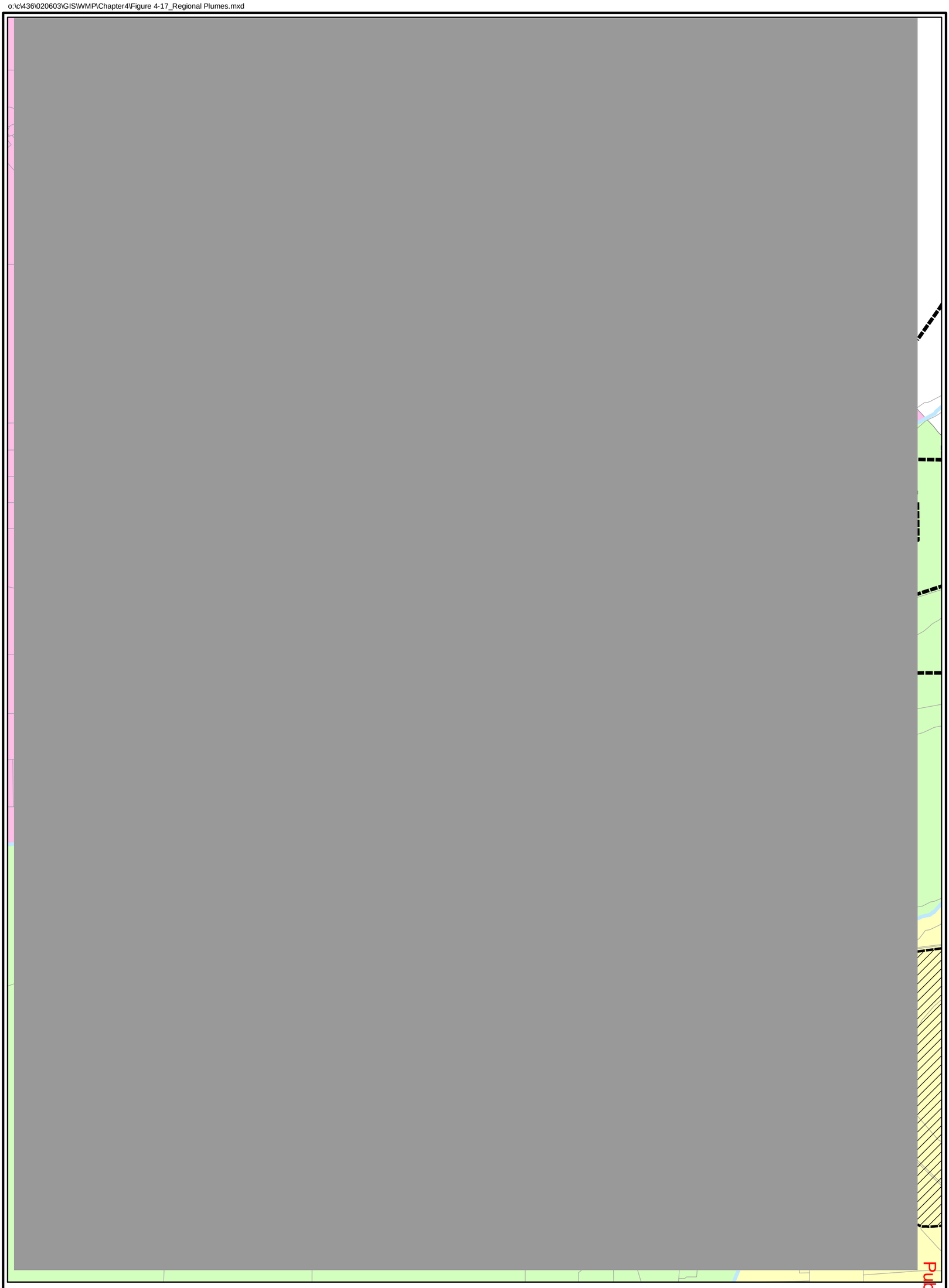

West Yost Associates
436\020603\2\gw\chhamsbdepthgw
Last Revised: 10/17/06

California Water Service District
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

***

o:\c\436\020603\GIS\WMP\Chapter4\Figure 4-17_Regional Plumes.mxd



LEGEND

- Active Well
- Inactive Well
- Major Rivers
- Contaminant Plumes
- Chico Sphere of Influence
- Blakely & Swartz Development
- East Butte Sub-Basin
- Vina Sub-Basin
- West Butte Sub-Basin
- Street

N

0 0.25 0.5 1

Scale in Miles

**FIGURE 4-17**

**California Water Service Company**
**Chico-Hamilton City District Water**
**Supply and Facilities Master Plan**

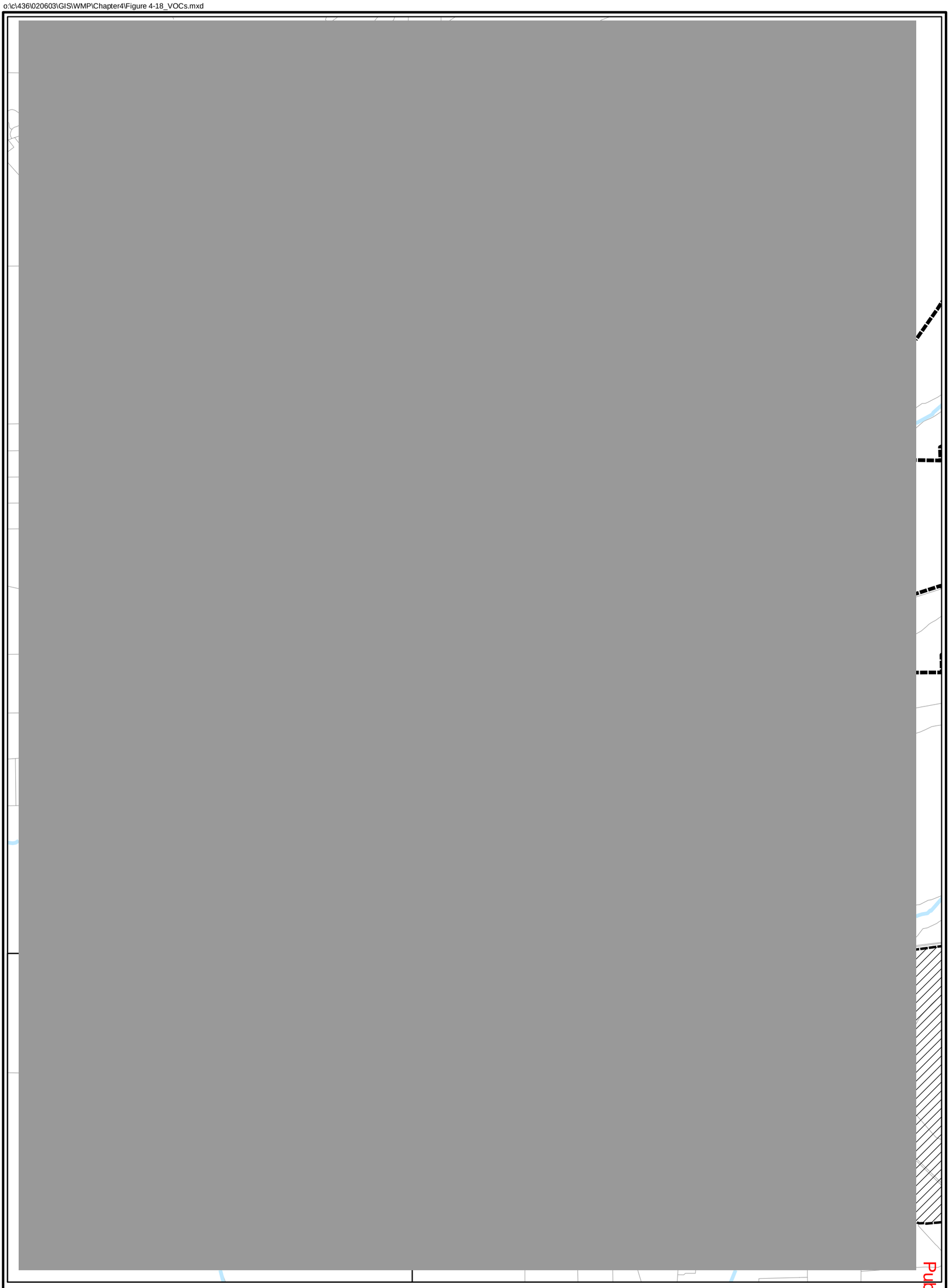
**KNOWN REGIONAL GROUNDWATER PLUMES**

WEST YOST ASSOCIATES
Consulting Engineers

Public Version

o:\c\436\020603\GIS\WMP\Chapter4\Figure 4-18_VOCs.mxd

***



LEGEND

- Active Wells
- Inactive Wells
- Major Rivers
- Chico Sphere of Influence
- Blakely & Swartz Development
- Street
- PCE
- TCE

N

0 0.25 0.5 1

Scale in Miles

**FIGURE 4-18**

**California Water Service Company**
**Chico-Hamilton City District Water**
**Supply and Facilities Master Plan**

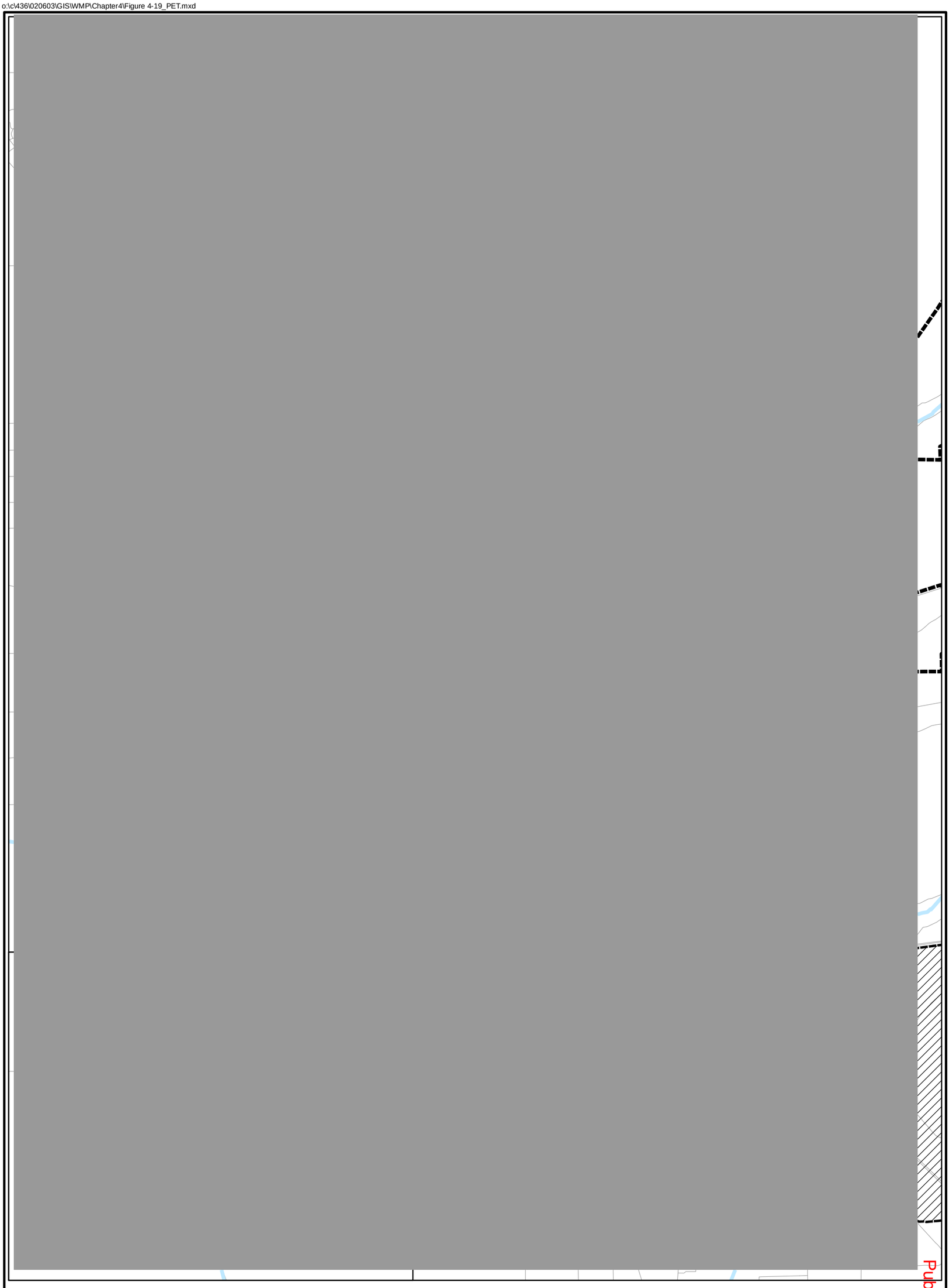
**KNOWN POINT SOURCES OF PCE & TCE GROUNDWATER CONTAMINATION**

WEST YOST ASSOCIATES
Consulting Engineers

Public Version

o:\c\436\020603\GIS\WMP\Chapter4\Figure 4-19_PET.mxd

***



LEGEND

- Active Well
- Inactive Well
- Major Rivers
- Chico Sphere of Influence
- Blakely & Swartz Development
- Street
- TPH
- MTBE
- BTEX

N

0 0.25 0.5 1

Scale in Miles

**FIGURE 4-19**

**California Water Service Company**
**Chico-Hamilton City District Water**
**Supply and Facilities Master Plan**

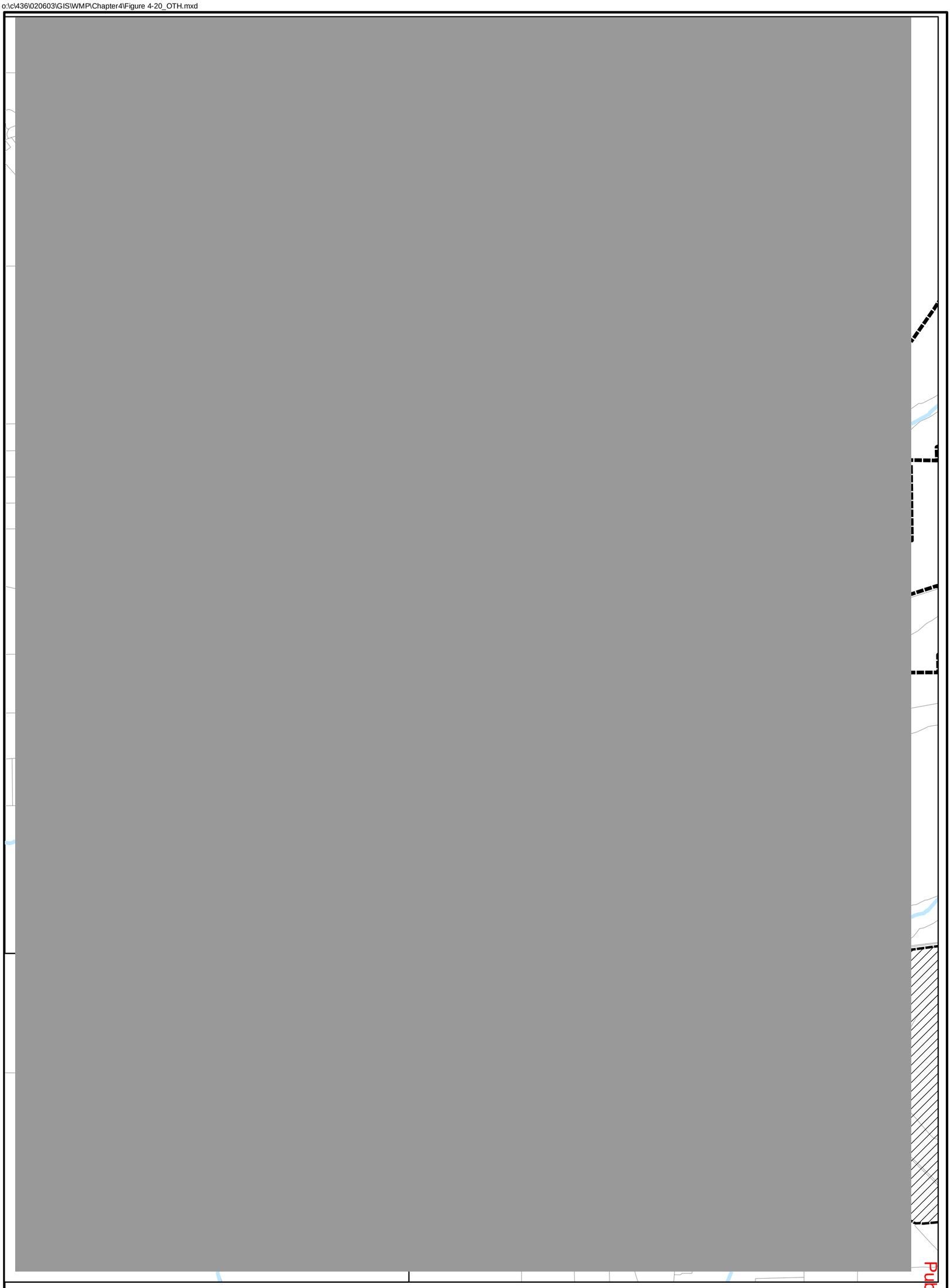
**KNOWN POINT SOURCES OF TPH, MTBE, & BTEX GROUNDWATER CONTAMINATION**

WEST YOST ASSOCIATES
Consulting Engineers

Public Version

o:\c\436\020603\GIS\WMP\Chapter4\Figure 4-20_OTH.mxd

***



**LEGEND**

- Active Well
- Inactive Well
- Major Rivers
- Chico Sphere of Influence
- Blakely & Swartz Development
- Street
- PCP & TCP
- PAH
- Cyanide
- Arsenic

N

0 0.25 0.5 1

Scale in Miles

# FIGURE 4-20

**California Water Service Company**
**Chico-Hamilton City District Water**
**Supply and Facilities Master Plan**

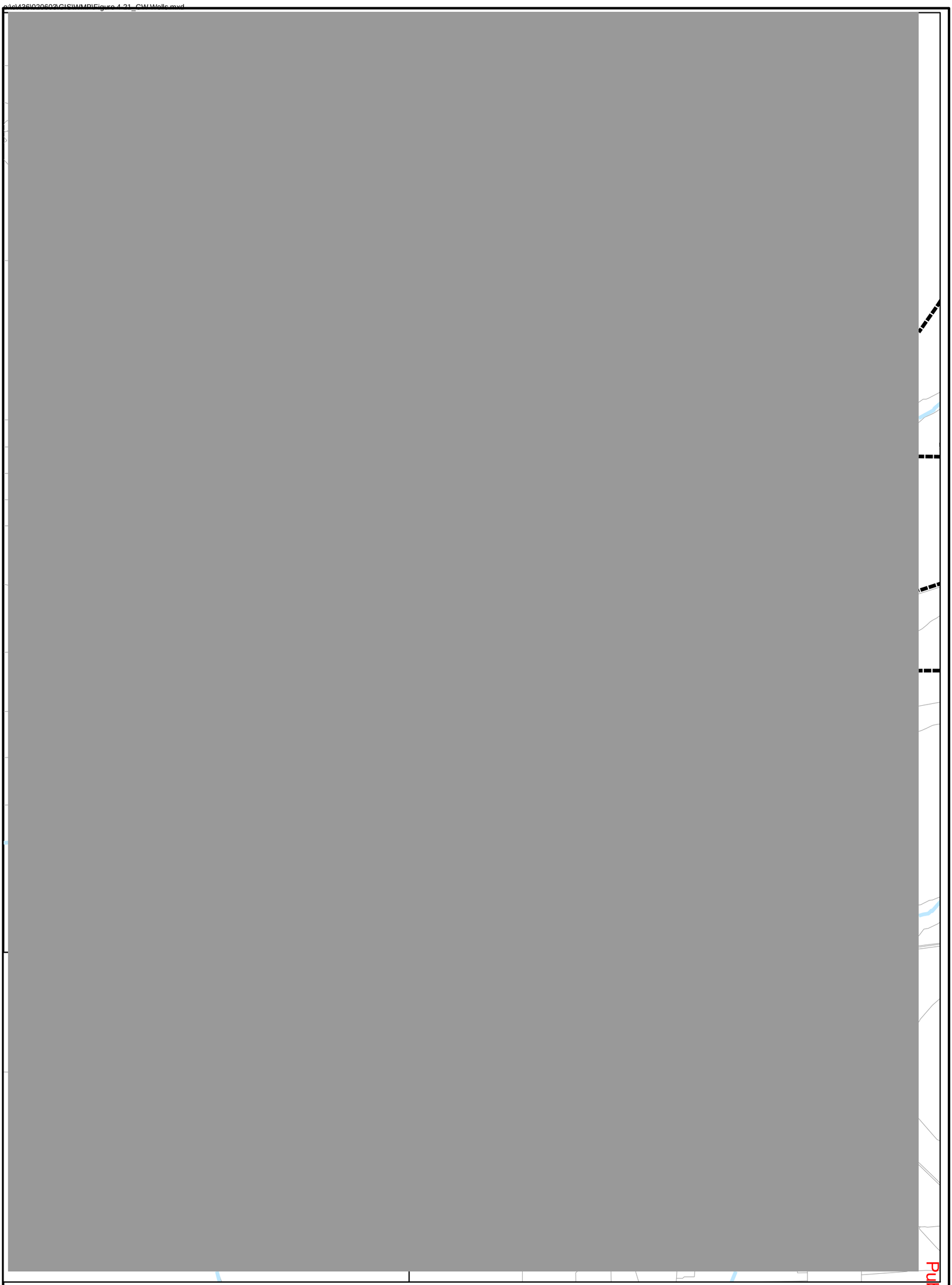
## KNOWN POINT SOURCES OF PCP, TCP, PAH, CYANIDE, AND ARSENIC GROUNDWATER CONTAMINATION

WEST YOST ASSOCIATES
Consulting Engineers

Public Version

***

e:\c\436\020602\GIS\WMP\Figure 4-21_GWWells.mxd



LEGEND

- Inactive Well: Water Quality
- Wellhead Treatment in Place
- Active Well: No Water Quality Issue
- Inactive Well: Not Related to Water Quality
- Major Rivers
- Contaminant Plumes
- Chico Sphere of Influence
- Street
- PCE
- DCE
- FE
- NO3
- TDS
- Taste & Odor

N

0 0.25 0.5 1

Scale in Miles

# FIGURE 4-21

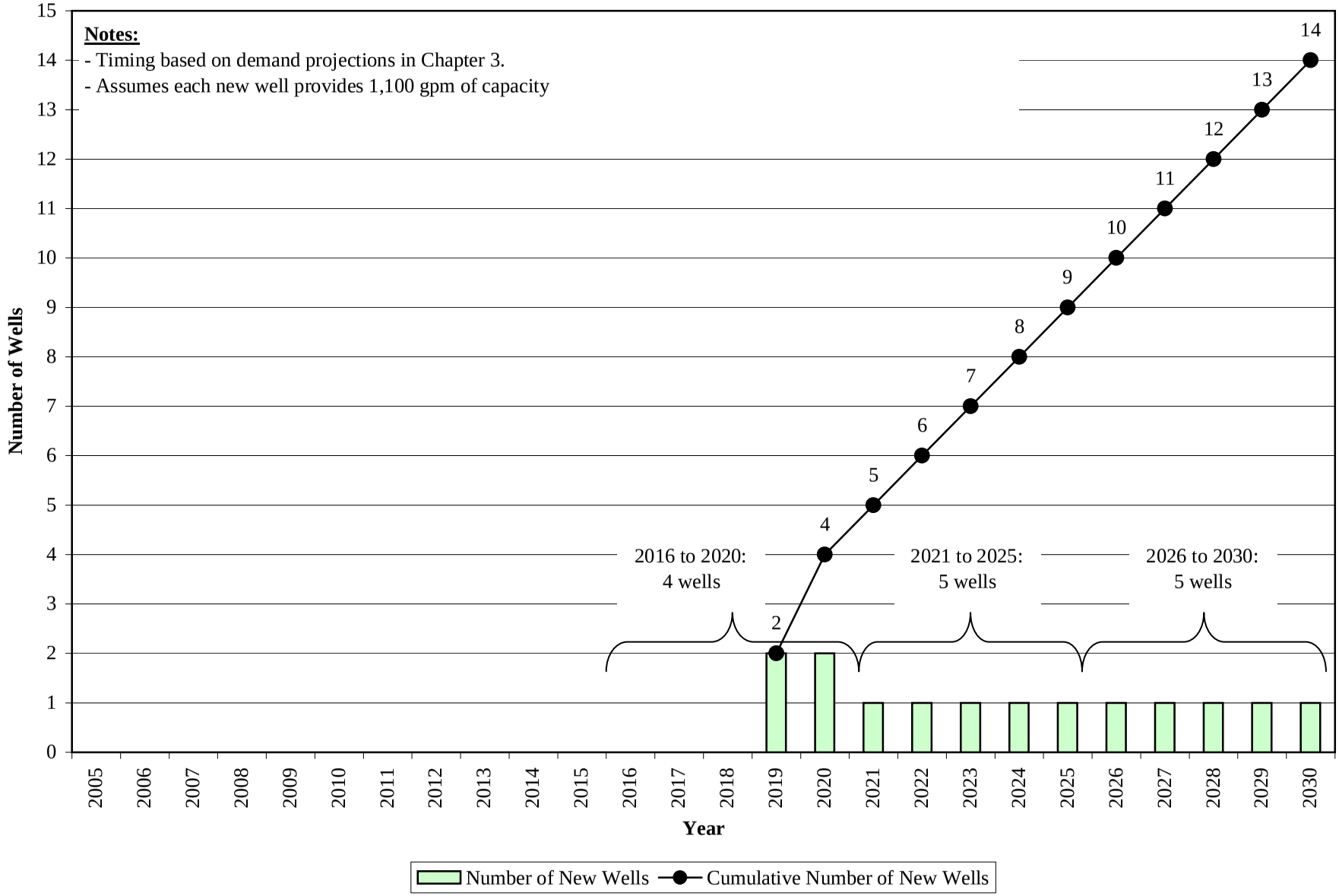
**California Water Service Company**
**Chico-Hamilton City District Water**
**Supply and Facilities Master Plan**

## SUMMARY OF KEY WATER QUALITY RESULTS IN CAL WATER WELLS

WEST YOST ASSOCIATES
Consulting Engineers

Public Version

## Figure 4-22. Projected Number of New Wells Required

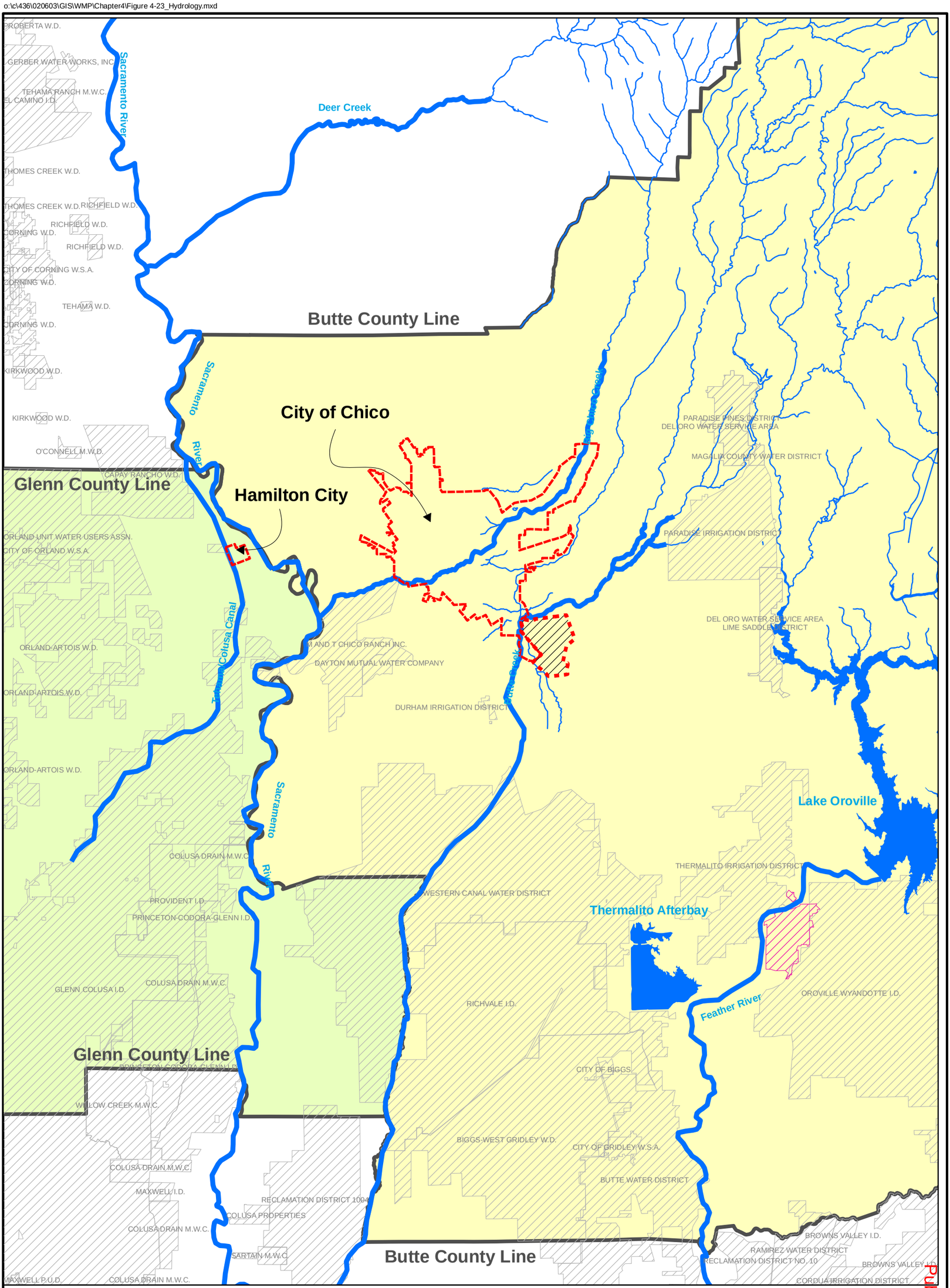



West Yost Associates
o:\c\436\020603\2\newwellsrequired
Last Revised: 04/41/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

o:\c\436\020603\GIS\WMP\Chapter4\Figure 4-23_Hydrology.mxd




LEGEND

- Glenn County
- Butte County
- Blakely & Swartz Development
- Major River
- Water Feature
- Cal Water Oroville District
- Other Water District
- Small Rivers/Streams
- Sphere of Influence

N

0 1.25 2.5 5

Scale in Miles

**FIGURE 4-23**

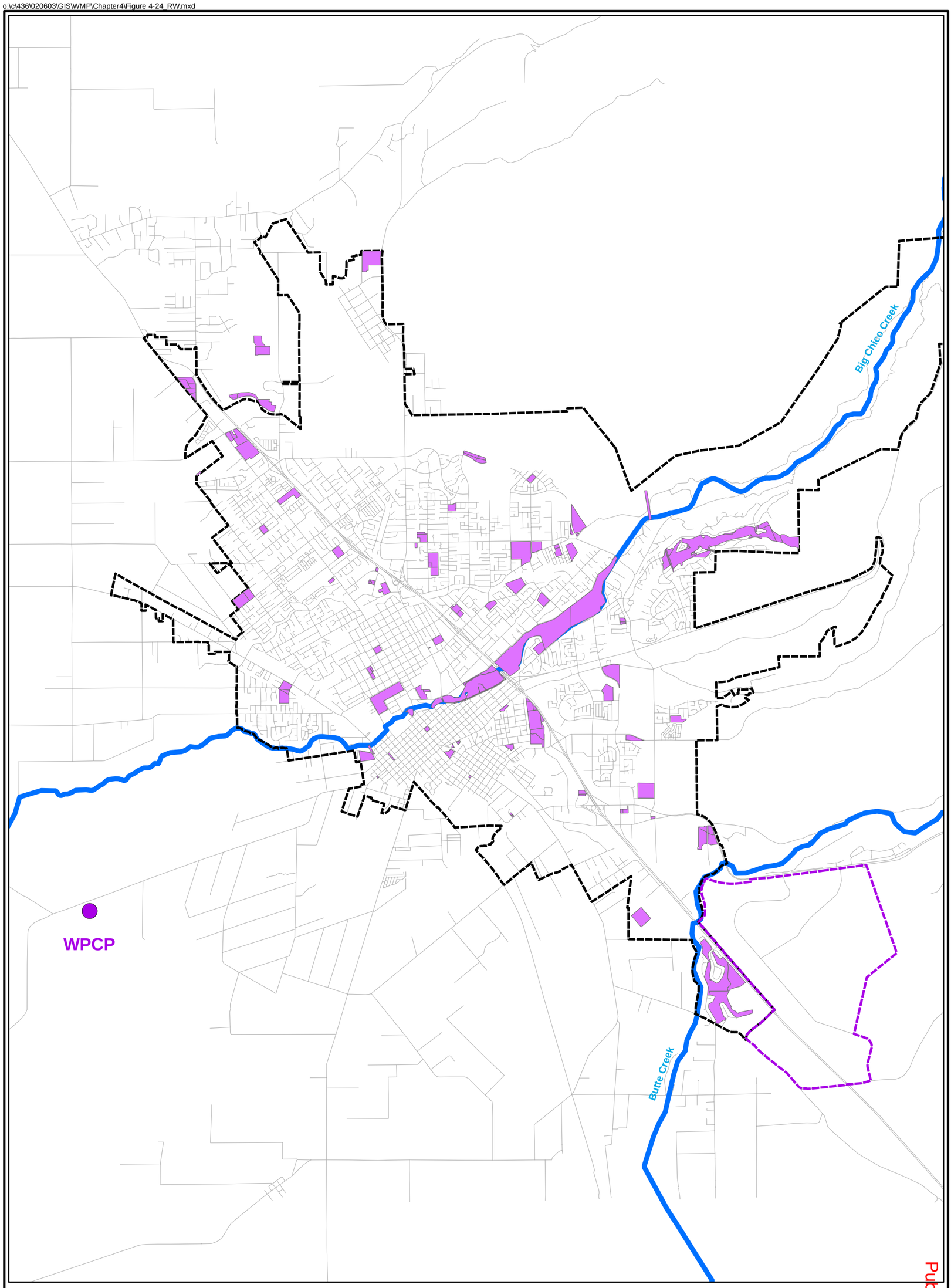
**California Water Service Company**
**Chico-Hamilton City District Water Supply and Facilities Master Plan**

**REGIONAL SURFACE WATER RESOURCES & PURVEYORS**

WEST YOST ASSOCIATES Consulting Engineers

Public Version

o:\c\436\020603\GIS\WMP\Chapter4\Figure 4-24_RW.mxd




LEGEND

- Water Pollution Control Plant (WPCP)
- Blakely & Swartz Development
- Chico Sphere of Influence
- Major Creeks or Rivers
- Water Feature
- Existing and Future Schools & Parks

N

0 0.35 0.7 1.4

Scale in Miles

**FIGURE 4-24**

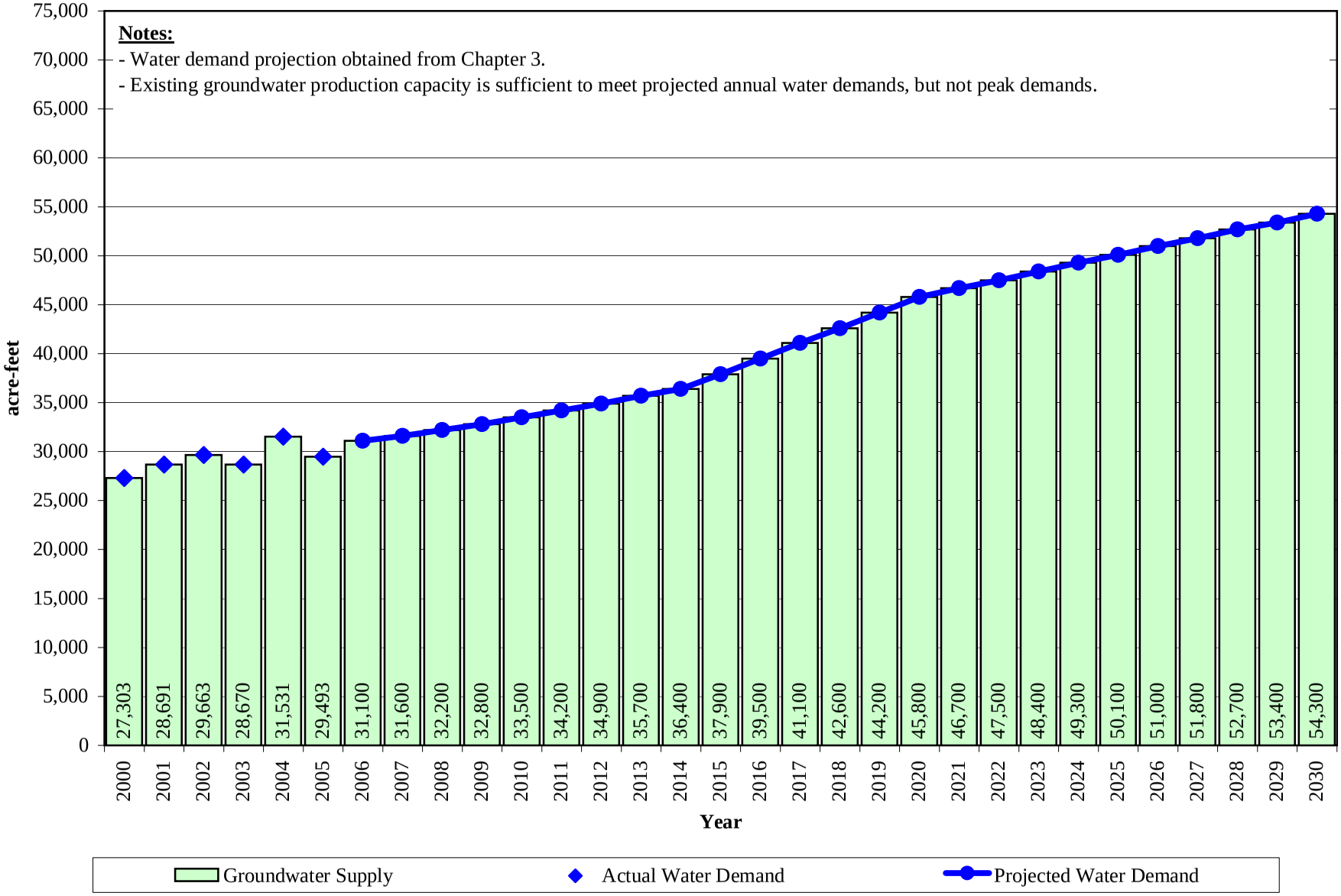
**California Water Service Company**
**Chico-Hamilton City District Water**
**Supply and Facilities Master Plan**

**LOCATION OF POTENTIAL RECYCLED WATER SUPPLY AND DEMAND**

WEST YOST ASSOCIATES Consulting Engineers

Public Version

## Figure 4-25. Comparison of Annual Water Supply and Demand

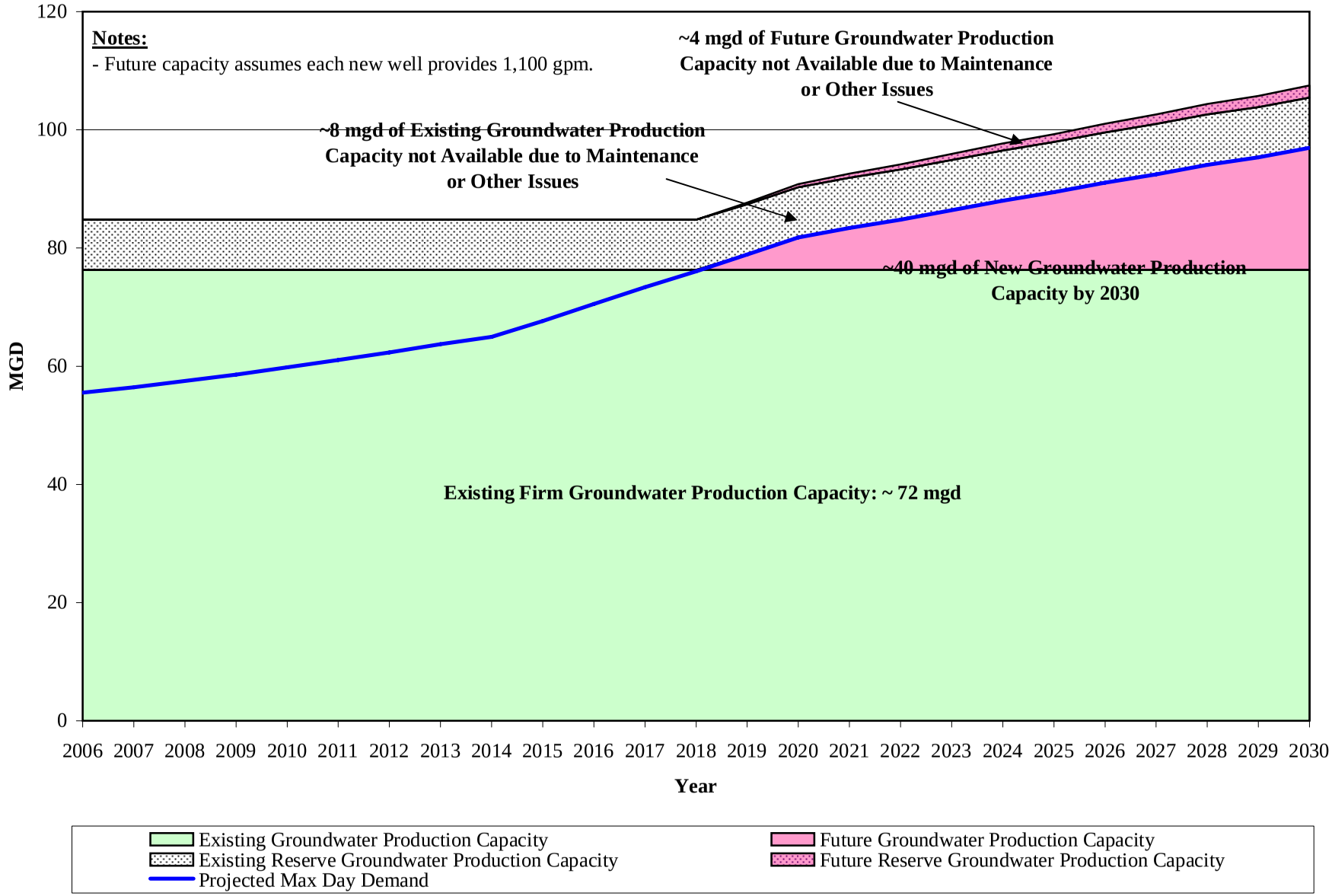



West Yost Associates
o:\c\436\02-06-03\te\supplyvsdemand
Last Revised: 04/11/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

## Figure 4-26. Projected Max Day Demands and Groundwater Production Capacity

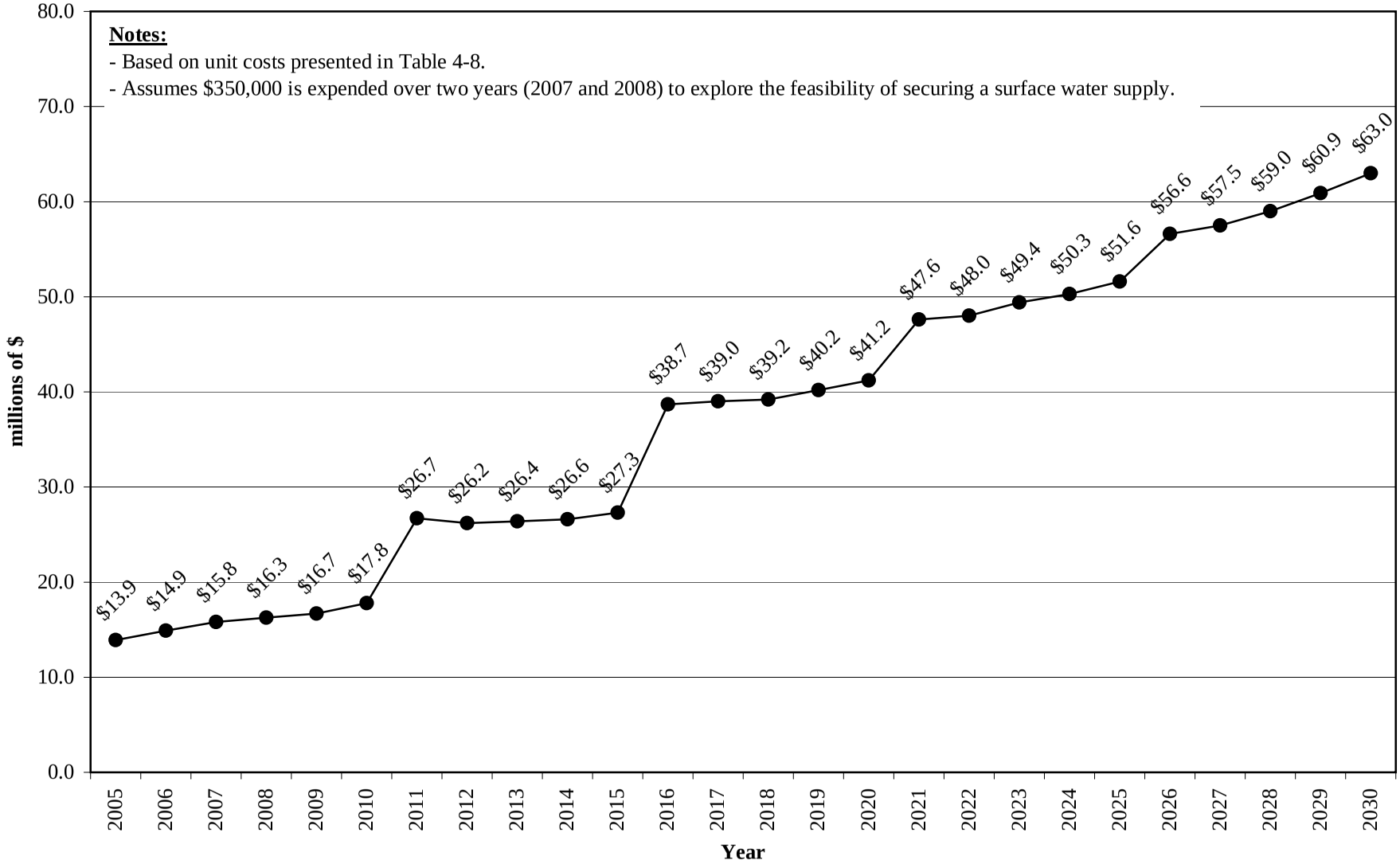



West Yost Associates
o:\c\436\020603\2\newwellsrequired
Last Revised: 12/18/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

## Figure 4-27. Projected Future Costs of Recommended Water Supply




Public Version

## REFERENCES

[1] Butte County Department of Water Resources and Conservation (BCDWRC), Camp Dresser & McKee (CDM), California Department of Water Resources (DWR), 2005. *Butte County Groundwater Inventory Analysis*. February 2005.

[2] Butte County Department of Water Resources and Conservation (BCDWRC), Camp Dresser & McKee (CDM), California Department of Water Resources (DWR), 2005. *Butte County Groundwater Inventory Analysis*. February 2005.

[3] Butte County Department of Water Resources and Conservation (BCDWRC), Camp Dresser & McKee (CDM), California Department of Water Resources (DWR), 2005. *Butte County Groundwater Inventory Analysis*. February 2005.

[4] Butte County Department of Water Resources and Conservation (BCDWRC), Camp Dresser & McKee (CDM), California Department of Water Resources (DWR), 2005. *Butte County Groundwater Inventory Analysis*. February 2005.

[5] Butte County Department of Water Resources and Conservation (BCDWRC), Camp Dresser & McKee (CDM), California Department of Water Resources (DWR), 2005. *Butte County Groundwater Inventory Analysis*. February 2005.

[6] Butte County Department of Water Resources and Conservation (BCDWRC), Camp Dresser & McKee (CDM), California Department of Water Resources (DWR), 2005. *Butte County Groundwater Inventory Analysis*. February 2005.

[7] Butte County Department of Water Resources and Conservation (BCDWRC), Camp Dresser & McKee (CDM), California Department of Water Resources (DWR), 2005. *Butte County Groundwater Inventory Analysis*. February 2005.

[8] Butte County Department of Water Resources and Conservation (BCDWRC), Camp Dresser & McKee (CDM), California Department of Water Resources (DWR), 2005. *Butte County Groundwater Inventory Analysis*. February 2005.

[9] Butte County Department of Water Resources and Conservation (BCDWRC), Camp Dresser & McKee (CDM), California Department of Water Resources (DWR), 2005. *Butte County Groundwater Inventory Analysis*. February 2005.

[10] Butte County Department of Water Resources and Conservation (BCDWRC), Camp Dresser & McKee (CDM), California Department of Water Resources (DWR), 2005. *Butte County Groundwater Inventory Analysis*. February 2005.

[11] Butte County Department of Water Resources and Conservation (BCDWRC), Camp Dresser & McKee (CDM), California Department of Water Resources (DWR), 2005. *Butte County Groundwater Inventory Analysis*. February 2005.

[12] Butte County Department of Water Resources and Conservation (BCDWRC), Camp Dresser & McKee (CDM), California Department of Water Resources (DWR), 2005. *Butte County Groundwater Inventory Analysis*. February 2005.

[13] Butte County Department of Water Resources and Conservation (BCDWRC), Camp Dresser & McKee (CDM), California Department of Water Resources (DWR), 2005. *Butte County Groundwater Inventory Analysis*. February 2005.

[14] Butte County Department of Water Resources and Conservation (BCDWRC), Camp Dresser & McKee (CDM), California Department of Water Resources (DWR), 2005. *Butte County Groundwater Inventory Analysis*. February 2005.

[15] Butte County Department of Water Resources and Conservation (BCDWRC), Camp Dresser & McKee (CDM), California Department of Water Resources (DWR), 2005. *Butte County Groundwater Inventory Analysis*. February 2005.

[16] Butte County Department of Water Resources and Conservation (BCDWRC), Camp Dresser & McKee (CDM), California Department of Water Resources (DWR), 2005. *Butte County Groundwater Inventory Analysis*. February 2005.

[17] Department of Water Resources (DWR) Bulletin 118, Groundwater Basin Descriptions, updated February 27, 2004.

[18] Department of Water Resources (DWR) Bulletin 118, Groundwater Basin Descriptions, updated February 27, 2004.

[19] DWR, preliminary data for Bulletin 132-05, Management of the California State Water Project, Appendix B, Table B-4, "Annual Table A Amounts to Project Water", October 2005.

[20] Butte County Code, Chapter 33A.

[21] Butte County Department of Water Resources and Conservation, 2004. Butte County Drought Preparation Plan.

[22] Wood Rodgers, 2003. Memorandum to the WAC: Preliminary Plan for Groundwater and Coordinated Water Management – Discussion Document. November 13.

Public Version



# Chapter 5: Planning and Design Criteria

*Chapter Contents:*


- Fire Flow Requirements
- Water Supply Capacity During High Demand Periods
- Pumping Facility Capacity
- Water Storage Capacity
- Water Transmission and Distribution System Sizing


*Chapter Highlights:*

In this chapter, planning and design criteria for the performance of system analysis of Cal Water's Chico-Hamilton City District water system are defined. These criteria include the desired minimum and maximum pressures, maximum velocity and head loss, fire flow and duration, definition of "emergency events", and storage components, including operational, fire flow and emergency. In addition, Cal Water's definition of a critical facility is also described in the chapter.

These criteria reflect typical water system industry standards, including the California Safe Drinking Water Act and related laws, California Public Utilities Commission's General Order 103, and American Water Works Association standards.

# CHAPTER 5. PLANNING AND DESIGN CRITERIA

The purpose of this chapter is to define the planning and design criteria for the performance of the Cal Water's Chico-Hamilton City District water distribution system. These criteria include the desired fire flow and flow duration, definition of "emergency events", pumping capacity, storage capacity components (including, operational, fire flow and emergency), minimum and maximum pressures, and maximum pipeline velocity and head loss. Subsequent sections of this chapter are as follows:

- Fire Flow Requirements
- Water Supply Capacity During High Demand Periods
- Pumping Facility Capacity
- Water Storage Capacity
- Water Transmission and Distribution System Sizing

These criteria, summarized in Table 5-1, reflect typical water system industry standards, including the California Safe Drinking Water Act and related laws, California Public Utilities Commission's General Order 103, and American Water Works Association standards.

## FIRE FLOW REQUIREMENTS

Cal Water is the purveyor of water for the Chico-Hamilton City District, but the City of Chico Fire Department and Hamilton City Fire Protection District are concerned with the availability of adequate water supply. Cal Water is responsible for supply and distribution of water, whereas the City of Chico Fire Department and Hamilton City Fire Protection District establishes minimum water flows required for fire fighting purposes.

The City of Chico Fire Department and Hamilton City Fire Protection District uses Uniform/California Fire Code (UFC/CFC) Table A-III-A-1 *Minimum Required Fire Flow and Flow Duration for Buildings* to assist them in establishing minimum fire flows and durations for individual structures. The Chico-Hamilton City District's current, generalized fire flow requirements by land use type are presented in Table 5-2. Comparison of the Chico-Hamilton City District's generalized fire flow requirements, with those of other agencies, indicates that the Chico-Hamilton City District's fire flow requirements are typical for a water agency of similar size.

## Table 5-1. California Water Service Company's Chico-Hamilton City District Planning and Design Criteria

| Component | Criteria | Remarks / Issues |
|---|---|---|
| **PERFORMANCE CRITERIA FOR PLANNING & DESIGN** | | |
| **Fire Flow Requirements (flow [gpm] @ duration [hours])** | | |
| Single-Family Residential | 1,500 gpm @ 2 hrs | Fire flows based on new development requirements. Existing development will be evaluated on a case by case basis, because of the historical varying standard. |
| Multi-Family Residential | 2,500 gpm @ 2 hrs | |
| Commercial | 3,000 gpm @ 3 hrs (with approved automatic sprinkler system) | |
| Institutional (schools, hospitals, etc.) | 4,000 gpm @ 4 hrs (with approved automatic sprinkler system) | |
| Industrial / Business Park | 4,000 gpm @ 4 hrs (with approved automatic sprinkler system) | |
| **Water Supply Capacity** | | |
| Maximum Day Demand Plus Fire Flow | Provide capacity equal to maximum day demand plus fire flow | |
| Peak Hour Demand | Provide capacity equal to peak hour demand | |
| **Pumping Facility Capacity** | | |
| Booster Pump Capacity | Equal to the maximum day demand for the pressure zone and/or service area the facility is serving. | Design for maximum day plus fire flow or peak hour (whichever is larger), only if no gravity storage is available within the pressure zone and/or service area. |
| Backup Power | Equal to the firm capacity of the pumping facility. | On-site generator for critical stations.[a]<br>Plug in portable generator for less critical stations. |
| **Water Storage and System Peaking Capacity** | | |
| Operational | 25 percent of maximum day demand | |
| Fire | Varies<br>(see requirements listed in remarks column) | Varies depending on required fire flow duration. Highest fire flow demand in any particular area controls size of required storage.<br>1,500 gpm @ 2 hrs = 0.18 MG<br>2,500 gpm @ 2 hrs = 0.30 MG<br>3,000 gpm @ 3 hrs = 0.54 MG<br>4,000 gpm @ 4 hrs = 0.96 MG |
| Emergency | Average day demand | Based on DHS recommendations |
| Emergency Storage Credit (ESC) | Equal to pumping capacity of wells with backup power. | Minimum credit is equal to zero, and the maximum credit is equal to the recommended emergency storage capacity. |
| Operational Storage Credit (OSC) | 50 percent of (firm groundwater pumping capcaity - MDD) | Minimum credit is equal to zero, and the maximum credit is equal to the recommended operational storage capacity. |
| Total Water Storage Capacity | Operational + Fire + Emergency - ESC - OSC | |
| **Water Transmission Line Sizing** | | |
| Diameter | 18-inches in diameter or larger | Criteria based on requirements for new development, existing transmission mains will be evaluated on case-by-case basis. Evaluation will include age, material type, velocity, headloss, and pressure. |
| Average Day Demand Condition | | |
| Minimum Pressure [psi] | 50 psi | |
| Maximum Pressure [psi] | 125 psi | |
| Maximum Velocity [ft/sec] | 3 fps | |
| Maximum Day Demand Condition | | |
| Minimum Pressure [psi] | 40 psi | |
| Maximum Head loss [ft/1000 ft] | 3 ft/kft | |
| Maximum Velocity [ft/sec] | 5 fps | |
| Peak Hour Demand Condition | | |
| Minimum Pressure [psi] | 40 psi | |
| Maximum Head loss [ft/1000 ft] | 3 ft/kft | |
| Maximum Velocity [ft/sec] | 5 fps | |
| Hazen Williams "C" Factor | 130 | For consistency in hydraulic modeling. |
| Pipeline Material | Ductile Iron, Concrete Cylinder or Steel | |
| **Water Distribution Line Sizing** | | |
| Diameter | Less than 18-inches in diameter | Must verify pipeline size with max day and fire flow analysis. |
| Average Day Demand Condition | | Criteria based on requirements for new development, existing distribution mains will be evaluated on case-by-case basis. Evaluation will include age, material type, velocity, headloss, and pressure. |
| Minimum Pressure [psi] | 50 psi | |
| Maximum Pressure [psi] | 125 psi | |
| Maximum Velocity [ft/sec] | 3 - 5 fps | |
| Maximum Day w/ Fire Flow Demand Condition | | |
| Minimum Pressure [psi] (at fire node) | 20 psi | |
| Maximum Head loss [ft/1000 ft] | 10 ft/kft | |
| Maximum Velocity [ft/sec] | 10 fps | |
| Peak Hour Demand Condition | | |
| Minimum Pressure [psi] | 40 psi | |
| Maximum Head loss [ft/1000 ft] | 10 ft/kft | |
| Maximum Velocity [ft/sec] | 7 fps | |
| Minimum Pipeline Sizes | | |
| Low Density Residential | 12" [sq mi grid], 8" [1/4 mi grid], 6" [other] | |
| Commercial | 8" + 12" [sq mi grid] | |
| Industrial | 12" | |
| Distribution to cul-de-sac / dead end street | 8-inch | |
| Distribution to fire hydrants | 8-inch | |
| Hazen Williams "C" Factor | 120 (Ductile, Iron, Steel); 130 (PVC) | For consistency in hydraulic modeling. |
| Pipeline Material | PVC, Ductile Iron, or Steel | |
| **OTHER CRITERIA** | | |
| Maximum Number of residential lots that can be served by a non-looped water pipeline | 25 lots | If a non-looped water line goes out-of-service, all associated residences lose water service. |

[a] A pumping facility is defined as critical if it provides service to pressure zones and/or service areas without sufficient emergency storage and that meet the following criterion:

- The largest facility that provides water to a particular pressure zone and/or service area;
- A facility that provides the sole source of water to single or multiple pressure zones and/or service areas;
- A facility that provides water from a supply turnout into pressure zones and/or service areas; and
- A facility that provides water from key (depends on capacity, quality and location) groundwater supply wells into a pressure zone and/or service area.

Public Version

**Table 5-2. Fire Flow Requirements[a,b]**

| Revenue Class | Fire Flow[c,d], gpm | Duration, hours | Storage Volume, MG |
|---|---|---|---|
| Residential | 1,000 | 2 | 0.12 |
| Multiple Residences | 2,500 | 2 | 0.30 |
| Commercial | 3,000 | 3 | 0.54 |
| Industrial | 4,000 | 4 | 0.96 |
| Government | 4,000 | 4 | 0.96 |

(a) Construction type and fire area are not generally known during the development of a master plan; consequently, fire flow requirements set forth in this table are based on previous estimates for these land use types in similar communities.

(b) Unique projects or projects with alternate building materials may require higher fire flows and will be reviewed by the Fire Marshal on a case-by-case basis (e.g., proposed commercial/industrial areas and schools).

(c) Both the City of Chico Fire Department and Hamilton City Fire Protection District normally allows up to a 50 percent reduction in fire flow if a building is sprinklered. However, the Fire Code also requires that no fire flow be less than 1,000 gpm for single family residential or 1,500 gpm for all other building types.

(d) Specific fire flows are determined from Table A-III-A-1 of the 2001 CFC, and depend on construction type and fire area. These fire flow requirements are based on buildings being fully sprinklered.

The criteria, as presented in Table 5-2, will be used for the evaluation of the existing and future water system. For planning purposes, fire flows are assumed to be met concurrently with a maximum day demand condition, while maintaining a minimum residual system pressure of 20 pounds per square inch (psi) throughout the Chico-Hamilton City District. Additionally, as discussed in subsequent sections of this chapter, fire flows presented in Table 5-2 and their expected duration are also used to establish storage capacity requirements.

## WATER SUPPLY CAPACITY DURING HIGH DEMAND PERIODS

The following criteria should be used to assess the adequacy of the Chico-Hamilton City District's water supply during high demand periods.

### Maximum Day Demand plus Fire Flow

In accordance with typical industry standards, the Chico-Hamilton City District's water supply system should have the capability to meet a system demand condition equal to the occurrence of a maximum day demand condition concurrent with a fire flow event. For planning purposes, it is assumed that the maximum day plus fire flow demand condition will consist of a single fire flow event.

The analysis of specific fire flow evaluations will be conducted assuming the largest booster pump at each station is offline (i.e., firm booster pumping capacity), regardless of whether or not

fire flow is provided by gravity storage, or the booster pump station. In addition, well pumps were assumed to pump at firm capacity (i.e., firm groundwater pumping capacity) during a specific fire flow evaluation.

Based on data provided by Cal Water, the current groundwater well capacity within the Chico-Hamilton City District's service area is approximately 66.7 mgd. Using an assumption that 10 percent of the groundwater production capacity is out of service for maintenance or other issues, the Chico-Hamilton City District can assume a *firm groundwater pumping capacity* of up to approximately 60.0 MG (90 percent of 66.7 MG for one day) from the groundwater wells.

These conservative assumptions ensure the reliability of the system to provide sufficient flow during emergency fire flow conditions. For future system improvement analyses, pump stations with only one booster pump, or without back-up power capability (either an onsite generator or adaptor for a plug-in generator), will not be considered to be available during a fire flow analysis. The selection of a well for the installation of a backup power supply will be based on the capacity, quality and location of the well.

**Peak Hour Demand**

If feasible, peak hour demand should be met from a combination of supply sources and treated water storage reservoirs.

## PUMPING FACILITY CAPACITY

Sufficient water system pumping capacity, in conjunction with available gravity storage, should be provided to meet the greater of these two demand conditions.

(1) A maximum day demand concurrent with a maximum fire flow event with the largest pump at each booster pump station in standby mode with well pumps assumed to operate at firm groundwater pumping capacity.

(2) A peak hour demand with the largest pump at each booster pump station in standby mode with well pumps assumed to operate at firm groundwater pumping capacity.

This maximum demand requirement sets the pumping capacity requirement.

## CRITICAL PUMPING FACILITY

Critical pumping facilities are defined as those facilities that provide service to pressure zones and/or service areas without sufficient emergency storage (see emergency storage section) and that meet the following criteria:

- The largest facility that provides water to a particular pressure zone and/or service area;
- A facility that provides the sole source of water to single or multiple pressure zones and/or service areas;

- A facility that provides water from a supply turnout into pressure zones and/or service areas; and
- A facility that provides water from key (depends on capacity, quality and location) groundwater supply wells into a pressure zone and/or service area.

All critical pumping facilities should be equipped with an on-site, back-up power generator. At less critical facilities a plug-in adapter will be used to allow interconnection to a portable generator, which will be brought to the site by Chico-Hamilton City District staff during a prolonged power outage. In addition, portable generator booster connections will be configured at all tank/booster locations.

If unavailable by gravity storage, the fire flow should be supplied with a National Fire Protection Association (NFPA) rated fire pump. If an NFPA rated fire pump is not used, then a pump(s) and motor(s) combination with a backup power source of sufficient capacity to meet the required maximum fire flow and pressure requirements, as determined by the Fire Department's Fire Marshal, will be required.

## WATER STORAGE CAPACITY

The total treated water storage capacity requirements will be evaluated based on the following three components:

- Operational Storage,
- Fire Storage, and
- Emergency Storage.

A discussion of these three components, along with a discussion of credits for existing groundwater supply, follows.

### Operational Storage

Over any 24-hour period, water demands will vary. Typically, higher water demands will occur during the early morning hours when people are irrigating landscape and getting ready to go to work and school. Water demands will then decline to some nominal baseline level (depending on the proximity to and water use patterns of adjacent commercial/industrial areas), and will then begin to increase again depending on outside water needs (and corresponding temperature), until it reaches a higher water demand in the early evening hours as people return home from work. Throughout the year, the peaks of this cycle will vary according to customer needs; thereby, creating a maximum day and peak hour demands.

Typically, water treatment plants, supply turnouts, and/or wells are operated at a constant rate over a 24-hour period (baseline), augmented by additional flow from storage tanks, supply turnouts and/or wells during peak demand periods. Storage tanks are normally refilled when demands drop below the baseline water production flow rate. The storage volume used to meet these peak demand periods is called operational storage.

The operational storage requirements will be calculated based on the diurnal demand in a pressure zone or service area. If sufficient data is not available to develop a diurnal demand, then the recommended volume of water to be held in reserve for operational storage should be at least equal to 25 percent of the total volume of water used on a maximum day demand condition.

**Fire Storage**

Fire fighting flow requirements are identified in the UFC. These requirements are based on flow (in gpm) for the building use type (*i.e.* commercial. residential, school, industrial *etc*.), size of building (in square feet), and type of construction (wood frame, metal, masonry, installation of sprinklers, *etc*.). After a fire flow requirement is established, it is multiplied by the required fire fighting duration to produce an estimate of the total volume of fire flow required. Table 5-2 presents the recommended fire flow criteria.

The highest recommended fire flow requirement in the Chico-Hamilton City District (see Table 5-2) is 4,000 gpm, for a duration of four hours for industrial areas (if sprinklered). The resulting volume needed for fire flow storage is 0.96 MG. The resulting fire flow volume determined for the Chico-Hamilton City District, where feasible, should be stored in reservoirs located within the closest pressure zone or readily available by gravity from storage in higher pressure zones.

**Emergency Storage**

A reserve of stored water is also required to meet demands during an emergency. An emergency is defined as an unforeseen or unplanned event that may degrade the quality or quantity of potable water supplies available to serve customers. There are three types of emergency events that a water utility typically prepares for:

- Minor emergency. A fairly routine, normal, or localized event that affects few customers, such as a pipeline break, malfunctioning valve, hydrant break, or a brief power loss. Utilities plan for minor emergencies and typically have staff and materials available to correct them.
- Major emergency. A disaster that affects an entire, and/or large, portion of a water system, lowers the quality and quantity of the water, or places the health and safety of a community at risk. Examples include water treatment plant failures, raw water contamination or major power grid outages. Water utilities infrequently experience major emergencies.
- Natural disaster. A disaster caused by natural forces or events that create water utility emergencies. Examples include earthquakes, forest or brush fires, hurricanes, tornados or high winds, floods, and other severe weather conditions such as freezing or drought.

Determination of the required volume of emergency storage is a policy decision based on the assessment of the risk of failures and the desired degree of system reliability. The amount of required emergency storage is a function of several factors including the diversity of the supply sources, redundancy and reliability of the production facilities, and the anticipated length of the emergency outage. In developing an emergency storage requirement for the Chico-Hamilton City

District, typical industry standards were used and the recommended criteria and assumptions are described in the following paragraphs.

The treated water emergency supply requirements, as published by the State Department of Health Services (DHS) in Title 22 Chapter 16, call for a minimum emergency supply in each pressure zone equivalent to the average day demand. American Water Works Association (AWWA) states that no formula exists for determining the amount of emergency storage required, that the decision will be made by the utility based on a judgment about the perceived vulnerability of the system.

For this Water Supply and Facilities Master Plan, it has been assumed that the emergency storage requirement will be based on minor emergencies and *specific* major emergency criteria. It is recommended that the Chico-Hamilton City District use DHS's suggested guideline of having a minimum quantity of emergency storage volume equivalent to the Chico-Hamilton City District's average day demand.

**Credits for Existing Groundwater Supply**

Because of the Chico-Hamilton City District's available wells, groundwater storage can account for a portion of the recommended water storage and system peaking capacity. However, sufficient water transmission facilities must be available to distribute this water to demand areas.

Groundwater credit can be defined using the following two categories:

- Emergency Storage Credit – Equal to the groundwater supply of potable water that can be reliably accessed (wells are equipped with auxiliary power). The minimum credit is equal to zero, and the maximum credit is equal to the recommended emergency storage capacity.
- Operational Storage Credit – Equal to a percentage of the groundwater supply that can be reliably accessed in excess of that which is required to meet maximum day demand (MDD). The supply used for this calculation assumes that 10 percent of the groundwater production capacity is out of service for maintenance or other issues. For the Chico-Hamilton City District, the Operational Storage Credit equals 50 percent of the difference between the firm groundwater pumping capacity and a maximum day demand (MDD). The estimated Operational Storage Credit is based on the Chico-Hamilton City District's peaking factors (MDD = 1.5 and PHD = 3.0) and can vary between Cal Water Districts. The minimum credit is equal to zero, and the maximum credit is equal to the recommended operational storage capacity or 25 percent of a maximum day demand.

**Total Storage Capacity**

The Chico-Hamilton City District's water storage capacity should be the sum of the following components:

- Operational: Volume of water necessary to meet diurnal peaks observed throughout the day, usually designed to be equivalent to at least 25 percent of the maximum day demand
- Fire Flow: Volume of water necessary to provide the maximum fire flow in the service area multiplied by the duration the flow rate that must be maintained
- Emergency: Volume of water necessary to provide an average day demand
- Emergency Storage Credit: Equal to the groundwater supply of potable water that can be reliably accessed (wells are equipped with auxiliary power)
- Operational Storage Credit: Equal to 50 percent of the difference between the firm groundwater pumping capacity and a maximum day demand

The amount of total system storage and system peaking capacity required to meet these criteria will change over time as the Chico-Hamilton City District continues to grow and demands increase.

## WATER TRANSMISSION AND DISTRIBUTION PIPELINE SIZING

The following criteria are to be used as guidelines for new transmission and distribution pipeline sizing. The Chico-Hamilton City District's existing system will be evaluated on a case–by-case basis. For example, if an existing pipeline experiences head loss in excess of the criteria described below during a maximum day plus fire flow event, this condition, by itself, does not necessarily indicate a problem as long as the minimum pressure criterion is satisfied.

Although these criteria and guidelines have been established, and will be used to size new pipelines, the Chico-Hamilton City District's existing system will be evaluated using pressure as the primary criterion; and secondary criteria, such as velocity, head loss, age, and material type, will be used as indicators for where water system improvements may be needed.

### Water Transmission System

Transmission pipelines are generally 18 inches in diameter or larger, and should be designed based on the criteria described below for average day, maximum day plus fire flow, and peak hour demand conditions. The criteria reflect industry standards and WYA's experience working with the Chico-Hamilton City District's existing water system.

<u>Average Day Demand</u>

- Pressures should be maintained between a maximum of 125 psi and a minimum of 50 psi.
- Maximum velocity within transmission pipelines should be 3 feet per second (fps).

Maximum Day Demand

- The minimum allowable service pressure should be 40 psi.
- The maximum velocity within the transmission system pipelines should be 5 fps.
- Head losses within the transmission system pipelines should be limited to 3 ft/kft of pipeline.

Peak Hour Demand

- The minimum allowable service pressure should be 40 psi.
- The maximum velocity within the transmission system pipelines should be 5 fps.
- Head losses within the transmission system pipelines should be limited to 3 ft/kft of pipeline.

**Water Distribution System**

Distribution pipelines are generally less than 18 inches in diameter, and should be sized based on the criteria described below for average day, maximum day plus fire flow, and peak hour demand conditions. The criteria reflect industry standards and WYA's experience working with the Chico-Hamilton City District's existing water system.

Average Day Demand

- Pressures should be maintained between a maximum of 125 psi and a minimum of 50 psi.
- The maximum velocity within distribution system pipelines should be 3 to 5 fps.

Maximum Day Demand plus Fire Flow

- The minimum allowable residual pressure should be 20 psi at the flowing fire hydrant.
- The maximum velocity within the distribution system pipelines should be 10 fps.
- Head losses within the distribution system pipelines should be limited to 10 ft/kft of pipeline.

Peak Hour Demand

- The minimum allowable service pressure should be 40 psi.
- The maximum velocity within the distribution system pipelines should be 7 fps.
- Head losses within the distribution system pipelines should be limited to 10 ft/kft of pipeline.

Public Version



# Chapter 6: Hydraulic Model

*Chapter Contents:*


- Development of the Hydraulic Model
- Hydraulic Model Calibration
- Hydraulic Model Verification


*Chapter Highlights:*

In the development of Cal Water's Chico-Hamilton City District hydraulic network model, WYA completed the following steps:

- Used Cal Water's existing water distribution system maps (exported from Cal Water's GIS) and existing digital water distribution maps in AutoCAD to create and update the hydraulic model:
- Verified that the hydraulic model system configuration (pipeline sizes, alignments, connections, and other facility sizes and locations) was representative of the current Cal Water Chico-Hamilton City District water system.
- Allocated existing water demands by using Cal Water's geocoded meter information to properly distribute demands within the hydraulic model.
- Calibrated Cal Water's water system hydraulic model to simulate pressures and flows observed in the field.

The water distribution model was then calibrated and verified using pressure and flow data observed in the field during July 2006:

- Twenty-two hydrant flow tests were conducted in the field on July 19 and July 20, 2006
- WYA collected SCADA data, both in electronic and circular chart format, on flows, tank levels and pump discharge pressures for each of the Cal Water stations during the period from July 10 2006 to July 25, 2006
- Twenty hydrant pressure recorders recorded pressures at 36 different locations throughout Cal Water's Chico-Hamilton City District from July 11 2006, to July 25, 2006.

# CHAPTER 6. HYDRAULIC MODEL

This chapter describes the development, calibration and verification of Cal Water's Chico-Hamilton City District water system hydraulic models.

To develop these two network models, WYA completed the following steps:

- Used Cal Water's existing water distribution system maps (exported from Cal Water's geographical information system (GIS)) and existing digital water distribution maps in AutoCAD to create the hydraulic model.
- Verified that the hydraulic model system configuration (pipeline sizes, alignments, connections, and other facility sizes and locations) was representative of Cal Water's current Chico-Hamilton City District water system.
- Allocated existing water demands by using Cal Water's geocoded meter information and land use to properly distribute demands within the hydraulic model.
- Calibrated Cal Water's water system hydraulic model to simulate pressures and flows observed in the field.

To accomplish these tasks, WYA worked closely with Cal Water's Engineering and Operations staff to obtain and review:

- Available operational information regarding existing transmission mains, storage tanks, groundwater wells, pump stations and other water facilities,
- As-built drawings and maps detailing each facility and older sections of the system to confirm pipeline sizes, material type, age, locations and alignments, and configuration into the distribution system, and
- Land use and available meter data.

The water distribution models were then calibrated and verified using pressure and flow data observed in the field during July 2006. The model development, calibration, and verification are described below.

## DEVELOPMENT OF THE HYDRAULIC MODEL

WYA developed hydraulic models of Cal Water's Chico-Hamilton City District potable water system using a series of steps that included the following:

- Description of the Model and Element Definition
- Pipelines, Nodes, and Junctions Imported into $H_2$OMAP
- Roughness Factors Assigned in $H_2$OMAP
- Accounts Geocoded in GIS

- Water Demands Allocated in $H_2OMAP$
- Elevations Allocated in $H_2OMAP$
- Pipelines Skeletonized in $H_2OMAP$
- Incorporating Station Elements in $H_2OMAP$
- Naming Scheme Used in $H_2OMAP$

Each of these steps is discussed in more detail below.

**Description of the Model and Element Definition**

MWHSoft's $H_2OMAP$ was the hydraulic modeling software used to represent Cal Water's water system in the District. This computer simulation model transforms information about the physical system into a mathematical model that solves for various flow conditions, and for each set of specified demands. The computer model then generates information on pressure, flow, velocity and head loss that is used to analyze the system performance and identify system deficiencies. The model can also be used to verify the adequacy of recommended or proposed system improvements.

The hydraulic model itself is actually represented by a skeletonized network of nodes (e.g., location of a tank, location where pressure is monitored), and node-connecting elements (e.g., pipes). However, because nodes are representative of actual facilities (e.g., tanks, pump stations, or wells) and physical locations, a definition of each element was created during the development of the hydraulic model. The description of nodes and node-connecting elements, as used in the development of the District models, is described as follows:

Node: Nodes, as defined for the District models, represent a transition in pipeline characteristic (e.g., diameter) or a point in the system where pressure or water quality is monitored. Elevation and physical facility location were the data requirements for nodes in the District models.

Junction: Junctions, as defined for the District models, represent a location where water is added (inflow) or subtracted (water demands) from the system. The demand at each junction, in addition to elevation and location, were the data requirements.

Pipe: Pipes (i.e., links), as defined for the District models, represent facilities that convey water from one point in the system to another, and were used to represent pipelines or check valves in the model. Diameter, from/to node or junction, and pipeline roughness factor were the input data required.

Reservoir: Reservoirs, as defined in the District models, represent external sources of water for the model (e.g., groundwater basin, lake, or treatment plant), and remain at a constant level irrespective of the flow unless they are specified as variable-head reservoirs. Reservoirs were used to represent the groundwater wells in the Chico-Hamilton City District models. Location, water service elevation, and nominal pressure were the data inputs to the District models.

Tank: Tanks, as defined for the District models, are distinguished from reservoirs by having a known finite volume and water surface elevations that change with time as water flows into or out of them. This element was used to represent Cal Water's storage tanks. Diameter, bottom elevation, overflow elevation, and location were the input data required.

Pump: Pumps, as defined for the District models, represent locations in the model where the hydraulic grade line is raised to overcome elevation differences and friction losses, and were used to represent pump stations. Elevation, diameter, number of pumps, pump test results, pump curves, and sequencing were the input data required.

**Pipelines, Nodes, and Junctions Imported into $H_2$OMAP**

Cal Water staff provided WYA with a GIS geodatabase file containing the geospatial location of existing pipelines, fittings, system valves, and control valves for both the Chico and Hamilton water systems. The geodatabase layer of the existing water pipelines did not include "from" and "to" nodes (i.e., points designating the beginning and end of the pipeline); consequently, WYA used Cal Water's existing fittings, system valves, and control valves as the beginning and end-points (from and to nodes) of the existing pipelines.

Using WYA's GIS system, the actual points as identified in the fittings, system valves, and control valve layers of the geodatabase that intersected existing pipelines (as identified in the pressurized main layer) were identified and imported into $H_2$OMAP. WYA then assigned the from and to nodes of the existing lines as a point from either the fittings, system valves, or control valves layer using the "fix network connectivity" feature of $H_2$OMAP. The "fix network connectivity" feature assigned the from and to node based on the actual point from either the fittings, system valves, or control valves layer that corresponded with the beginning and end of the existing pipeline; all other points not used as a from or to node were subsequently removed from the model. This was completed for both the Chico and Hamilton City hydraulic models.

**Roughness Factors Assigned in $H_2$OMAP**

The original geodatabase layer for existing pipelines did not include roughness factors, but did include material type, an attribute that can be used as a surrogate for roughness factors. Consequently, WYA assigned a preliminary roughness factor (i.e., C-factor), based on extensive experience and professional judgment, to each pipeline using its material type as a surrogate in model. Table 6-1 presents the preliminary C-factors assigned to each of the twenty-two different material types within Cal Water's Chico-Hamilton City District water system. These C-factors were then validated during calibration of the hydraulic model (see subsequent sections below).

**Table 6-1. Preliminary C-Factors Assigned in the Model**

| Pipeline Material Acronym[a] | Assumed Pipeline Material Type | C-factor Used ≤ 8-inches | C-factor Used > 8-inches |
|---|---|---|---|
| AC | Asbestos Cement | 130 | 140 |
| CI | Cast Iron | 110 | 120 |
| CICL | Cast Iron Cement Lined | 120 | 130 |
| CL | Cement Lined | 120 | 130 |
| CL&C | Cement Lined & Coated | 120 | 130 |
| CML&C | Cement Mortar Lined & Coated | 120 | 130 |
| DI | Ductile Iron | 130 | 140 |
| OD | Concrete | 110 | 120 |
| PVC | Polyvinyl Chloride | 140 | 150 |
| SS | Standard Steel | 120 | 130 |
| STD STL | Standard Steel | 120 | 130 |
| STL | Steel | 120 | 130 |
| STL & CL | Steel & Cement Lined | 120 | 130 |
| STL CL&C | Steel Cement Lined & Coated | 120 | 130 |
| Steel Concrete Line | | 120 | 130 |
| RCP | Reinforced Concrete Pipe | 120 | 130 |
| WS | Welded Steel | 120 | 130 |
| CL&C WSP | Cement Lined & Coated Welded Steel Pipe | 120 | 130 |
| CML&C WSP | Cement Mortar Lined & Coated Welded Steel | 120 | 130 |
| D&W | Coated Steel | 120 | 130 |
| TRANS | Transite | 120 | 130 |
| WI | Wrought Iron | 100 | 120 |

[a] Acronym obtained from geodatabase layer PressurizedMain for the District

### Accounts Geocoded in GIS

Cal Water provided WYA with a spreadsheet (CON CH_HC 20060227.xls) containing account data by address (including the zip code) and revenue class for each month of 2005. The data provided in the spreadsheet also included Residential-Flat accounts within the City of Chico (i.e., accounts that are not metered). Using this spreadsheet and special GIS street file maps, WYA then spatially located (i.e., geocoded) each of the water service accounts.

WYA was able to locate 97 percent (25,135 out of 25,845 accounts) of the total number of accounts present in the demand spreadsheet provided, which included both metered and flat accounts. This represented approximately 96 percent of the total "metered" water demand within the City of Chico. The percentage of accounts that could be geocoded within Hamilton City was less than 60 percent because the accounts were not in the spreadsheet provided or sufficient GIS street data was not readily available to use in the allocation. As will be discussed below, existing water demands for Hamilton City were allocated into the hydraulic model using existing land use data.

The remaining accounts in the City of Chico were either irrigation meters located in areas that did not have an address, construction meters without proper addresses, or located in new developments whose streets were not yet available in the GIS street maps. Table 6-2 below presents the geocoding results for the City of Chico.

**Table 6-2. Geocoding Results for the City of Chico**

| Category | Number of Accounts | Total "Metered" Demand, afa | Average Day Demand, gpm |
|---|---|---|---|
| Actual[(a)] | 25,845 | 16,197 | 10,041 |
| Geocoded[(b)] | 25,135 | 15,477 | 9,595 |
| Percent of Actual | 97% | 96% | 96% |

(a) Data obtained from "CON CH_HC 20060227.xls" provided by Cal Water at March 30, 2006, kick-off meeting, and does not include unaccounted-for water

(b) Based on WYA's GIS

Figure 6-1 compares the geocoded water demand data with existing pipelines imported into $H_2$OMAP for the City of Chico. As shown on Figure 6-1, all areas with geocoded meters also had an existing pipeline, indicating that the geodatabase layer used as the basis for the hydraulic model appears to have contained all existing pipelines.

Additionally, through the geocoding process, WYA was able locate 99 percent of the Residential-Flat customers within the City of Chico; however, each of these spatially located services did not have an associated water demand for 2005. Consequently, water demands for Residential-Flat customers were aggregately assigned to each customer as the ratio of the total water use (as estimated in Chapter 3) by the total number of accounts.

### Water Demands Allocated in $H_2$OMAP

WYA prefers to allocate water demands before skeletonizing the hydraulic model (i.e., reduce the number of pipelines) so that nodes with large demands (usually greater than 5 gpm) remain in the model, helping to facilitate the calibration and verification process. Consequently, WYA allocated 2005 water demands into both hydraulic models before skeletonizing the pipelines.

For the City of Chico water system, actual "metered" water demands were allocated into the hydraulic model using the geocoded demand data developed in the previous section and the "Demand Allocation/Pro" module of $H_2$OMAP (Allocation Module). The Allocation Module automatically assigned the geocoded demand point to the closest pipeline to its position in the system.

For the Hamilton City water system, water demands were allocated into the hydraulic model using the existing land use map and unit demand factors previously presented in Chapter 3, and the Allocation Module. The Allocation Module uses GIS technology to allocate demands based upon a direct spatial intersection between demand categorization polygons (land use polygons) and the demand node area coverage polygons (Thiessen service area polygons). Table 6-3 presents the water use demands that were allocated into the Hamilton City model.

**Table 6-3. Demand Allocation for Hamilton City**

| Existing Land Use | Area, acres | Unit Factor/acre/yr | Water Demand, af/yr |
|---|---|---|---|
| Residential | 131.8 | 3.0 | 395.5 |
| Commercial | 27.5 | 3.8 | 104.4 |
| Government | 36.7 | 1.7 | 62.4 |
| Total, af/yr | -- | -- | 562.3 |
| Total, gpm | -- | -- | 348.6 |

Figure 6-2 illustrates the service area polygons that were created using the Thiessen Polygon generation capability provided by the Allocation Module. These features allowed WYA to automatically create a distinct service area polygon for each demand node. Thiessen polygons provide a means to divide an area into polygons by creating regions that bisect known points. These polygons typically signify the bounded region closest to each of the junction nodes.

Additionally, WYA was able to allocate demands within both hydraulic models by revenue class designation, providing Cal Water additional flexibility in the model. For the City of Chico hydraulic model, WYA was also able to allocate water demands for the summer and winter season, providing Cal Water the ability to use the model for water quality analysis in the future; seasonal water demands could not be allocated into the Hamilton City hydraulic model because monthly water demands were not available.

Consequently, three demand sets were incorporated into the hydraulic model for the City of Chico (Average Day, Summer, and Winter), each allocated into revenue classes, while one demand set was allocated by revenue classes into the hydraulic model for Hamilton City. Table 6-4 below presents the demand column assigned to each revenue class within both hydraulic models.

**Table 6-4. Revenue Class Assignment**

| Revenue Class Number[(a)] | Revenue Class Description | Demand Column in Model[(b)] |
|---|---|---|
| 1 | Residential Metered | 1 |
| 2 | Business Metered | 2 |
| 3 | Industrial Metered | 3 |
| 7 | Farm Irrigation Metered | 4 |
| 11 | Public Authority Metered | 5 |
| 15 | Multiple Residential Metered | 6 |
| 8 | Other Sales & Svc | 7 |
| 4 | Residential Flat | 8 |
| 12 | Public Authority Flat | 9 |

(a) Data obtained from "CON CH_HC 20060227.xls" provided by Cal Water at March 30, 2006, kick-off meeting, and does not include unaccounted-for water

(b) Column number corresponds to Demand # Column in Junction database in the $H_2$OMAP Model.

### Elevations Allocated in $H_2$OMAP

Digital topology information for the District was extracted as a GIS shapefile using TopoDepot®, a software program WYA uses to determine preliminary elevations for assignment in the hydraulic models; certain service elevations (at the existing stations) were later confirmed during calibration. The shapefiles were then imported into the hydraulic models and service elevations were assigned to each node using $H_2$OMAP's Smart Topology feature.

### Pipelines Skeletonized in $H_2$OMAP

Once 2005 water demands and elevations were allocated into both models, and material types and diameters were confirmed, WYA skeletonized the hydraulic model for the City of Chico using $H_2$OMAP's Skeletonizer to reduce the number of pipelines. No pipes were skeletonized from the Hamilton City hydraulic model due to its small size. This feature of $H_2$OMAP allowed WYA to eliminate excessive pipeline segmentation (series pipes) in the City of Chico by dissolving interior nodes based on material type and diameter, and maintaining nodes with demands larger than 5 gpm or elevation changes greater than 5 feet. In addition, WYA removed dead-end segments less than 300 feet in length.

Figure 6-3 compares the City of Chico hydraulic model before and after skeletonization. As shown in Figure 6-3, the hydraulic model for the City of Chico was reduced from 15,543 pipes to 7,794 pipes; providing Cal Water with a more streamlined hydraulic model. WYA also included attributes in the model database (original geodatabase layer and object ID) of both hydraulic models, allowing Cal Water GIS staff to leverage or integrate information into Cal Water's GIS, although there is no specific GIS-to-Model dynamic link.

### Incorporating Station Elements in $H_2OMAP$

After skeletonization of the pipelines, major system facilities (e.g., groundwater wells, pump stations, and storage tanks) were imported into both the Chico and Hamilton City models. Each of these facilities was entered into the models by hand based on actual construction or "as-built" drawings provided by Cal Water staff.

### Naming Scheme Used in $H_2OMAP$

Once the models were skeletonized and major facilities imported into the models, each model element was given a label, which was then used to identify the type of model element, the element's purpose, and the element's location. Assigning each model element a specific label allows the modeler to easily locate specific elements or more readily identify potential problems during the calibration and verification process.

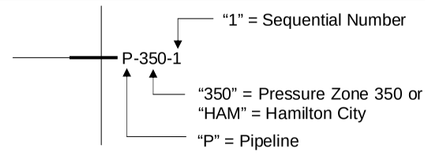
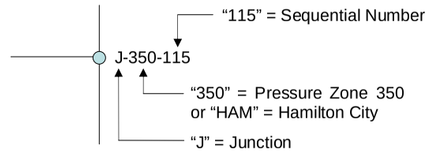
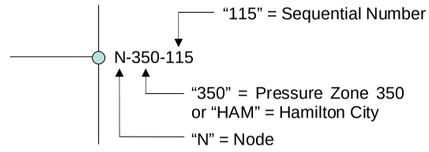
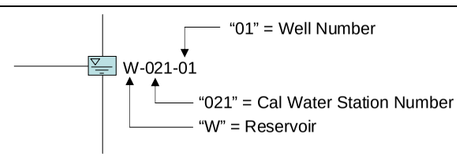
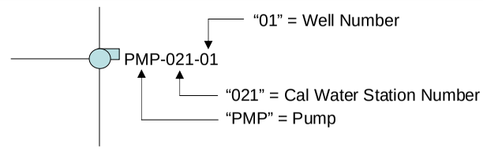
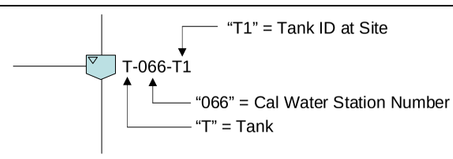
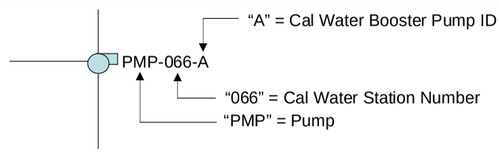
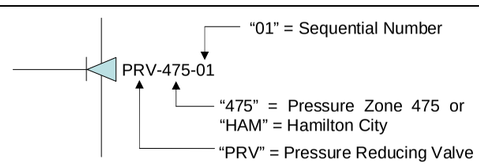
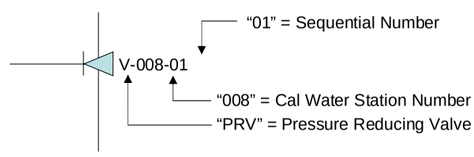
Based on WYA's experience and discussion with Cal Water staff, the District models were populated using the naming scheme presented in Table 6-5. As shown in Table 6-5, the naming scheme utilized Cal Water's existing labeling scheme for the District water system.

## HYDRAULIC MODEL CALIBRATION

The hydraulic models for the District were calibrated to confirm that the computer simulation model can accurately represent the operation of the water distribution system under varying conditions. After refining/enhancing Cal Water's hydraulic models, twenty-six locations were chosen in the City of Chico and two locations were chosen in Hamilton City for possible hydrant flow testing (see Figure 6-4). Associated pipeline C-factor evaluations were initially performed in the field on July 19 and July 20, 2006. Since no age information was available on these pipelines, selection of these hydrant test sites was based only on the size and material type of the pipelines involved in the tests. These tests were used to evaluate pipeline friction factors (C-factors) and to calibrate the models to ensure that both models closely represented actual observed pressure conditions in the field.

Of the original 28 tests identified, 22 were preformed in the field and the remaining 6 were not performed due to location constraint identified by Cal Water staff. Each test involved flowing water through pipelines of a particular size and material type, and measuring the pressure drops along the pipelines to determine friction losses. The test procedure consisted of monitoring discharge and pressure at the key flowing hydrant, and pressures at other hydrants along the supply routes to that key hydrant. Static pressures were measured while the key hydrant was closed, and residual pressures were measured while the key hydrant was flowing.

**Table 6-5. Naming Scheme for Network Elements**

| Model Component | Naming Scheme |
|---|---|
| Pipelines |  |
| Junctions |  |
| Nodes |  |
| Wells |  |
| Well Pumps |  |
| Tanks |  |
| Booster Pumps |  |
| Control Valves |  <br>  |

Public Version

**C-factor Test Results**

Prior to any model runs, each pipeline was assigned a preliminary C-factor based on the pipeline size and material type as presented in Table 6-1. The assigned C-factor in the hydraulic model reflects observed field conditions.

Pipelines in the Cal Water water system in the City of Chico range in size from 2-inches to 14-inches in diameter, and pipelines in Hamilton City range in size from 3-inches to 8-inches in diameter. Five major pipeline materials in both Chico and Hamilton City of the Cal Water water system include AC, CI, DI, PVC, and Steel. Other pipeline materials as listed on Table 6-1 are also found in the Cal Water water system. Using the District models of the Cal Water water system, each hydrant flow test was simulated. Results were compared to the field data to determine the accuracy of the models. The differences between observed static and residual pressures for the field hydrant test, compared to readings predicted by the models, were calculated. The goal of the calibration effort was to achieve no greater than a 5 pounds per square inch (psi) differential between the field hydrant test data and predicted model results. The C-factor tests resulted in a calibrated model C-factors range from 100 to 150, except for the steel pipeline in Hamilton City. The calibrated model C-factor for this pipeline type is 30.

The results of this initial hydraulic model C-factor tests generally validated the system pipeline configuration and confirmed the assumed C-factors in Table 6-1. The average differentials between those pressures observed in the field and those predicted by the model were within ±5 psi.

The number and spatially distributed hydrant flow test locations provided varied conditions to test the accuracy of the hydraulic model to simulate the operation of existing water facilities. The results of the calibration runs from the remaining hydrant tests indicated that the model simulated the Cal Water water system with a high level of accuracy and was able to match field-observed pressures and flows.

The detailed results of individual calibration tests are provided in Appendix L.

**Diurnal Curve Development**

WYA collected SCADA data, both in electronic and circular chart format, on flows, tank levels and pump discharge pressures for each of the Cal Water stations during the period from July 10 to July 25, 2006.

To add the time variable to Cal Water's Chico-Hamilton City District models and create a true extended period simulation (EPS) model to compare to the collected SCADA data, WYA developed realistic diurnal patterns for each of Cal Water's pressure zones. To create this diurnal pattern, hourly production data from all of Cal Water's pump stations, wells and tanks were summed using individual SCADA flow recordings to represent total demand in Cal Water's Chico-Hamilton City District water system over 48-consecutive hours for each of the five (5) pressure zones in the City of Chico, and 1 pressure zone in Hamilton City as indicated on Table 6-6. The resulting diurnal pattern is provided in Appendix D. By using this pattern, the model can more accurately represent fluctuations in demand over the indicated time period.

**Table 6-6. Demand Diurnal Dates**

| | Diurnal Pattern |
|---|---|
| **Chico Diurnals** | |
| Pressure Zone 350 | July 20 to July 21, 2006 |
| Pressure Zones 400, 475, 635 and 795 | July 12 to July 13, 2006 |
| **Hamilton City Diurnal** | July 12 to July 13, 2006 |

However, in order to develop these patterns, certain assumptions were required. Most of these assumptions were made due to discrepancies of flow data from Cal Water's stations. Tables 6-7 and 6-8 provide a summary of the available data for facilities in the City of Chico and facilities in Hamilton City, respectively. The data, either electronic or hard copy circular charts, was available to develop the diurnal curves for each pressure zone. As presented in Table 6-7, facilities located at higher pressure zones in the City of Chico lacked information on flows entering/leaving their stations. In a majority of the stations, the flows from the booster pump stations were required to be estimated based on the change in level of the tank supplying the pump stations. Since some of the booster pump stations can be supplied from either the tanks or the pressure zone filling the tanks, there could be some discrepancies in the assumed flow through each booster pump. The following paragraphs provide the methodology used in the development of each diurnal curve for each pressure zone.

### Chico Pressure Zone 350

Pressure Zone 350 is predominately supplied water from groundwater wells. There are three stations, including Stations 1, 3 and 8 which have elevated tanks on site next to groundwater wells. These elevated tanks are not the source of supply for Pressure Zone 350. These stations are not operated under normal conditions, and the groundwater wells in these stations are part of the source of supply to Pressure Zone 350. Flow information for groundwater wells is available from either circular chart or SCADA. The circular charts for Stations 47, 48, 51 and 52 indicate that the pen on the chart recorder was drawing beyond the maximum flow range which is 950 gpm and 1,000 gpm. There is no electronic SCADA information for these stations; assumptions had to be made to develop a flow number. Stations 30, 56 and 63 have circular chart data that is not calibrated to zero; so assumptions have to be made to obtain the more accurate flow. Flow information for Stations 28 and 38 which were obtained from the Cal Water SCADA system was found to be 2.5 and 10 times higher than the circular chart. Per discussion with Cal Water staff, the SCADA information for these stations is not accurate (SCADA readings are higher than telemetry chart), and the circular chart should be used to obtain the more accurate flow to represent supplies from these stations.

**Table 6-7. Available SCADA Information From Cal Water Stations for the City of Chico**

| | | | SCADA - Chart | | | | SCADA - Electronic | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Pressure | | | | Pressure | | | |
| Station | Facility | Zone | Discharge | Suction | Level | Flow | Discharge | Suction | Level | Flow |
| 001 | Well 04 | 350 | Zero readings | | | Zero readings | Zero readings | | | Yes, readings indicate station was not primary supply. |
| | Tank 01 | | | | | | | | | |
| | Tank 02 | | | | | | | | | |
| | Control Valve | | | | | | | | | |
| 3 | Well 03 | 350 | Zero readings | | | Zero readings | Zero readings | | | Zero readings |
| | Tank 04 | | | | No tank readings | | | | No tank readings | |
| | Control Valve | | | | | | | | | |
| 005 | Well 02 | 350 | Yes | | | Yes | | | | |
| 007 | Well 04 | 350 | Yes | | | Yes | | | | |
| 008 | Well 01 | 350 | | | | Yes | Yes | | | Yes, readings are not consistent with chart. |
| | Tank 03 | | | | No tank readings | | | | No tank readings | |
| | Control Valve | | | | | | | | | |
| 011 | Well 01 | 350 | Yes | | | Yes | | | | |
| 012 | Well 01 | 350 | Yes | | | Yes | | | | |
| 014 | Well 01 | 350 | Yes | | | Yes | | | | |
| 016 | Well 01 | 350 | | | | Yes | Yes | | | Zero readings |
| 017 | Well 01 | 350 | Yes | | | Yes | | | | |
| 018 | Well 01 | 350 | Yes | | | Yes | | | | |
| 019 | Well 01 | 350 | Yes | | | Yes | | | | |
| 020 | Well 01 | 350 | Yes | | | Yes | | | | |
| 021 | Well 01 | 350 | | | | Yes | Yes | | | Zero readings |
| 022 | Well 01 | 350 | Yes | | | Yes | | | | |
| 023[c] | Well 01 | 350 | | | | | | | | |
| 024 | Well 01 | 350 | | | | | Yes | | | Yes |
| 025 | Well 01 | 350 | Yes | | | Yes | | | | |
| 026 | Well 01 | 350 | | | | | Yes | | | Yes |
| 027 | Well 01 | 350 | Yes | | | Yes | | | | |
| 028 | Well 01 | 350 | | | | | Yes | | | Yes[a], readings are 2.5 times higher than chart. Flows were adjusted based on chart. |
| 029 | Well 01 | 350 | Yes | | | Yes | | | | |
| 030 | Well 01 | 350 | Yes | | | Yes, chart was not calibrated to zero, all readings were adjusted to 20 gpm lower than initial readings. | | | | |
| 031 | Well 01 | 350 | Yes | | | Yes | | | | |
| 032 | Well 01 | 350 | | | | Yes | Yes | | | Yes[a], readings are 2 times higher than chart. Chart flow readings were used for diurnal. |
| 033[c] | Well 01 | 350 | | | | | Zero readings | | | Zero readings |
| 034 | Well 01 | 350 | Yes | | | Yes | | | | |
| 035 | Well 01 | 350 | Yes | | | Yes | | | | |
| 037 | Well 01 | 350 | | | | Yes | Yes | | | Zero readings |
| 038 | Well 01 | 350 | | | | | Yes | | | Yes(a), readings are between 50s to 80s. These readings are 10 times smaller than chart. |
| 039 | Well 01 | 350 | Yes | | | Yes | | | | |
| 041 | Well 01 | 350 | Yes | | | Yes | | | | |
| 042 | Well 01 | 350 | Yes | | | Yes | | | | |
| 044 | Well 01 | 400 | | | | | Yes | | | Yes |
| | Hydropneumatic Tank | | | | | | | | | |
| 046 | Well 01 | 350 | | | | | Yes, readings are constant, quality indicators are bad. | | | Yes*, readings are between 0.8 to 1 (data quality indicated bad reading). chart readings were also zero, and were used for diurnal. |
| 047 | Well 01 | 350 | Yes | | | Yes, some readings are off the maximum chart range 950 gpm. Assumed readings are 950 gpm when it was off chart. | | | | |
| 048 | Well 01 | 350 | Yes | | | Yes, some readings are off the maximum chart range 1,000 gpm. Assumed readings are 1,000 gpm when it was off chart. | | | | |
| 049 | Well 01 | 350 | | | | Yes | Yes | | | No flow readings |
| 050 | Well 01 | 475 | Yes | | | Yes | Yes | | | Zero readings |
| | Hydropneumatic Tank | | | | | | | | | |
| 051 | Well 01 | 350 | Yes | | | Yes, some readings are off the maximum chart range 1,000 gpm. Assumed readings are 1,000 gpm when it was off chart. | | | | |
| 052 | Well 01 | 350 | Yes | | | Yes, some readings are off the maximum chart range 1,000 gpm. Assumed readings are 1,000 gpm when it was off chart. | | | | |
| 053 | Well 01 | 350 | | | | Yes | Yes | | | Zero readings |
| 054 | Well 01 | 350 | | | | Yes | Zero readings | | | Zero readings |
| 056 | Well 01 | 350 | Yes | | | Yes, chart was not calibrated to zero, all readings were adjusted to 150 gpm lower than initial readings. | | | | |
| 057 | Well 01 | 350 | Yes | | | Yes | | | | |
| 059 | Well 01 | 350 | Yes | | | Yes | | | | |
| 061 | Well 01 | 350 | | | | Yes | Yes | | | Yes(a), readings are between 0 to 70s (data quality indicated good reading). These readings are not consistent with chart. |
| 062 | Well 01 | 350 | | | | Yes | Yes | | | Yes(a), readings are between 40s to 70s (data quality indicated good reading). These readings are not consistent with chart. |
| 063 | Well 01 | 350 | Yes | | | Yes, chart was not calibrated to zero, all readings were adjusted to 30 gpm lower than initial readings. | | | | |
| 064 | Well 01 | 400 | | | | | Yes | | | Yes* |
| | Hydropneumatic Tank | | | | | | | | | |
| 065 | Well 01 | 475 | | | | | Yes | | | Yes |
| | Hydropneumatic Tank | | | | | | | | | |
| 66 | Tank 01 | 635 | | | | | | | Yes | |
| | Tank 02 | | | | | | | | Yes | |
| | Control Valve | | | | | | | | | |
| | Hydropneumatic Tank 01 | | | | | | | | | |
| | Hydropneumatic Tank 02 | | | | | | | | | |
| | BPS A/B | | | | | | Yes | Yes | | |
| | BPS C/D | 795 | | | | | | | | |
| 067 | Well 01 | 475 | | | | | Yes | | | Yes[a] |
| 068 | Well 01 | 350 | | | | Yes | Yes | | | No flow readings |
| 069 | Well 01 | 350 | | | | Yes | Yes | | | No flow readings |
| 070 | Well 01 | 475 | | | | | Yes | | | Yes[a] |
| | Hydropneumatic Tank | | | | | | | | | |
| 071 | Well 01 | 350 | | | | | Yes | | | Yes[a] |
| 072 | Well 01 | 475 | | | | | Yes | | | Yes[a] |
| 073 | BPS A/B | 635 | Yes | | | Yes | No pressure readings | | | Readings are all 5 gpm, and quality indicators are all bad. |
| 074 | Tank 01 | 635 | | | | | | | Yes | |

[a] SCADA readings were confirmed using Telemetry Chart.

[b] Charts were not available for 7/12 to 7/13 and 7/20 to 7/21. Daily production data confirmed no flow from this station.

[c] Facility was under repaired.

Public Version

**Table 6-8. Available SCADA Information From Cal Water Stations for Hamilton City**

| STATION | FACILITY | ZONE | SCADA - CIRCULAR CHART | | | | SCADA - ELECTRONIC | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | PRESSURE | | | | PRESSURE | | | |
| | | | Discharge | Suction | LEVEL | FLOW | Discharge | Suction | LEVEL | FLOW |
| 1 | Well 01 | | | | | | Yes | | | Yes |
| | Tank 01 | | | | | | | | Yes | |
| | Hydropneumatic Tank | HC | | | | | | | | |
| 2 | Well 01 | | | | | | Yes (one pressure for both Well 01 and Well 02) | | | Yes |
| | Well 02 | | | | | | | | | Yes |
| | Hydropneumatic Tank | HC | | | | | | | | |

Public Version

Pressure Zone 350 could be supplemented by Pressure Zone 475 through PRV stations located on Manzanita Avenue and Hooker Oak Avenue. These PRVs did not have flow measurement device, therefore, the amount of flow through these PRVs were estimated based on available flow in Pressure Zone 475 and the size of PRV.

Figure 6-B-1 presents the hourly flow rate that is being used by Pressure Zone 350.

**Chico Pressure Zone 400**

Pressure Zone 400 is a small pressure zone which is served from Stations 44 and 64. These stations are groundwater wells with hydropneumatic (pressurized) tanks. Flow information is available from both groundwater wells. There is no information available from hydropneumatic tanks; therefore, flow information from groundwater wells was used to develop the diurnal curve for this pressure zone. Figure 6-B-2 presents the hourly flow rate that is being used by Pressure Zone 400.

**Chico Pressure Zone 475**

Pressure Zone 475 encompasses two areas which are not physically connected. The first area is located north of Eaton Road which is only served from Station 72. Flow information is available from the SCADA system. The second area is located east of Pressure Zone 350. This is the largest coverage area for Pressure Zone 475. This area is served from groundwater wells including Stations 50, 65, 67 and 70, and is also served by gravity from storage tanks through an altitude valve located at Station 66. Flow information is available for all groundwater wells from either the SCADA system or circular chart. There is no flow information available at Station 66, except for tank level and discharge/system pressure. There are two Booster Pump Stations (BPS) at Station 66. BPS 66 A and B is used to deliver water from Pressure Zone 475 to Pressure Zone 635. BPS 66 C and D is used to boost water from Pressure Zone 475 to Pressure Zone 795. Station 66 also floats off Pressure Zone 475. Since there is no flow information available for the booster pumps; consequently, there is no way to calculate the amount of flow from storage tanks at Station 66 to Pressure Zones 475, 635 and 795. Assumptions have to be made to obtain flow from Station 66 to Pressure Zones 475, 635 and 795. Any flow supplied by the tank (drawdown) was assumed to be pumped through the booster pumps into Pressure Zones 635 and 795, and to be supplied to Pressure Zone 475. The hourly flows from booster pumps at Station 66 to Pressure Zones 635 and 795 were assumed based on the operating condition and the system pressure trends from SCADA and circular charts. The remaining flow supplied by the tank (drawdown) after subtracting the pumped flow was assumed to be the flow into Pressure Zone 475. As described in Pressure Zone 350, two PRVs located on Manzanita Avenue and Hooker Oak Avenue provide water from Pressure Zone 475 to Pressure Zone 350. The amount of water conveyed from Pressure Zone 475 to Pressure Zone 350 is unknown, and has to be estimated based on the available supply in Pressure Zone 475 and the size of valve at the PRV station.

Figure 6-B-3 presents the hourly flow rate that is being used by Pressure Zone 475.

### Chico Pressure Zone 635

As previously described, Pressure Zone 635 is served from BPS 66 A and B; it is also served from Station 73 A and B, and Station 74. Flow information is available for all stations, except Station 66 A and B. As previously described, flow from Station 66 A and B was assumed based on the operating conditions and the system pressure trends from SCADA and circular charts. Figure 6-B-4 presents the hourly flow rate that is being used by Pressure Zone 635.

### Chico Pressure Zone 795

Pressure Zone 795 is relatively small and the flow data from Station 66 C and D is not available; consequently, assumptions have to be made to develop the diurnal for this pressure zone. The flow supplied by the tank (drawdown) and the operation condition based on the SCADA and circular charts from Station 66 were used to estimate the hourly flow rate supplied into Pressure Zone 795 at Station 66 C and D (see Figure 6-B-5).

### Hamilton City Pressure Zone

The Cal Water Hamilton City system is served by Stations 1, 2-1 and 2-2. Groundwater wells are the only supply in Hamilton City. Flow data are available from SCADA only. There is no tank level data for the elevated storage tank at Station 1. According to Cal Water staff, the elevated tank is not directly used to supply flow to Hamilton City. The hourly flow in Hamilton City is based on flow pumped at Stations 1, 2-1 and 2-2. Figure 6-B-6 presents the hourly flow rate that is being used by Pressure Zone 730.

## HYDRAULIC MODEL VERIFICATION

Verifying that a model replicates field conditions requires thorough knowledge of how the system performs over a wide range of operating conditions. To ensure that the hydraulic model was correctly configured and capable of producing results that are consistent with those observed in the field, a verification process was carried out. Hydrant pressure recorders (HPRs) were used to record pressures in the field. The data was then compared with model-predicted pressures at the same system locations. Other pressure points monitored by Cal Water were also used in the verification process. The description of the verification process, and the results, are described below.

### Pressure Verification

Twenty hydrant pressure recorders were placed in 36 different locations within Cal Water's Chico-Hamilton City District water distribution system. Each HPR collected field-pressure data at a particular location for approximately one week (from July 11, 2006 to July 25, 2006). The locations were selected based on their proximity to the transmission mains and at extreme elevation (low and high) in each of Cal Water's pressure zones. The HPRs were grouped into 2 rotation cycles, and were moved weekly from one group of pressure zones to the other. The first rotation cycle covered Cal Water's 400, 475, 635 and 795 Pressure Zones in the City of Chico, and Hamilton City. The second rotation covered Cal Water's 350 Pressure Zone in the City of Chico. Figure 6-5 shows the overall locations of each HPR by monitoring group.

Following the integration of the diurnal patterns into the hydraulic model, an EPS modeling run was performed and the resulting pressures at each of the HPRs, and the flow and pressure of pump stations were graphed. To verify whether Cal Water's Chico-Hamilton City District hydraulic models were accurately predicting flow, model-predicted pressures and tank levels were compared to actual field data.

**Verification Result**

Due to the complexity of Cal Water's distribution system, the verification process was grouped into six service areas based on pressure zones. These service areas are Pressure Zones 350, 400, 475, 635, 795, and Hamilton City.

Graphs of representative comparisons between model-predicted and field-observed pressures and flow are provided in Figures 6-6 through 6-21. Individual graphs of facility comparisons between model-predicted and field-observed pressures and levels are provided in Appendix M.

The results of each of the service areas are further described below.

Pressure Zone 350

Groundwater wells are the only supply to Cal Water's Pressure Zone 350. Verification results in this pressure zone indicate that model-simulated pump station flow and pressure comparisons at each of Cal Water's Pressure Zone 350 stations are similar to the recorded SCADA or recorded telemetry chart station flow and pressure, as illustrated in Figures 6-6 through 6-10. Overall, both the model-simulated station flows and system pressure time varying trends track very closely with the recorded SCADA reading or recorded telemetry chart reading. Although trending well, as shown in all figures, the model-simulated pressure trends for all stations are as high as approximately 17 psi higher than the recorded readings on SCADA or the telemetry charts during the 3 a.m. to 9 a.m. period, during this two-day simulation period. This pressure differential was further evaluated by comparing the recorded flow readings. As previously discussed in the diurnal development section, there are four well stations (Stations 47, 48, 51, and 52) which have no electronic SCADA flow records; consequently, telemetry charts were used to establish flow from each station. As shown on Figure 6-10A, the data from the telemetry charts clearly show that the scales on these charts are not appropriate to capture the peak system demands. These telemetry charts show that flows at these stations "pegged-out" on the chart recorder at a flow of approximately 1,000 gpm (actual flows were probably higher). These stations have the physical ability to deliver more than 1,000 gpm; however, Cal Water's telemetry charts are only able to record up to 1,000 gpm. WYA used this maximum recorded flow of 1,000 gpm from the telemetry chart in our diurnal development, and then in the verification process. However, because these peak system flows have been probably underestimated at these stations, the model-simulated pressures are not as low as recorded by electronic SCADA or telemetry chart, leading to the observed larger pressure differential during peak demand period. WYA recommends that Cal Water verify the telemetry charts range on Stations 47, 48, 51, and 52.

The pressure recorder comparisons for simulated pressure and recorded field pressure readings trend closely as shown in Figure 6-11. Figure 6-11 also indicates that simulated pressures at 3 a.m. to 9 a.m. in the morning for a two-day simulation period were higher than the recorded field

pressure readings as discussed above. This pressure discrepancy is probably the result of the underestimation of peak flows by some of Cal Water's telemetry chart recorders, which were used in the flow assumption establishing the diurnal curve development as discussed above.

Pressure Zone 400

Cal Water's Stations 44 and 64 are the main supply to Pressure Zone 400. Results of Cal Water's station verification in this pressure zone are illustrated in Figures 6-12 and 6-13. During the verification period, Station 64 was the only groundwater well that was operating to supply water to this pressure zone. The model-simulated flow comparison is similar to the recorded SCADA. The simulated downstream pressure of Stations 44 and 64 trends exactly with recorded SCADA readings.

As illustrated in Figure 6-13, the simulated pressure for the pressure recorder in this pressure zone trends closely to the recorded field pressure reading. This result indicates that the demand in this pressure zone is properly allocated.

Pressure Zone 475

The main supplies to Pressure Zone 475 are Stations 50, 65, 66 (from two storage tanks), 67, 70 and 72. All Cal Water Stations in this pressure zone have hydropneumatic tanks, except Station 67. This pressure zone also supplies Pressure Zone 635 through BPS 66 A and B, and Station 73.

The results of the verification in this pressure zone indicate that the model-simulated pressure comparison can not replicate the recorded SCADA or recorded telemetry chart pressure (see Figures 6-14 and 6-15) when hydropneumatic tanks are included in the verification process. The operating condition (high and low pressure condition) of the hydropneumatic tanks for Stations 50, 65, 70 and 72 were estimated from the chart pressure readings during the verification period. To verify the configuration and the demand allocation of this pressure zone, another verification method was simulated in the model. This method did not include the hydropneumatic tanks, and verification results indicate that the model-simulated pressure comparison is similar to the recorded SCADA or recorded telemetry chart pressure. The trend follows closely with the recorded SCADA reading or recorded telemetry chart reading.

As illustrated in Figure 6-16, the overall simulated pressure for pressure recorders is similar to the field pressure reading, except recorder B-2 which is located at Hancock Drive. This area is in Pressure Zone 475, but it is not physically connected to the other Pressure Zone 475 area. This area is served through Station 72. There are two valves which connect Pressure Zone 475 to Pressure Zone 350. The type of valves is sustaining and/or reducing valves which are assumed to have various flows over 48-hours during the verification process. WYA believes that this pressure issue is not related to demand allocation, but it is related to flow through these sustaining and/or reducing valves. Our rationale for this is that the simulated pressure trend follows closely to the recorded field pressure reading. WYA recommends Cal Water confirm the condition of these valves during the verification period. In addition, due to inadequate flow information regarding the flow quantities being conveyed by gravity to this pressure zone (and being pumped into the other two zones this station serves), and the flow splits that WYA had to assume due to this lack

of data, there is discrepancy between the model-predicted pressure and the field-recorded pressure.

Pressure Zone 635

Cal Water's Pressure Zone 635 is supplied through Stations 66, 73 and 74. This pressure zone also supplies Pressure Zone 795 through BPS 66 C and D.

The verification result in this pressure zone indicates that the model-simulated flow rate comparison is similar to the recorded SCADA or recorded telemetry chart flow rate (see Figure 6-17). The trend follows closely with the recorded SCADA reading or recorded telemetry chart reading.

As illustrated in Figure 6-18, the simulated pressures for the pressure recorders in this pressure zone also trend closely to the recorded field pressure readings. These results indicate that the demand in this pressure zone is properly allocated.

Pressure Zone 795

Cal Water's Pressure Zone 795 is supplied through BPS 66 C and D.

The verification results for Pressure Zone 795 indicate that the model-simulated flow rate comparison is consistent to the recorded SCADA or recorded telemetry chart flow rate (see Figures 6-19).

Figure 6-18 shows that the simulated pressure for the HPR in Pressure Zone 795 trends closely to the recorded field pressure reading. This result indicates that the demand in this pressure zone is properly allocated, and the estimated flow through BPS 66 C and D in diurnal development is appropriate.

Hamilton City

Cal Water's Hamilton City system is supplied through Stations 1 and 2. Station 1 has an elevated tank which is not used as a normal operational facility, and it is not included in the verification process. Station 2 has two groundwater wells on the site.

The verification results for Hamilton City indicate that the model-simulated flow rate comparison is consistent to the recorded SCADA or recorded telemetry chart flow rate (see Figure 6-20).

Figure 6-21 shows that the simulated pressure for the HPR in Pressure Zone 795 trends closely to the recorded field pressure reading. This result indicates that the demand in this pressure zone is properly allocated.

**Verification Findings and Conclusions**

Overall, the results from the hydraulic model verification process validated the system configuration and demand allocation. However, based on the lack of accurate SCADA information from the District's facilities, it was impossible to refine the verification results. Pump

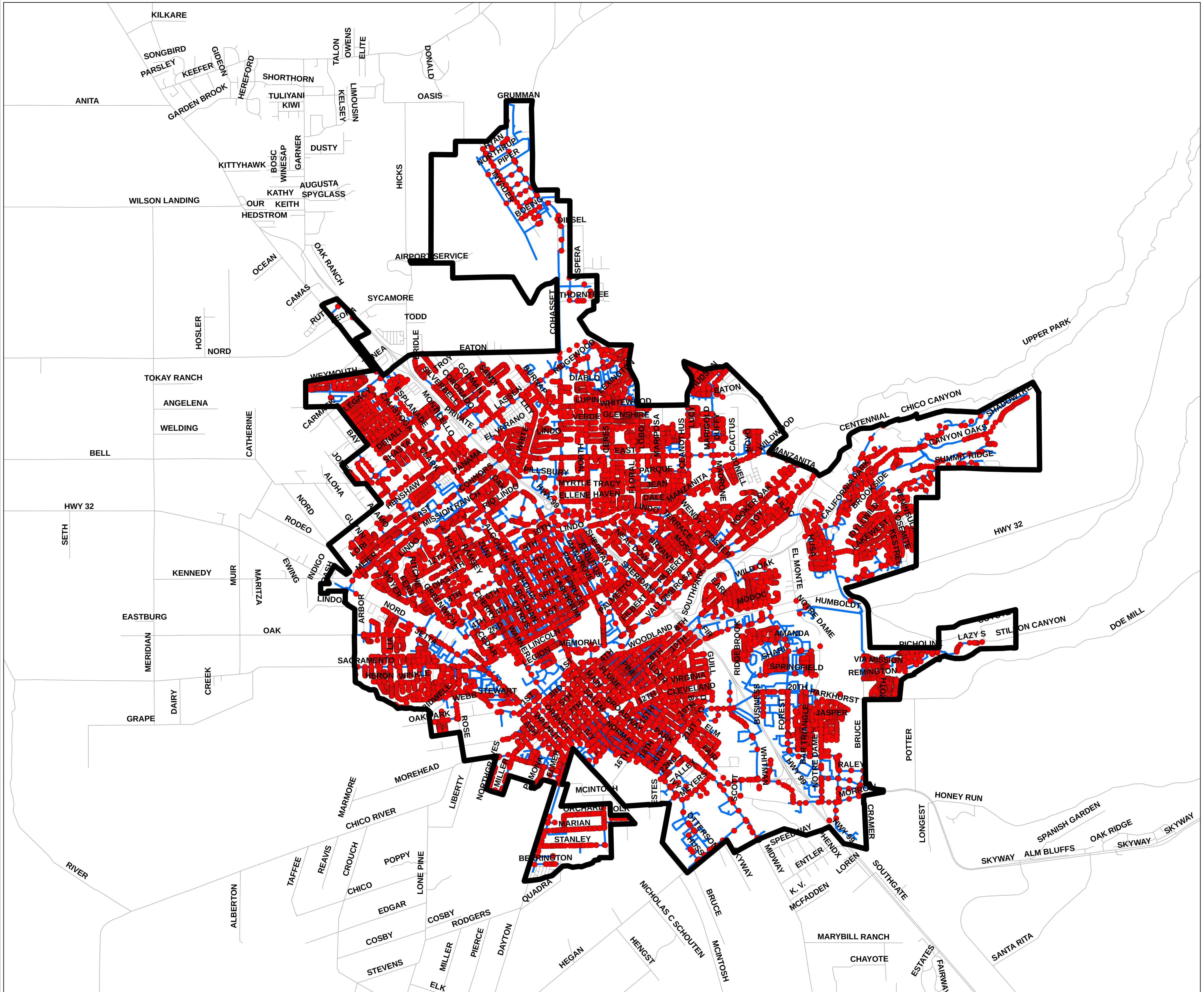
station flow rate comparisons at each of Cal Water's operated facilities trended accurately for both SCADA and field readings. Comparisons of HPR and model-simulated data trended well. Most of the trends, though not exact, follow closely with the recorded HPR pressures. It is our recommendation that Cal Water continue to update/verify pipeline system configurations in the model as new facilities are constructed. It is also recommended to calibrate and confirm that the SCADA system is tracking good system information.

Based on the results of our verification, it can be concluded that the model provides an accurate operational representation of Cal Water's Chico-Hamilton City District water distribution system, and is more than adequate for use as a planning and operational tool.

# FIGURE 6-1

**California Water Service Company**
**Chico - Hamilton City District Water Supply and Facilities Master Plan**

## GEOCODED METERS




0 0.5 1 2
Scale in Miles

## NOTES:

## LEGEND:

- Water Service Area
- City of Chico-Geocode
- Streets
- Pipeline

O:\c\436\02-06-03\GIS\WMP\Chapter 6\Figure 6-1_GeoCode.mxd

Public Version

**FIGURE 6-2**

**California Water Service Company**
**Chico - Hamilton City District Water Supply and Facilities Master Plan**

## HAMILTON CITY DEMAND ALLOCATION

**NOTES:**

**LEGEND:**

- Residential
- Commercial
- Government
- Open Space/Agriculture
- Vacant
- Streets
- Junction
- Thiessen Polygon

0 0.05 0.1 0.2
Scale in Miles

WEST YOST ASSOCIATES
Consulting Engineers

O:\c\436\02-06-03\GIS\WMP\Chapter 6\Figure 6-2_HC_polygons.mxd

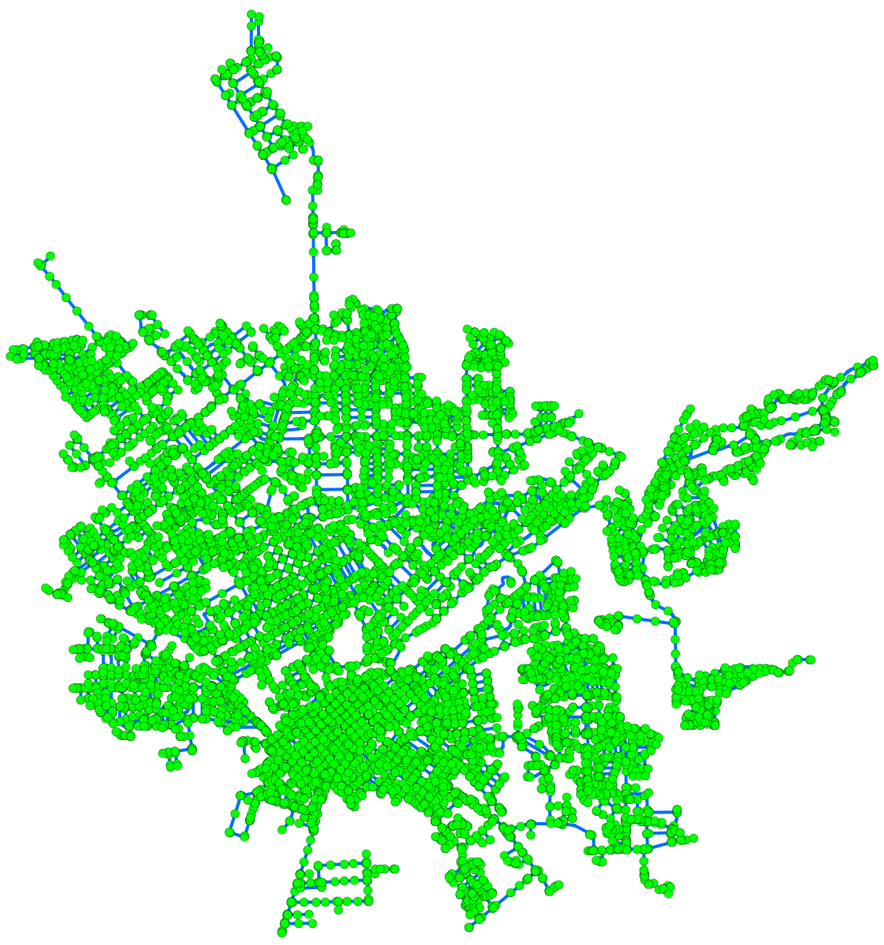
Public Version

**FIGURE 6-3**

**California Water Service Company**
**Chico - Hamilton City District Water Supply and Facilities Master Plan**

## SKELETONIZATION

## BEFORE SKELETONIZATION



**15,543 Links**

## AFTER SKELETONIZATION

**7,794 Links**

N

0 0.5 1 2

Scale in Miles

**NOTES:**

**LEGEND:**

- Junction
- Pipeline

O:\c\436\02-06-03\GIS\WMP\Chapter 6\Figure 6-3_Skeletonization.mxd

***

Public Version

**FIGURE 6-4**

**California Water Service Company**
**Chico - Hamilton City District Water Supply and Facilities Master Plan**

## HYDRANT TEST LOCATIONS

N

0 0.375 0.75 1.5
Scale in Miles

## LEGEND:

- Stations
- Priority 1 Hydrant Test (14 Tests)
- Priority 2 Hydrant Test (5 Tests)
- Alternate (9 Tests)
- Street
- Cal Water Service Area

**PressureZones**

- 350
- 400
- 475
- 635

CALIFORNIA WATER SERVICE CO.

WEST YOST ASSOCIATES
Consulting Engineers

O:\CA3902.06-0302.05\WMP\Chw\Figure 6-4_C-Tests.mxd

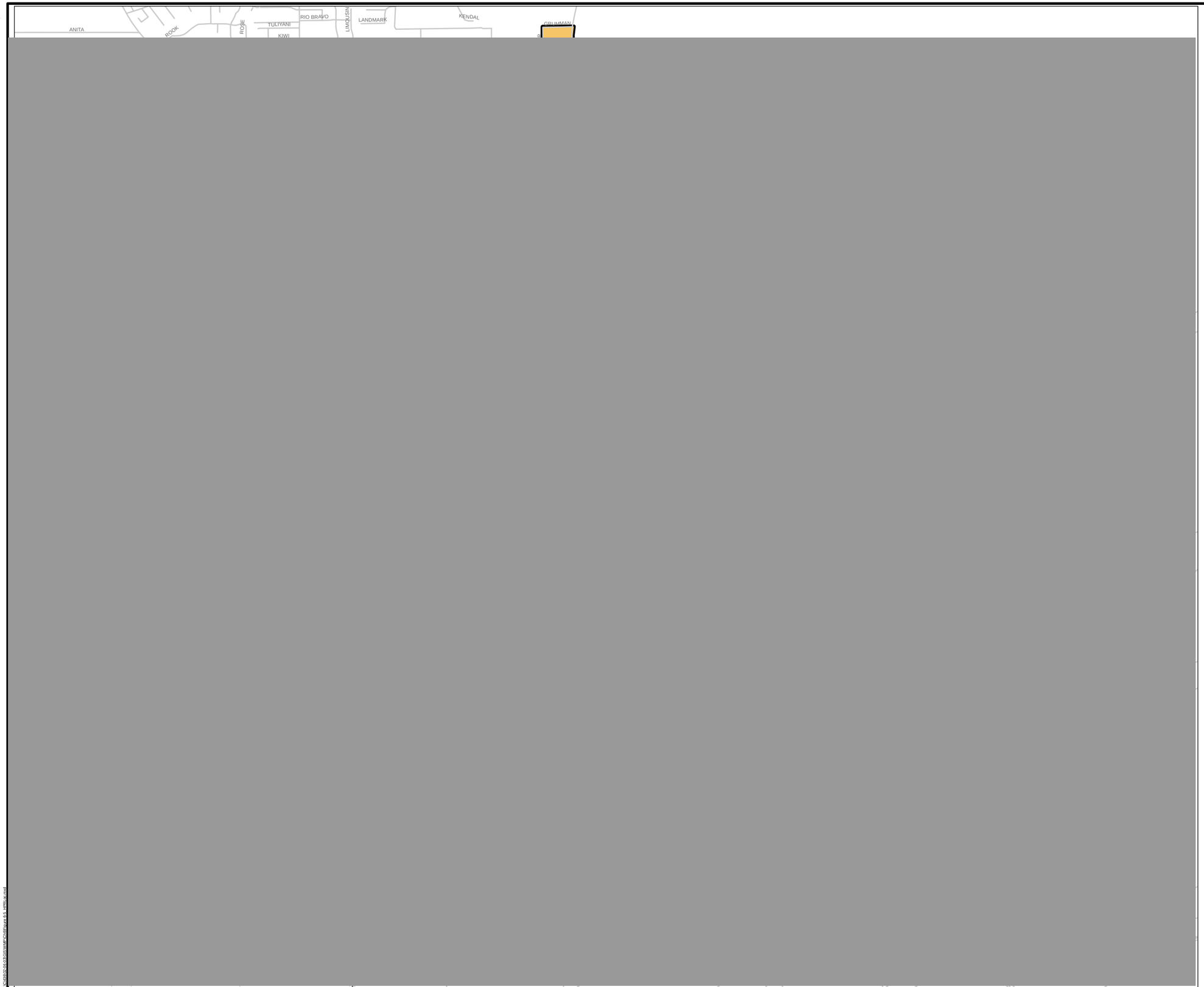
***

Public Version

# FIGURE 6-5

**California Water Service Company**
**Chico - Hamilton City District Water Supply and Facilities Master Plan**

## HYDRANT PRESSURE RECORDER LOCATIONS




N

0 0.35 0.7 1.4

Scale in Miles

## LEGEND:

- Station
- Street
- Cal Water Service Area

**HPR Rotation**

- 1
- 2

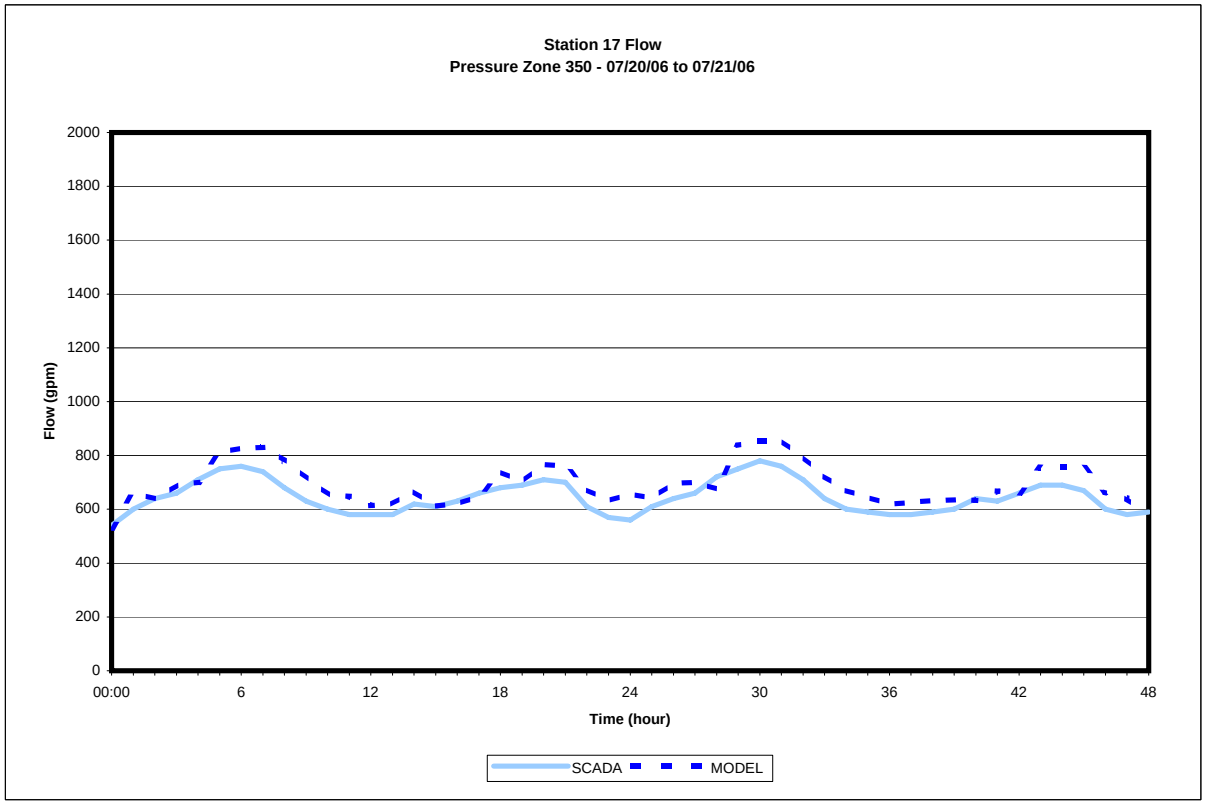
**PressureZones**

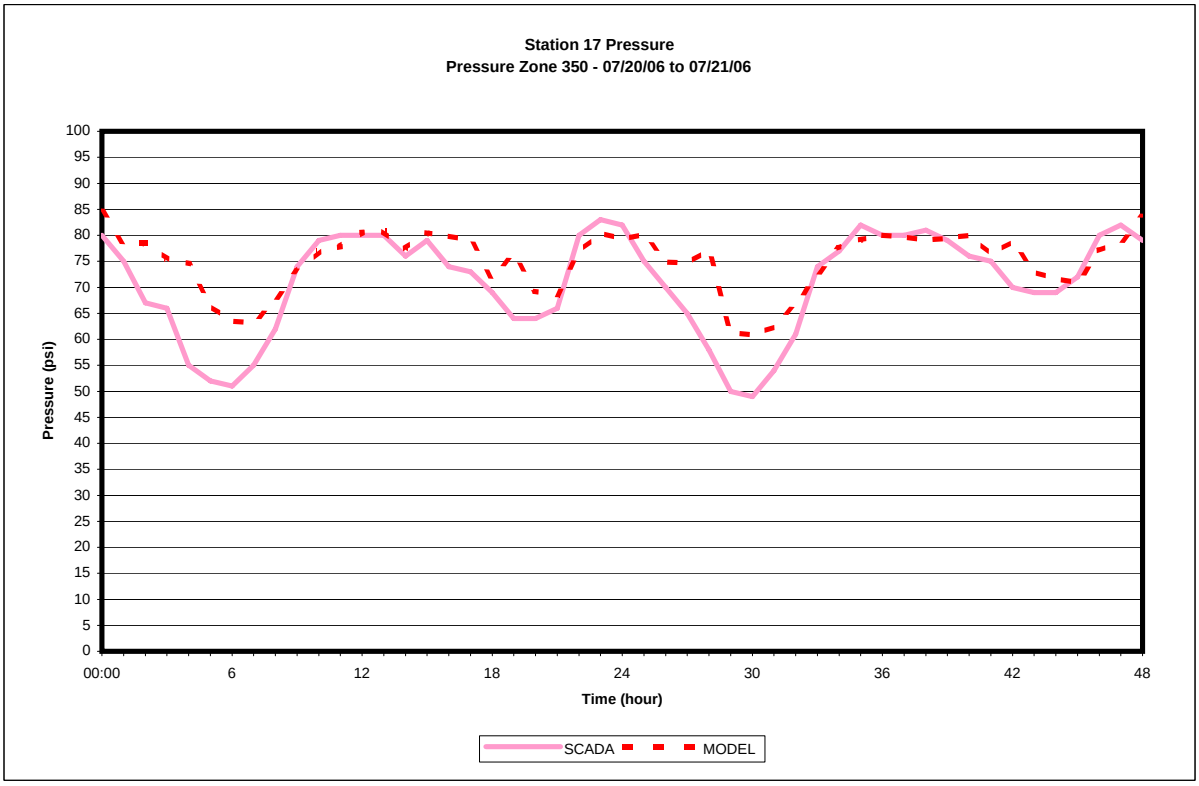
- 350
- 400
- 475
- 635

CALIFORNIA WATER SERVICE CO.

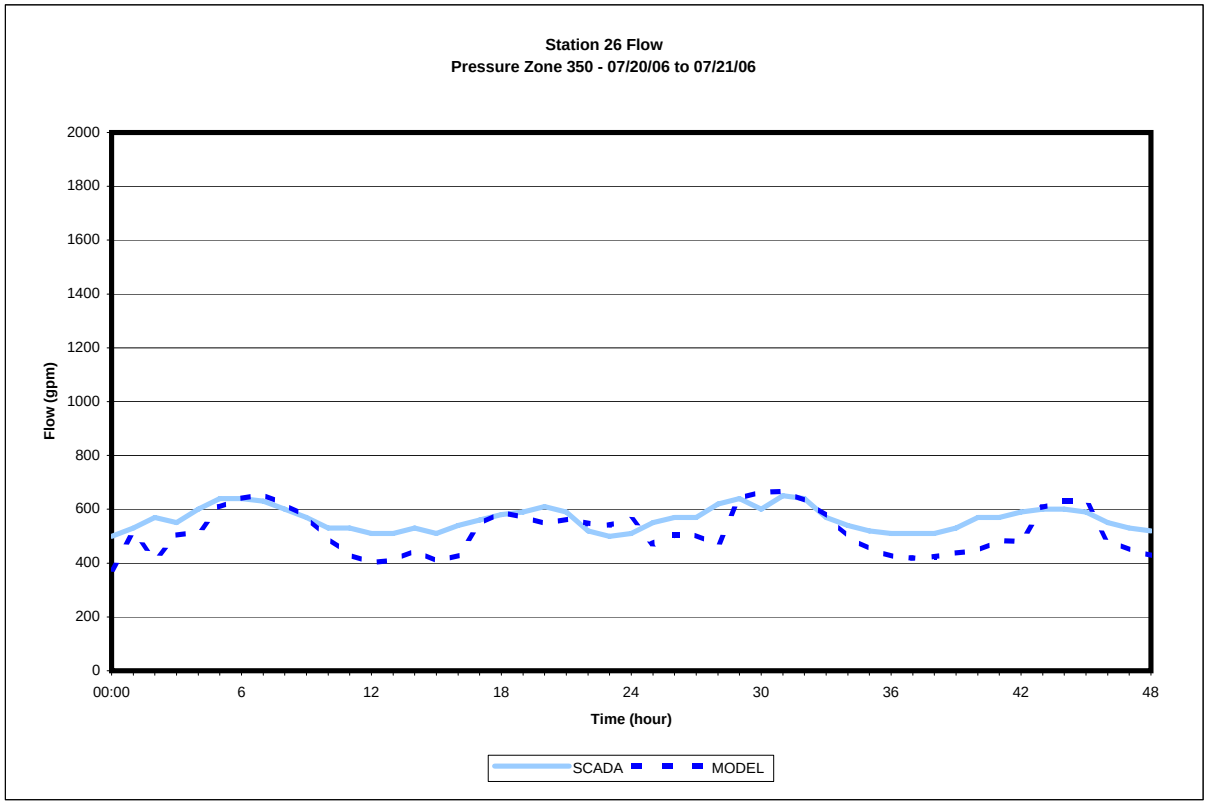
WEST YOST ASSOCIATES
Consulting Engineers

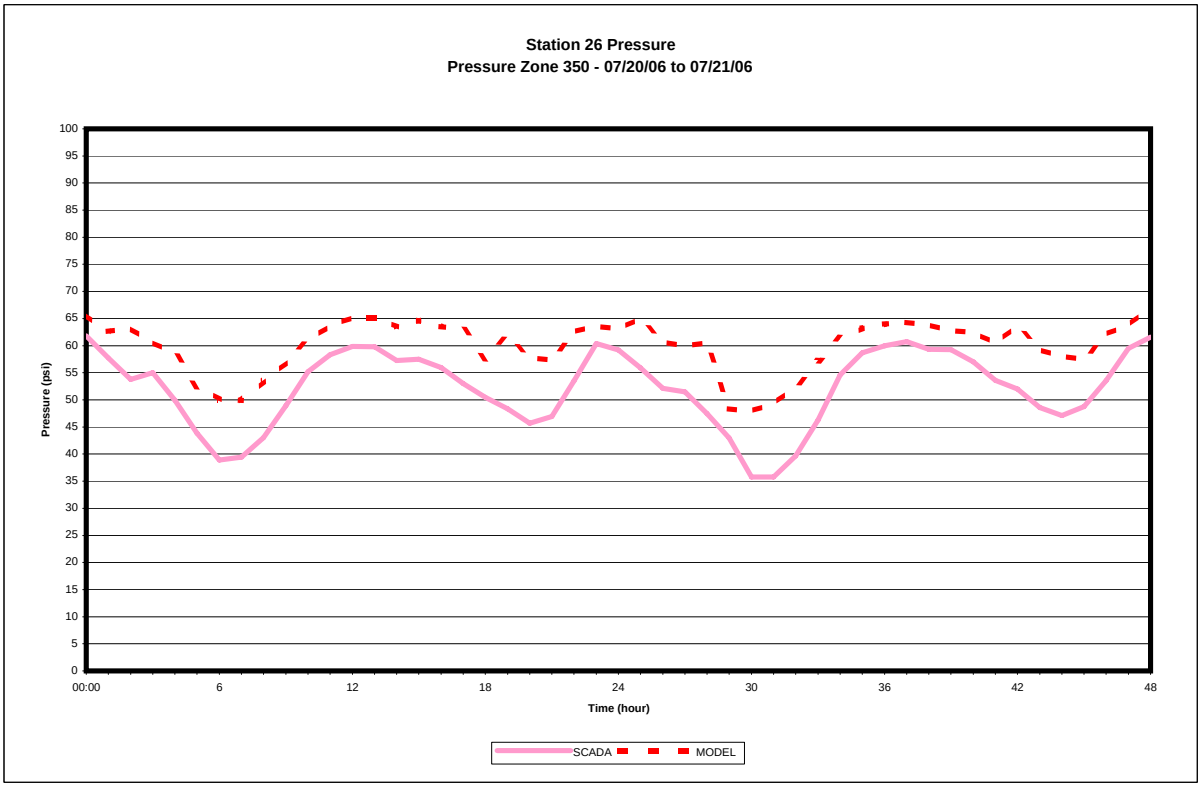
## Figure 6-6. Cal Water's Station Verification for Pressure Zone 350



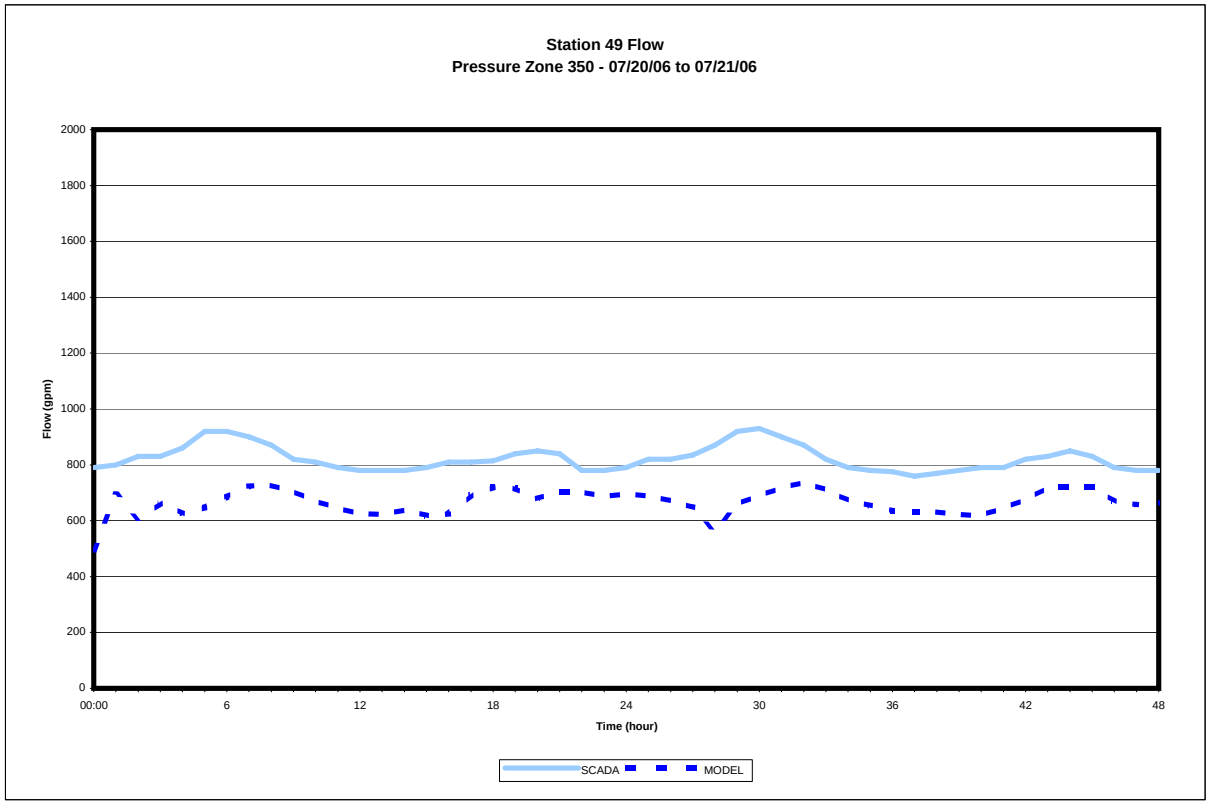



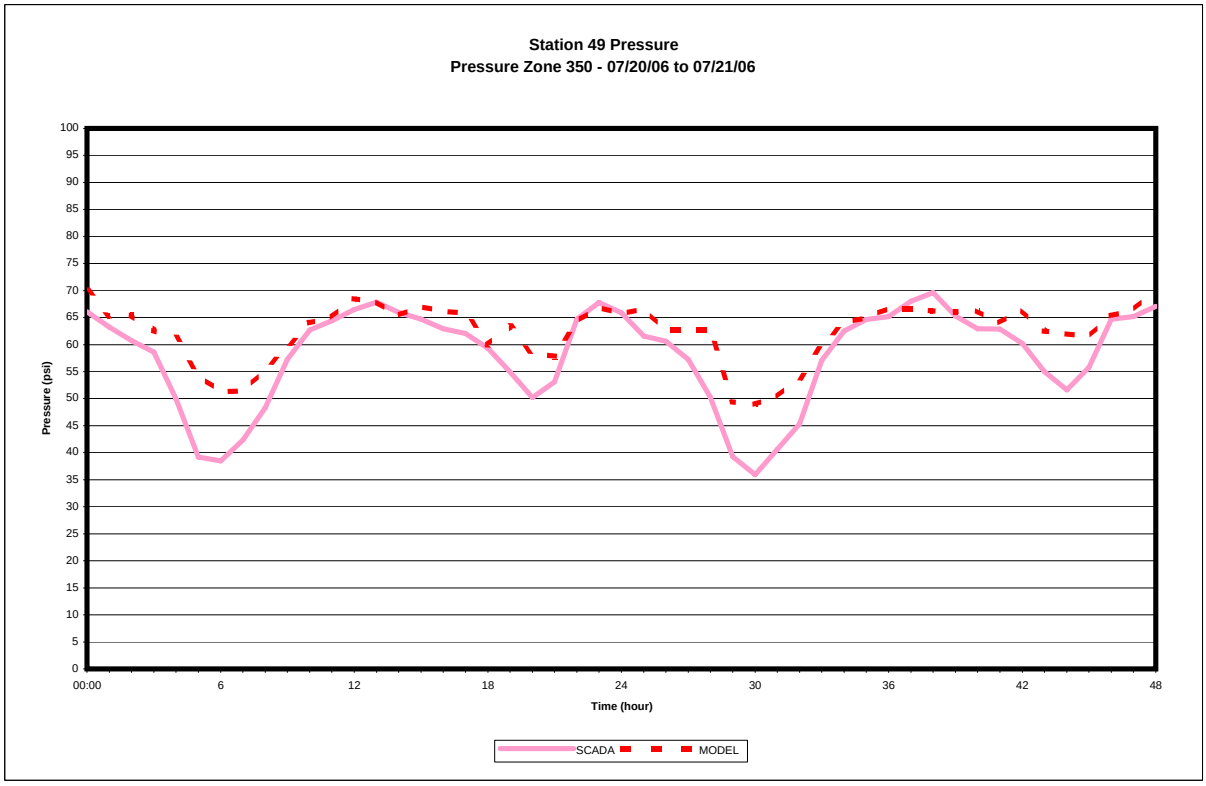
## Figure 6-7. Cal Water's Station Verification for Pressure Zone 350



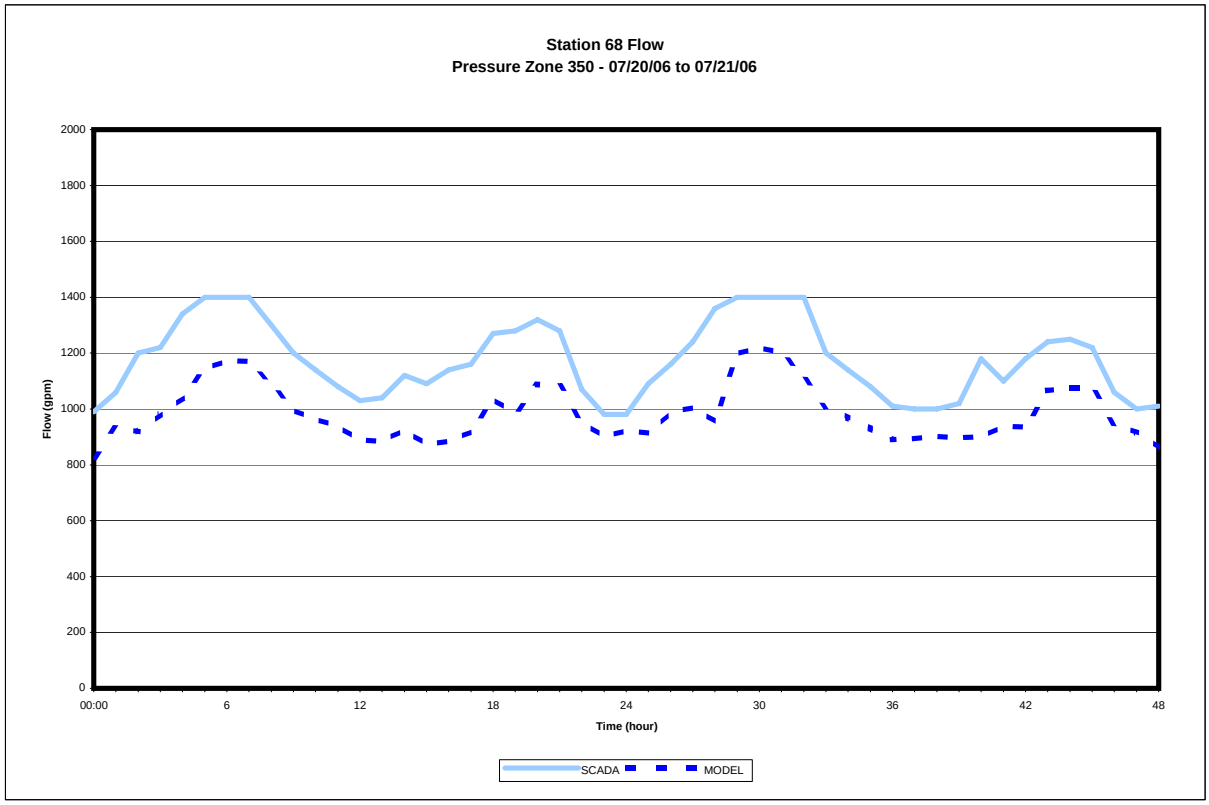



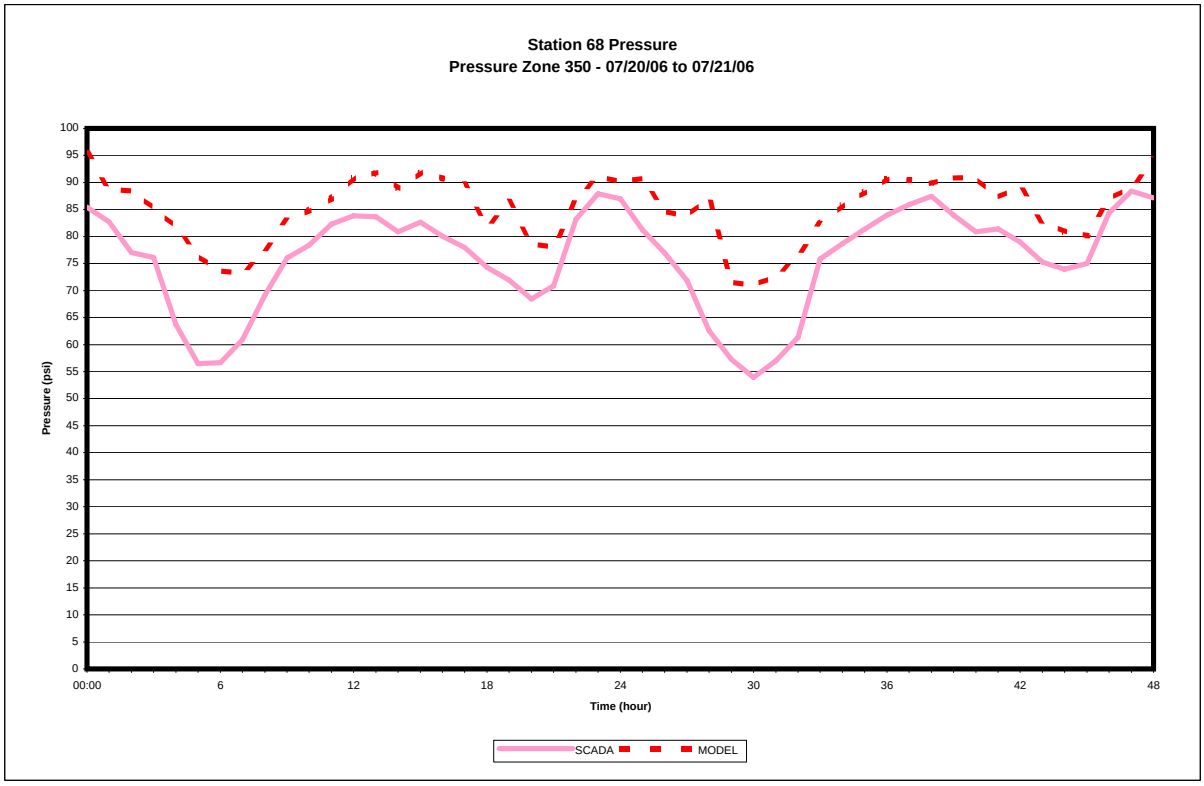
## Figure 6-8. Cal Water's Station Verification for Pressure Zone 350



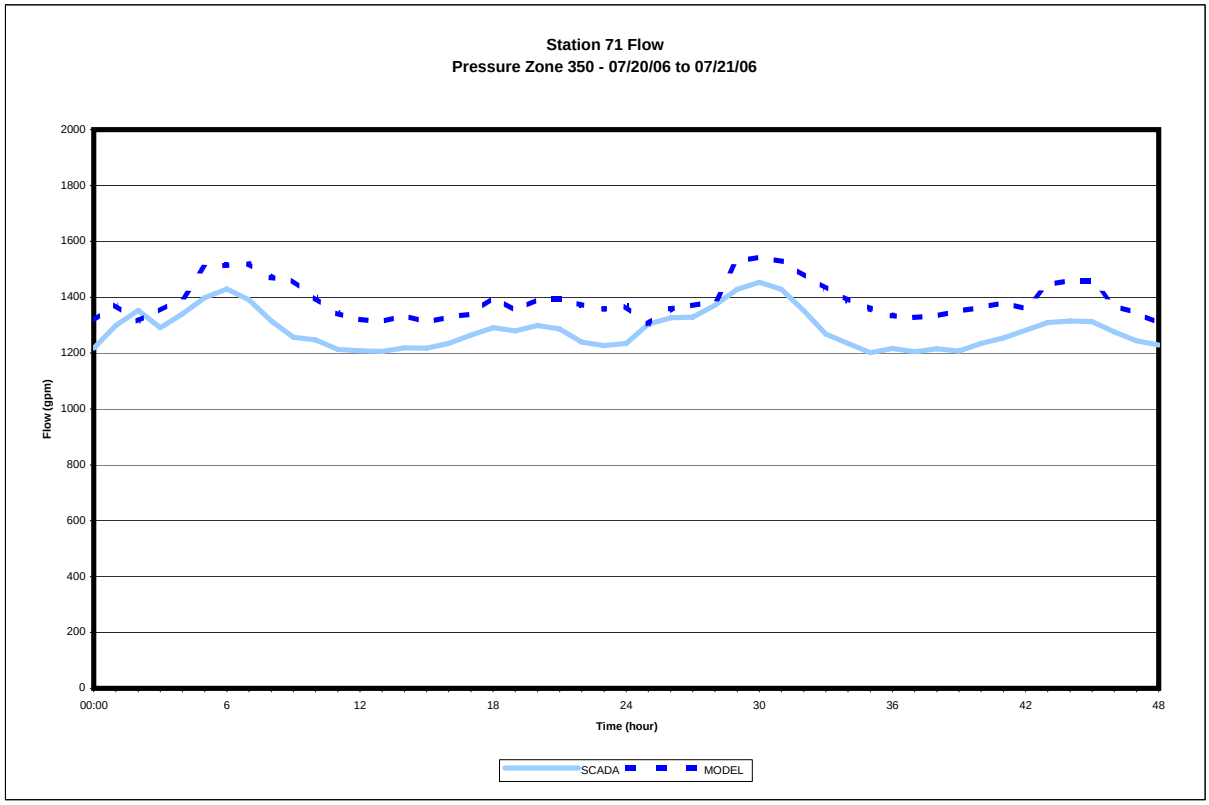



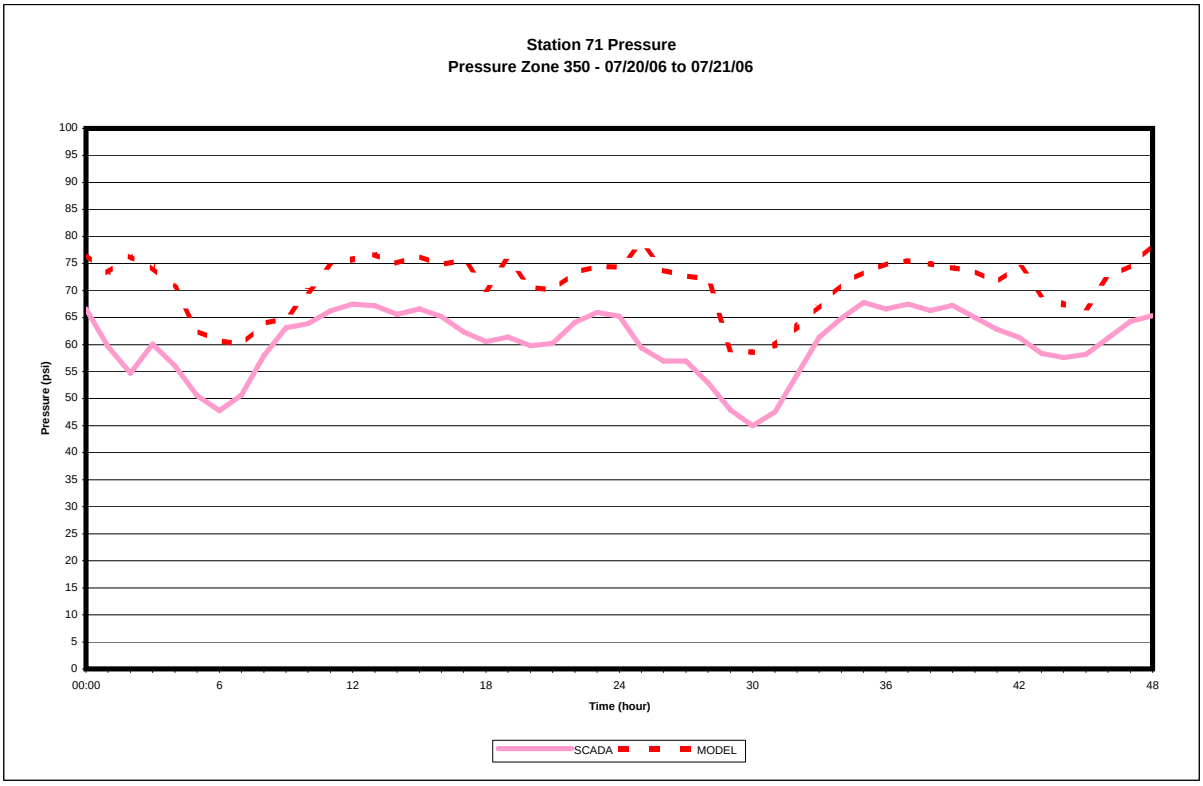
## Figure 6-9. Cal Water's Station Verification for Pressure Zone 350



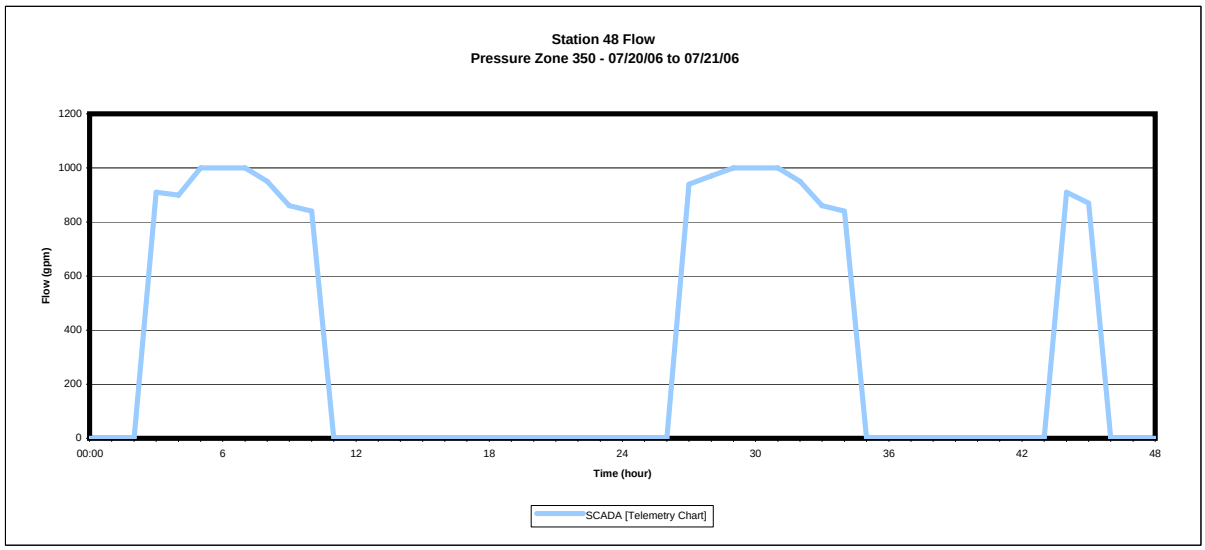
## Figure 6-10. Cal Water's Station Verification for Pressure Zone 350

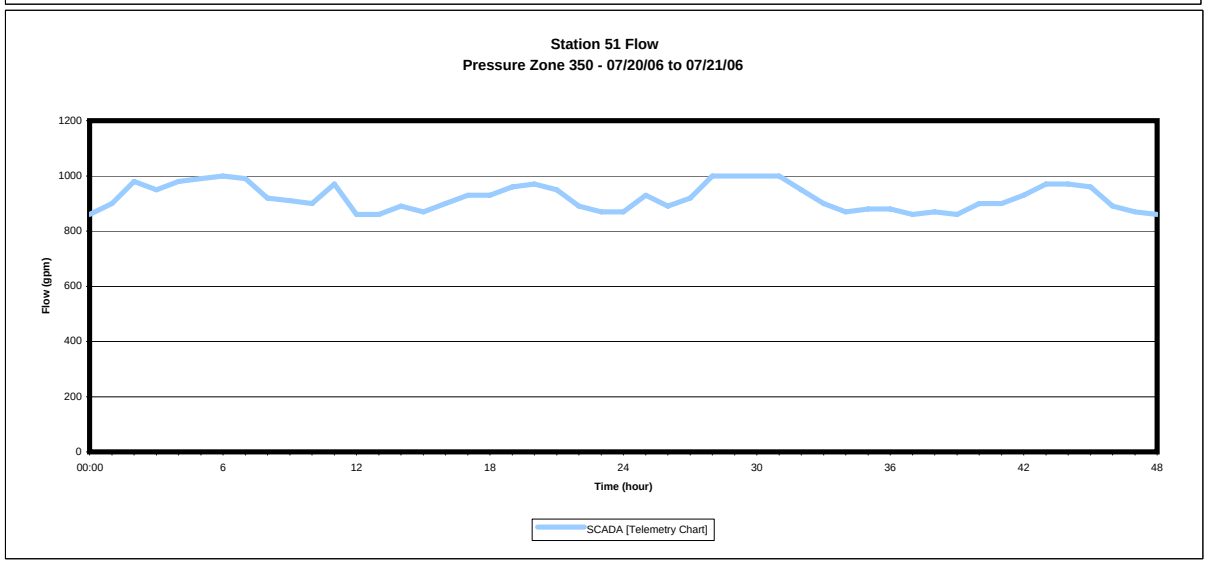


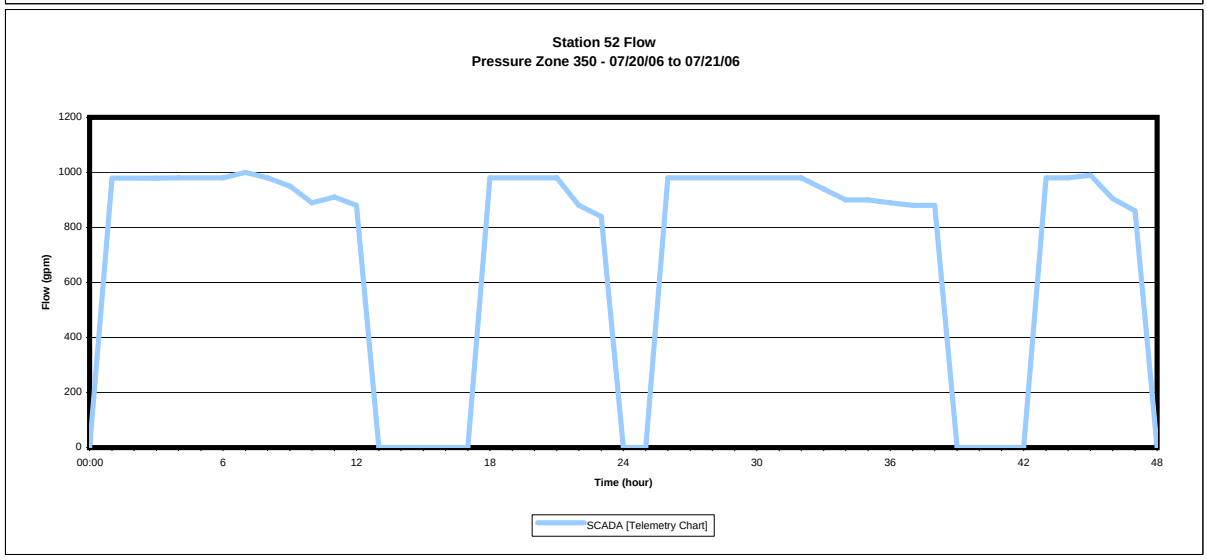



Public Version

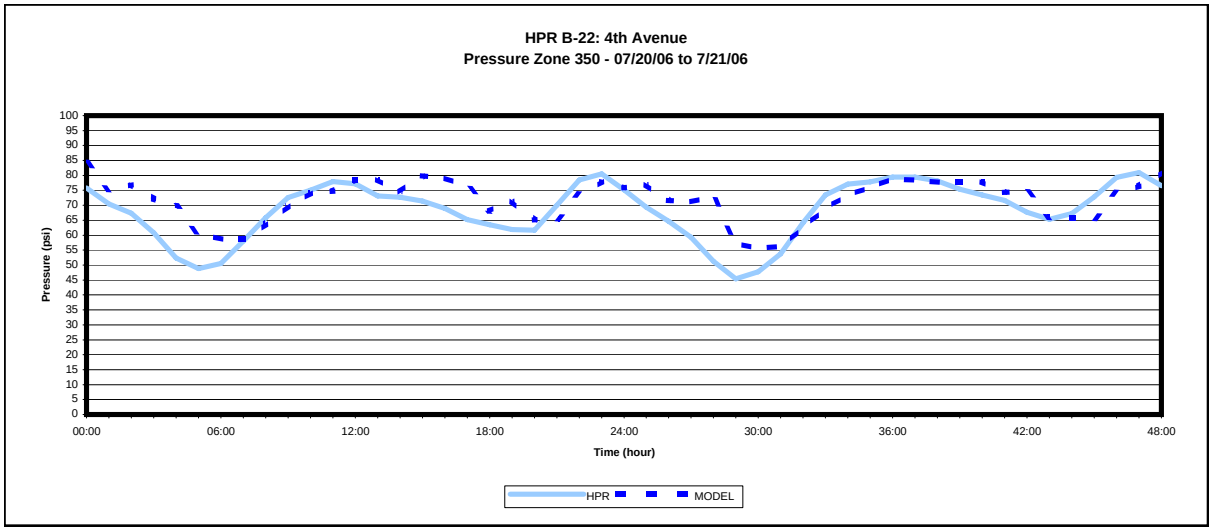
## Figure 6-10A. Cal Water's Pressure Zone 350 Stations 48, 51 and 52

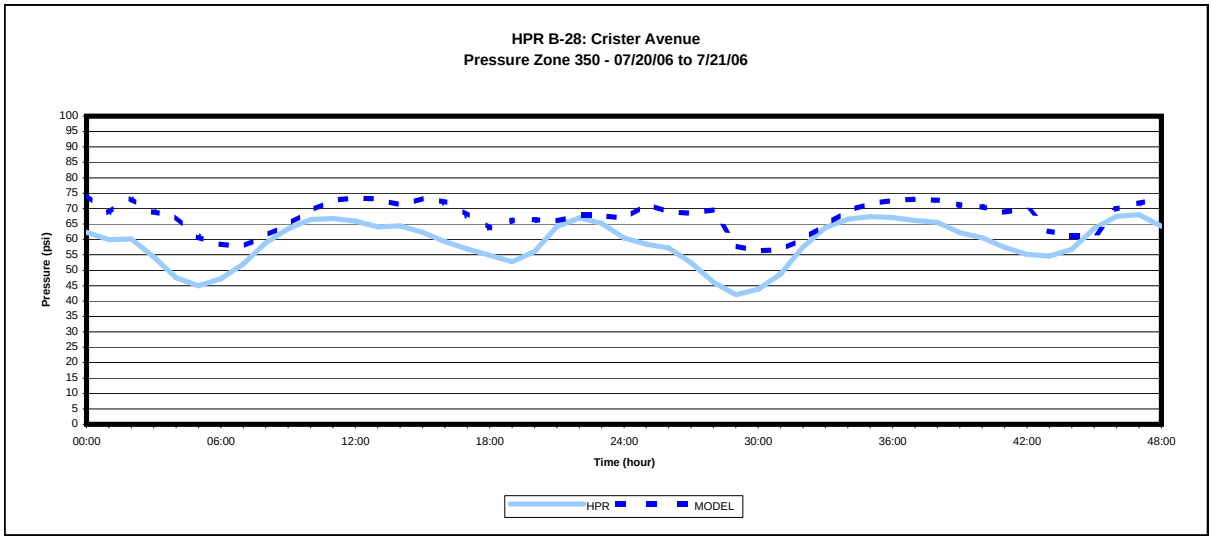


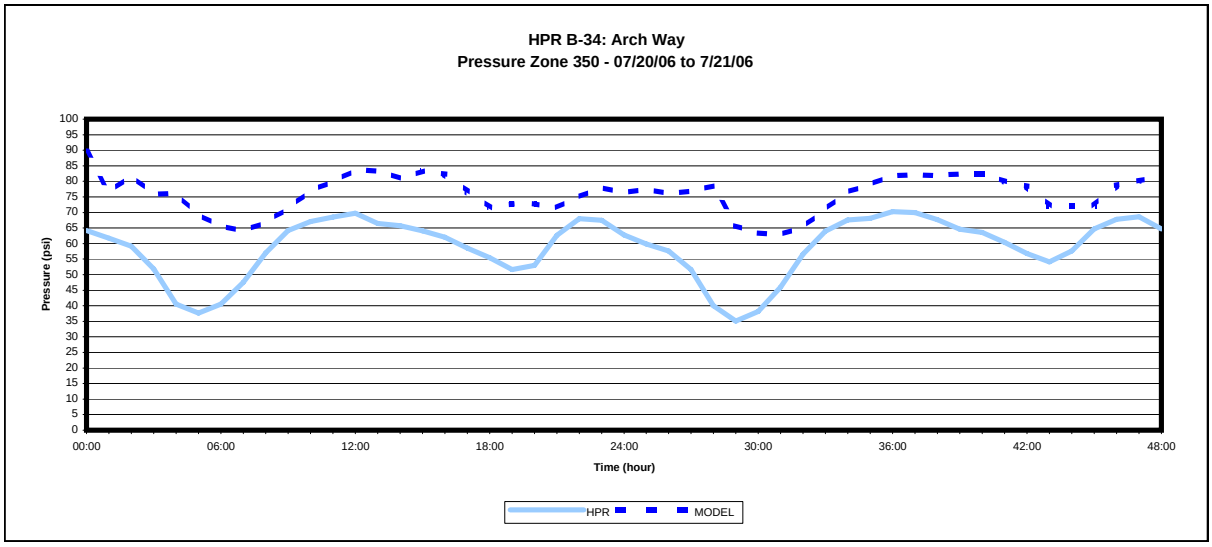



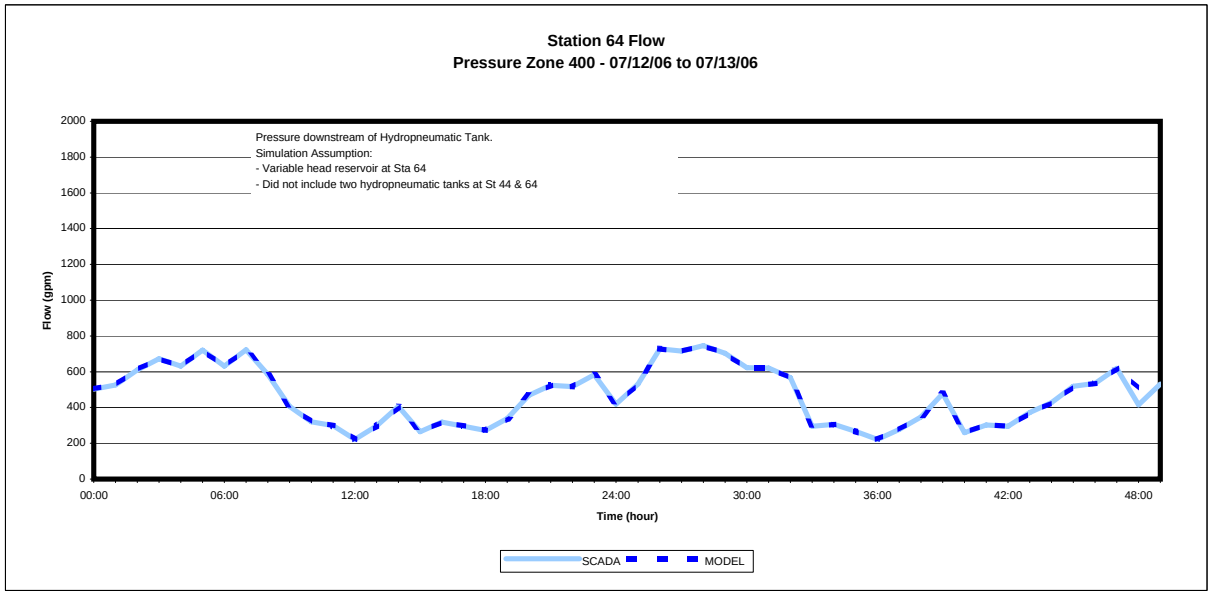
## Figure 6-11. Pressure Comparison Between Field Recording and Model Simulation in Pressure Zone 350



## Figure 6-12. Cal Water's Station Verification for Pressure Zone 400



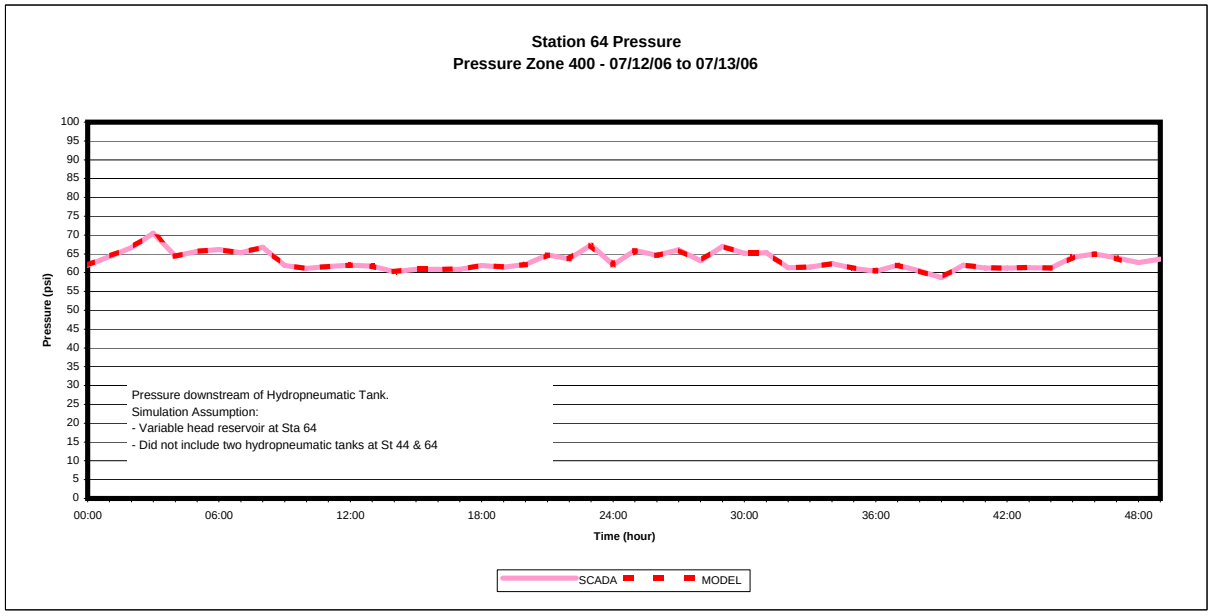
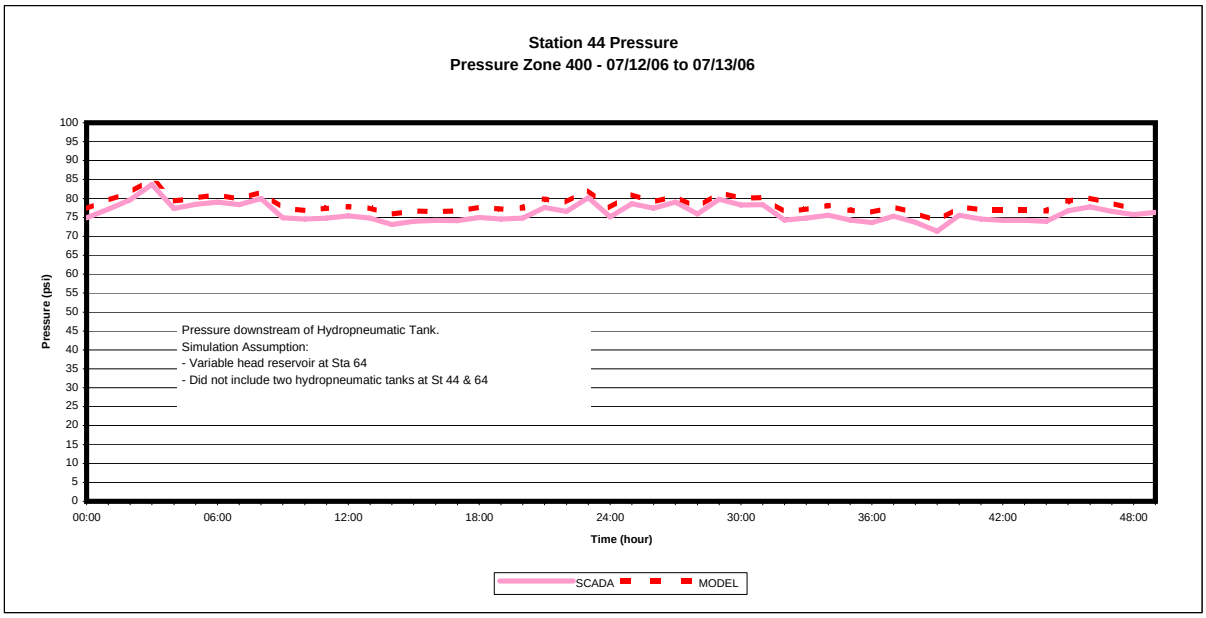
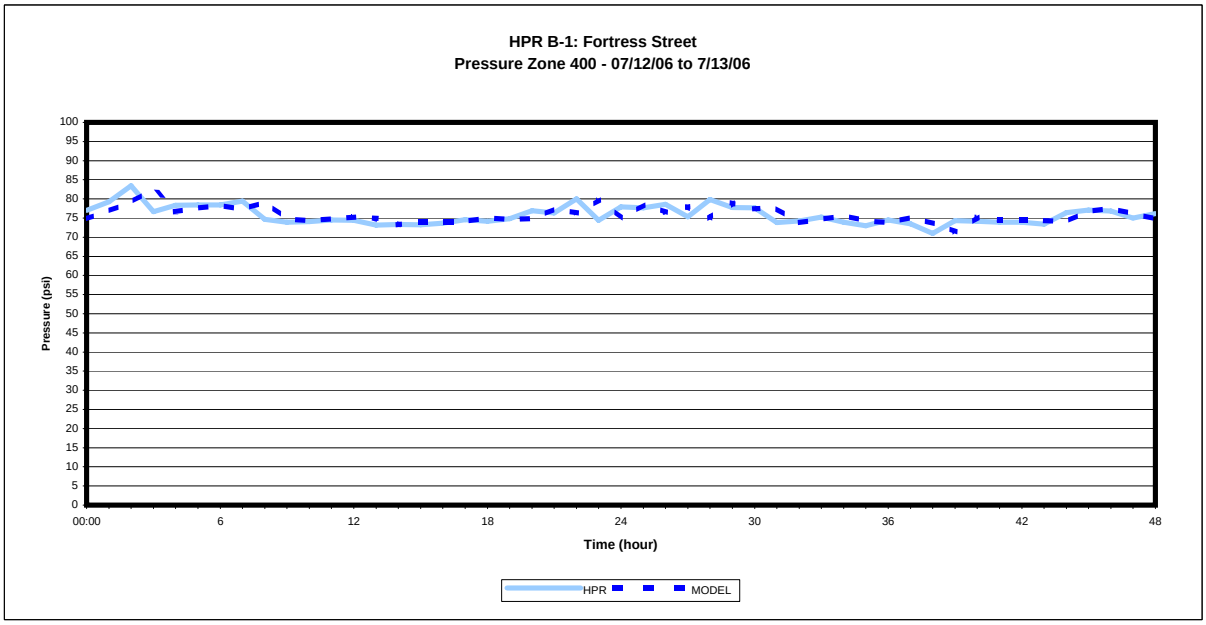
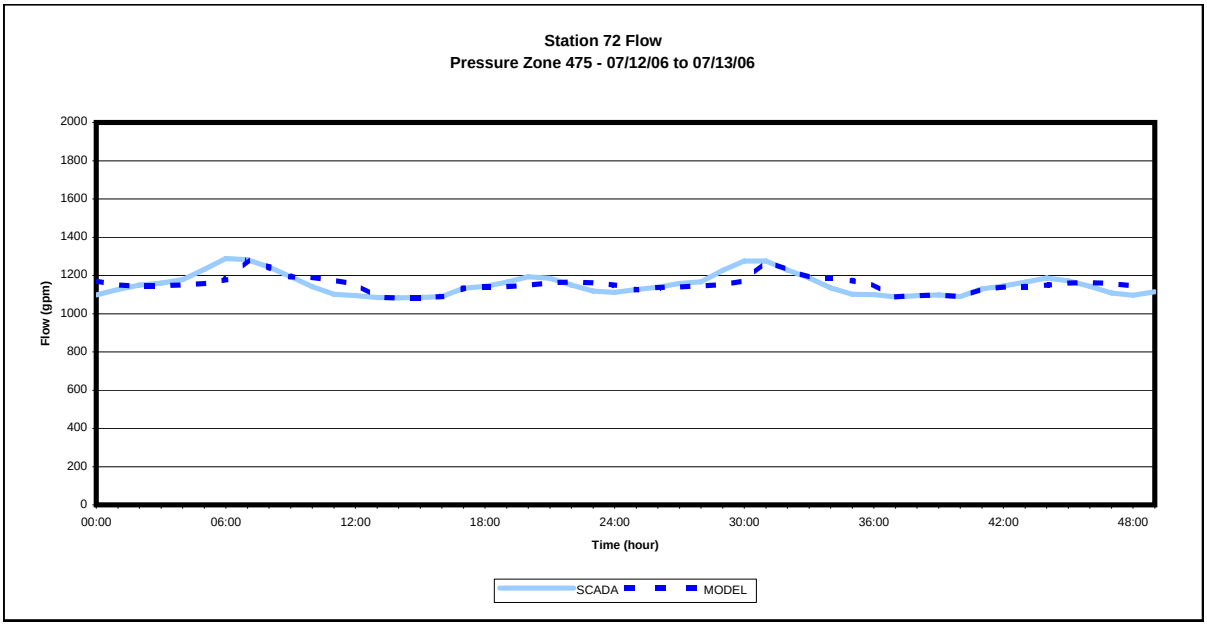



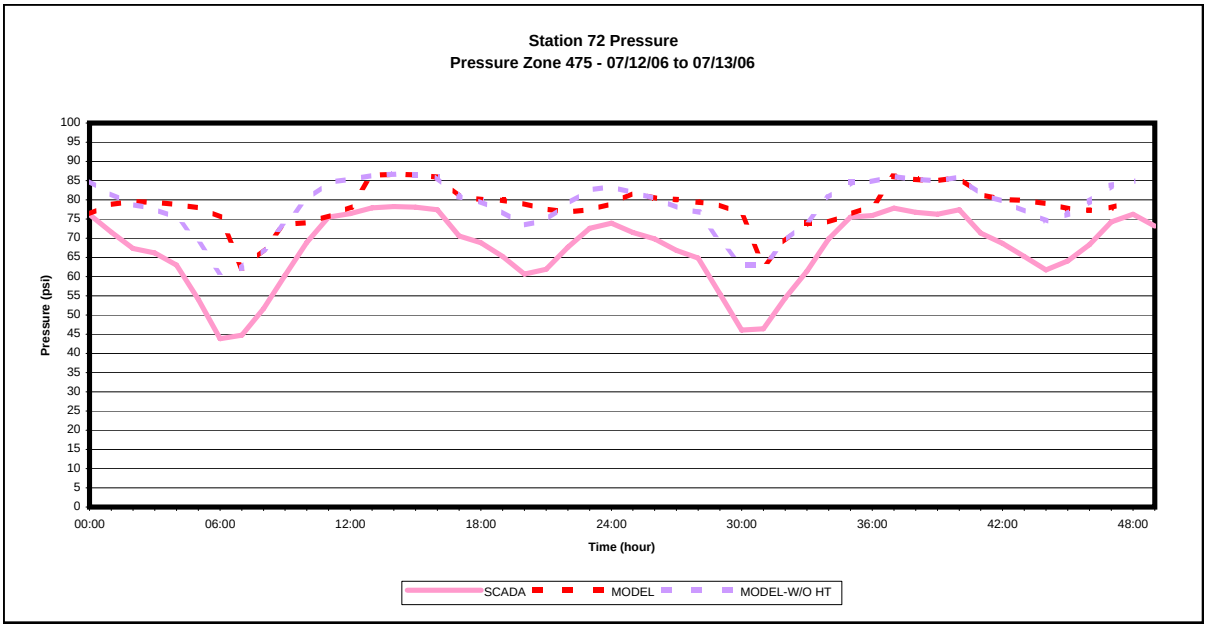
**Figure 6-13. Cal Water's Station Verification and Pressure Comparison Between Field Recording and Model Simulation in Pressure Zone 400**



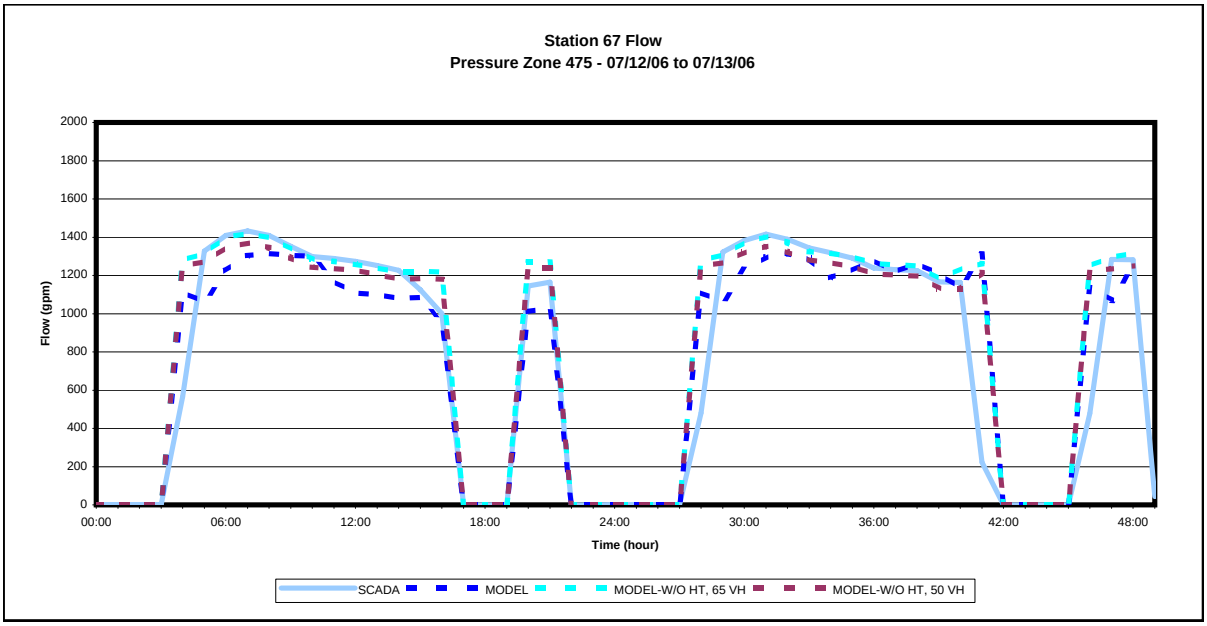



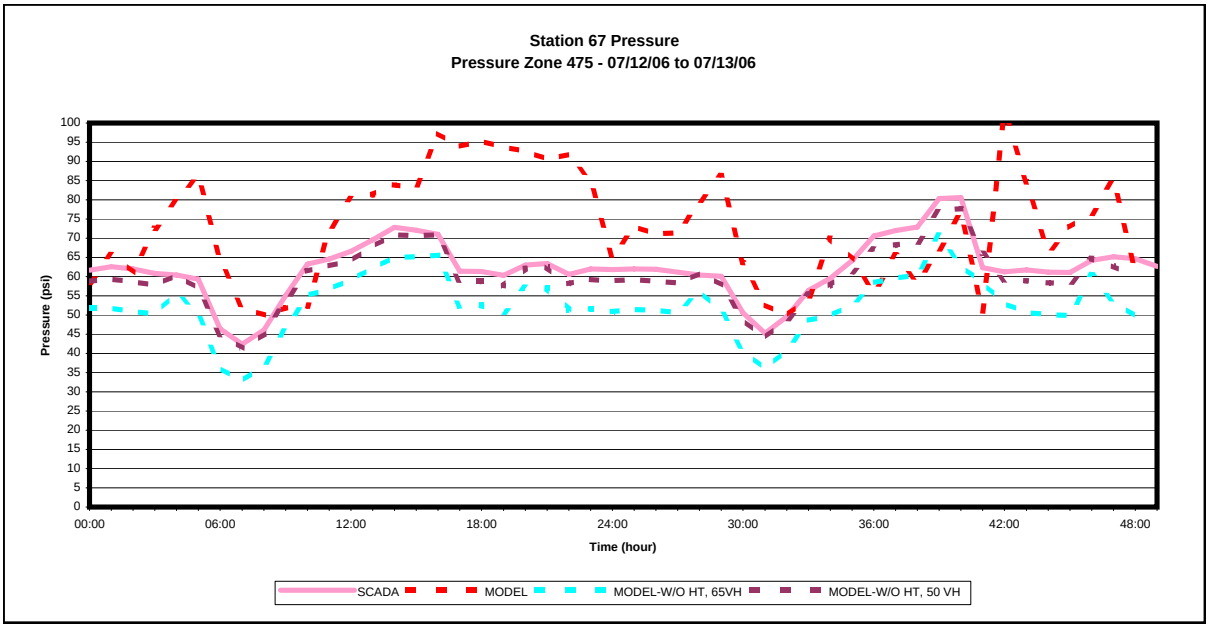
## Figure 6-14. Cal Water's Station Verification for Pressure Zone 475



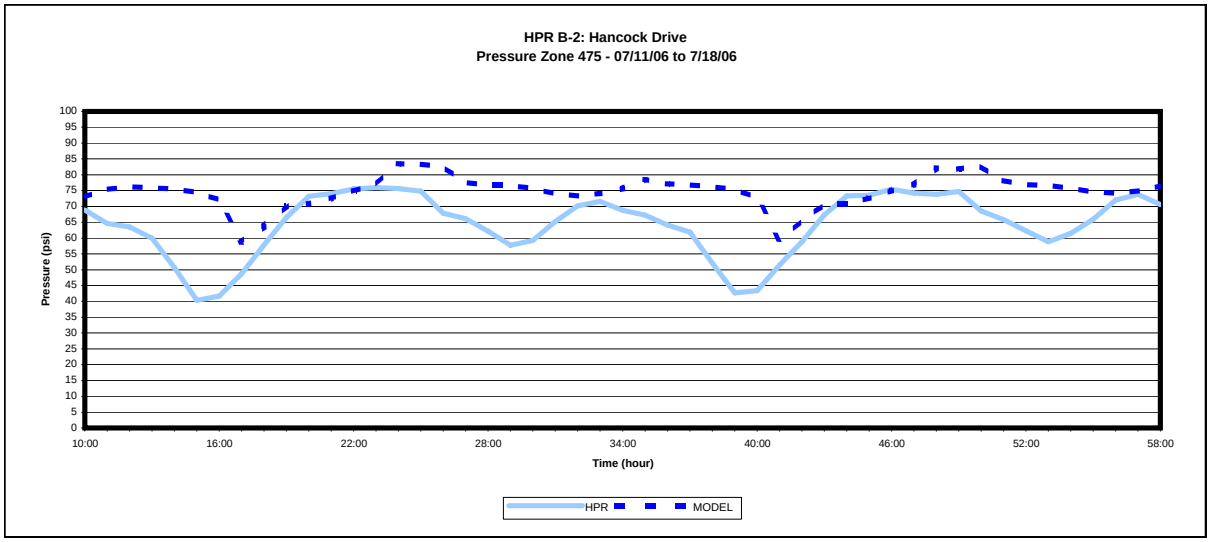



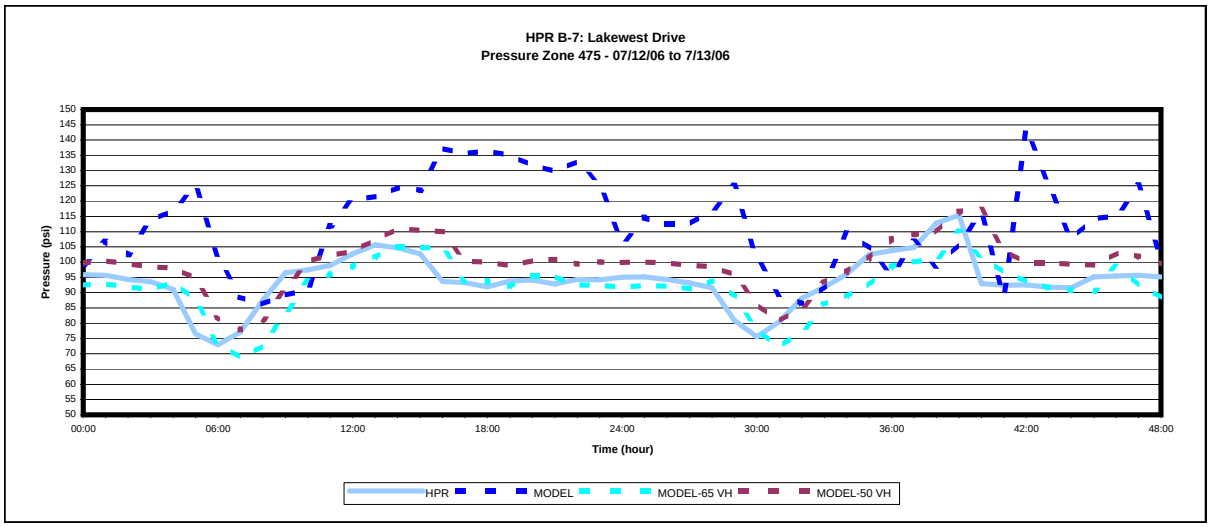
## Figure 6-15. Cal Water's Station Verification for Pressure Zone 475

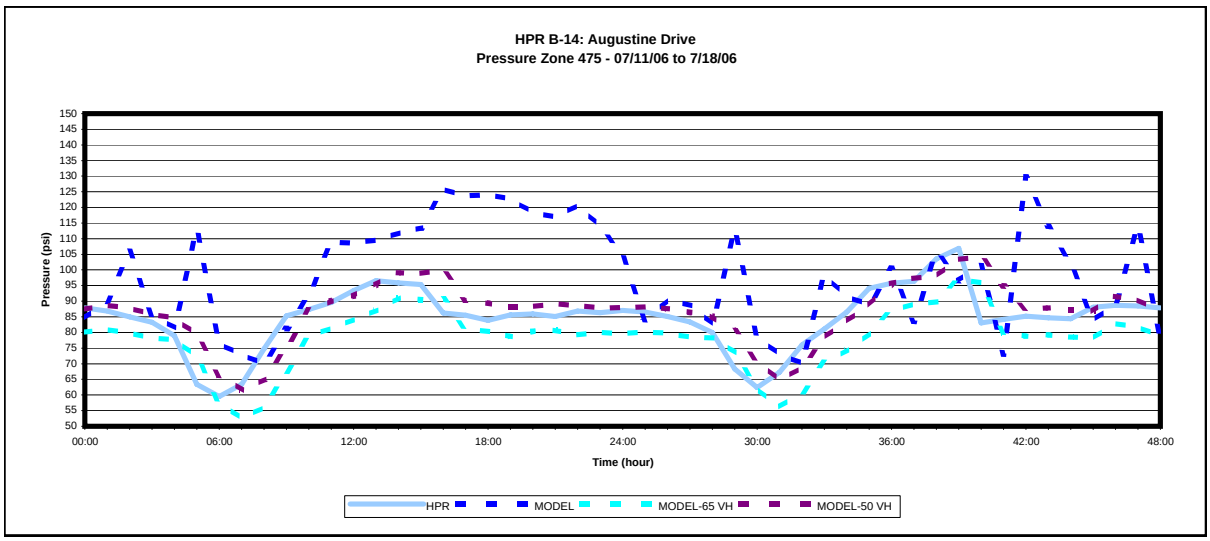


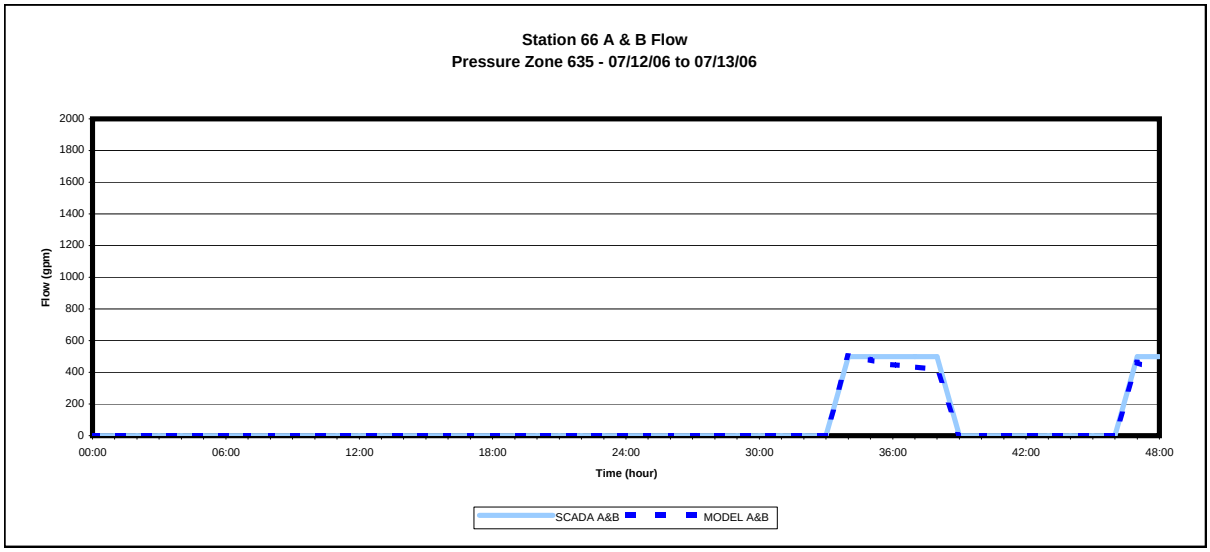
## Figure 6-16. Pressure Comparison Between Field Recording and Model Simulation in Pressure Zone 475

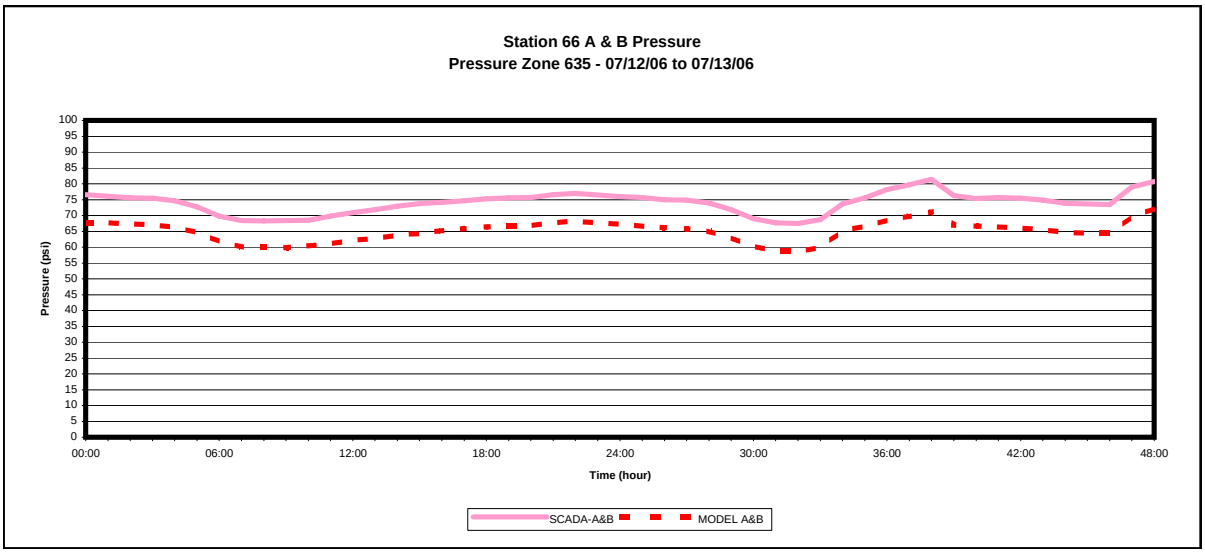


## Figure 6-17. Cal Water's Station Verification for Pressure Zone 635



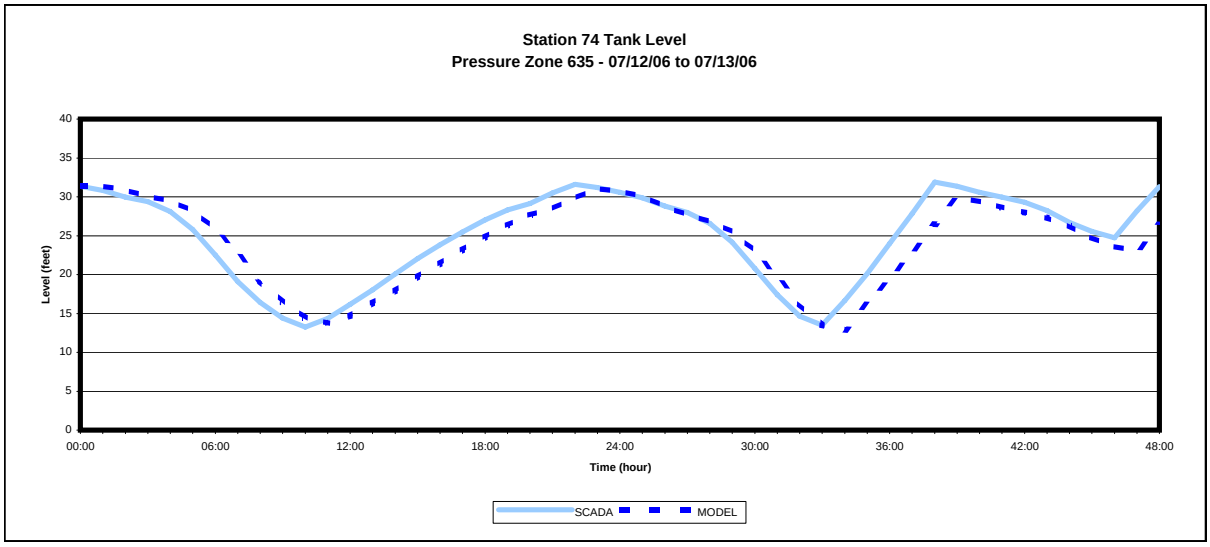
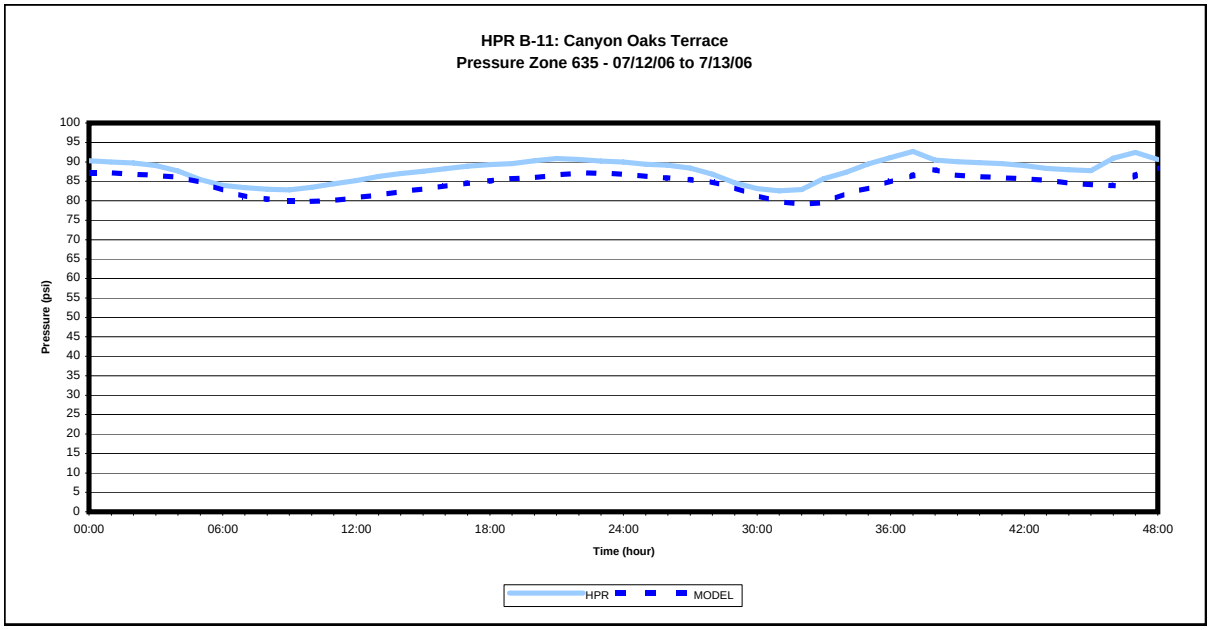
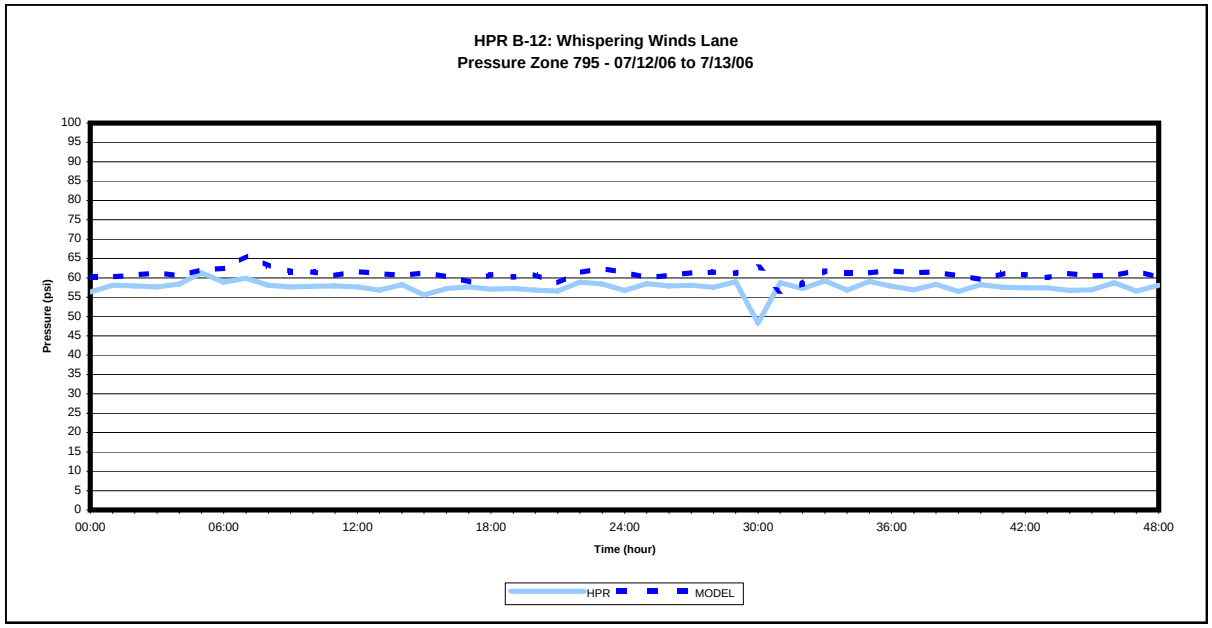
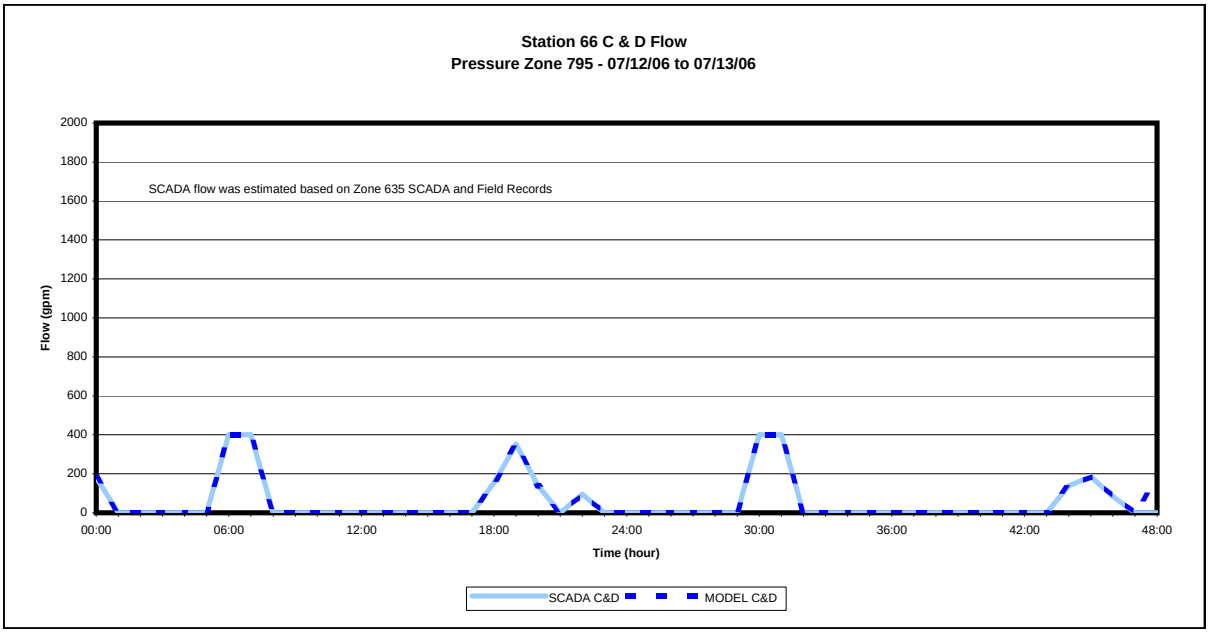



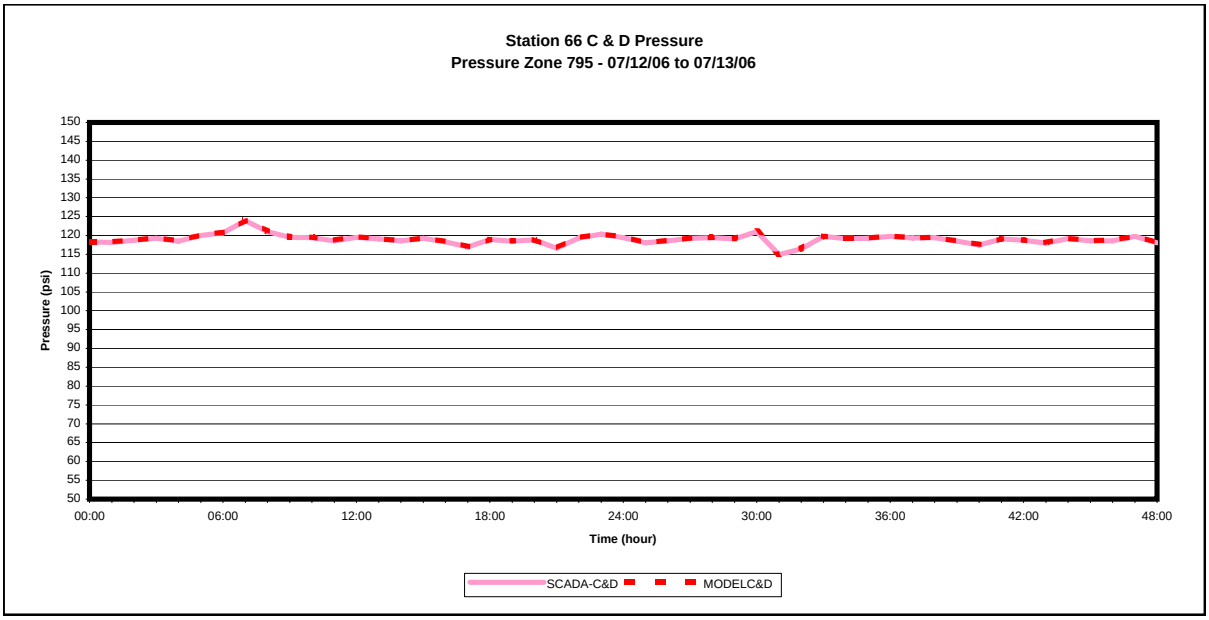
**Figure 6-18. Pressure Comparison Between Field Recording and Model Simulation in Pressure Zones 635 and 795**



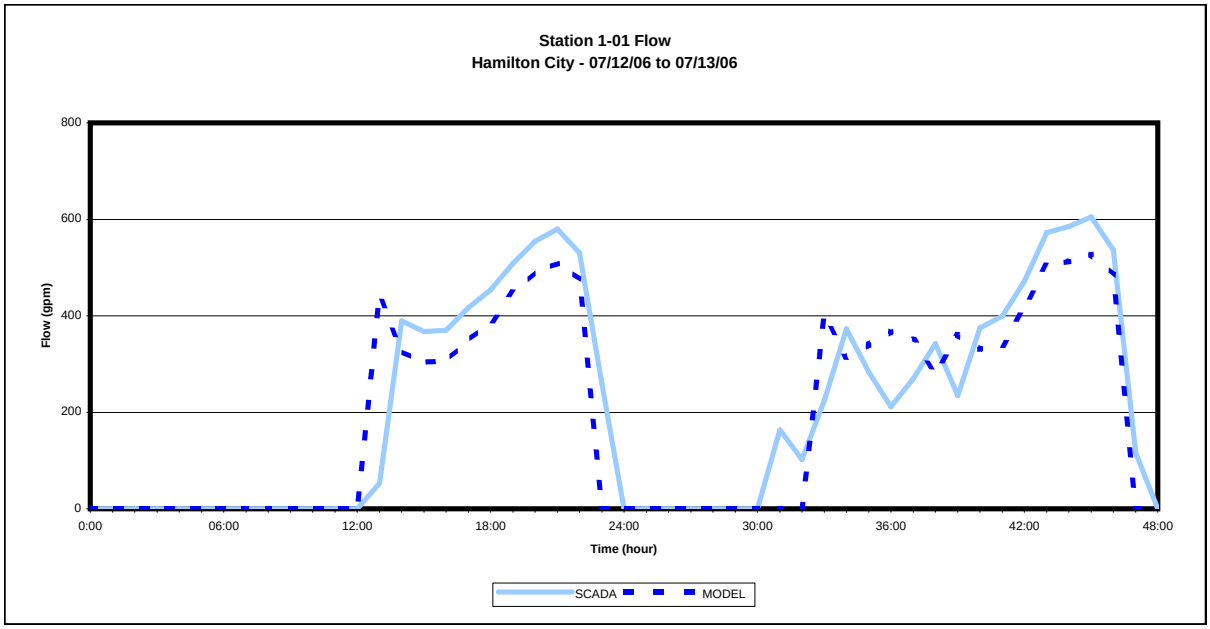



## Figure 6-19. Cal Water's Station Verification for Pressure Zone 795



## Figure 6-20. Cal Water's Station Verification for Hamilton City



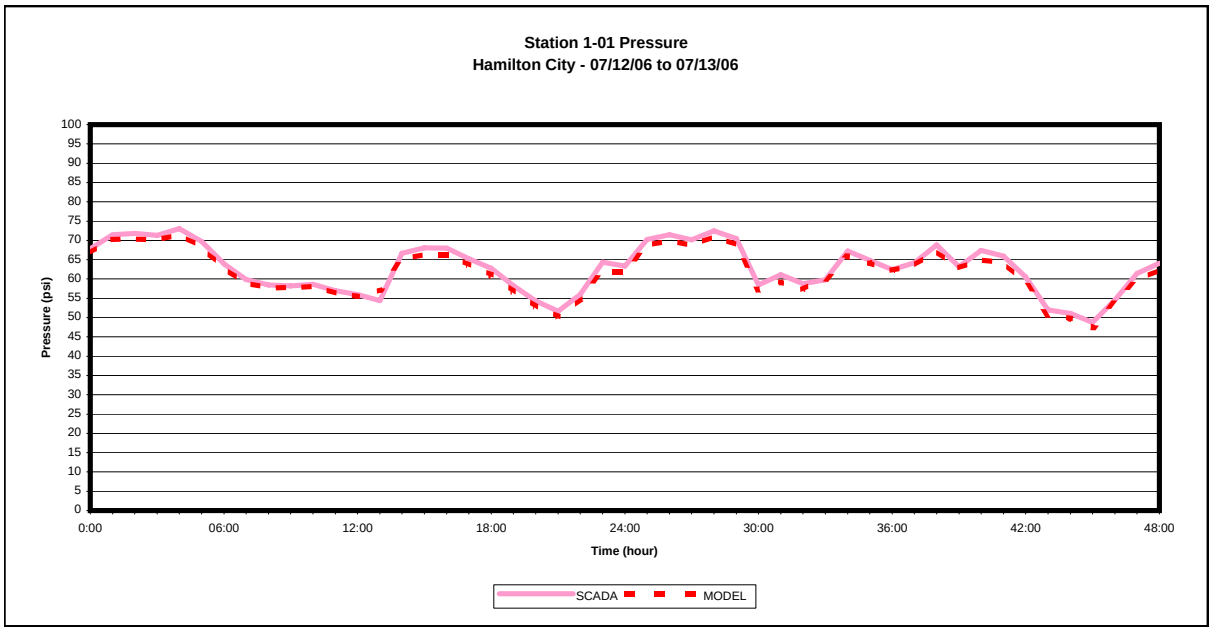
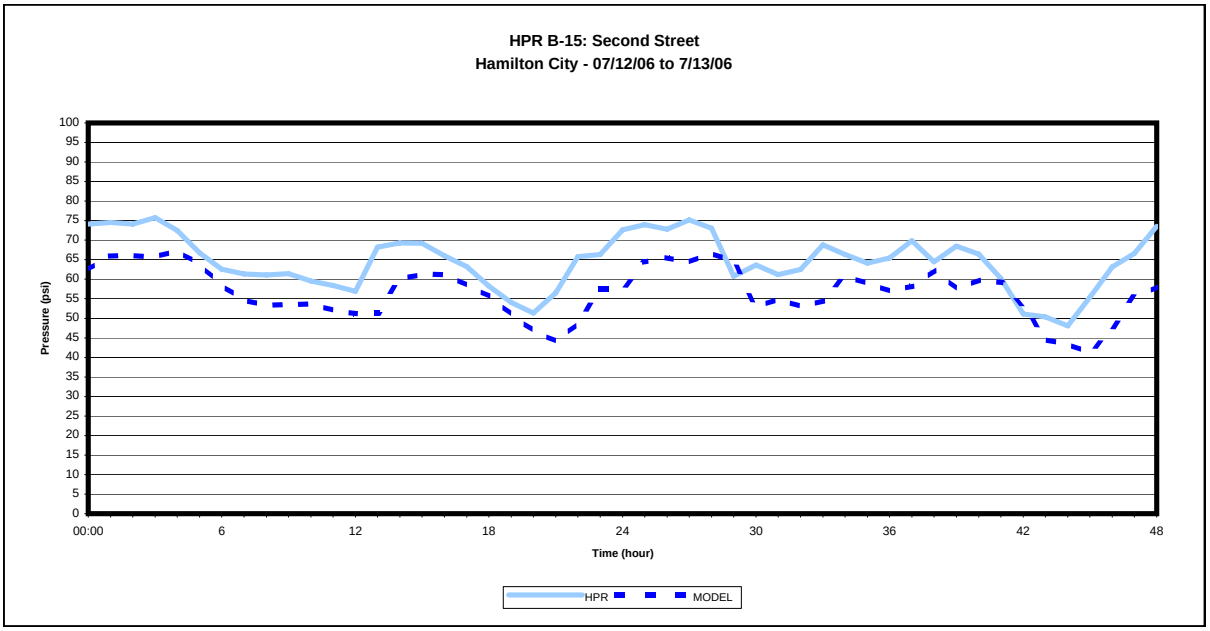
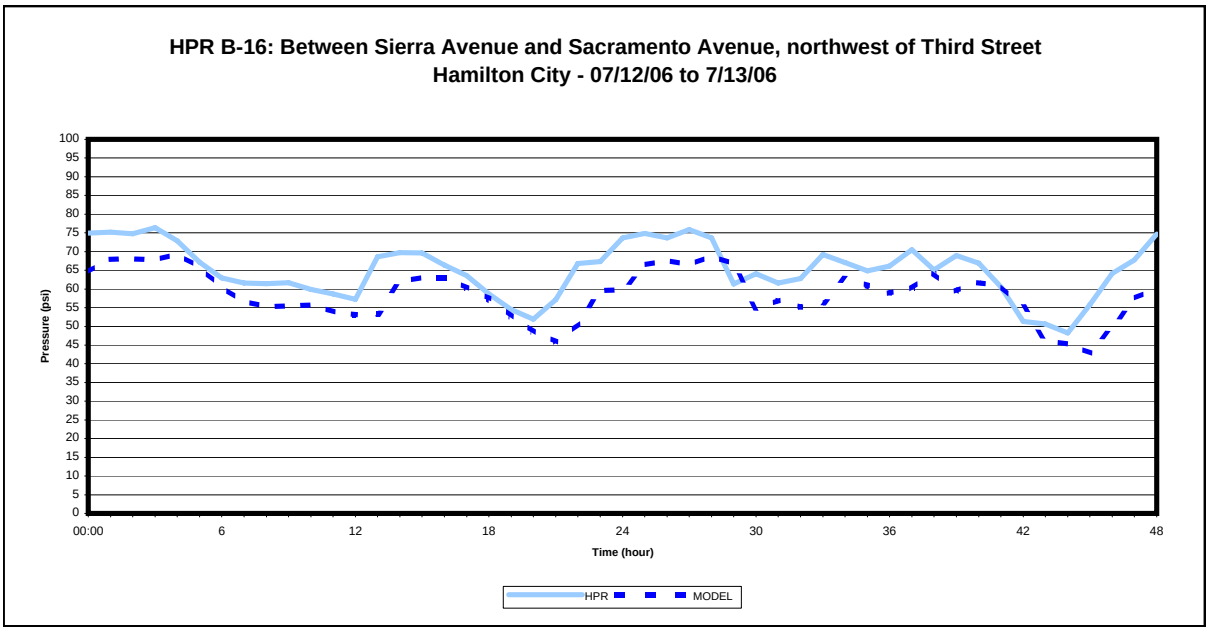



**Figure 6-21. Pressure Comparison Between Field Recording and Model Simulationin Hamilton City**



Public Version



# Chapter 7: Inventory and Assessment of Facilities Conditions and Capacity

*Chapter Contents:*


- Summary of Key Findings
- Assessment Process
- Station Assessment
- Renewal and Replacement Schedule


*Chapter Highlights:*

The purpose of this chapter is to provide Cal Water with a summary of the inventory and assessment WYA conducted for Cal Water Chico-Hamilton City District's water system. This chapter documents the inventory of the existing pumping and storage facilities as well as the SCADA systems owned and operated by Cal Water's Chico-Hamilton City District. This chapter also describes the general condition and capacities of the facilities obtained through a "desktop level" assessment. Major deficiencies identified through the conditions assessment and recommendations to address those deficiencies are provided in this chapter. This information will be used with the water supply evaluation and hydraulic analysis to develop the long term capital improvement program for the Chico-Hamilton City District Water Supply and Facility Master Plan.

The intent of this system facilities conditions and capacity assessment is to determine the general condition of each facility through a "desktop level" evaluation of the data available from Cal Water's files. Any data gaps discovered during the database search were reported to Cal Water. Through discussions with Cal Water staff and limited site-specific visual observations, WYA developed an updated system inventory of the Chico-Hamilton City District.

Cal Water Chico-Hamilton City District staff indicated that the following improvements would be helpful in the operation of the Chico-Hamilton City District System:

*R&R Projects*

- Reactivate the inactive Station 033 (in process)
- Install GAC system for Stations 040 for reactivation of the station
- Rehabilitate Station 058 to remove odor, taste and color
- Complete interior painting for Tank 2 of Station 001 in the Chico system (in progress)
- Replace cathodic protection anodes for Tank 2 of Station 001 in the Chico system (by 2007)
- Paint the exterior of Tank 1 at Station 066 and the interior of Tank 3 at Station 008 in the Chico system (by 2007)
- Paint the interior of Tank 4 at Station 003 in the Chico system (by 2008)
- On an on-going basis, replace all oil lube type pumps to water lube type pumps with a mechanical seal
- On an on-going basis, continue to relocate disinfectant supplies and dosing equipment out of the pump facilities into a fiberglass shed or separate room in the pump buildings.

# CHAPTER 7. INVENTORY AND ASSESSMENT OF FACILITIES CONDITIONS AND CAPACITY

The purpose of this Chapter is to provide Cal Water with a summary of the inventory and assessment WYA conducted for Cal Water Chico-Hamilton City District's water system. This chapter documents the inventory of the existing pumping and storage facilities as well as the SCADA systems owned and operated by Cal Water's Chico-Hamilton City District. This chapter also describes the general condition and capacities of the facilities obtained through a "desktop level" assessment. Major deficiencies identified through the conditions assessment and recommendations to address those deficiencies are provided in this Chapter. This information will be used with the water supply evaluation and hydraulic analysis to develop the long term capital improvement program for the Chico-Hamilton City District Water Supply and Facility Master Plan.

Key sections of this chapter include:

- Summary of Key Findings
- Assessment Process
- Station Assessment
- Renewal and Replacement Schedule

## SUMMARY OF KEY FINDINGS

Specific improvement recommendations will be developed in conjunction with the findings from the water supply evaluation and the hydraulic analysis of facilities in the Chico-Hamilton City District's Water Supply and Facilities Master Plan. The improvements will depend on the groundwater supply recommendations, which will determine where future supply sources will be located, and the hydraulic evaluation of the distribution system, which will determine where additional capacity may be needed.

The intent of this system facilities conditions and capacity assessment is to determine the general condition of each facility through a "desktop level" evaluation of the data available from Cal Water's files. Any data gaps discovered during the database search were reported to Cal Water. Through discussions with Cal Water staff and limited site-specific visual observations, WYA developed an updated system inventory of the Chico-Hamilton City District. The results of this updated system inventory and assessment are summarized in Table 1 of Appendix N.

WYA also interviewed Cal Water Operations and Engineering staff to evaluate the reporting needs and requirements for the existing SCADA system. WYA used this information in an assessment of Cal Water's SCADA system to make recommendations to improve the accuracy, usefulness and timeliness of information for cost-effective operational control of the Chico-Hamilton City District water system. The following paragraphs provide a summary of the key findings of our inventory and general condition assessment.

**Booster Pump and Motors**

A total of eight active booster pumps and motors (Stations 16, 50, 66, and 73) are located in the Chico-Hamilton City District with various age distributions (see Figures 7-1 and 7-2). The oldest is located in Station 50. Based on its age of 27 years, this booster pump requires renewal and replacement (R&R). However, no R&R is recommended for this booster pump since it is currently inactive. The booster pump at Station 16 received an R&R in 2000 and was operating at a 71 percent operating efficiency. Booster Pumps 66A and 66B are each 16 years old. Although within the typical design life[1], these booster pumps may need R&R based on their operating efficiencies of 41 percent and 58 percent, respectively. The remaining four booster pumps (66C and 66D) at this station were installed in 2001 and only scheduled maintenance is required. The two booster pumps in Station 73, which fill Tanks 1 and 2 at Station 66, were newly installed in 2004. Installing and operating a new booster pump downstream of the elevated tanks (i.e. at Station 001 in Chico) would improve tank cycling.

**Wells**

The median age of the 60 active wells within the Chico-Hamilton City District is 39.5 years. Approximately 42 percent of the active wells have reached or exceeded the typical design life (see Figure 7-3). Since the remaining useful life of a well cannot be determined by age alone, it is recommended that the Chico-Hamilton City District examine the structural integrity of the well casing. Based on the limited well video records collected to date, Chico-Hamilton City District staff does not recall any wells with failing or damaged well casing. To accurately assess the well condition and determine the maintenance required, it is recommended that a Well Management Plan, similar to that recommended for the Salinas District, be developed for the continued use of aging wells. Water quality is discussed individually in the groundwater supply section of the Water Supply and Facilities Master Plan. Based on the age and discussions with Chico-Hamilton City District staff, WYA's recommendations are as follows:

- Station 040 should be reactivated with GAC well head treatment as planned,
- Reactivate Station 033 (in process), and
- Rehabilitate the well at Station 058 for odor, taste and color.

This should occur within the next five years as a part of the R&R activities.

[1] The typical design lives assumed are 45 years for wells, 25 years for mechanical equipment (booster pump and motors, and well pump and motors), 60 years for steel tanks (elevated, ground level, and pressurized), and 10 years for SCADA equipment. This is based on WYA's experience, professional judgment, and industry standards.

**Well Pump and Motors**

The median ages of the Chico-Hamilton City District's well pumps and well pump motors are 14 years and 18 years, respectively. This is due to the significant R&R activities in the last 20 years. Given that the typical design life for mechanical equipment, such as pumps and motors, is typically 20 to 25 years, approximately 33 percent of the active well pumps and 37 percent of the active well pump motors have reached or exceeded their typical design life (see Figures 7-4 and 7-5). Age alone does not determine the remaining useful life of well pumps and motors. The age, in combination with the operating efficiency and the number of operating hours, should be used to set priorities for the R&R activities. Based on discussions with Chico-Hamilton City District staff, the Chico-Hamilton City District has started to replace pumps with oil lube-type lubrication mechanisms because they pose growth opportunities for bacteria at the water-oil interface. The Chico-Hamilton City District has started replacing the well pumps with water lube type pumps. Certain water lube-type well pumps are sealed by a packing gland which leaks and creates opportunity for corrosion around the well heads. WYA recommends all oil lube pumps be replaced with water lube type with a mechanical seal.

**Tanks**

The Chico-Hamilton City District maintains seven steel storage tanks for Chico and one for Hamilton City with various age distributions (see Figure 7-6). Four of the seven storage tanks in Chico are elevated while the remaining three are at grade. All elevated tanks have either reached or exceeded the typical design life. Two of the oldest elevated tanks (Tanks 1 and 2 at Station 001 in Chico) have become landmarks within the City of Chico.

Elevated tanks in Chico do not cycle, because the normal pressure in the downtown area is greater than the hydraulic grade line (HGL) of the tanks. Although booster pumps downstream of the elevated tanks would provide turnover, the Chico-Hamilton City District currently drains the tanks periodically to minimize the effects of stagnation (i.e., dissipation of chlorine and growth of bacteria). The one tank in Hamilton City is elevated, and although only a 25,000 gallon-tank, the Chico-Hamilton City District decided to continue maintaining this tank since it provides system pressure and successfully prevented water supply contamination during flood events in the past. The Chico-Hamilton City District also maintains three welded steel tanks at grade; these tanks have been recently constructed and are within their typical service life.
As part of the Chico-Hamilton City District's on-going tank maintenance, the following has been scheduled:

- Station 001 Tank 2 - Complete interior painting (currently in progress)
- Station 001 Tank 2 - Replace cathodic protection anodes (by 2007)
- Station 066 Tank 1 - Paint exterior (by 2007)
- Station 008 Tank 3 - Paint interior (by 2007)
- Station 003 Tank 4 - Paint interior (by 2008)

Based on discussions with Chico-Hamilton City District staff, WYA recommends that the hydraulic model of the Chico-Hamilton City District be simulated to assess the benefit of installing booster pumps at the base of elevated tanks to improve tank cycling.

**Auxiliary Power**

Of the 63 active well and booster pump stations in the Chico-Hamilton City District, 24 are equipped with auxiliary power sources in the form of generators, petro-powered direct drive motors or are connected to a auxiliary power source in another station. The Chico-Hamilton City District maintains these generators or petro-powered direct drive motors by running each for two 30-minute periods monthly, and providing annual preventative maintenance such as oil change and battery testing. Although some are very old, the Chico-Hamilton City District has no plans to replace any of the auxiliary power supplies in the near future.

**Disinfectant Storage**

Although disinfection equipment for chlorine tablets were found in some of the inactive stations visited, the Chico-Hamilton City District currently uses sodium hypochlorite as a disinfectant to maintain chlorine residuals in the water supply. With the exception of Stations 061 and 062 in the Chico system, which are equipped with sodium hypochlorite generators, the disinfectant supply is provided by a vendor in 15- or 50-gallon plastic bins.

As evident in several stations, chlorine vapor accelerates the corrosion of nearby mechanical and electrical equipment. The Chico-Hamilton City District is in the transition of relocating these disinfectant supplies and dosing equipment from the pump building to a dedicated storage room such as a separate partitioned room in the pump building or storage shed outside the pump building. The Chico-Hamilton City District is installing approximately five storage sheds per year for this purpose. Any weight on top of the disinfectant storage bins, including the dosing equipment, should be removed to maintain the structural integrity of the bins and the dosing equipment warranties.

While some of the stations with separate partitioned room for storing the disinfectant were missing the secondary containment or ramp to the secondary containment, all designated disinfectant storage facilities were equipped with eye wash stations, a dosing equipment stand, and a ventilation fan.

**Telemetry Systems**

The SCADA system at the Chico-Hamilton City District consists of a central computer located at the Chico-Hamilton City District office building, 34 remote sites with Remote Telemetry Units (RTU), and sensors and switches. The main antenna, repeater and switching equipment are installed in Station 66. The Chico-Hamilton City District maintains three radio frequency channels for SCADA communication.

Approximately half of the Chico-Hamilton City District stations are equipped with chart recorders only. Generally, operations staffs have experienced stable data transmissions from all remote sites. However, it was observed during a site visit that some of the flow and pressure data reported by SCADA did not match the chart recorder values. WYA recommends SCADA calibration and continued installation of SCADA system to stations equipped with only chart recorders.

Based on our meetings with Cal Water operation and engineering staff, the following capital and maintenance considerations for the Chico-Hamilton City District are recommended.

Capital Considerations:

The Chico-Hamilton City District will be adding new RTUs to remote sites as planned in 2005. The Chico-Hamilton City District should consider the following when installing new or replacing old and/or damaged RTUs:

- Using SCADAPack RTUs.
- Monitoring, at a minimum, flow, pressure, and pump status at each location.
- Installing power meters to interface with the RTU to monitor the well efficiencies at each site.
- Installing on-line chemical testing (total chlorine and nitrates) monitored by SCADA.
- Installing security alarms and cameras at high risk locations with digital video recorders located at each site, and video transferred on demand to a central viewing location.

Maintenance Considerations:

The Chico-Hamilton City District should continue their scheduled maintenance program to track all equipment installation dates, regular maintenance and calibrations. The following is a minimal list of what should be considered for maintenance of the SCADA system:

- The Chico-Hamilton City District should continue to maintain its FCC licensed radio frequencies for SCADA communications to ensure the integrity of the SCADA system.
- The Chico-Hamilton City District should have a spare computer, preloaded with SCADA software, to quickly replace any failed computer.
- SCADA graphics programming should be maintained constantly to meet the needs of operations of the Chico-Hamilton City District system.
- SCADA software should be maintained to meet version upgrade needs.
- The Chico-Hamilton City District should have several RTUs on hand for emergency repair needs, and at least one of each type of instrumentation equipment (this will shorten down time for any one RTU site).

- The Chico-Hamilton City District should expect that at least six RTUs, or about 10 percent of the total RTUs, will need to be replaced every year (this will allow for rotating out all RTUs every ten years).

A more detailed assessment for the Chico-Hamilton City District's SCADA system is documented in a separate memorandum in Appendix O.

## ASSESSMENT PROCESS

The assessment process was limited to specific site visits, discussions with Chico-Hamilton City District operation and engineering staff and review of the system schematic, system map and facilities data provided by the Chico-Hamilton City District. A site visit to twenty-two (22) stations was conducted on July 26, 2006; the inspection team consisted of WYA and Chico-Hamilton City District operations staff. The typical process followed in assessment for the Chico-Hamilton City District facilities was as follows:

- Asset Inventory
- Record Examination
- Staff Interviews
- Visual Survey

A summary of each process is provided in the following sections.

### Asset Inventory

A general inventory of the major assets owned by the Chico-Hamilton City District was developed based on interviews with Chico-Hamilton City District staff and the following databases:

- CH_Pumps 3 2006.xls
- CH_Wells 3 2006.xls
- CH_Tanks 3 2006.xls
- CH_Most_Recent_Pump_Test 5 2006.xls
- A maintenance projects list for tanks painting
- Chico-Hamilton City SCADA Telemetry.xls
- Station Equipment Profile for Hamilton City stations (PDFs)

Asset inventories include existing wells, well pumps and motors, booster pumps and motors, storage tanks, hydropneumatic tanks, SCADA systems, and structures that house any of the above equipment.

A summary of the number of asset inventory for Chico-Hamilton City District facilities is provided in Table 2 of Appendix N.

**Record Examination**

WYA reviewed the "2006 Maintenance Tour" report for the Chico-Hamilton City District, conducted by the Engineering-Maintenance Department from February 28 to March 1, 2006. WYA also reviewed the 2006 Annual Inspection Report for the Chico system and the 2005 Annual Inspection Report for the Hamilton City system prepared by California Department of Health Services (District No. 21). No study addressing the seismic concerns for the elevated tanks was available.

**Staff Interview**

Interviews of the operation, maintenance, and SCADA systems staff were critical to the conditions assessment. These interviews verified inventories, communicated operations and maintenance issues, and delineated specific facilities with deficiencies. WYA interviewed Chico-Hamilton City District staff at the District office in Chico, and Cal Water staff at the Cal Water Corporate office in San Jose, California.

**Visual Survey**

A site-specific field visit was led by Chico-Hamilton City District operations staff on July 26, 2006. Stations visited were 001, 004, 013, 016, 021, 024, 026, 031, 033, 040, 042, 044, 046, 053, 056, 058, 059, 061, 064, 066, 068, and 071. These stations were selected to include inactive stations, stations with known deficiencies, stations currently inactive but planned for rehabilitation, and well maintained stations. Conditions Assessment Forms for the stations visited are included in Appendix P. Photos taken onsite during the visit are provided in Appendix Q. The conditions assessment was performed by grouping the facilities by their condition, including "E" for excellent condition, "A" for average condition, and "P" for poor condition. A facility with an "E" rating is in good working order with no deficiencies. A facility with an "A" rating is in good working order with signs of wear and tear but free of no major deficiencies. A facility with a "P" rating is in need of R&R as the functionality of the facility is compromised by one or more significant deficiencies.

Information pertaining to stations not visited was obtained from interviews, historical photos, and other records provided by the Chico-Hamilton City District.

## STATION ASSESSMENT

The Chico-Hamilton City District has 60 active stations located throughout the Chico-Hamilton City distribution system. A majority of these stations include a well which serves as a source of water supply for the Chico-Hamilton City District. Commonly found in a station are wells, booster pumps, hydropneumatic tanks and storage tanks.

Overall, the Chico-Hamilton City District's water system facilities are well maintained and operated by highly qualified professional staff. Brief descriptions of each station visited followed by general conditions and capacities noted in the field are provided below. Photos of the facilities discussed are provided in Appendix Q. A summary of the recommendations is presented in Table 3 of Appendix N.

**Station 001**

This station is located [redacted] and is currently active. It consists of an electrical panel with a corrugated metal pane mounted on the top as a roof, it also has a well, SCADA system, a plastic shed intended for storing chlorine equipment and supplies, and two elevated storage tanks. This station has no auxiliary power.

The well was installed in 1909. The total depth of the well is 499 feet with a 10-inch diameter well casing extending to a depth of 499 feet. The static depth to water is approximately 75 feet. The well is equipped with a Byron Jackson pump. This pump was installed in 1952 with a design flow of 500 gpm at 214 feet of head. Installed in 1952, the pump motor is rated at 35 hp, manufactured by U.S. Electric Motors. The most recent pump test was performed in 2000, at which time the operating efficiency of 44 percent was obtained. The California Public Utilities Commission's rating on this pump is "Low." The Chico-Hamilton City District operated this well 4 percent of the time from 2000 to 2001.

Tank 1 was installed in 1905 and has a capacity of 70,000 gallons. Tank 2 was installed in 1913 and has a capacity of 130,000 gallons. The elevated tanks are made of welded steel, each with a cone roof and are supported by four truss columns on concrete footings. The bottom of Tanks 1 and 2 are above grade 86 feet and 78 feet, respectively. These tanks are rarely cycled due to the normal system pressure which is maintained above the hydraulic grade line of these two tanks. The tanks are painted and the Chico-Hamilton City District maintains the cathodic protection. Matured trees surround the facility, but do not appear hazardous to the safety of the facilities.

The well, which was off at the time of our visit, is only used occasionally according to the Chico-Hamilton City District. The overall condition of the exterior paint appeared aged and minor rusty spots were noticeable at the bottom of the electrical panel. The Chico-Hamilton City District plans to paint the exterior of Tank 2 in the summer of 2006.

The plastic storage shed did not contain any disinfectant supplies or disinfection equipment. The well and electrical panel are secured with chain link fence and a pad lock. The Chico-Hamilton City District plans to fence in the tanks in order to improve security.

This station is equipped with a chart recorder and an RTU, and the discharge pressure and flow are recorded. The RTU (SCADAPack) was installed within the last 12 months.

Based on the 2006 Maintenance Tour, the upper bearing of the motor is noisy when operating.

*Recommendation*: In the next 5 years, repaint Tank 2 and erect fencing along the perimeter of the tank site as planned. Investigate the noise from the upper bearing of the motor and complete the interior painting currently in progress at Tank 2. Replace cathodic protection anodes in 2007, and evaluate the integrity of the well casing. Also, evaluate the benefit of the two elevated tanks with a new booster pump installed downstream.

**Station 004**

This station is located [redacted] and is inactive due to low yield (approximately 200 gpm) and heavy sand.

This station consists of an electrical panel, a well with a submersible pump and motor, and a plastic storage shed. A corrugated metal pane mounted on the top of the electrical panel serves as the roof. Calcium hypochlorite equipment is stored in the plastic storage shed, but it was inoperable due to lack of plumbing. This station has no auxiliary power.

The well was installed in 1960. The total depth of the well is 766 feet with a 16-inch diameter well casing extending to a depth of 764 feet. The well is equipped with a Byron Jackson pump, Model 122CKMH. This pump was installed in 1960 with a design flow of 1,000 gpm at 217 feet of head. Installed in 1976, the pump motor is rated at 75 hp, manufactured by Byron Jackson (Model Type H).

Overall paint condition was faded, and the electrical panel is secured with a pad lock. The Chico-Hamilton City District has no immediate plans to reactivate this station.

This station is equipped with a chart recorder and an RTU, and the discharge pressure and flow are recorded. The RTU (SCADAPack) was installed within the last 12 months.

*Recommendation*: Provide the scheduled minimum maintenance.

**Station 013**

This station is located at the Corner of West 12th Street and Chestnut Street and is currently inactive due to water quality issues, primarily taste and odor.

The station consists of a building that contains a well, a pump, and board-mounted electrical controls. The building is constructed of sheet metal siding on a concrete slab, which shows minor cracks. A sand trap is located next to the building. This station has no auxiliary power.

The well was installed in 1948. The total depth of the well is 500 feet with a 16-inch diameter well casing extending to a depth of 500 feet. This station is equipped with a chart recorder only, and the discharge pressure and flow are recorded.

*Recommendation*: Provide the scheduled minimum maintenance.

**Station 016**

This station is located [redacted] and is currently active. This station consists of a building, in which the well and electrical control panel is placed, a two-stage air stripper for PCE, and a wet well and booster pump. The building, which is constructed with sheet metal siding, is approximately sized, however, is crowded by chlorine supplies and metering equipment. Two 50-gallon sodium hypochlorite bins were stored with no secondary containment or other safety measures, including an eye wash station. The building is in need of new interior and exterior paint. This station has no auxiliary power.

The well was installed in 1949. The total depth of the well is 550 feet with 16- and 10-inch diameter well casings. The static depth to water is approximately 96.2 feet. The well is equipped with a Peerless pump, Model 10 HXB. This pump was installed in 1982 with a design flow of 900 gpm at 110 feet of head. A new pump motor was installed in 2002. The most recent pump test was performed in 2002, results from this test indicated an operating efficiency of 77 percent. The California Public Utilities Commission's rating on this pump is “Excellent.” The Chico-Hamilton City District operated this well 78 percent of the time from 2000 to 2001.

This station was pumping at the time of our visit. The air stripper, which is located outside of the building, draws the air from the inside of the pump building, providing ventilation for the building. The booster pump, which was repaired in March 2006, is placed on top of a wet well below ground. Tall trees nearby the air stripper unit are very close to the facility and could be hazardous during windy conditions. Chlorine equipment and a storage bin should be moved out of the building and stored in a separate shed equipped with secondary containment.

This station is equipped with a chart recorder and an RTU, and the discharge pressure and flow are recorded. The RTU (SCADAPack) was installed within the last 12 months.

*Recommendation*: In the next 5 years, trim branches of tall trees nearby, move the disinfection supply and equipment out of the pump building and store them in a separate shed equipped with secondary containment. Also, examine the conditions of the well and booster pump motor as they have lasted beyond the typical design life.

**Station 021**

This station is located between 1559 and 1575 Citrus Avenue and is currently active. This station consists of a small wooden building with an asphalt shingle roof, a well, a fiberglass shed, and a GAC treatment system. This station has no auxiliary power.

The well was installed in 1953. The total depth of the well is 630 feet with 16- and 10-inch diameter well casings extending to a depth of 630 feet. The static depth to water is approximately 70.1 feet. The well is equipped with a Layne & Bowler pump. This pump was installed in 1953 with a design flow of 850 gpm. The pump motor is rated at 60 hp, manufactured by General Electric (Model 5KS364DT6005D2) and was also installed in 1953. The most recent pump test was performed in 2001, results from this test indicated an operating efficiency of 72 percent. The

California Public Utilities Commission's rating on this pump is “Excellent.” The Chico-Hamilton City District operated this well 94 percent of the time from 2000 to 2001.

This station was pumping at the time of visit. Minor cracks were noted on the concrete slab. The floor was partially wet from the condensation around the piping due to cold groundwater. An 8 foot by 8 foot fiberglass shed holds sodium hypochlorite supply in two 50-gallon bins and a metering pump by Alldos (Model 208). The two bins are placed in secondary containment. The GAC tower, which was moved from Station 015, is bolted to the concrete pad. Exterior paint on the GAC tower is in poor condition. The media was replaced one week prior to the field visit. The differential pressure was approximately 4 psi through the GAC tower. (With spent media, the head loss could be as much as 20 psi.)

This station is equipped with a chart recorder and an RTU, and the discharge pressure and flow are recorded. The RTU (SCADAPack) was installed within the last 12 months.

*Recommendation*: In the next 5 years, paint the exterior of the building and the GAC tower, and examine the conditions of the well and well pump as they have lasted beyond the typical design life.

**Station 024**

This station is located [redacted] and is currently active. This station consists of a small wooden building with an asphalt shingle roof, a well, and a fiberglass shed. This station has no auxiliary power.

The well was installed in 1955. The total depth of the well is 601 feet with 16- and 10-inch diameter well casings extending to a depth of 601 feet. The static depth to water is approximately 105.9 feet. The well is equipped with a Byron Jackson pump. This pump was installed in 1955 with a design flow of 750 gpm at 255 feet of head. The pump motor is rated at 60 hp, manufactured by General Electric (Model 5KS364DT6005) and was also installed in 1955. The most recent pump test was performed in 2004, the results from this indicated an operating efficiency of 67 percent. The California Public Utilities Commission's rating on this pump is “Excellent.” The Chico-Hamilton City District operated this well 37 percent of the time from 2000 to 2001.

This station was pumping at the rate of 550 gpm during the July 2006 site visit. Interior and exterior paint conditions were adequate. The well is equipped with a board-mounted chlorine analyzer. The electrical panel is placed directly on the concrete floor. The pump packing is mechanically sealed.

An 8 foot by 8 foot fiberglass shed holds sodium hypochlorite supply in two 50-gallon bins and a metering pump by Alldos (Model 508). The two bins are placed in secondary containment. This station is equipped with a chart recorder and an RTU (ModiCon), and the discharge pressure and flow are recorded.

The annual inspection report by DHS indicates this station was at one time equipped with a sand trap. It also indicates that the well was rehabilitated approximately 2 years ago and has had problems with bacteria. The Chico-Hamilton City District installed a continuous chlorine analyzer and monitors the chlorine residual level year-round.

*Recommendation*: In the next 5 years, evaluate the conditions of the well and well pump motor as they have lasted beyond the typical design life.

**Station 026**

This station is located [redacted] and is currently active. A small wooden building (approximately 12 foot by 12 foot) with an asphalt shingle roof contains the well and the electrical panel. This station has no auxiliary power, but is equipped with secondary containment for an above ground fuel storage tank.

The well was installed in 1959. The total depth of the well is 775 feet with a 16-inch diameter well casing extending to a depth of 778 feet. The static depth to water is approximately 129 feet. The well is equipped with a Layne & Bowler pump, Model 12RXL. This pump is an oil lube type pump, installed in 1990 with a design flow of 850 gpm at 270 feet of head. The pump motor is rated at 75 hp, manufactured by General Electric (Model 5KS6268XH1A), and was also installed in 1984. The most recent pump test was performed in 2001, and the results from this test indicated an operating efficiency of 65 percent. The California Public Utilities Commission's rating on this pump is “Good.” The Chico-Hamilton City District operated this well continuously in 2000 and 2001.

The paint condition for the interior is adequate, but is in poor condition for the exterior. An 8 foot by 8 foot fiberglass shed behind the chain link fence holds the sodium hypochlorite supply in two 50-gallon bins and a metering pump (Alldos Model 208). The electrical panel is placed directly on the concrete floor. The floor is stained and not clean. The station drawing shows a 500-gallon diesel tank, but no auxiliary power supply was noted at the time of the visit.

This station is equipped with a chart recorder and an RTU, and the discharge pressure and flow are recorded. The RTU (SCADAPack) was installed within the last 12 months.

*Recommendation*: In the next 5 years, paint the exterior of the pump building.

**Station 031**

This station is located between 1158 and 1164 E. Avenue and is currently active. This station consists of a small wooden building with an asphalt shingle roof, a well, and a fiberglass shed. The well was producing 700 gpm at the time of our visit (7/26/06 2:40 PM) with 70 psi discharge pressure. This station has no auxiliary power.

The well was installed in 1960. The total depth of the well is 678 feet with a 16-inch diameter well casing extending to a depth of 678 feet. The static depth to water is approximately 100 feet. The well is equipped with a Layne & Bowler pump (Model 12RL). This pump was installed in

1996 with a design flow of 950 gpm at 240 feet of head. The pump motor is rated at 75 hp, manufactured by U.S. Electric Motors was also installed in 1996. The most recent pump test was performed in 2004, and the results from this test indicated an operating efficiency of 63 percent. The California Public Utilities Commission's rating on this pump is “Good.” The Chico-Hamilton City District operated this well 41 percent of the time from 2000 to 2001.

The motor is oil lubed and very loud, however the oil level was good. This station is operated continuously during the summer. Poor exterior paint condition was noted. Minor cracks on concrete slab were noted. One of the exterior louvers was bent, but functional. An 8 foot by 8 foot fiberglass shed behind the new chain link fence holds the sodium hypochlorite supply in two 50-gallon bins and a metering pump (Alldos Model 208). The electrical panel was placed directly on the concrete floor.

This station is equipped with a chart recorder only and the discharge pressure and flow are recorded.

According to the annual inspection report by DHS, water looks greenish at start up for unknown reason, so the initial discharge is wasted into a storm drain. Based on the maintenance tour, the paint is in poor condition.

*Recommendation*: Paint the exterior of the building, and verify the existence of the auxiliary power supply.

**Station 033**

This station is located [redacted] and is inactive due to water quality issues. However, this station is expected to be reactivated upon the completion of recent rehabilitation work.

This station consists of a small wooden building (approximately 12 foot by 12 foot) with an asphalt shingle roof as a pump building, a well, an electrical panel with a board-mounted chlorine analyzer, and a fiberglass shed. This station has a gasoline engine direct drive as auxiliary power.

The well was installed in 1961. The total depth of the well is 740 feet with a 16-inch diameter well casing extending to a depth of 740 feet. The static depth to water is approximately 140.3 feet. The well is newly equipped with a Byron Jackson pump (Model 10MCL). This pump was installed in 2006 with a design flow of 690 gpm at 392 feet of head. Installed in 2006, the pump motor is rated at 75 hp, manufactured by Johnson Clear & MFG (Model 33118-HD75EL). The Chico-Hamilton City District operated this well 55 percent of the time from 2000 to 2001.

The exterior of the building is in need of new paint. Minor cracks on the concrete slab were also noted. An 8 foot by 8 foot fiberglass shed behind the chain link fence holds the sodium hypochlorite supply in two 50-gallon bins and a metering pump (Alldos Model 208). The electrical panel is placed directly on the concrete floor. A small horizontally placed sand trap is located outside the pump building. This station is equipped with a chart recorder and an RTU (ModiCon), and the discharge pressure and flow are recorded.

DHS has commented in the annual inspection report that the sand trap blow-off pipe should be provided with an adequate air gap and a screen. The 2006 maintenance tour report indicated that the muffler on roof is rusted. It also reported a lack of well flushing ability, however, a newly installed drainage line, which would allow flushing of the well, was noted at the time of the visit.

*Recommendation*: In the next 5 years, paint the building, and evaluate the conditions of the well and well pump as they have lasted beyond the typical design life.

**Station 040**

This station is located [redacted] and is inactive due to VOC (cis-1,2 Dichloroethylene). The Chico-Hamilton City District is planning to install GAC treatment onsite to reactivate this station.

The station has no pump building, but consists of an 8 foot by 8 foot corrugated PVC pane erected over the top of the electrical panel which currently serves as a roof for the electrical panel. The electrical panel is rusted at the bottom. This station has no auxiliary power.

The well was installed in 1968. The total depth of the well is 500 feet with a 16-inch diameter well casing extending to a depth of 500 feet. The well is equipped with a Layne & Bowler pump (Model 10RL). This pump was installed in 1968 with a design flow of 825 gpm at 225 feet of head. The pump motor is rated at 60 hp, manufactured by General Electric (Model 5K6257XH5A) was also installed in 1968.

The asphalt concrete pavement around concrete footing is in very poor condition. The plastic storage shed onsite no longer stores the disinfection equipment. A padlock secures the gate to the chain link fence. The pump is housed in a separate metal shed nearby.

This station is equipped with a chart recorder only and the discharge pressure and flow are recorded.

*Recommendation*: Provide the minimum scheduled maintenance.

**Station 042**

This station is located behind 55 Rose Ave and is currently active. The pump building is constructed with concrete masonry unit (CMU) walls with a flat sliding roof. The building has an adequate work space, but is crowded by disinfection equipment and supplies. The station is active but was under repair at the time of the July 2006 site visit due to a bad motor. This station has a gasoline engine generator as auxiliary power.

The well was installed in 1970. The total depth of the well is 520 feet with a 16-inch diameter well casing extending to a depth of 520 feet. The static depth to water is approximately 54.2 feet. The well is equipped with a Layne & Bowler pump (Model 12 RM). This pump was installed in 1970 with a design flow of 850 gpm at 218 feet of head. The pump motor is rated at 35 hp, manufactured by General Electric (Model 5K445XC4A), and was also installed in 1970. The

most recent pump test was performed in 2001, and results from this test indicated an operating efficiency of 53 percent. The California Public Utilities Commission's rating on this pump is "Low." Cal Water operated this well 7 percent of the time from 2000 to 2001.

The electrical panel is placed directly on the concrete slab. This station is operated mainly during summer months. Water from flushing the system prior to summer use is discharged into a man-made pond around the site. The pond was dry at the time of our visit.

This station is equipped with a chart recorder and an RTU, and the discharge pressure and flow are recorded. The RTU (SCADAPack) was installed within the last 12 months. In the annual inspection report by DHS, it was indicated that the end of basin discharge pipe is cracked and broken rendering the screen ineffective. DHS recommended that the pipe be cut back and re-screened.

*Recommendation*: Repair or replace the pump motor.

**Station 044**

This station is located [redacted] and is currently active. The pump building consists of an old corrugated galvanized metal structure with corrugated galvanized metal roof. The building in general appears aged. The interior is partitioned into two rooms; a pump room and a disinfection room. The pump room contains the well, electrical panel, SCADA, and the auxiliary power supply. The disinfection room contains two 15-gallon sodium hypochlorite bins and metering equipment. This station has a diesel engine generator as auxiliary power.

The well was installed in 1942. The total depth of the well is 428 feet with 10-, 12-, and 14-inch diameter well casings extending to a depth of 428 feet. The static depth to water is approximately 98.2 feet. The well is equipped with a Goulds pump. This pump was installed in May 2005 with a design flow of 700 gpm at 296 feet of head. Installed in 2000, the pump motor is rated at 75 hp, manufactured by U.S. Electric Motors. The lubrication for the pump is provided by water and the pump packing is mechanically sealed. The Chico-Hamilton City District plans to install a variable frequency drive in order to prevent frequent start and stop of the pump triggered by the pressure drop in the hydropneumatic tank and to extend the service life of the pump.

The disinfection room is also used to archive pressure and flow charts. A small air compressor is located next to the electrical panel for pressurizing the hydropneumatic tank. The hydropneumatic tank is placed on three concrete footings. The station is also equipped with a 500-gallon gasoline storage tank inside a newly installed chain link fence. The electrical panel is on a 3-inch concrete pad, but not secured to the wall.

No mechanical deficiencies were noted by the 2006 maintenance tour report, but it recommends painting the exterior of the building trims and the 20,000-gallon hydropneumatic tank. This station is equipped with a chart recorder and an RTU (ModiCon) and the discharge pressure and flow are recorded.

*Recommendation*: In the next 5 years, secure the electrical panel, paint the exterior of the building trims and the hydropneumatic tank. Also, evaluate the conditions of the well and well pump as they have lasted beyond the typical design life. Install the variable frequency drive as planned, and adjust the pressure set point at the hydropneumatic tank.

**Station 046**

This station is located [redacted] and is currently active. The pump building is a CMU with a corrugated fiberglass roof. Minor cracks on the concrete slab were noticed. The GAC treatment for PCE removal is onsite. It is normally operated continuously, but was off at the time of July 2006 site visit as the Chico-Hamilton City District waits for the lab results on the performance of the newly changed GAC media, which occurred the day before the field visit. This station has no auxiliary power.

The well was installed in 1972. The total depth of the well is 470 feet with a 16-inch diameter well casing extending to a depth of 470 feet. The static depth to water is approximately 66 feet. The well is equipped with a Layne & Bowler – Peerless pump (Model 12RL). This pump was installed in 1994 with a design flow of 500 gpm at 295 feet of head. Installed in 1972, the pump motor is rated at 75 hp, manufactured by U.S. Electric Motors (Model D38058). The most recent pump test was performed in 2001, and results from the test indicated an operating efficiency of 75 percent. The California Public Utilities Commission's rating on this pump is “Excellent.” The Chico-Hamilton City District operated this well 48 percent of the time from 2000 to 2001.

An 8 foot by 8 foot fiberglass shed stores sodium hypochlorite in two 50-gallon bins and a meter pump. The electrical panel is placed directly on a concrete slab; it is rusty at the bottom. This station is equipped with a chart recorder and an RTU, and the discharge pressure and flow are recorded. The RTU (SCADAPack) was installed within the last 12 months.

*Recommendation*: In the next 5 years, remove the rust and repaint the electrical panel and evaluate the conditions of the well pump motor as it exceeded the typical design life.

**Station 053**

This station is located across from 2090 Notre Dame and is currently active. The pump building is a CMU with a corrugated fiberglass roof. Minor cracks on the concrete slab were noticed. The pump was operating at the time of our visit. This station has a diesel engine direct drive as auxiliary power.

The well was installed in 1977. The total depth of the well is 500 feet with a 16-inch diameter well casing extending to a depth of 500 feet. The static depth to water is approximately 134 feet. The well is equipped with an Aurora pump (Model 12RC). This pump was installed in 1977 with a design flow of 1,100 gpm. Installed in 1984, the pump motor is rated at 100 hp, manufactured by General Electric (Model 5KS6268XH4A). The most recent pump test was performed in 2001, results from this test indicated an operating efficiency of 70 percent. The California Public Utilities Commission's rating on this pump is “Good.” The Chico-Hamilton City District operated this well 97 percent of the time from 2000 to 2001.

An 8 foot by 8 foot fiberglass shed stores sodium hypochlorite in three 50-gallon bins and a meter pump. The electrical panel is placed on a 2-inch concrete pad. One of the panes at the electrical panel is bent and has become rusted.

This station is equipped with a chart recorder and an RTU (ModiCon) and the discharge pressure and flow are recorded.

*Recommendation*: In the next 5 years, repair the bent pane at the electrical panel and evaluate the conditions of the well pump as it has exceeded the typical design life.

**Station 056**

This station is located [redacted] and is currently active. The pump building is a CMU with a corrugated fiberglass roof. Minor cracks on the concrete slab were noticed. The station is active and is operated during the peak hours of the morning. This station has a diesel engine direct drive as auxiliary power.

The well was installed in 1978. The total depth of the well is 504 feet with a 16-inch diameter well casing extending to a depth of 504 feet. The static depth to water is approximately 57.8 feet. The well is equipped with an Aurora – Layne & Bowler pump (Model 12RXL). This pump was installed in 1978 with a design flow of 900 gpm at 275 feet of head. The pump motor is rated at 75 hp, manufactured by Newman and was also installed in 1978. The most recent pump test was performed in 2002, results from this test indicated an operating efficiency of 66 percent. The California Public Utilities Commission's rating on this pump is “Good.” Cal Water operated this well 30 percent of the time from 2000 to 2001.

The engine exhaust pipe penetrates one of the walls. However, the seal is loose and there are signs of the exhaust fume reentering the building. An 8 foot by 8 foot fiberglass shed stores sodium hypochlorite in two 50-gallon bins and a metering pump, it is missing an “Eye Wash” sign. The electrical panel is placed on a 3-inch concrete pad. Heavy rust is noted at the bottom half of the electrical panel.

This station is equipped with a chart recorder and an RTU, and the discharge pressure and flow are recorded. The RTU (SCADAPack) was installed within the last 12 months. DHS indicated in the annual inspection report that a hole was noted in the pump base. Based on the maintenance tour, the building trim on the corner is deformed and the fuel tank convault needs resealing or repainting.

*Recommendation*: In the next 5 years, the loose engine exhaust seal should be corrected. Furnish the missing “Eye Wash” sign, remove the rust and repaint the electrical panel, repair/replace building trim and repaint the fuel tank convault. Also, evaluate the conditions of the well pump and well pump motor as they have exceeded the typical design life.

**Station 058**

This station is located [redacted]nd is inactive due to water quality issues.

The pump building is a CMU with an asphalt shingle roof. The northeastern part of the roof shows signs of rot. Minor cracks on the concrete slab were noticed. This station has no auxiliary power.

The well was installed in 1981. The total depth of the well is 560 feet with a 16-inch diameter well casing extending to a depth of 560 feet. The well is equipped with an Aurora – Layne & Bowler pump (Model 12RL). This pump was installed in 1981 with a design flow of 1,000 gpm at 246 feet of head. The pump motor is rated at 75 hp, manufactured by General Electric (Model 5K6255XM533A) and was also installed in 1981.

This station is equipped with a chart recorder to record discharge pressure and flow. Based on the 2006 maintenance tour report, the lack of a tie-in to the drainage pipeline prevents well rehabilitation.

*Recommendation*: Consider installing the tie-in with the drainage pipeline, rehabilitating the well and reactivating the station.

**Station 059**

This station is located [redacted] and is currently active. The pump building is a CMU with an asphalt shingle roof. This station has a diesel engine generator as auxiliary power.

The well was installed in 1981. The total depth of the well is 520 feet with a 16-inch diameter well casing extending to a depth of 520 feet. The static depth to water is approximately 50 feet. The well is equipped with a Layne & Bowler pump (Model 11MQH). This pump is an oil lube type, installed in 2000 with a design flow of 1,100 gpm. The pump motor is rated at 75 hp, manufactured by General Electric Motors (Model 5K6255XM673A) and was also installed in 2000. The most recent pump test was performed in 2001, and results from this test indicated an operating efficiency of 64 percent. The California Public Utilities Commission's rating on this pump is “Good.” The Chico-Hamilton City District operated this well 24 percent of the time from 2000 to 2001.

The station is active and pump was operating at 827 gpm at the time of visit. Minor cracks were noted on the concrete slab. Two 50-gallon bins containing sodium hypochlorite are stored near the well and the emergency generator unit. The electrical panel is placed on a 3-inch concrete pad.

This station is equipped with a chart recorder only and the discharge pressure and flow are recorded.

*Recommendation*: In the next 5 years, move the hypochlorite bins outside in a separate shed.

**Station 061**

This station is located [redacted], behind Chico mall and is currently active. The station consists of a well, pump building, and a wooden shed containing chlorine generating equipment. The pump building is a CMU with an asphalt shingle roof. This station has no auxiliary power.

The well was installed in 1989. The total depth of the well is 560 feet with a 16-inch diameter well casing extending to a depth of 560 feet. The static depth to water is approximately 109.7 feet. The well is equipped with a Layne & Bowler Verti-Line pump (Model 12RM). This pump was installed in 1989 with a design flow of 1,100 gpm at 245 feet of head. The pump motor is rated at 100 hp, manufactured by General Electric (Model 5KS404DP6005) and was also installed in 1989. The most recent pump test was performed in 2001, and results from this test indicated an operating efficiency of 72 percent. The California Public Utilities Commission's rating on this pump is “Excellent.” The Chico-Hamilton City District operated this well 87 percent of the time from 2000 to 2001.

The building provides adequate work space. However, it is temporarily crowded by storing bleach bottles and bags of salt as the chlorine generator is under repair.

This station is active and was pumping at 730 gpm at the time of the site visit. The electrical panel is placed on a 3-inch concrete pad. A long vertical crack that runs from the ceiling to floor was noted near the building entry door.

This station is equipped with a chart recorder and an RTU, to record discharge pressure and flow. The RTU (SCADAPack) was installed within the last 12 months.

DHS noted in the annual inspection report that the chlorine is generated at 6 pounds per day using Clor-Tec and stored in a 150-gallon day tank at 0.8 percent solution.

*Recommendation*: In the next 5 years, inspect structure for increased deterioration or defects. Repair the disinfectant generator (in process).

**Station 064**

This station is located [redacted] and is currently active. The pump building is a CMU with an asphalt shingle roof. The diesel engine generator at Station 044 also supplies the auxiliary power for this station.

The well was installed in 1988. The total depth of the well is 5,609 feet with a 16-inch diameter well casing extending to a depth of 560 feet. The static depth to water is approximately 128 feet. The well is equipped with a Byron Jackson pump (Model 11MQH). This pump was installed in 1988 with a design flow of 850 gpm at 270 feet of head. The pump motor is rated at 75 hp, manufactured by General Electric (Model 5KS365DP6005A) and was also installed in 1988. The most recent pump test was performed in 2002, and results from this test indicated an operating efficiency of 63 percent. The California Public Utilities Commission's rating on this pump is

"Good." The Chico-Hamilton City District operated this well 9 percent of the time from 2000 to 2001.

Minor cracks on concrete slab and walls were noted. The building provides adequate working space, but is crowded by two 15-gallon disinfectant supply bins and metering equipment.

This station was off at the time of the July 2006 site visit. The electrical panel was placed on a 3-inch concrete pad, but is rusty at the bottom. A 5,000-gallon hydropneumatic tank is located next to the building, along with a compressor.

No mechanical deficiencies were noted in the maintenance tour, but it recommends painting the building trims and the hydropneumatic tank. This station is equipped with a chart recorder and an RTU (ModiCon) and the discharge pressure and flow are recorded.

*Recommendation*: In the next 5 years, move the hypochlorite supply bins to a separate shed with a secondary containment. Paint the building trims and the hydropneumatic tank.

**Station 066**

This station is located [redacted] and is currently active. This station has two CMU buildings each with an asphalt shingle roof. The well is equipped with two welded steel storage tanks and two hydropneumatic tanks. This station has two auxiliary powers. Cathodic protection is maintained by the Chico-Hamilton City District.

Booster Pumps A and B were installed in 1990. The booster pumps are made by Layne & Bowler (Model 10RL), and are capable of pumping 500 gpm at 180 feet of head, each, powered by 30 hp US electric motors. Installed in 2001, Booster Pumps C and D are made by Goulds (Model 9RCLC-DWT) with a design flow of 400 gpm at 332 feet of head. The pump motors are made by VHS Premium Eff., rated at 60 hp each.

Booster Pumps A and B pump to Zone 635 by pressurizing the 10,000-gallon hydropneumatic tank. Booster Pumps C and D pump to Zone 795 by pressurizing the other 10,000-gallon hydropneumatic tank.

Tank 1 was constructed in 1974, has the capacity of 570,000 gallons and sits on a concrete ring foundation. Tank 1 is filled by booster pumps at Station 073 and drawn by gravity to supply Zone 475. Booster Pumps A and B also draw water from Tank 1. Paint is brittle and easily chipped. Flexible joint (not EBAA) is placed in the inlet/outlet pipe. The building that houses Booster Pumps A and B also holds the communication equipment: signal repeater, an emergency generator, and an antenna (outside). The electrical panel is placed on a 3-inch concrete pad. Booster Pump A was operating at 300 gpm. Booster Pump B was off at the time of the July 2006 site visit.

Tank 2 was constructed in 2003, has the capacity of 520,000 gallons and sits on a concrete ring foundation. Tank 2 is filled by booster pumps at Station 073 and drawn by Booster Pumps C and D. The exterior was coated by urethane to 10 mils. The interior is lined with epoxy to 15

mils. Flexible joint (EBAA) is placed in the inlet/outlet pipe. The electrical panel is placed directly on the concrete slab. The emergency generator for Booster Pumps C and D is located just outside of the building. This generator also serves the entire station except for Booster Pumps A and B.

This station is equipped with a chart recorder and an RTU (ModiCon) and the discharge pressure and flow are recorded.

*Recommendation*: In the next 5 years, repaint Tank 2 exterior as scheduled. We would also recommend repainting Tank 1 due to how easily the paint can chip.

**Station 068**

This station is located [redacted] and is currently active. The pump building is a CMU with an asphalt shingle roof, and provides a good working space inside. This station has no auxiliary power.

The well was installed in 1998. The total depth of the well is 610 feet with a 16-inch diameter well casing extending to a depth of 570 feet. The static depth to water is approximately 49 feet. The well is equipped with a Goulds pump (Model 12DHLC). This pump was installed in 1998 with a design flow of 1,200 gpm at 210 feet of head. The pump lubrication is provided by water. The pump motor is rated at 100 hp, manufactured by U.S. Electric Motors (Model R485A-804-4286M) and was also installed in 1998. The most recent pump test was performed in 2004 and results from this test indicated an operating efficiency of 68 percent. The California Public Utilities Commission's rating on this pump is “Good.” The Chico-Hamilton City District operated this well 14 percent of the time from 2000 to 2001.

The station was operating at 1,100 gpm at the time of our visit. Condensation wets the pump head and piping and drips onto the concrete slab floor. The building is partitioned to separate the disinfectant and metering equipment from the well. Two 50-gallon sodium hypochlorite bins and a metering pump provide the disinfectant dose. The disinfection room is not equipped with a ramp to the secondary containment. The electrical panel is placed on a 3-inch concrete pad. This station is equipped with a chart recorder and an RTU, and the discharge pressure and flow are recorded. The RTU (SCADAPack) was installed within the last 12 months.

In the annual inspection report, DHS commented that this station has a nitrate problem. However, according to the DHS record from 1994, nitrate concentration was below the trigger level of 23 mg/L as $NO_3$.

*Recommendation*: In the next 5 years, provide a ramp to the secondary containment.

**Station 071**

This station is located [redacted] and is currently active. This station has no auxiliary power.

The well was installed in 2001. The total depth of the well is 570 feet with a 16-inch diameter well casing extending to a depth of 570 feet. The static depth to water is approximately 119 feet. The well is equipped with a Goulds pump (Model 12DHLC). This pump was installed in 2001 with a design flow of 1,500 gpm at 277 feet of head. Installed at the same time, the pump motor is rated at 150 hp, manufactured by U.S. Electric Motors. The most recent pump test was performed in 2002, and results from this test indicated an operating efficiency of 68 percent. The California Public Utilities Commission's rating on this pump is “Good.”

The station was operating at 1,385 gpm at the time of the July 2006 site visit. The pump lubrication is provided by water. The pump building is a CMU with an asphalt shingle roof. There appears to be good working space in the pump building. The building is partitioned to store chlorine and metering equipment in one of the two rooms. Two 50-gallon sodium hypochlorite bins and a metering pump were stored in one room. The paint on the pump motor appeared in poor condition, but staff explained that the appearance is due to salt build up from chronic leaks. The new electrical panel is placed on a 3-inch concrete pad.

This station is equipped with a chart recorder and an RTU (ModiCon) and the discharge pressure and flow are recorded. The RTU is embedded in the electrical panel.

*Recommendation*: In the next 5 years, service the pump to minimize the leaks and repaint the well head if damaged.

## RENEWAL AND REPLACEMENT SCHEDULE

Chico-Hamilton City District staff indicated that the following improvements would be helpful in the operation of the Chico-Hamilton City District system in the next five years.

R&R Projects

- Reactivate the inactive Station 033 (in process)
- Install GAC system for Stations 040 for reactivation of the station
- Rehabilitate Station 058 to remove odor, taste and color
- Complete interior painting for Tank 2 of Station 001 in the Chico system (in progress)
- Replace cathodic protection anodes for Tank 2 of Station 001 in the Chico system (by 2007)
- Paint the exterior of Tank 1 at Station 066 and the interior of Tank 3 at Station 008 in the Chico system (by 2007)
- Paint the interior of Tank 4 at Station 003 in the Chico system (by 2008)

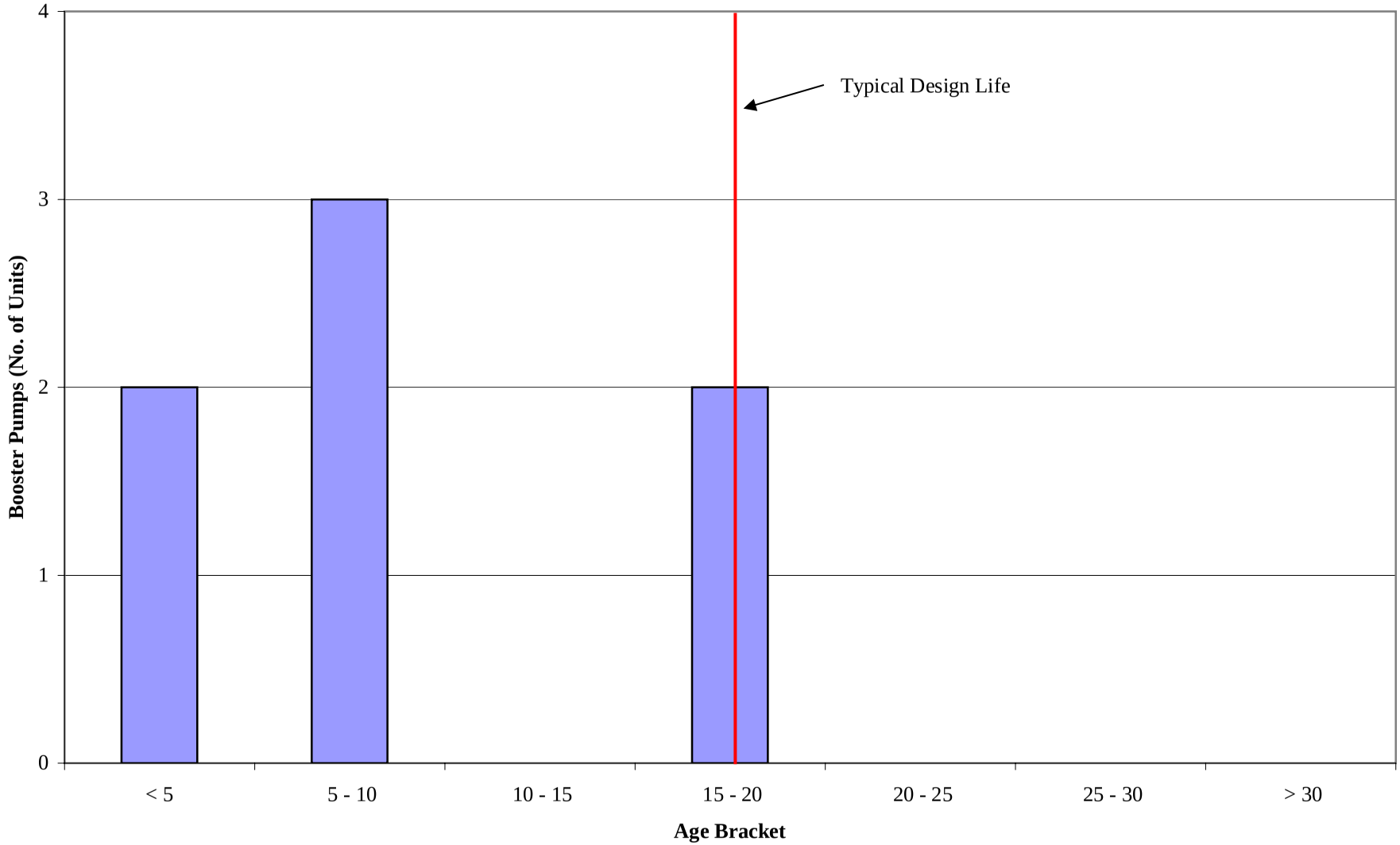
- On an on-going basis, replace all oil lube type pumps to water lube type pumps with a mechanical seal
- On an on-going basis, continue to relocate disinfectant supplies and dosing equipment out of the pump facilities into a fiberglass shed or separate room in the pump buildings.

A "desktop level" R&R schedule was developed based on incorporating the Chico-Hamilton City District staff's concerns, correcting the deficiencies in the Chico-Hamilton City District's facilities as identified during the field visit, and the theoretical R&R timing estimated by the age and typical design life for given facilities.

A summary of the preliminary R&R schedule is provided in Table 1 of Appendix N in five-year increments. A preliminary R&R cost estimate in five-year increments is shown in Figure 7-7. The cost estimates for the first five years reflect the construction cost for the R&R projects and does not include land acquisition, engineering, legal, administrative costs, and construction contingencies.

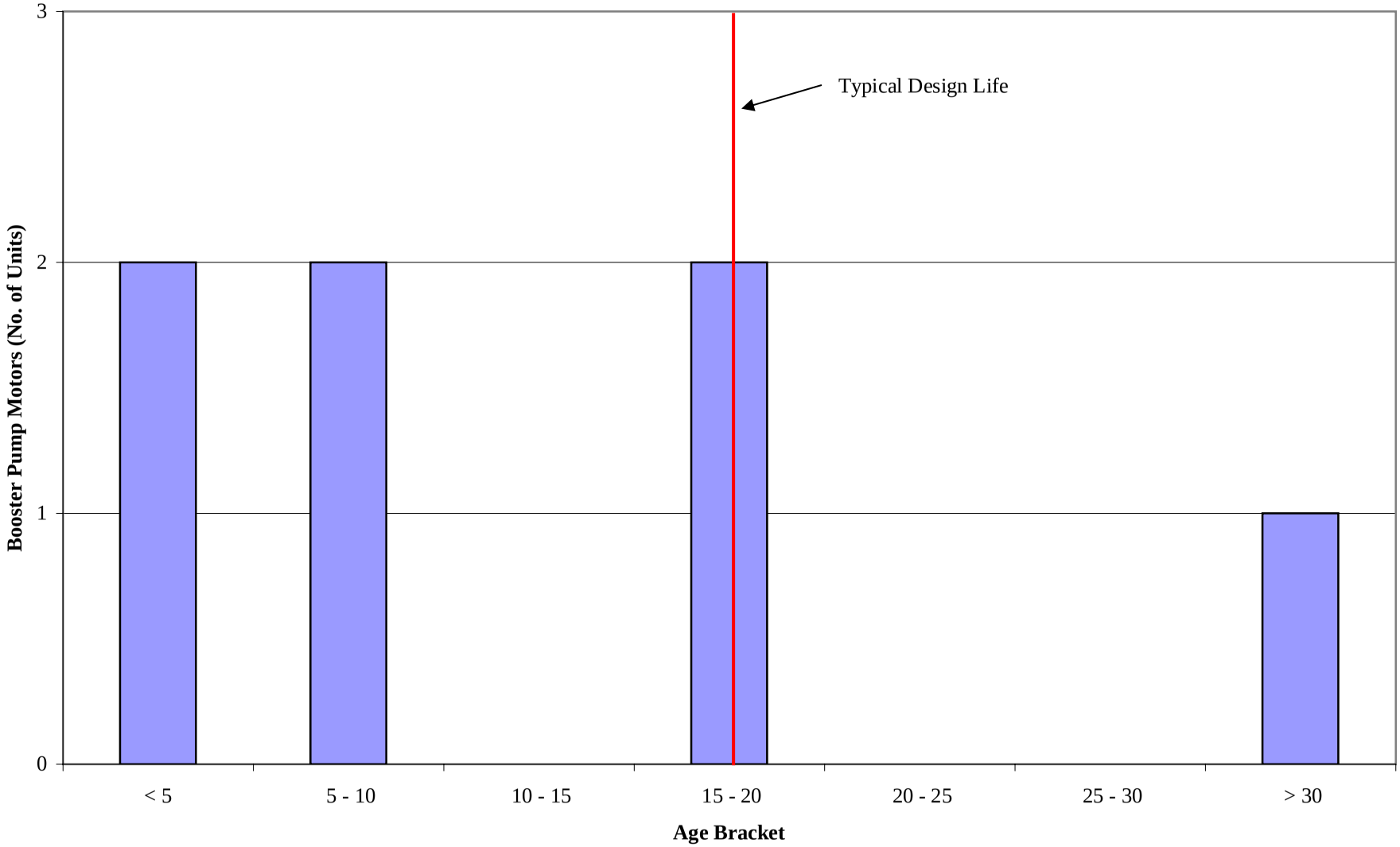
Because the cost for renewing an old well varies, to be conservative for planning purposes, it is assumed that a well with an age in excess of the typical design life of 45 years is to be replaced. In actuality, the replacement schedule would be determined on a case-by-case basis after considering many factors including, but not limited to, the structural integrity of the casing, water quality and yield, budget limitations and staffing availability. It is recommended that the Chico-Hamilton City District develop and implement a well management plan, similar to that recommended for the Salinas District, to accurately assess the well condition and determine the maintenance required.

**Figure 7-1. Age Distribution for Chico-Hamilton City District Booster Pumps**




Public Version

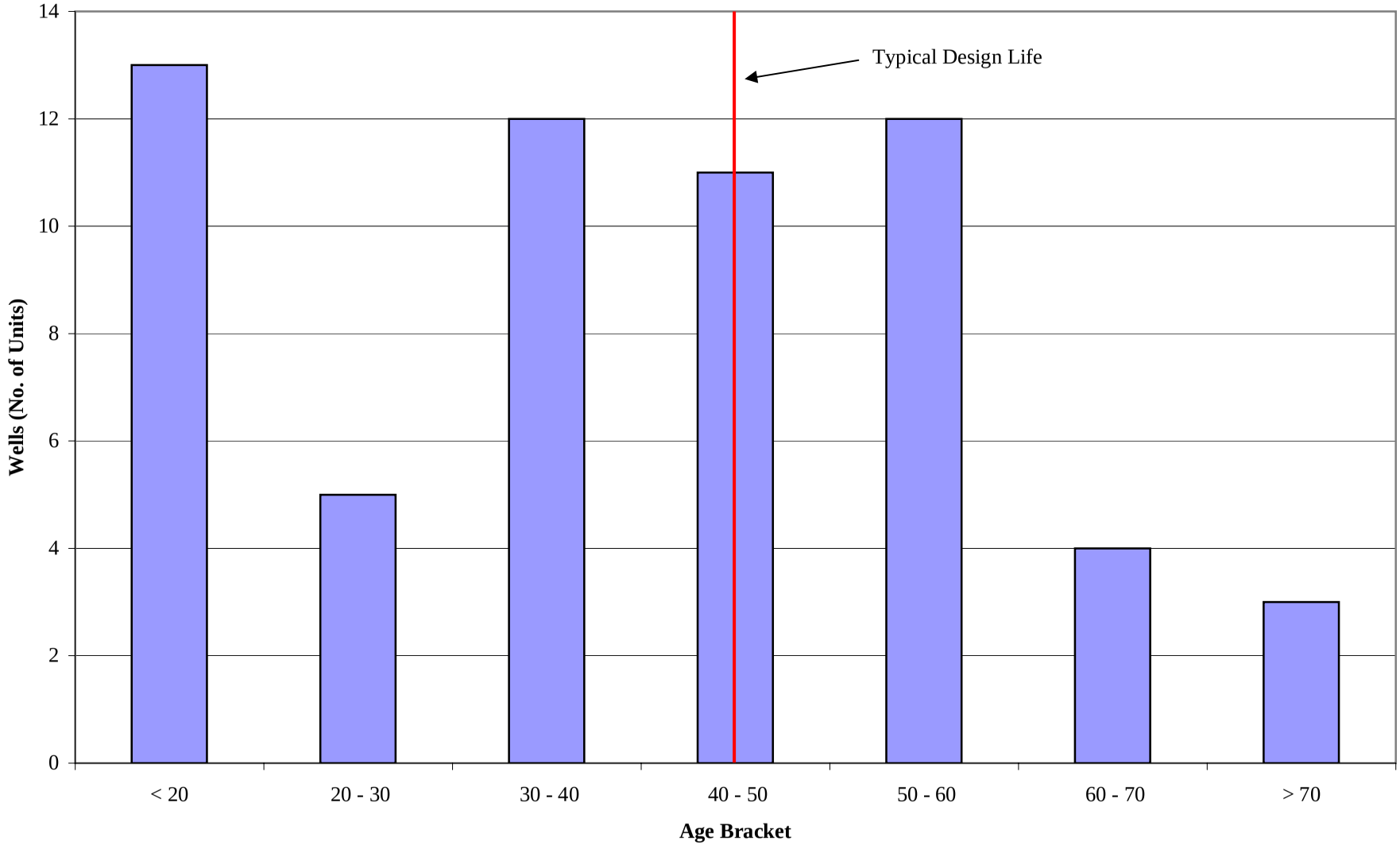
**Figure 7-2. Age Distribution for Chico-Hamilton City District Booster Pump Motors**






Public Version

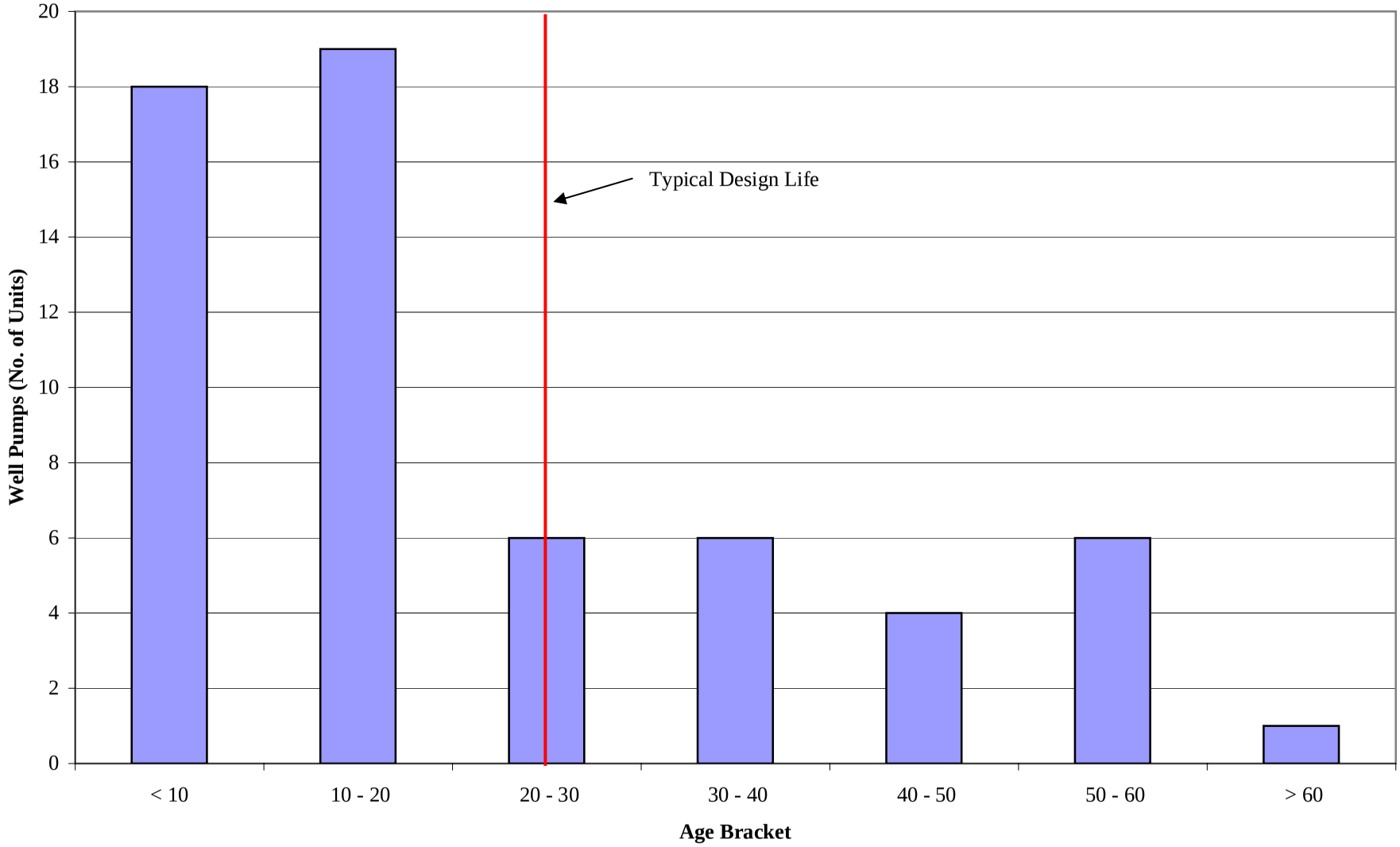
**Figure 7-3. Age Distribution for Chico-Hamilton City District Wells**






Public Version

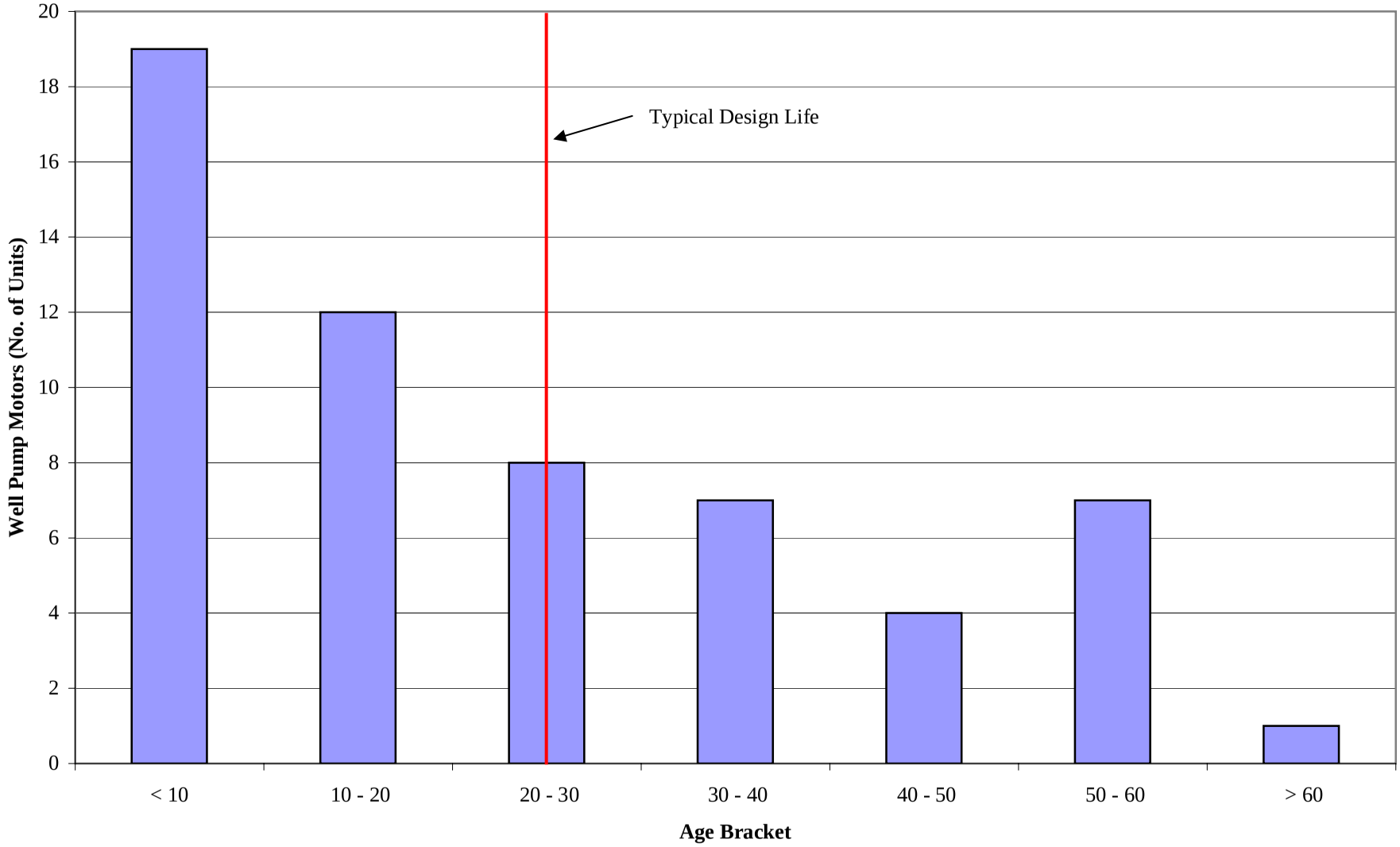
**Figure 7-4. Age Distribution for Chico-Hamilton City District Well Pumps**






Public Version

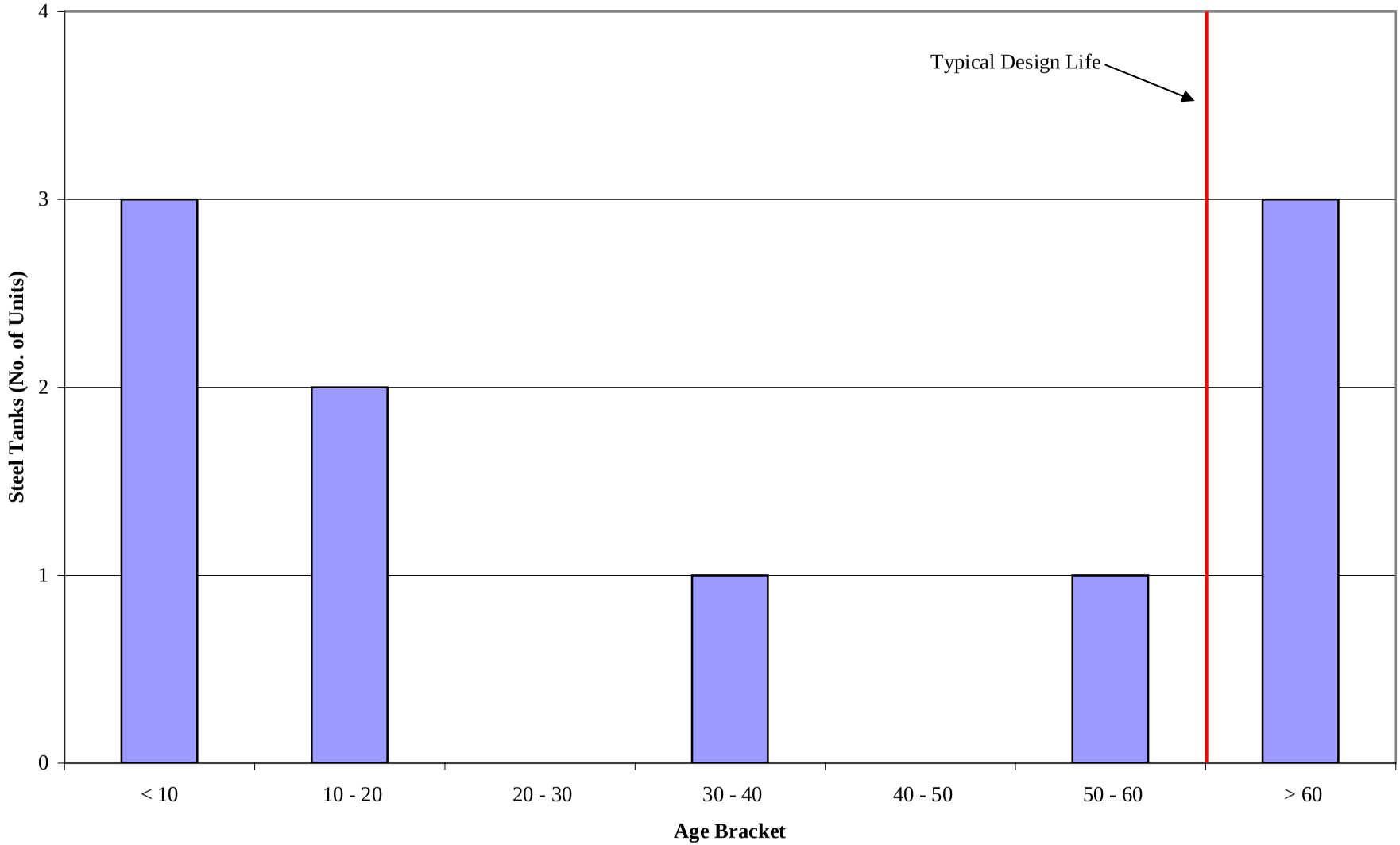
**Figure 7-5. Age Distribution for Chico-Hamilton City District Well Pump Motors**






Public Version

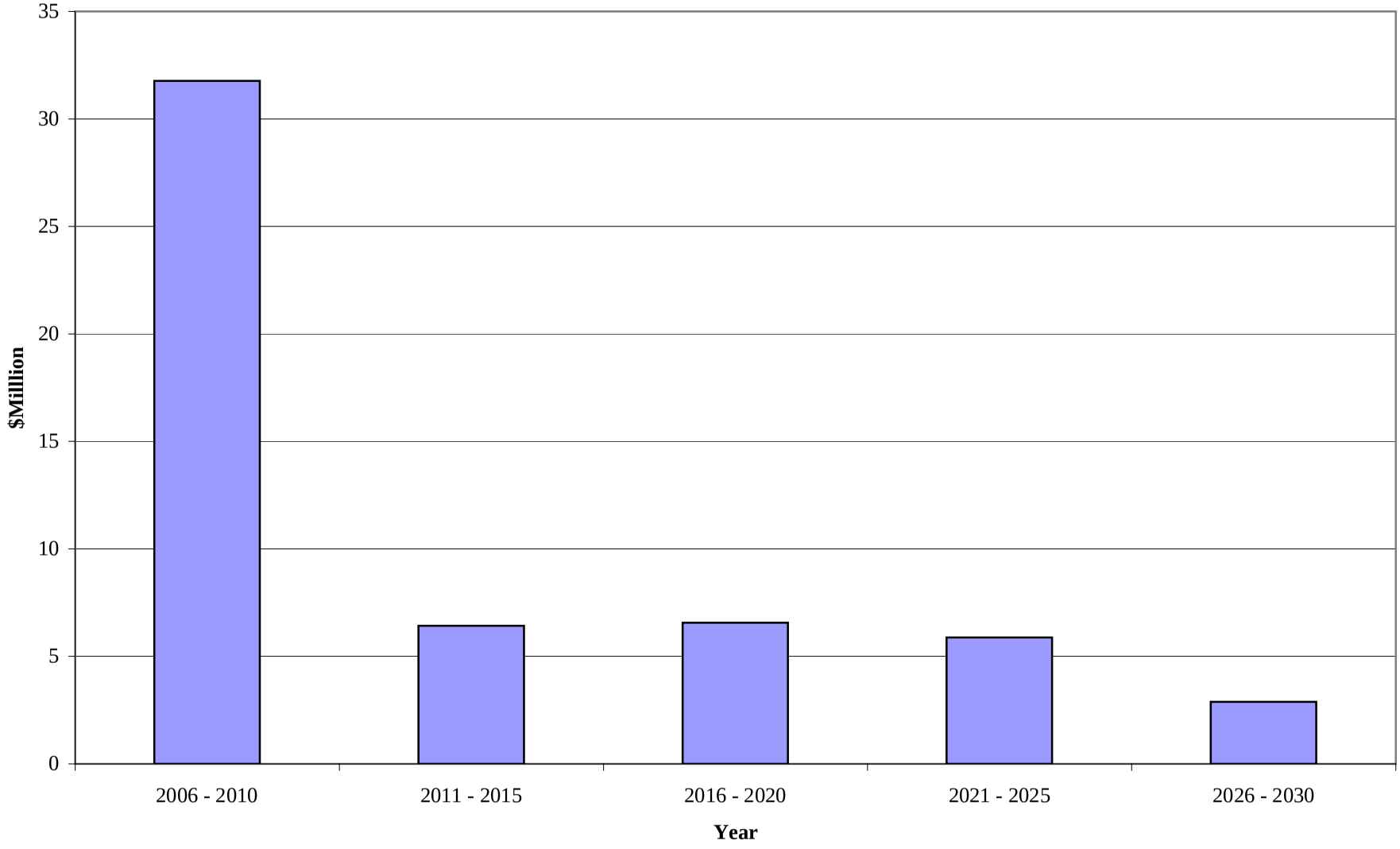
**Figure 7-6. Age Distribution for Chico-Hamilton City District Steel Tanks**






Public Version

**Figure 7-7. Preliminary Renewal and Replacement Cost for Chico-Hamilton City District**




Public Version

# Chapter 8: Evaluation of Existing Water System

*Chapter Contents:*


- Existing Water Demands
- Existing System Evaluation Methodology
  - ❖Water Storage Capacity Evaluation
  - ❖Pumping Capacity Evaluation
  - ❖Water Distribution System Analysis
- Evaluation Results
- Summary of Recommended Improvements for Existing Potable Water System


*Chapter Highlights:*

This chapter presents an overview evaluation of the Chico-Hamilton City District's existing water system and its ability to meet the Chico-Hamilton City District's recommended performance and planning criteria under existing demand conditions. The evaluation includes an analysis of water storage capacity, pumping capacity, and the existing distribution system's ability to meet recommended operational and design criteria under maximum day demand plus fire flow and peak hour demand conditions. The evaluation was conducted by WYA using the updated hydraulic model described in Chapter 6. The evaluations, findings, and recommendations for addressing the identified existing water system deficiencies are organized by pressure zone. A description of the recommended CIP to implement the recommended improvements, including an estimate of probable construction costs, is provided in Chapter 10.

*Summary of Existing Potable Water System Recommendations:*

*Pipelines*

- Pressure Zone 350
  - Install 645 feet of new 8-inch diameter pipeline along Eastwood Avenue
  - Upsize ~167 feet of existing 2-inch diameter pipeline along Pine Street to 8-inch diameter pipeline
- Hamilton City
  - Upsize ~196 feet of existing 6-inch diameter pipeline along 6th Street to 12-inch diameter pipeline
  - Upsize ~762 feet of existing 6-inch diameter pipeline along 6th Street to 8-inch diameter pipeline
  - Upsize ~514 feet of existing 6-inch diameter pipeline along 1st Street to 8-inch diameter pipeline
  - Install 2,320 feet of new 12-inch diameter pipeline along Broadway Avenue
  - Install 630 feet of new 12-inch diameter pipeline along 2nd Street
  - Upsize ~250 feet of existing 6-inch diameter pipeline along 2nd Street to 8-inch diameter pipeline
  - Install 1,048 feet of new 8-inch diameter pipeline along 5th Street
  - Install 198 feet of new 8-inch diameter pipeline along 2nd Street
  - Install 208 feet of new 8-inch diameter pipeline along 4th Street

*Pump Stations*

- A new 7.49 mgd pump station to convey water from a new 2.7 MG storage tank in Pressure Zone 350.
- New 3.24 mgd, 6.34 mgd, and 4.54 mgd pump stations to convey water from each of the three new 1.0 MG storage tanks in Pressure Zone 350.
- A new 6.84 mgd pump station at Station 44 in Pressure Zone 400.
- An additional 2.44 mgd of pumping capacity at Station 66 in Pressure Zone 795.
- A new 6.93 mgd pump station to convey water from a new 1.0 MG storage tank in Hamilton City.

*Storage Facilities*

- A new 2.7 MG storage tank located at Silver Dollar Way near the Chico-Hamilton District office.
- A new 1.0 MG storage tank located at Mcintosh Avenue, west of Dayton Road.
- A new 1.0 MG storage tank located between Bruce Road and Potter Road.
- A new 1.0 MG storage tank located southwest of Highway 99 and Entler Avenue (west of Norfield Avenue).
- A new 1.0 MG storage tank at Station 44 in Pressure Zone 400.
- A new 1.0 MG storage tank located north of Broadway and 6th Street (future commercial land use parcel) in Hamilton City.

*Standby Generators*

- Install standby generators at Stations 54, 71, and 75.

# CHAPTER 8. EVALUATION OF EXISTING WATER SYSTEM

This chapter presents an overview evaluation of the Chico-Hamilton City District's existing water system (see Figure 8-1) and its ability to meet the Chico-Hamilton City District's recommended performance and planning criteria under existing demand conditions. The evaluation includes an analysis of water storage capacity, pumping capacity, and the existing distribution system's ability to meet recommended operational and design criteria under maximum day demand plus fire flow and peak hour demand conditions. The evaluation was conducted by WYA using the updated hydraulic model described in Chapter 6. The evaluations, findings, and recommendations for addressing the identified existing water system deficiencies are organized by pressure zone. A description of the recommended CIP to implement the recommended improvements, including an estimate of probable construction costs, is provided in Chapter 10.

## EXISTING WATER DEMANDS

The existing water demands for the Chico-Hamilton City District's water system were estimated based on land use (see Figure 8-2) and production data provided by Cal Water. Table 8-1 summarizes the existing demands for each of the Chico-Hamilton City District's pressure zones.

**Table 8-1. Existing Potable Demands for the Chico-Hamilton City District[(a)]**

| Pressure Zone | Average Day Demand[(a)], gpm | Maximum Day Demand[(b)], gpm | Peak Hour Demand[(c)], gpm |
|---|---|---|---|
| Chico | | | |
| 350 | 16,368 | 32,735 | 49,103 |
| 400 | 122 | 244 | 366 |
| 475 | 1,505 | 3,011 | 4,516 |
| 635 | 135 | 269 | 404 |
| 795 | 13 | 26 | 39 |
| Chico Total | 18,143 | 36,285 | 54,428 |
| Hamilton City | | | |
| Hamilton | 380 | 760 | 1,140 |
| Hamilton Total | 380 | 760 | 1,140 |
| District Total | 18,523 | 37,045 | 55,568 |

(a) Chico and Hamilton City average day demands are based on 2006 production data.
(b) Maximum day demand is 2.0 times the average day demand.
(c) Peak hour demand is 3.0 times the average day demand.

## EXISTING SYSTEM EVALUATION METHODOLOGY

### Water Storage Capacity Evaluation

There are four elevated storage tanks and three ground-level reservoirs in the Chico-Hamilton City District's water system. Together, the storage must be sufficient to meet the Chico-Hamilton City District water system's operational, fire flow, and emergency storage criteria. The volumes required for each of these three storage components are detailed below:

- Operational Storage: 25 percent of maximum day demand (equivalent to fifty percent of average day demand);
- Emergency Storage: 50 percent of maximum day demand (equivalent to one average day demand); and
- Fire Flow Storage: The required fire flow times the fire flow duration period, as required by the Chico-Hamilton City Fire Department. The highest Chico-Hamilton City District fire flow of 4,000 gpm for a duration of 4 hours was assumed for this analysis.

Because of the District's available wells, the groundwater basin can account for a credit against the required water storage. The emergency storage credit reflects only that groundwater supply which can be reliably accessed when needed (i.e., only wells equipped with auxiliary power). The operational storage credit assumes that 50 percent of the firm groundwater supply (assumes 10 percent of the groundwater production capacity (for Pressure Zone 350 which has numerous wells) or the largest well (in other pressure zones) is out of service for maintenance or water quality issues) in excess of what is required to meet maximum day demand, is available for operational use.

The existing storage facilities were evaluated to determine whether they have sufficient capacity to provide the required operational, fire flow, and emergency storage. The Chico-Hamilton City District currently has 2.4 MG of water storage as indicated in Table 8-2.

### Pumping Capacity Evaluation

The Chico-Hamilton City District's pumping capacity has been evaluated to assess its ability to deliver a firm, reliable capacity to the existing service area. At each of the BPSs, the firm booster pumping capacity is defined as the total pump station installed capacity with the largest pump out of service. To ensure pumping capacity reliability, each BPS should have at least two pumps, a lead pump and a standby pump, to use in the event of a mechanical failure. All Chico-Hamilton City District's booster pump stations meet this criterion (see Table 8-3). The firm groundwater pumping capacity is defined as 90 percent of total groundwater pumping capacity (assumes 10 percent of total groundwater pumping capacity is not available due to maintenance requirements or other issues, e.g., water quality) for Pressure Zone 350 which has numerous wells. For the other pressure zones which have fewer wells, the firm groundwater pumping capacity is defined as the groundwater pumping capacity assuming the largest well is not available due to maintenance requirements or other issues, e.g., water quality.

## Table 8-2. Summary of Existing Storage Requirements

| Pressure Zone | Chico-Hamilton City District Station | Existing Reservoir Capacity, MG | Required Storage Capacity: Operational, MG[a] | Required Storage Capacity: Fire Flow, MG[b] | Required Storage Capacity: Emergency, MG[c] | Total Required Storage, MG | Additional Required Storage, MG |
|---|---|---|---|---|---|---|---|
| Zone 350 | 001-T1 | 0.10 | | | | | |
| | 001-T2 | 0.15 | | | | | |
| | 003-T4 | 0.30 | | | | | |
| | 008-T1 | 0.30 | | | | | |
| | Subtotal Pressure Zone 350 | 0.85 | 11.78 | 0.96 | 23.57 | | |
| | Groundwater Storage Credits [d] | | (7.06) | 0.00 | (17.09) | | |
| | Required Storage | | 4.72 | 0.96 | 6.48 | 12.16 | 11.31 |
| Zone 400 | None | - | | | | | |
| | Subtotal Pressure Zone 400 | 0.00 | 0.09 | 0.96 | 0.18 | | |
| | Groundwater Storage Credits [d] | | (0.33) | 0.00 | (2.23) | | |
| | Required Storage | | 0.00 | 0.96 | 0.00 | 0.96 | 0.96 |
| Zone 475 | 066-T1 | 0.50 | | | | | |
| | 066-T2 | 0.50 | | | | | |
| | Subtotal Pressure Zone 475 | 1.00 | 1.08 | 0.96 | 2.17 | | |
| | Groundwater Storage Credits [d] | | (1.97) | 0.00 | (5.40) | | |
| | Required Storage | | 0.00 | 0.96 | 0.00 | 0.96 | 0.00 |
| Zone 635 | 074-T1 | 0.50 | | | | | |
| | Subtotal Pressure Zone 635 | 0.50 | 0.10 | 0.18 | 0.19 | | |
| | Groundwater Storage Credits [d] | | 0.00 | 0.00 | 0.00 | | |
| | Required Storage | | 0.10 | 0.18 | 0.19 | 0.47 | 0.00 |
| Zone 795 | None | - | | | | | |
| | Subtotal Pressure Zone 795 | 0.00 | 0.01 | 0.18 | 0.02 | | |
| | Groundwater Storage Credits [d] | | 0.00 | 0.00 | 0.00 | | |
| | Required Storage | | 0.01 | 0.18 | 0.02 | 0.21 | 0.21 |
| Hamilton City | T1-01 | 0.02 | | | | | |
| | Subtotal Hamilton City | 0.02 | 0.27 | 0.96 | 0.55 | | |
| | Groundwater Storage Credits [d] | | (0.33) | 0.00 | (2.88) | | |
| | Required Storage | | 0.00 | 0.96 | 0.00 | 0.96 | 0.94 |

[a] Based on 25 percent of a maximum day demand.

[b] Fire flows based on 2 hr duration x 1,500 gpm or 4 hr duration x 4,000 gpm for residential and school/industrial land uses, respectively.

[c] Based on 50 percent of a maximum day demand (equivalent to one average day demand).

[d] Emergency storage credit is equal to 100% of the total pumping capacity for active wells with backup power. Operational storage credit is equal to 50% of the difference between the firm groundwater pumping capacity and the maximum day demand.



Public Version

**Table 8-3. Summary of the Chico-Hamilton City District's Existing Pumping Facilities[a]**

| Service Area | Station | Pump HP | Pump A, gpm | Pump B, gpm | Pump C, gpm | Pump D, gpm | Total Capacity, gpm | Firm Capacity, gpm[b] |
|---|---|---|---|---|---|---|---|---|
| Chico | | | | | | | | |
| Zone 350 | 001-4 | 35 | 500 | | | | 500 | [c] |
| | 003-3 | 40 | 400 | | | | 400 | [c] |
| | 005-02 | 75 | 610 | | | | 610 | [c] |
| | 007-04 | 75 | 880 | | | | 880 | [c] |
| | 008-01 | 60 | 900 | | | | 900 | [c] |
| | 011-01 | 50 | 600 | | | | 600 | [c] |
| | 012-01 | 50 | 600 | | | | 600 | [c] |
| | 014-01 | 30 | 550 | | | | 550 | [c] |
| | 016-01 | 30 | 900 | | | | 900 | [c] |
| | 017-01 | 60 | 900 | | | | 900 | [c] |
| | 018-01 | 60 | 900 | | | | 900 | [c] |
| | 019-01 | 60 | 700 | | | | 700 | [c] |
| | 020-01 | 60 | 900 | | | | 900 | [c] |
| | 021-01 | 0 | 850 | | | | 850 | [c] |
| | 022-01 | 60 | 800 | | | | 800 | [c] |
| | 023-01 | 75 | 1,350 | | | | 1,350 | [c] |
| | 024-01 | 60 | 750 | | | | 750 | [c] |
| | 025-01 | 75 | 1,000 | | | | 1,000 | [c] |
| | 026-01 | 75 | 850 | | | | 850 | [c] |
| | 027-01 | 75 | 1,000 | | | | 1,000 | [c] |
| | 028-01 | 75 | 800 | | | | 800 | [c] |
| | 029-01 | 75 | 1,000 | | | | 1,000 | [c] |
| | 030-01 | 75 | 1,000 | | | | 1,000 | [c] |
| | 031-01 | 75 | 950 | | | | 950 | [c] |
| | 032-01 | 75 | 950 | | | | 950 | [c] |
| | 034-01 | 75 | 1,200 | | | | 1,200 | [c] |
| | 035-01 | 75 | 1,000 | | | | 1,000 | [c] |
| | 037-01 | 75 | 900 | | | | 900 | [c] |
| | 038-01 | 75 | 850 | | | | 850 | [c] |
| | 039-01 | 75 | 1,000 | | | | 1,000 | [c] |
| | 041-01 | 100 | 1,100 | | | | 1,100 | [c] |
| | 042-01 | 75 | 850 | | | | 850 | [c] |
| | 046-01 | 75 | 500 | | | | 500 | [c] |
| | 047-01 | 0 | 751 | | | | 751 | [c] |
| | 048-01 | 75 | 900 | | | | 900 | [c] |
| | 049-01 | 75 | 900 | | | | 900 | [c] |
| | 051-01 | 75 | 1,100 | | | | 1,100 | [c] |
| | 052-01 | 75 | 1,100 | | | | 1,100 | [c] |
| | 053-01 | 100 | 1,100 | | | | 1,100 | [c] |
| | 054-01 | 100 | 1,770 | | | | 1,770 | [c] |
| | 056-01 | 75 | 900 | | | | 900 | [c] |
| | 057-01 | 100 | 1,000 | | | | 1,000 | [c] |
| | 059-01 | 75 | 1,100 | | | | 1,100 | [c] |
| | 061-01 | 100 | 1,100 | | | | 1,100 | [c] |
| | 062-01 | 75 | 1,000 | | | | 1,000 | [c] |
| | 063-01 | 75 | 1,050 | | | | 1,050 | [c] |
| | 068-01 | 100 | 1,200 | | | | 1,200 | [c] |
| | 069-01 | 100 | 1,000 | | | | 1,000 | [c] |
| | 071-01 | 150 | 1,500 | | | | 1,500 | [c] |
| | 075-01 | NA | 1,800 | | | | 1,800 | [c] |
| Zone 400 | 044-01 | 75 | 700 | | | | 700 | [c] |
| | 064-01 | 75 | 850 | | | | 850 | [c] |
| Zone 475 | 033-01 | 75 | 600 | | | | 600 | [c] |
| | 050-01 | 100 | 850 | | | | 850 | [c] |
| | 065-01 | 150 | 1,150 | | | | 1,150 | [c] |
| | 067-01 | 150 | 1,200 | | | | 1,200 | [c] |
| | 070-01 | 125 | 950 | | | | 950 | [c] |
| | 072-01 | 150 | 1,000 | | | | 1,000 | [c] |
| | 076-01 | NA | 1,300 | | | | 1,300 | [c] |
| Zone 635 | 66 | 30/30 | 500 | 500 | | | 1,000 | 500 |
| | 73 | 40/40 | 600 | 600 | | | 1,200 | 600 |
| Zone 795 | 66 | 60/60 | | | 400 | 400 | 800 | 400 |
| **Chico Pumping Capacity, gpm** | | | | | | | **58,911** | **1,500** |
| **Chico Pumping Capacity, mgd** | | | | | | | **84.8** | **2.2** |
| Hamilton City | | | | | | | | |
| HC | 001-01 | 20 | 600 | | | | 600 | [c] |
| | 002-01 | 50 | 850 | | | | 850 | [c] |
| | 002-02 | 40 | 550 | | | | 550 | [c] |
| **Hamilton City Pumping Capacity, gpm** | | | | | | | 2,000 | 0 |
| **Hamilton City Pumping Capacity, mgd** | | | | | | | **2.9** | **0.0** |
| **Chico-Hamilton City District Total Pumping Capacity, gpm** | | | | | | | **60,911** | **1,500** |
| **Chico-Hamilton City District Total Pumping Capacity, mgd** | | | | | | | **87.7** | **2.2** |

[a] Pump flow data provided by Cal Water and detailed in "CH Wells 3 2006.xls" and "CH Pumps 3 2006.xls"

[b] Firm capacity for booster pump stations is defined as pumping capacity with largest the pump out of service.

[c] Firm groundwater capacity is defined as 90% of the total groundwater production capacity for Pressure Zone 350 (which has numerous wells). For the other pressure zones with only a few wells, firm groundwater capacity is defined as pumping capacity with the largest pump out of service.

Public Version

The pumping capacity criterion for the water system requires that there be sufficient total pumping capacity to meet maximum day demand within each pressure zone, or any pressure zone located above that pressure zone which the pump station is serving. Details of the capacity of each pump are provided in Table 8-4. In addition, all critical pumping facilities should be equipped with an on-site, stand-by power generator. Critical pumping facilities are defined as those facilities that provide service to pressure zones and/or service areas without sufficient emergency storage and that meet the following criteria:

- The largest facility that provides water to a particular pressure zone and/or service area;
- A facility that provides the sole source of water to single or multiple pressure zones and/or service areas;
- A facility that provides water from key groundwater supply wells (depends on capacity, quality, and location) into a pressure zone and/or service area.

**Water Distribution System Analysis**

Steady state hydraulic analyses using the updated model were conducted to identify areas of the existing potable water system that do not meet the recommended system performance criteria. The results of the evaluation of the water distribution system are presented below for the following existing demand scenarios:

- Peak Hour Demand—peak hour demands are met by either the combined flows from supply sources and storage reservoirs, or from the pump stations and storage reservoirs. A peak hour flow condition was simulated for the existing distribution facilities to evaluate their capability to meet this peak hour demand condition.
- Maximum Day Demand plus Fire Flow—to evaluate the system under the maximum day demand plus fire flow condition, a two-step analysis was performed. The first step used the $H_2$OMAP "Available Fire Flow Analysis" option to determine if the minimum pressure and required fire flow could be met with the existing water facilities. Fire flow demands were assigned and simulated at selected nodes. These selected nodes were determined based on critical criteria including nodes located at high elevations, high demands, and/or in areas at the extremities of the existing pressure zone. If the analysis indicated that the system failed to meet the minimum requirements for pressure and flow, a second analysis was performed. The second analysis involved running the model with pipeline improvements/system modifications added to the distribution system to eliminate previously identified deficiencies.

**Table 8-4. Summary of Capacity Requirements of Existing Pumping Facilities**

| Service Area | Pump Station | Total Capacity, gpm | Firm Capacity, gpm[a] | Existing Backup Power | Existing Average Day Demand | Existing Maximum Day Demand[b] | Existing Maximum Day Demand plus Fire Flow | Existing Peak Hour Demand[c] | Required Additional Firm Pumping Capacity, gpm |
|---|---|---|---|---|---|---|---|---|---|
| Chico | | | | | | | | | |
| Zone 350 [d] | 001-4 | 500 | 42,544 | | 16,368 | 32,735 | 36,735 | 49,103 | 3,892 |
| | 003-3 | 400 | | | | | | | |
| | 005-02 | 610 | | Natural Gas | | | | | |
| | 007-04 | 880 | | | | | | | |
| | 008-01 | 900 | | | | | | | |
| | 011-01 | 600 | | | | | | | |
| | 012-01 | 600 | | | | | | | |
| | 014-01 | 550 | | | | | | | |
| | 016-01 | 900 | | | | | | | |
| | 017-01 | 900 | | | | | | | |
| | 018-01 | 900 | | | | | | | |
| | 019-01 | 700 | | | | | | | |
| | 020-01 | 900 | | | | | | | |
| | 021-01 | 850 | | | | | | | |
| | 022-01 | 800 | | | | | | | |
| | 023-01 | 1,350 | | Diesel Generator | | | | | |
| | 024-01 | 750 | | | | | | | |
| | 025-01 | 1,000 | | Diesel Generator | | | | | |
| | 026-01 | 850 | | | | | | | |
| | 027-01 | 1,000 | | | | | | | |
| | 028-01 | 800 | | | | | | | |
| | 029-01 | 1,000 | | | | | | | |
| | 030-01 | 1,000 | | | | | | | |
| | 031-01 | 950 | | | | | | | |
| | 032-01 | 950 | | Diesel Generator | | | | | |
| | 034-01 | 1,200 | | Gas Engine, DD | | | | | |
| | 035-01 | 1,000 | | | | | | | |
| | 037-01 | 900 | | | | | | | |
| | 038-01 | 850 | | | | | | | |
| | 039-01 | 1,000 | | Natural Gas, DD | | | | | |
| | 041-01 | 1,100 | | | | | | | |
| | 042-01 | 850 | | Gas Generator | | | | | |
| | 046-01 | 500 | | | | | | | |
| | 047-01 | 711 | | Natural Gas, DD | | | | | |
| | 048-01 | 900 | | | | | | | |
| | 049-01 | 900 | | | | | | | |
| | 051-01 | 1,100 | | | | | | | |
| | 052-01 | 1,100 | | Diesel Engine, DD | | | | | |
| | 053-01 | 1,100 | | Diesel Engine, DD | | | | | |
| | 054-01 | 1,770 | | | | | | | |
| | 056-01 | 900 | | Diesel Engine, DD | | | | | |
| | 057-01 | 1,000 | | | | | | | |
| | 059-01 | 1,100 | | Diesel Engine, DD | | | | | |
| | 061-01 | 1,100 | | | | | | | |
| | 062-01 | 1,000 | | | | | | | |
| | 063-01 | 1,050 | | | | | | | |
| | 068-01 | 1,200 | | | | | | | |
| | 069-01 | 1,000 | | | | | | | |
| | 071-01 | 1,500 | | | | | | | |
| | 075-01 | 1,800 | | | | | | | |
| | Subtotal | 47,271 | 42,544 | | | | | | |
| Zone 400 | 044-01 | 700 | 700 | Diesel Generator | 122 | 244 | 4,244 | 366 | 3,544 |
| | 064-01 | 850 | | Diesel Generator | | | | | |
| | Subtotal | 1,550 | 700 | | | | | | |
| Zone 475 [e] | 033-01 | 600 | 5,750 | Gas Engine, DD | 1,505 | 3,306 | 7,306 | 4,962 | 106 |
| | 050-01 | 850 | | | | | | | |
| | 065-01 | 1,150 | | | | | | | |
| | 067-01 | 1,200 | | Diesel Generator | | | | | |
| | 070-01 | 950 | | Diesel Generator | | | | | |
| | 072-01 | 1,000 | | Diesel Generator | | | | | |
| | 076-01 | 1,300 | | | | | | | |
| | Subtotal | 7,050 | 5,750 | | | | | | |
| Zone 635 [f] | 66 | 1,000 | 500 | | 135 | 269 | 1,769 | 404 | 0 |
| | 73 | 1,200 | 600 | | | | | | |
| | Subtotal | 2,200 | 1,100 | | | | | | |
| Zone 795 | 66 | 800 | 400 | | 13 | 26 | 1,526 | 39 | 1,126 |
| | Subtotal | 800 | 400 | | | | | | |
| **Chico Pumping Capacity, gpm** | | **58,871** | **50,494** | | **18,143** | **36,580** | **51,580** | **54,873.4** | **8,668** |
| **Chico Pumping Capacity, mgd** | | **84.77** | **72.71** | | **26.13** | **52.68** | **74.28** | **79.0** | **12.48** |
| Hamilton City | | | | | | | | | |
| HC | 001-01 | 600 | 1,150 | Diesel Generator | 380 | 760 | 4,760 | 1,140 | 3,610 |
| | 002-01 | 850 | | Diesel Generator | | | | | |
| | 002-02 | 550 | | Diesel Generator | | | | | |
| | Subtotal | 2,000 | 1,150 | | | | | | |
| **Hamilton City Pumping Capacity, gpm** | | **2,000** | **1,150** | | **380** | **760** | **4,760** | **1,140** | **3,610** |
| **Hamilton City Pumping Capacity, mgd** | | **2.88** | **1.66** | | **0.55** | **1.09** | **6.85** | **1.64** | **5.20** |
| **Total Pumping Capacity, gpm** | | **60,871** | **51,644** | | **18,523** | **37,340** | **56,340** | **56,013** | **12,278** |
| **Total Pumping Capacity, mgd** | | **87.65** | **74.37** | | **26.67** | **53.77** | **81.13** | **80.66** | **17.68** |

[a] Firm capacity for booster pump stations is defined as pumping capacity with the largest pump out of service and/or single pump with backup generator. Firm groundwater pumping capacity is equal to 90% of the total groundwater pumping capacity for Pressure Zone 350 which has numerous wells (assumes 10 percent of wells lost for reasons other than power loss, e.g. well maintenance or water quality). For the other pressure zones with fewer wells, the firm groundwater pumping capacity is defined as the pumping capacity with the largest pump of of service.

[b] Maximum day demand equals 2.0 times average day demand.

[c] Peak hour demand equals 3.0 times average day demand.

[d] Includes use of 665 gpm from Station 8 tank and 2,002 gpm for Pressure Zone 475.

[e] Includes use of 1,450 gpm from Station 66 tanks. Because Pressure Zone 475 is a main supply to pressure zones above it, maximum day and peak hour demand also includes demands in Pressure Zones 635 and 795.

[f] Includes use of 1,368 gpm from Station 74 tank.

Public Version

As shown in Table 8-1, the total Chico-Hamilton City District existing service area peak hour demand was calculated to be 54,428 gpm (78.4 mgd). This peak hour demand represents a peaking factor of 3.0 times the average day demand. During a peak hour condition, a minimum pressure of 40 psi must be maintained throughout the system. Maximum head loss per thousand feet of distribution main should not exceed 10 ft/kft and maximum velocities should not exceed 7 fps. Details of system pressures in each of the Chico-Hamilton City District's pressure zones as simulated in the model under the peak hour demand condition are discussed below.

Fire flow demands were simulated at various locations within the Chico-Hamilton City District's service area to determine whether or not the minimum residual pressure criterion of 20 psi within the pressure zone could be met during a maximum day demand condition with a concurrent fire flow. Table 8-5 presents fire flow demand requirements based on land use categories, this data is also illustrated on Figure 8-3.

**Table 8-5. Chico-Hamilton City District Fire Flow Demand Requirements[(a)]**

| Land Use | Fire Flow, gpm | Duration, hours |
|---|---|---|
| Residential | 1,500 | 2 |
| Multiple Residencies | 2,500 | 2 |
| Commercial | 3,000 | 3 |
| Industrial | 4,000 | 4 |
| Government | 4,000 | 4 |

(a) Specific fire flows were determined from Table A-III-A-1 of the 2001 CFC, and depend on construction type and fire area. These fire flow requirements are based on buildings being fully sprinkled.

Pipelines are typically designed to deliver peak hour flows and maximum day demands plus fire flows within acceptable pressure, velocity, and head loss ranges as stated in Chapter 5. System improvements needed to comply with operational and design criteria were added to the system and are also described below.

## EVALUATION RESULTS

The following describes the evaluation of water storage capacity, pumping capacity, and water distribution system by individual pressure zone.

### Pressure Zone 350

Water Storage Capacity

Table 8-6 presents a summary of the operational, fire flow, and emergency storage requirements for Pressure Zone 350.

**Table 8-6. Pressure Zone 350 Storage Requirements**

| Storage Component | Criteria | Pressure Zone 350 Storage Required, MG |
|---|---|---|
| Operational | 25% of max day demand | 11.78 |
| Operational Storage Credit | 50% of excess of groundwater supply[(a)] | (7.06) |
| | Operational Storage Required | 4.72 |
| Fire Flow | 4,000 gpm for 4 hours | 0.96 |
| Emergency | 50% of max day demand (100% of average day demand) | 23.57 |
| Emergency Storage Credit | 100% of wells with auxiliary power | (17.09) |
| | Emergency Storage Required | 6.48 |
| | Total Storage Requirement | 12.16 |
| | Existing Storage Available | 0.85 |
| | Current Storage Deficiency | 11.31 |

(a) Excess groundwater supply is equal to the firm groundwater pumping capacity minus the maximum day demand requirement.

As shown in Table 8-6, there is a 11.31 MG storage deficiency in Pressure Zone 350.

To address the storage deficiency, WYA recommends providing 5.7 MG of additional storage capacity in Pressure Zone 350 to provide for the required operational and fire flow storage (4.72 MG + 0.96 MG = 5.68 MG). These recommended new storage facilities (and associated booster pump facilities) are as follows:

- 2.7 MG storage tank with a 7.49 mgd booster pump station to be located at Silver Dollar Way, northwest of the Cal Water Chico-Hamilton City District office
- 1.0 MG storage tank with a 3.24 mgd booster pump station to be located at Mcintosh Avenue, west of Dayton Road
- 1.0 MG storage tank with a 6.34 mgd booster pump station to be located between Bruce Road and Potter Road
- 1.0 MG storage tank with a 4.54 mgd booster pump station to be located southwest of Highway 99 and Entler Avenue (west of Norfield Avenue)

To address the emergency storage deficiency, WYA recommends adding auxiliary power to additional wells within Pressure Zone 350 to increase the emergency storage credit. If auxiliary power is added at Stations 54, 71, and 75 (these are newer wells with high pumping capacities), an additional emergency storage credit of 7.3 MG would be added to Pressure Zone 350, which would satisfy the emergency storage required (6.48 MG).

Pumping Capacity

Table 8-7 provides a summary of the evaluation of the wells serving Pressure Zone 350.

**Table 8-7. Summary of Pressure Zone 350 Pumping Capacity**

| | Pressure Zone 350 |
|---|---|
| Wells Serving Pressure Zone | 1, 3, 5, 7, 8, 11, 12, 14, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 34, 35, 37, 38, 39, 41, 42, 46, 47, 48, 49, 51, 52, 53, 54, 56, 57, 59, 61, 62, 63, 68, 69, 71 and 75 |
| Firm groundwater pumping capacity, gpm[(a)] | 42,544 |
| Average day demand in pressure zone, gpm | 16,368 |
| Maximum day demand plus fire flow in pressure zone, gpm[(b)] | 36,735 |
| Peak hour demand in pressure zone, gpm[(c)] | 49,103 |
| Reliability: At least two pumps (1 duty pump and 1 standby pump) to use in the event of mechanical failure | No[(a)] |
| Backup power provided | 11,871[(d)] |
| Adequate capacity during maximum day plus fire flow demand | Yes |
| Adequate capacity during peak hour demand | No |
| Additional capacity required, gpm | 3,892[(e)] |

(a) There are only wells serving Pressure Zone 350. All wells have only one pump. The total firm groundwater pumping capacity assumes 10% of wells can be out service for maintenance or other issues (e.g., water quality). Therefore, the firm groundwater pumping capacity is 42,544 gpm (90% of 47,271 gpm).

(b) Maximum day demand equals 2.0 times average day demand. Fire flow demand is 4,000 gpm for 4 hours.

(c) Peak hour demand equals 3.0 times average day demand.

(d) Backup power is provided at Stations 5, 23, 25, 32, 34, 39, 42, 47, 52, 53, 56, and 59. Total capacity of these pumps is 11,871 gpm.

(e) The hydraulic model indicates that approximately 665 gpm can be supplied from Station 8 tank during a peak hour demand condition (no flow can be supplied from Stations 1 and 3 tanks due to the HGL of these facility). An additional 2,002 gpm of supply can be conveyed from Pressure Zone 475 to Pressure Zone 350 through two Pressure Reducing Valves (PRV) located at Manzanita and East Avenue and at Hooker Oak. Additional capacity required is Peak hour demand (49,103 gpm) – Firm pumping capacity (42,544 gpm) – Station 8 tank (665 gpm) – Supply from PZ 475 (2,002 gpm) = 3,892 gpm.

As shown in Table 8-7, an additional firm pumping capacity of 3,892 gpm is required in Pressure Zone 350. This additional pumping capacity will be provided by a 7.49 mgd booster pump station (total capacity of 5,200 gpm; firm pumping capacity of 3,900 gpm) recommended to be constructed with the new 2.7 mgd storage tank to be located at Silver Dollar Way, northwest of the Cal Water Chico-Hamilton City District office (see discussion above).

Water Distribution System

*Peak Hour*

During a peak hour demand condition, results indicate that the existing system in Pressure Zone 350 could adequately deliver peak hour demands under the Chico-Hamilton City District's minimum pressure criteria of 40 psi (see Figure 8-4). System pressures in this pressure zone ranged from 43 to 104 psi.

As illustrated on Figure 8-4, most of the pipelines in Pressure Zone 350 meet the Chico-Hamilton City District's maximum velocities and head losses criteria of 7 fps and 10 ft/kft, respectively. However, there is approximately 7,144 feet of 4-inch diameter, or less, pipelines that exceed the head loss criteria. Because these pipelines meet the velocity requirement, no mitigation is recommended.

*Maximum Day plus Fire Flow Demand*

The fire flow simulation results show that one of the areas in Pressure Zone 350 could not maintain minimum system pressure under the required fire flow, or could not be served from nearby fire hydrants (*i.e.*, nearby hydrants were not capable of supplying the required fire flow demand).

A 2,500 gpm fire flow was simulated at the closest hydrant on Pine Street (between 9$^{th}$ Street and Eastwood Avenue). Modeling results indicate the existing 2-inch diameter is undersized to supply the required fire flow to this area.

The recommended improvements are shown on Figure 8-5, and include: installation of an 8-inch diameter pipeline (approximately 645 feet) along Eastwood Avenue, and replacement of the existing 2-inch diameter main along Pine Street (approximately a 167 feet section of pipeline northwest of the intersection of Pine Street and Eastwood Avenue) with an 8-inch diameter pipeline. The new 8-inch diameter pipeline will provide reliability to this area during a fire flow event. In addition, a new hydrant is recommended to be installed on the new 8-inch pipeline along Eastwood Avenue.

**Pressure Zone 400**

Water Storage Capacity

Table 8-8 presents a summary of the operational, fire flow and emergency storage requirements for Pressure Zone 400.

**Table 8-8. Pressure Zone 400 Storage Requirements**

| Storage Component | Criteria | Pressure Zone 400 Storage Required, MG |
|---|---|---|
| Operational | 25% of max day demand | 0.09 |
| Operational Storage Credit | 50% of excess of groundwater supply[(a)] | (0.33) |
| | Operational Storage Required | 0 |
| Fire Flow | 4,000 gpm for 4 hours | 0.96 |
| Emergency | 50% of max day demand (100% of average day demand) | 0.18 |
| Emergency Storage Credit | 100% of wells with auxiliary power | (2.33) |
| | Emergency Storage Required | 0 |
| | Total Storage Requirement | 0.96 |
| | Existing Storage Available | 0 |
| | Current Storage Deficiency | 0.96 |

(a) Excess groundwater supply is equal to the firm groundwater pumping capacity minus the maximum day demand requirement.

As shown in Table 8-8, the operational storage credit and the emergency storage credit meet the operational and emergency storage requirements, respectively, for Pressure Zone 400. The only additional storage required in Pressure Zone 400 is for fire flow and equals 0.96 MG. To meet this storage requirement, it is recommended that a new 1.0 MG storage tank be constructed at Station 44 in Pressure Zone 400.

Pumping Capacity

Table 8-9 provides a summary of the evaluation of the wells serving Pressure Zone 400.

**Table 8-9. Summary of Pressure Zone 400 Pumping Capacity**

| | Pressure Zone 400 |
|---|---|
| Wells Serving Pressure Zone | 44 and 64 |
| Firm groundwater pumping capacity, gpm[(a)] | 700 |
| Average day demand in pressure zone, gpm | 122 |
| Maximum day plus fire flow demand in pressure zone, gpm[(b)] | 4,244 |
| Peak hour demand in pressure zone, gpm[(c)] | 366 |
| Reliability: At least two pumps (1 duty pump and 1 standby pump) to use in the event of mechanical failure | No[(a)] |
| Backup power provided | Yes |
| Adequate capacity during maximum day plus fire flow demand | No |
| Adequate capacity during peak hour demand | Yes |
| Additional capacity required, gpm | 3,544[(d)] |

(a) There are only wells serving Pressure Zone 400. All wells only have one pump. Because there are only two wells in Pressure Zone 400, the firm groundwater pumping capacity assumes that the largest well is out of service for maintenance or other issues (e.g., water quality). Therefore, the firm groundwater pumping capacity is 700 gpm (1,550 gpm – 850 gpm for largest well).

(b) Maximum day demand equals 2.0 times average day demand. Fire flow demand is 4,000 gpm for 4 hours.

(c) Peak hour demand equals 3.0 times average day demand.

(d) Although the hydraulic model indicates that approximately 1,330 gpm can be supplied through the existing PRV from Pressure Zone 350 to Pressure Zone 400 during maximum day plus fire flow demand conditions, because this pressure zone mainly serves industrial land uses with high fire flow demands, it is recommended that the existing PRV be replaced with a booster pump station. Based on this, the additional pumping capacity required is Max Day Plus Fire Flow (4,244 gpm) – Firm Pumping Capacity (700 gpm) = 3,544 gpm.

Table 8-9 indicates that 3,544 gpm of additional firm pumping capacity is required within Pressure Zone 400. To meet this requirement, it is recommended that the existing PRV station at Cohasset, which serves as an emergency connection, be replaced with a 6.84 mgd booster pump station located at Station 44 capable of pumping a total of 4,750 gpm (firm capacity of 3,560 gpm). This recommended new booster pump station would also provide emergency supply during a fire flow event.

Water Distribution System

*Peak Hour*

During a peak hour demand condition, results indicate that the existing system in Pressure Zone 400 could adequately deliver peak hour demands under the Chico-Hamilton City District's minimum pressure criteria of 40 psi (see Figure 8-6). Pressure within Pressure Zone 400 ranged from 46 to 74 psi.

As illustrated on Figure 8-6, velocities for pipelines in Pressure Zone 400 meet the Chico-Hamilton City District's maximum criteria of 7 fps. All pipelines in Pressure Zone 400 meet the maximum head loss criteria of 10 ft/kft, except for pipelines located east of Marauder Street and downstream of Station 44. Head losses were 19 and 14 ft/kft, respectively. Because these pipelines meet the velocity criteria, no replacement is recommended.

*Maximum Day plus Fire Flow Demand*

A fire flow of 4,000 gpm was simulated at the intersection of Fortress and Piper. Results indicate that the existing distribution system was not able to meet fire flow requirements in Pressure Zone 400. The groundwater pumping capacity in Pressure Zone 400 could not meet the 4,000 gpm fire flow during maximum day demand. The previously recommended booster pump station at Station 44 (see Pumping Capacity section above) is required. If the recommended booster pump station is constructed, hydraulic results indicate that the Pressure Zone 400 system will be able to meet the minimum required residual pressure during a 4,000 gpm fire flow demand. Head loss per thousand feet is higher in adjacent pipelines than the desired 10 ft/kft but velocities are all below 10 fps. Thus, no improvements are recommended.

**Pressure Zone 475**

Water Storage Capacity

Table 8-10 presents a summary of the operational, fire flow, and emergency storage requirements for Pressure Zone 475.

**Table 8-10. Pressure Zone 475 Storage Requirements**

| Storage Component | Criteria | Pressure Zone 475 Storage Required, MG |
|---|---|---|
| Operational | 25% of max day demand | 1.08 |
| Operational Storage Credit | 50% of excess of groundwater supply[(a)] | (1.97) |
| | Operational Storage Required | 0 |
| Fire Flow | 4,000 gpm for 4 hours | 0.96 |
| Emergency | 50% of max day demand (100% of average day demand) | 2.17 |
| Emergency Storage Credit | 100% of wells with auxiliary power | (5.40) |
| | Emergency Storage Required | 0 |
| | Total Storage Requirement | 0.96 |
| | Existing Storage Available | 1.0 |
| | Current Storage Deficiency | 0 |

(a) Excess groundwater supply is equal to the firm groundwater pumping capacity minus the maximum day demand requirement.

As shown in Table 8-10, the storage evaluation for Pressure Zone 475 shows that the existing 1.0 MG of available storage meets the storage requirements within Pressure Zone 475.

Pumping Capacity

Table 8-11 provides a summary of the evaluation of the wells serving Pressure Zone 475.

**Table 8-11. Summary of Pressure Zone 475 Pumping Capacity**

| | Pressure Zone 475 |
|---|---|
| Wells Serving Pressure Zone | 33, 50, 65, 67, 70, 72 and 76 |
| Firm groundwater pumping capacity, gpm[(a)] | 5,750 |
| Average day demand in pressure zone, gpm | 1,505 |
| Maximum day plus fire flow demand in pressure zone, gpm[(b)] | 7,306 |
| Peak hour demand in pressure zone, gpm[(c)] | 4,962 |
| Reliability: At least two pumps (1 duty pump and 1 standby pump) to use in the event of mechanical failure | No |
| Backup power provided | 3,750[(d)] |
| Adequate capacity during maximum day plus fire flow demand | No |
| Adequate capacity during peak hour demand | Yes |
| Additional capacity required, gpm | 106[(e)] |

(a) There are only wells serving Pressure Zone 475. All wells only have one pump. Because there are only seven wells in Pressure Zone 475, the firm groundwater pumping capacity assumes that the largest well is out of service for maintenance or other issues (e.g., water quality). Therefore, the firm groundwater pumping capacity is 5,750 gpm (7,050 gpm – 1,300 gpm for largest well).

(b) Maximum day demand equals 2.0 times average day demand. Because Pressure Zone 475 is a main supply to pressure zones above it, maximum day demand includes demand in Pressure Zone 475, 635, and 795. Fire flow demand is 4,000 gpm for 4 hours.

(c) Peak hour demand equals 3.0 times average day demand. Because Pressure Zone 475 is a main supply to pressure zones above it, peak hour demand includes demand in Pressure Zone 475, 635, and 795.

(d) Backup power is provided at Stations 33, 67, 70, and 72. Total capacity of these pumps is 3,750 gpm.

(e) The hydraulic model indicates that approximately 1,450 gpm can be supplied by storage tanks at Station 66. Based on this, the additional pumping capacity required is Max Day Plus Fire (7,306 gpm) – Firm Pumping Capacity (5,750 gpm) – Station 66 Storage Tanks (1,450 gpm) = 106 gpm.

Table 8-11 indicates a slight pumping capacity deficiency of 106 gpm in Pressure Zone 475. However, because the deficiency is so slight (less than 2 percent of the firm groundwater pumping capacity), additional pumping capacity is not recommended at this time.

Water Distribution System

*Peak Hour*

During a peak hour demand condition, results indicate that the existing system in Pressure Zone 475 could adequately deliver peak hour demands under the Chico-Hamilton City District's minimum pressure criteria of 40 psi to most of the pressure zone (see Figure 8-7). System pressures within the pressure zone ranged from 43 to 102 psi.

As shown on Figure 8-7, a few pipelines exceeded the Chico-Hamilton City District's maximum design criteria of 10 ft/kft head losses. However, these pipelines were all below the District's maximum velocity criteria of 7 fps, except for one pipeline which had a velocity of 7.11 fps. Since this velocity is only slightly above the District's maximum criteria, no improvements are recommended.

*Maximum Day plus Fire Flow Demand*

A fire flow demand of 4,000 gpm was simulated at the intersection of Bruce Road and Picholine Way in Pressure Zone 475. Results indicate that the existing distribution system in Pressure Zone 475 is able to meet the required residual pressure. A fire flow of 1,500 gpm was also simulated at the higher topographical area on Sparrow Hawk Lane, and results indicate that the existing distribution system is able to meet the minimum required residual pressure of 20 psi.

**Pressure Zone 635**

Water Storage Capacity

Table 8-12 presents a summary of the operational, fire flow, and emergency storage requirements for Pressure Zone 635.

**Table 8-12. Pressure Zone 635 Storage Requirements**

| Storage Component | Criteria | Pressure Zone 635 Storage Required, MG |
|---|---|---|
| Operational | 25% of max day demand | 0.10 |
| Operational Storage Credit | 50% of excess of groundwater supply[(a)] | 0 |
| | Operational Storage Required | 0.10 |
| Fire Flow | 1,500 gpm for 2 hours | 0.18 |
| Emergency | 50% of max day demand (100% of average day demand) | 0.19 |
| Emergency Storage Credit | 100% of wells with auxiliary power | 0 |
| | Emergency Storage Required | 0.19 |
| | Total Storage Requirement | 0.47 |
| | Existing Storage Available | 0.5 |
| | Current Storage Deficiency | 0 |

(a) Excess groundwater supply is equal to the firm groundwater pumping capacity minus the maximum day demand requirement.

As shown in Table 8-12, the storage evaluation for Pressure Zone 635 shows that the existing 0.5 MG of available storage meets the storage requirements within Pressure Zone 635.

Pumping Capacity

Table 8-13 provides a summary of the evaluation of the pump stations serving Pressure Zone 635.

**Table 8-13. Summary of Pressure Zone 635 Pumping Capacity**

| | Pressure Zone 635 |
|---|---|
| Pump Stations Serving Pressure Zone | 66 and 73 |
| Firm booster pumping capacity, gpm | 1,100 |
| Average day demand in pressure zone, gpm | 135 |
| Maximum day plus fire flow demand in pressure zone, gpm[(a)] | 1,769 |
| Peak hour demand in pressure zone, gpm[(b)] | 404 |
| Reliability: At least two pumps (1 duty pump and 1 standby pump) to use in the event of mechanical failure | Yes |
| Backup power provided | No |
| Adequate capacity during maximum day plus fire flow demand | No |
| Adequate capacity during peak hour demand | Yes |
| Additional capacity required, gpm | 0[(c)] |

(a) Maximum day demand equals 2.0 times average day demand. Fire flow demand is 1,500 gpm for 2 hours.
(b) Peak hour demand equals 3.0 times average day demand.
(c) The hydraulic model indicates that approximately 1,368 gpm can be supplied from Station 74 tank during a maximum day plus fire flow demand conditions. Based on this, the additional pumping capacity required is Max Day Plus Fire (1,769 gpm) – Firm Pumping Capacity (1,100 gpm) – Station 74 Storage Tank (1,368 gpm) = 0 gpm.

Table 8-13 indicates that, with the supply from the Station 74 tank during a maximum day demand plus fire flow condition, no additional pumping capacity is required within Pressure Zone 635.

Water Distribution System

*Peak Hour*

During a peak hour demand condition, results indicate that the existing system in Pressure Zone 635 could deliver peak hour demands under the Chico-Hamilton City District's minimum pressure criteria of 40 psi (see Figure 8-8). System pressures in Pressure Zone 635 range from 41 to 132 psi.

Head losses and velocities in Pressure Zone 635 meet the Chico-Hamilton City District maximum design criteria of 10 ft/kft and 7 fps as shown on Figure 8-8.

*Maximum Day plus Fire Flow Demand*

A fire flow demand of 1,500 gpm was simulated in Pressure Zone 635 at the intersection of Delaney Drive and Titleist Way, and on Shadowtree Lane. Results indicate that the existing system in Pressure Zone 635 is able to meet the required residual pressure.

**Pressure Zone 795**

Water Storage Capacity

Table 8-14 presents a summary of the operational, fire flow, and emergency storage requirements for Pressure Zone 795.

**Table 8-14. Pressure Zone 795 Storage Requirements**

| Storage Component | Criteria | Pressure Zone 795 Storage Required, MG |
|---|---|---|
| Operational | 25% of max day demand | 0.01 |
| Operational Storage Credit | 50% of excess of groundwater supply[(a)] | 0 |
| | Operational Storage Required | 0.01 |
| Fire Flow | 1,500 gpm for 2 hours | 0.18 |
| Emergency | 50% of max day demand (100% of average day demand) | 0.02 |
| Emergency Storage Credit | 100% of wells with auxiliary power | 0 |
| | Emergency Storage Required | 0.02 |
| | Total Storage Requirement | 0.21 |
| | Existing Storage Available | 0 |
| | Current Storage Deficiency | 0.21 |

(a) Excess groundwater supply is equal to the firm groundwater pumping capacity minus the maximum day demand requirement.

As shown in Table 8-14, there is a storage deficiency of 0.21 MG in Pressure Zone 795. Currently, this pressure zone is served through a booster pump station with a 0.01 MG hydropneumatic tank. Until the District builds out the remainder of the planned service area in this pressure zone (see Chapter 9 for buildout evaluation), no storage is recommended for the existing system.

Pumping Capacity

Table 8-15 provides a summary of the evaluation of the pump station serving Pressure Zone 795.

**Table 8-15. Summary of Pressure Zone 795 Pumping Capacity**

| | Pressure Zone 795 |
|---|---|
| Pump Station Serving Pressure Zone | 66 |
| Firm booster pumping capacity, gpm | 400 |
| Average day demand in pressure zone, gpm | 13 |
| Maximum day plus fire flow demand in pressure zone, gpm[(a)] | 1,526 |
| Peak hour demand in pressure zone, gpm[(b)] | 39 |
| Reliability: At least two pumps (1 duty pump and 1 standby pump) to use in the event of mechanical failure | Yes |
| Backup power provided | No |
| Adequate capacity during maximum day plus fire flow demand | No |
| Adequate capacity during peak hour demand | Yes |
| Additional capacity required, gpm | 1,126[(c)] |

(a) Maximum day demand equals 2.0 times average day demand. Fire flow demand is 1,500 gpm for 2 hours.
(b) Peak hour demand equals 3.0 times average day demand.
(c) The additional pumping capacity required is Max Day Plus Fire (1,526 gpm) – Firm Pumping Capacity (400 gpm) = 1,126 gpm.

As shown in Table 8-15, there is a pumping capacity deficit within Pressure Zone 795. An additional 1,126 gpm of firm pumping capacity is required. Therefore, 2.44 mgd (total capacity 1,695 gpm; firm capacity 1,130 gpm) of additional pumping capacity is recommended in Pressure Zone 795 at Station 66.

Water Distribution System

*Peak Hour*

During peak hour demand condition, results indicate that the existing system in Pressure Zone 795 could not deliver the minimum required pressure under a peak hour demand condition. There are two areas in Pressure Zone 795 where pressures are less than the minimum pressure criteria of 40 psi (see Figure 8-9). These areas are located at Whispering Winds near the Station 74 tank site, at Shadybrook near Rising Ridge and at Summit Ridge Terrace. These areas have elevation higher than 610 feet (with the highest elevation at 645 feet) which is the existing upper service elevation of

the pressure zone. Pressures range between 22 to 38 psi. Based on the location of these low pressures, it does not make sense to create a separate pressure zone. However, this may be a policy issue that should be addressed by the District. At a minimum, low pressure agreements should be in place.

Head losses and velocities in Pressure Zone 795 are adequate to meet the Chico-Hamilton City District maximum design criteria of 10 ft/kft and 7 fps as shown on Figure 8-9.

*Maximum Day plus Fire Flow Demand*

A fire flow demand of 1,500 gpm was simulated in Pressure Zone 795 at the intersection of Summit Ridge and Horizon Point. Results indicate that the existing system in Pressure Zone 795 is able to meet the required residual pressure when both pumps C and D at Station 66 are operating.

**Hamilton City**

Water Storage Capacity

Table 8-16 presents a summary of the operational, fire flow, and emergency storage requirements for Hamilton City.

**Table 8-16. Hamilton City Storage Requirements**

| Storage Component | Criteria | Hamilton City Storage Required, MG |
|---|---|---|
| Operational | 25% of max day demand | 0.27 |
| Operational Storage Credit | 50% of excess of groundwater supply[(a)] | (0.33) |
| | Operational Storage Required | 0 |
| Fire Flow | 4,000 gpm for 4 hours | 0.96 |
| Emergency | 50% of max day demand (100% of average day demand) | 0.55 |
| Emergency Storage Credit | 100% of wells with auxiliary power | (2.88) |
| | Emergency Storage Required | 0 |
| | Total Storage Requirement | 0.96 |
| | Existing Storage Available | 0.02 |
| | Current Storage Deficiency | 0.94 |

(a) Excess groundwater supply is equal to the firm groundwater pumping capacity minus the maximum day demand requirement.

As shown in Table 8-16, the operational storage credit and the emergency storage credit meets the operational and emergency storage criteria, respectively. The only additional storage required in Hamilton City is for fire flow and equals 0.96 MG. Therefore, a new 1 MG storage tank is recommended to serve Hamilton City. This new storage tank should be constructed north of Broadway and 6th Street (a future commercial land use parcel).

Pumping Capacity

Table 8-17 provides a summary of the evaluation of the wells serving Hamilton City.

**Table 8-17. Summary of Hamilton City Pumping Capacity**

| | Hamilton City |
|---|---|
| Wells Serving Pressure Zone | 1-01, 2-01, and 2-02 |
| Firm groundwater pumping capacity, gpm[(a)] | 1,150 |
| Average day demand in pressure zone, gpm | 380 |
| Maximum day demand plus fire flow in pressure zone, gpm[(b)] | 4,760 |
| Peak hour demand in pressure zone, gpm[(c)] | 1,140 |
| Reliability: At least two pumps (1 duty pump and 1 standby pump) to use in the event of mechanical failure | No[(a)] |
| Backup power provided | Yes |
| Adequate capacity during maximum day plus fire flow demand | No |
| Adequate capacity during peak hour demand | Yes |
| Additional capacity required, gpm | 3,610[(d)] |

(a) There are only wells serving Hamilton City. All wells only have one pump. Because there are only three wells in Hamilton City, the firm groundwater pumping capacity assumes that the largest well is out of service for maintenance or other issues (e.g., water quality). Therefore, the firm groundwater pumping capacity is 1,150 gpm (2,000 gpm – 850 gpm for largest well).

(b) Maximum day demand equals 2.0 times average day demand. Fire flow demand is 4,000 gpm for 4 hours.

(c) Peak hour demand equals 3.0 times average day demand.

(d) Although hydraulic model indicates that approximately 3,768 gpm can be supplied from Stations 1 and 2 hydropneumatic tanks, no storage credit is given because the size of each tank is 10,000 gallon. These tanks only can supply flow into the system for 6 minutes. The hydraulic model also indicates that no flow can be supplied from the Station 1 elevated tank due to the hydraulic grade line of this tank. Based on this, the additional pumping capacity required is Max Day Plus Fire (4,760 gpm) – Firm Pumping Capacity (1,150 gpm) = 3,610 gpm.

As shown in Table 8-17, there is a pumping capacity deficit within Hamilton City. An additional 3,610 gpm of firm pumping capacity is required. Therefore, an additional 6.93 mgd of pumping capacity (total capacity of 4,810 gpm; firm capacity of 3,610 gpm) is recommended in Hamilton City.

Water Distribution System

*Peak Hour*

During a peak hour demand condition, results indicate that the existing system in Hamilton City could adequately deliver peak hour demands, under the Chico-Hamilton City District's minimum pressure criteria of 40 psi (see Figure 8-10).

As illustrated on Figure 8-10, most pipelines meet the District's maximum velocity and head loss criteria. However, the few locations with pipelines that have head losses and/or velocity above the District's maximum criteria are:

- At Station 1, there are 6-inch diameter standard steel pipelines which exceed the District's maximum velocity criteria of 7 fps; and
- Near Station 1, there is approximately 450 feet of 6-inch diameter standard steel pipeline on First Street between Broadway and Walsh Avenue which have high head losses and velocities. A pipeline replacement recommendation is discussed in the Maximum Day plus Fire Flow Demand section below.

*Maximum Day plus Fire Flow Demand*

A fire flow demand of 4,000 was simulated for a school land use type in two areas: On 6th Street and Capay Avenue; and on Capay Avenue and 2nd Street. Results indicate that the existing system in Hamilton City is not able to meet the required residual pressure. This is due to undersized pipelines and/or the age of steel pipeline (low C-factor) in this area.

Results from the fire flow evaluation at the school located on 6th Street and Capay Avenue indicate that the existing pipelines near this site are undersized for a 4,000 gpm fire flow event. To provide this magnitude of fire flow demand, WYA recommends construction and replacement as follows (see Figure 8-11 for detailed locations):

- Install a new 12-inch diameter pipeline along Broadway Avenue, from 1st Street to 6th Street (approximately 2,892 feet)
- Replace the existing 6-inch diameter pipeline along 6th Street, from Broadway Avenue to alley located southwest of Capay Avenue (approximately 196 feet) to a 12-inch diameter pipeline
- Replace the existing 6-inch diameter pipeline along 6th Street from the alley between Broadway Avenue and Los Robles to alley located west of Capay Avenue (approximately 762 feet) with an 8-inch diameter pipeline
- Replace the existing 6-inch diameter pipeline (approximately 515 feet) along 1st Street from Station 1 site to Broadway Avenue to a 12-inch diameter pipeline

Results from the fire flow evaluation at the school site located on Capay Avenue and 2nd Street indicate that the existing pipelines near this site are undersized for a 4,000 gpm fire flow event. To provide fire flow demand, WYA recommends the following improvements (see Figure 8-12):

- Install a new 12-inch diameter pipeline along 2nd Street, from Broadway to the alley between Los Robles Avenue and Capay Avenue (approximately 630 feet)
- Replace the existing 6-inch diameter pipeline along 2nd Street, from the alley between Los Robles Avenue and Capay Avenue to Capay Avenue (approximately 250 feet) to an 8-inch diameter pipeline

A fire flow demand of 3,000 gpm was simulated at 6th Street between Shasta Avenue and Sierra Avenue, and results indicate that the existing system in Hamilton City is not able to meet the required residual pressure. To provide a 3,000 gpm fire flow to hydrants located on 6th Street (between Shasta Avenue and Sierra Avenue), WYA recommends the following improvements (see Figure 8-13):

- Install approximately 1,048 feet of an 8-inch diameter pipeline along 5th Street from the existing pipeline near Station 2 to the alley between Shasta Avenue and Sierra Avenue

A fire flow demand of 1,500 gpm was simulated at two locations within Hamilton City. The first fire flow was simulated on 2nd Street between Sierra Avenue and Sacramento Avenue. Results indicate that the existing system in Hamilton City is not able to meet the required residual pressure at this site. To provide a 1,500 gpm fire flow to the hydrant located on 2nd Street, WYA recommends installing an 8-inch diameter pipeline (approximately 198 feet) along 2nd Street from Sacramento Avenue to the alley between Sacramento Avenue and Sierra Avenue (see Figure 8-14). A second fire flow was simulated on 4th Street, between Los Robles Avenue and Broadway Avenue. Results also indicate that the existing system is not able to meet the required residual pressure. To meet the required minimum residual pressure, WYA recommends installing an 8-inch diameter pipeline (approximately 208 feet) along 4th Street, from Broadway Avenue to the alley between Broadway Avenue and Los Robles Avenue (see Figure 8-15).

## SUMMARY OF RECOMMENDED IMPROVEMENTS FOR EXISTING POTABLE WATER SYSTEM

The recommended improvements needed to eliminate deficiencies identified in the analysis of the existing distribution systems are summarized below and are shown on Figure 8-16. The estimated costs for these recommended improvements are discussed in Chapter 10.

### Pipelines

- To alleviate minimum pressure problems during maximum day demand plus fire flow in Pressure Zone 350, the following improvements are recommended.
  - Install 645 feet of new 8-inch diameter pipeline along Eastwood Avenue
  - Upsize approximately 167 feet of an existing 2-inch diameter pipeline along Pine Street to an 8-inch diameter pipeline
- To alleviate head loss problems during maximum day demand plus fire flow in Hamilton City, the following improvements are recommended:
  - Upsize approximately 196 feet of an existing 6-inch diameter pipeline along 6th Street to a 12-inch diameter pipeline
  - Upsize approximately 762 feet of an existing 6-inch diameter pipeline along 6th Street to an 8-inch diameter pipeline
  - Upsize approximately 515 feet of an existing 6-inch diameter pipeline along 1st Street to an 8-inch diameter pipeline
  - Install 2,892 feet of a new 12-inch diameter pipeline along Broadway Avenue
  - Install 630 feet of a new 12-inch diameter pipeline along 2nd Street
  - Upsize approximately 250 feet of an existing 6-inch diameter pipeline along 2nd Street to an 8-inch diameter pipeline
  - Install 1,048 feet of a new 8-inch diameter pipeline along 5th Street

— Install 198 feet of a new 8-inch diameter pipeline along 2nd Street

— Install 208 feet of a new 8-inch diameter pipeline along 4th Street

**Pump Stations**

- A new 7.49 mgd booster pump station should be constructed to convey water from a new 2.7 MG storage tank located at Silver Dollar Way to increase storage in Pressure Zone 350.
- A new 3.24 mgd booster pump station should be constructed to convey water from a new 1.0 MG storage tank to be located at Mcintosh Avenue, west of Dayton Road to increase storage in Pressure Zone 350.
- A new 6.34 mgd booster pump station should be constructed to convey water from a new 1.0 MG storage tank to be located between Bruce Road and Potter Road to increase storage in Pressure Zone 350.
- A new 4.54 mgd booster pump station should be constructed to convey water from a new 1.0 MG storage tank to be located southwest of Highway 99 and Entler Avenue (west of Norfield Avenue) to increase storage in Pressure Zone 350.
- A new 6.84 mgd booster pump station should be constructed at Station 44 to provide maximum day plus fire flow demand in Pressure Zone 400.
- An additional 2.44 mgd of total pumping capacity should be provided at Station 66 to provide maximum day plus fire flow demand in Pressure Zone 795.
- A new 6.93 mgd booster pump station should be constructed in Hamilton City to convey water from a new 1.0 MG storage tank located north of Broadway and 6th Street (future commercial land use parcel).

**Storage Facilities**

- To alleviate operational and fire flow storage deficiencies, an additional 5.7 MG of storage should be provided in Pressure Zone 350. These facilities should include the following:

  — 2.7 MG storage tank with a 7.49 mgd booster pump station to be located at Silver Dollar Way, northwest of the Cal Water Chico-Hamilton City District office

  — 1.0 MG storage tank with a 3.24 mgd booster pump station to be located at Mcintosh Avenue, west of Dayton Road

  — 1.0 MG storage tank with a 6.34 mgd booster pump station to be located between Bruce Road and Potter Road

  — 1.0 MG storage tank with a 4.54 mgd booster pump station to be located southwest of Highway 99 and Entler Avenue (west of Norfield Ave)

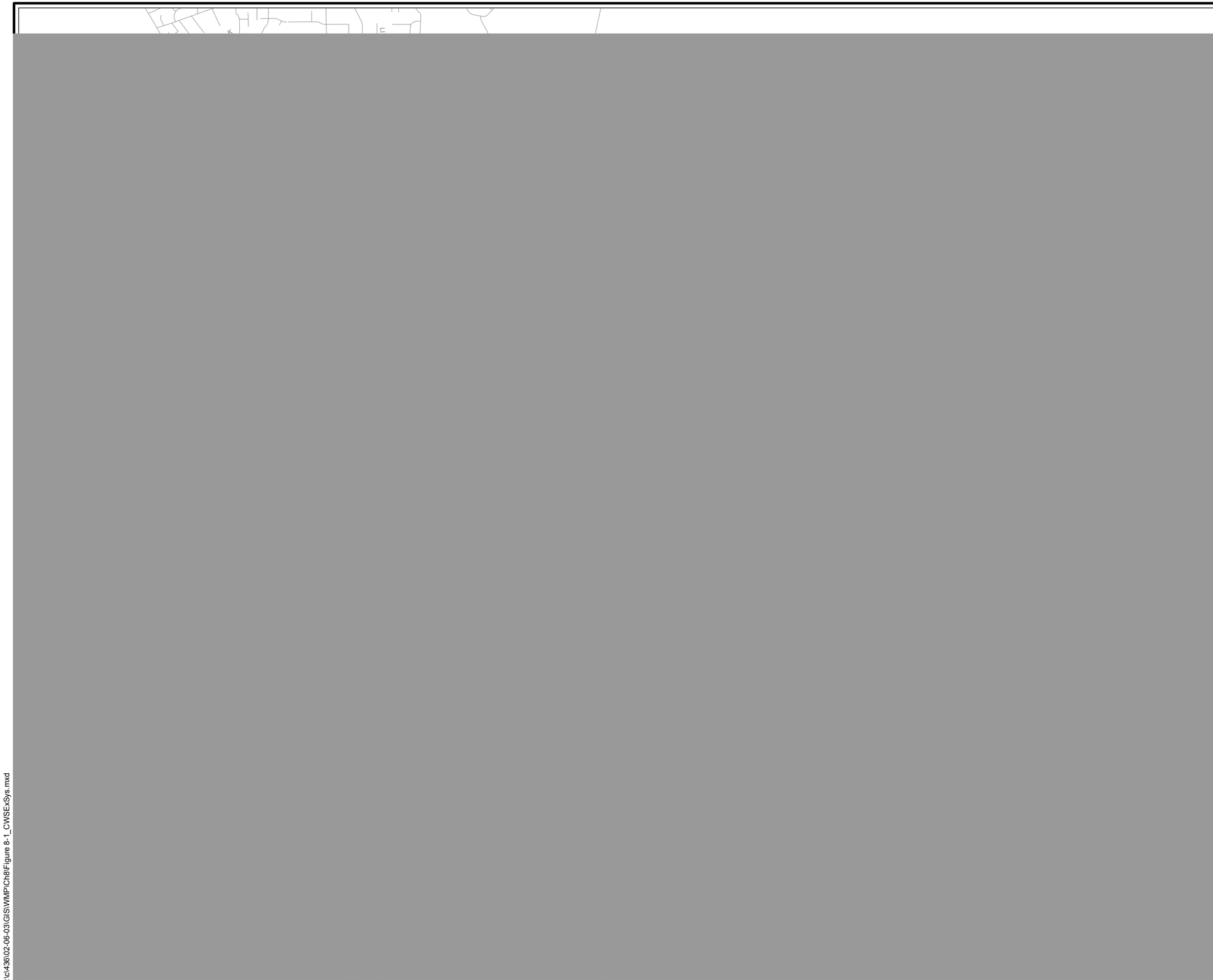
- To alleviate fire flow storage requirements in Pressure Zone 400, a new 1.0 MG storage tank should be constructed at Station 44 in Pressure Zone 400.

- To alleviate fire flow storage requirements in Hamilton City, a new 1.0 MG storage tank with a 6.93 mgd booster pump should be constructed north of Broadway and 6th Street (future commercial land use parcel).

**Standby Generators**

- To increase the emergency storage credit in Pressure Zone 350, standby generators should be installed at Stations 54, 71, and 75.

***



Public Version

**FIGURE 8-1**

**California Water Service Company Chico - Hamilton City District Water Supply and Facilities Master Plan**

## EXISTING WATER SYSTEM

N

0 0.2 0.4 0.8

Scale in Miles

NOTES:

LEGEND:

- Station
- Cal Water Service Area
- Pipeline Diameter < 12-inch
- Pipeline Diameter ≥ 12-inch

**Pressure Zone**

- 350
- 400
- 475
- 635
- 795
- Street

CALIFORNIA WATER SERVICE CO.

WEST YOST ASSOCIATES Consulting Engineers

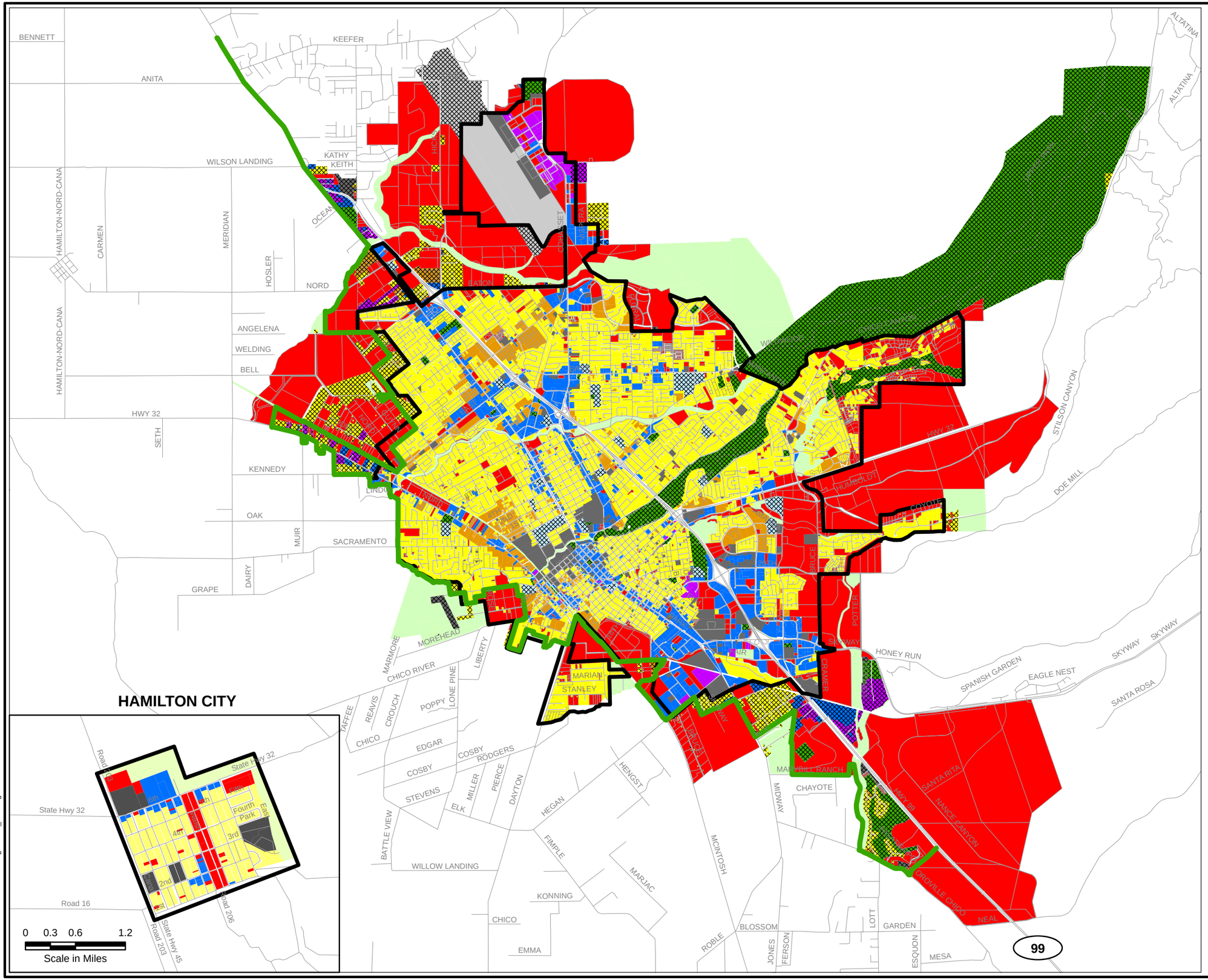
o:\c\436\02-06-03\GIS\WMP\Ch8\Figure 8-1_CWSExSys.mxd

Public Version

# FIGURE 8-2

## California Water Service Company Chico-Hamilton District Water Supply and Facilities Master Plan

## EXISTING LAND USE




NOTES:

Greenline is an urban growth boundary adopted Butte County in 1982.

LEGEND:

- Cal Water Service Area
- Assumed Served by Private Well
- Residential
- Multiple Residences
- Commercial
- Industrial
- Government
- Parks & Recreation
- School
- Open Space/Agriculture
- No Water Demand - Runway
- Vacant (to be developed)
- Street
- Greenline

0 0.5 1 2

Scale in Miles

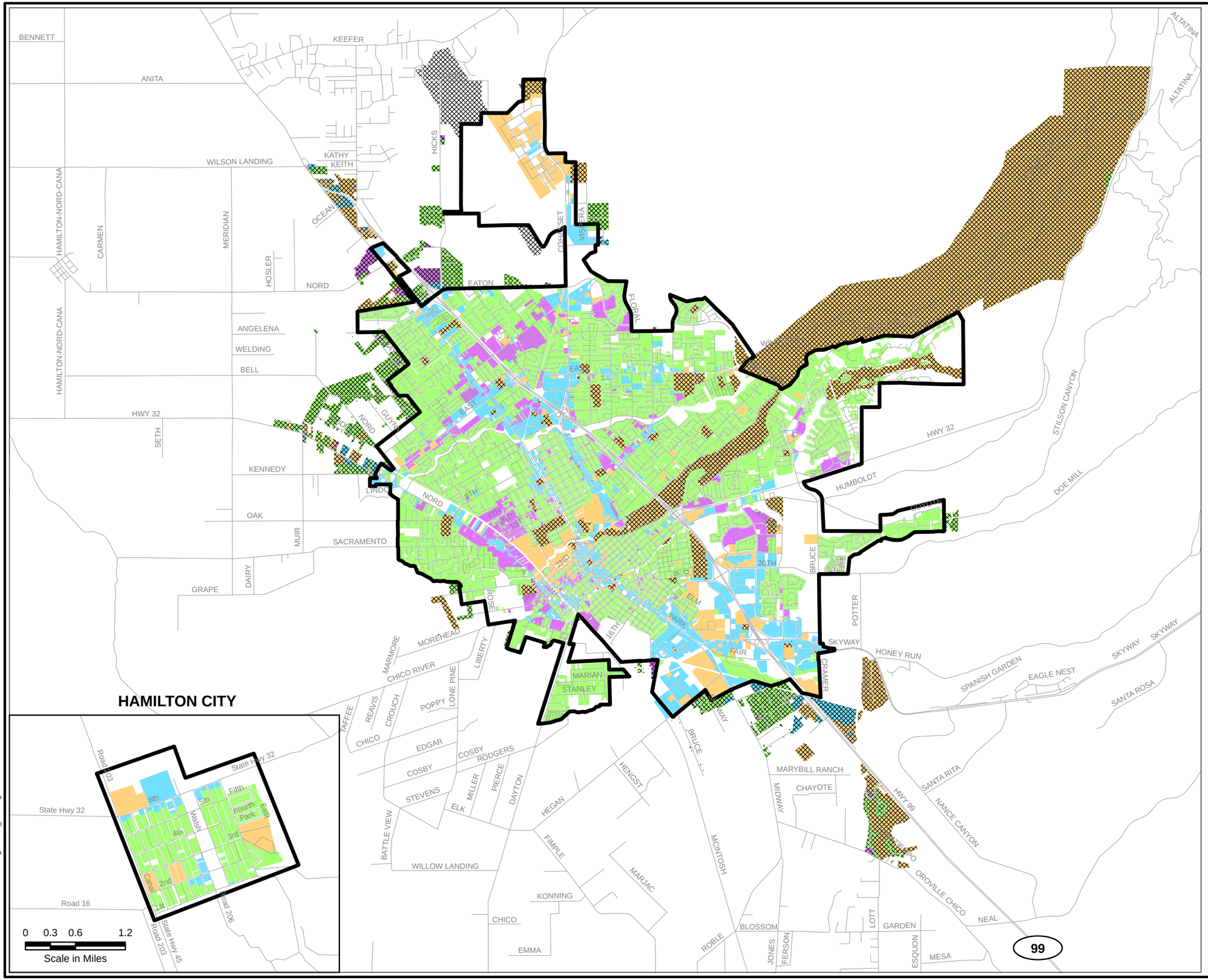
o:\c\436\02-06-03\GIS\WMP\Ch8\Figure 8-2_ExistingLandUse.mxd

Public Version

# FIGURE 8-3

**California Water Service Company**
**Chico-Hamilton District Water Supply and Facilities Master Plan**

## EXISTING SYSTEM FIRE FLOW DEMANDS




NOTES:

LEGEND:

- Cal Water Service Area
- Assumed Served by Private Well
- Street

**Fire Flow Demand**

- 1,500 gpm for 2 hours
- 2,500 gpm for 2 hours
- 3,000 gpm for 3 hours
- 4,000 gpm for 4 hours

N

0 0.5 1 2

Scale in Miles

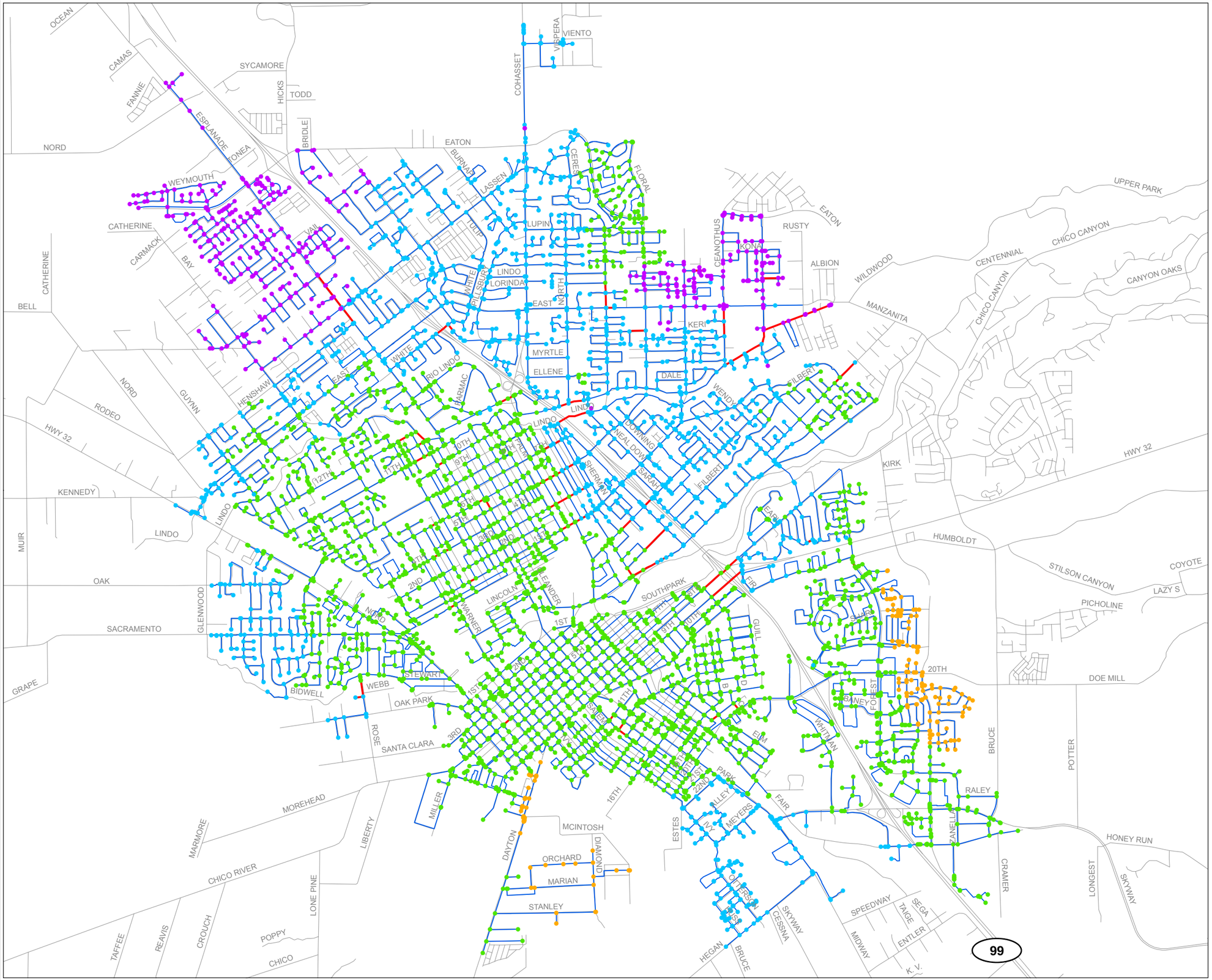
o:\c\436\02-06-03\GIS\WMP\Ch8\Figure 8-2_ExistingLandUse.mxd

Public Version

# FIGURE 8-4

**California Water Service Company**
**Chico-Hamilton District Water Supply and Facilities Master Plan**

## PRESSURE ZONE 350 PEAK HOUR ANALYSIS




NOTES:

LEGEND:

- Pressure < 40 psi
- 40 ≤ Pressure < 50 psi
- 50 ≤ Pressure < 60 psi
- 60 ≤ Pressure < 70 psi
- Pressure ≥ 70 psi
- HL/1000 < 10 ft/kft
- HL/1000 ≥10 ft/kft
- Street

N

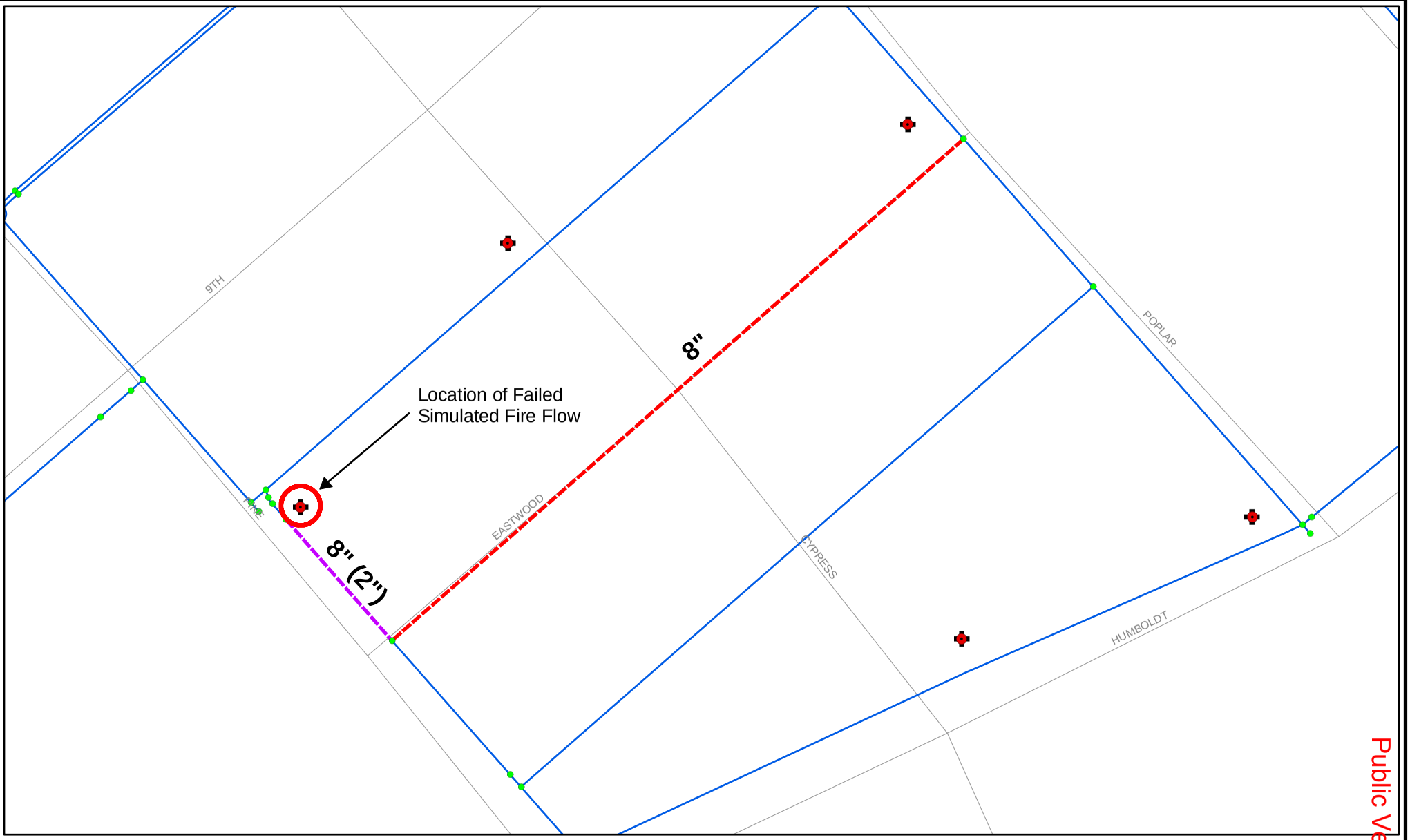
0 0.25 0.5 1

Scale in Miles

WEST YOST ASSOCIATES Consulting Engineers

o:\c436\02-06-03\GIS\WMP\Ch8\Figure 8-4_ExistingPH_PZ350.mxd

O\C\436\020603\GIS\WMP Figures\Chapter 8\Figure 8-5_PZ350 FF Rec.mxd




LEGEND:

- Hydrant
- Existing Pipeline
- Proposed Pipeline
- Increased Pipeline Diameter
- Street

8" (2") Recommended (Existing) Diameters

N

0 40 80 160

Scale in Feet

**FIGURE 8-5**

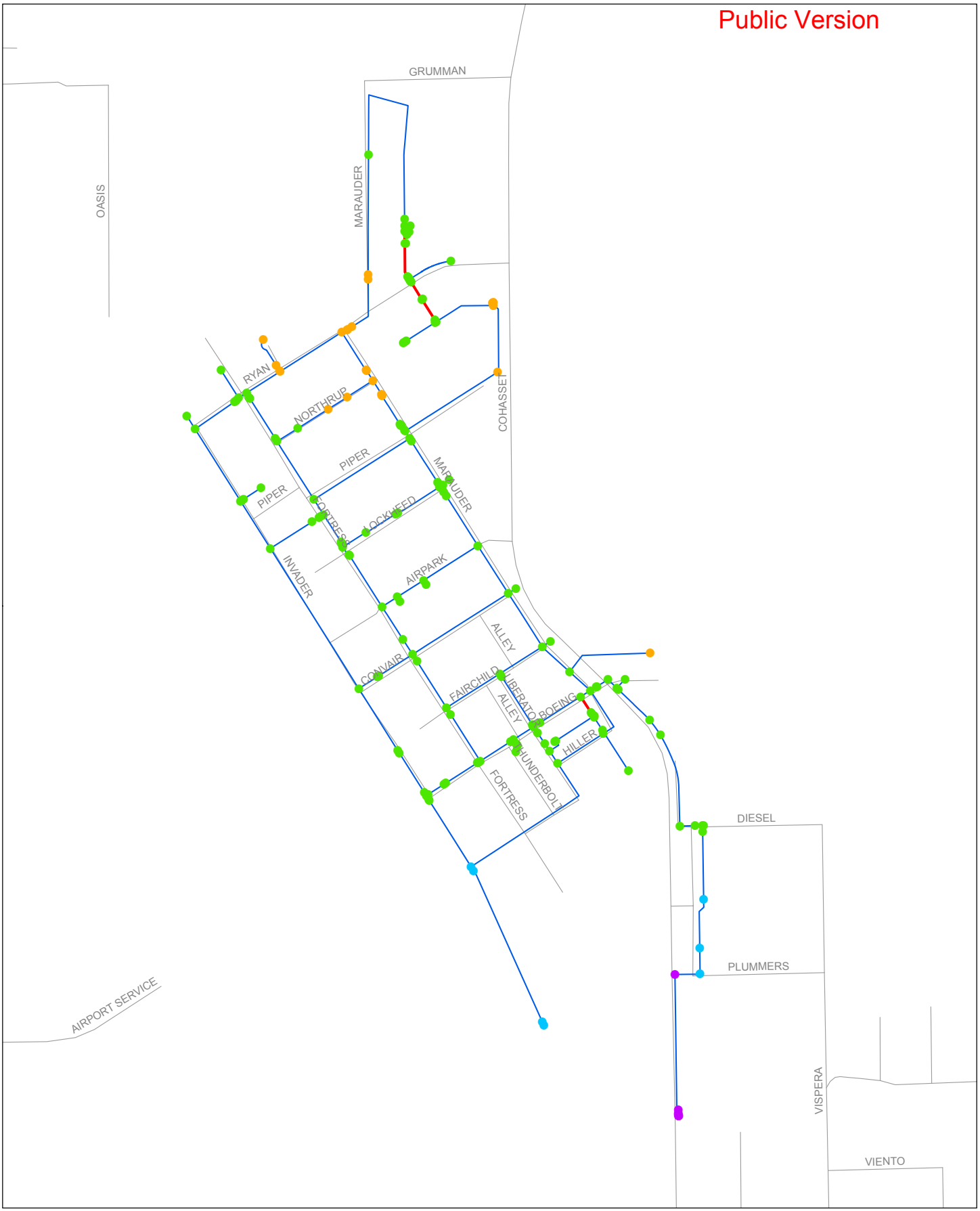
**California Water Service Company**
**Chico-Hamilton District Water**
**Supply and Facilities Master Plan**

**PRESSURE ZONE 350**
**FIRE FLOW RECOMMENDATION**

WEST YOST ASSOCIATES Consulting Engineers

Public Version

Public Version




LEGEND:

- Pressure < 40 psi
- 40 ≤ Pressure < 50 psi
- 50 ≤ Pressure < 60 psi
- 60 ≤ Pressure < 70 psi
- Pressure ≥ 70 psi

- HL/1000 < 10 ft/kft
- HL/1000 ≥10 ft/kft
- Street

N

0 0.045 0.09 0.18

Scale in Miles

**FIGURE 8-6**

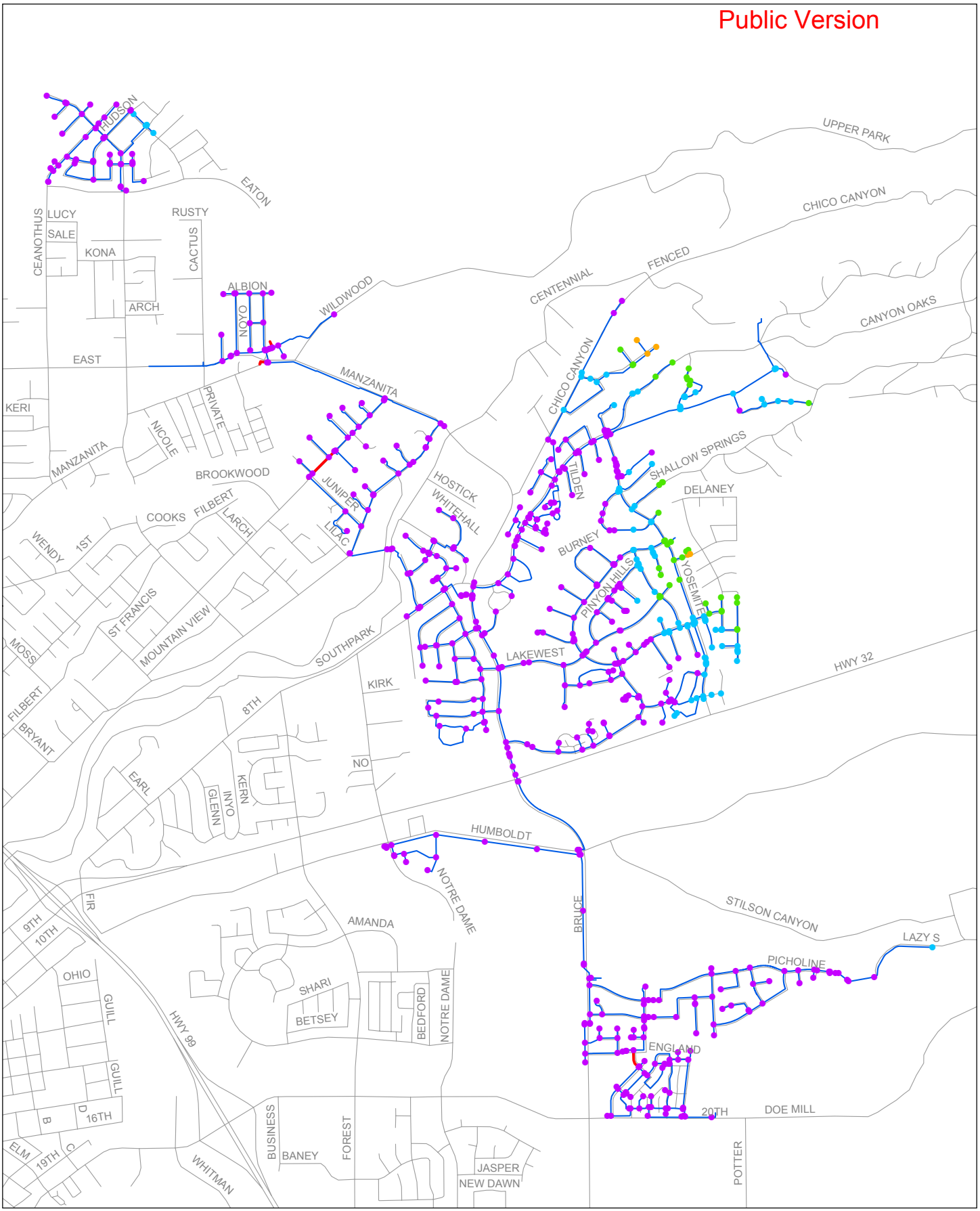
**California Water Service Company**
**Chico-Hamilton District Water**
**Supply and Facilities Master Plan**

**PRESSURE ZONE 400**
**PEAK HOUR ANALYSIS**

WEST YOST ASSOCIATES Consulting Engineers

o:\c\436\02-06-03\GIS\WMP\Ch8\Figure 8-6_ExistingPH_PZ400.mxd

Public Version




LEGEND:

- Pressure < 40 psi
- 40 ≤ Pressure < 50 psi
- 50 ≤ Pressure < 60 psi
- 60 ≤ Pressure < 70 psi
- Pressure ≥ 70 psi
- HL/1000 < 10 ft/kft
- HL/1000 ≥10 ft/kft
- Street

N

0 0.1 0.2 0.4

Scale in Miles

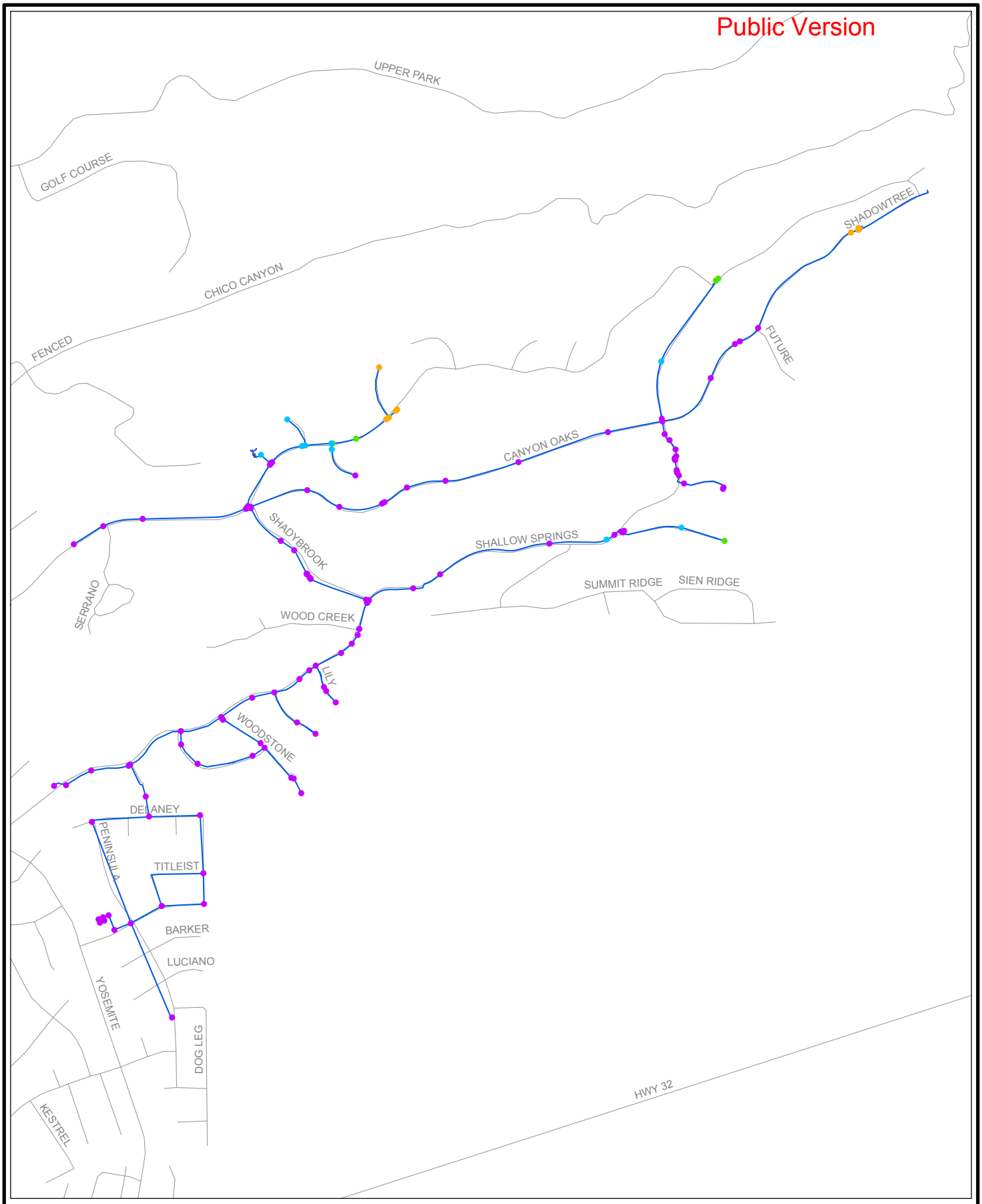
**FIGURE 8-7**

**California Water Service Company**
**Chico-Hamilton District Water**
**Supply and Facilities Master Plan**

**PRESSURE ZONE 475**
**PEAK HOUR ANALYSIS**

WEST YOST ASSOCIATES Consulting Engineers

o:\c\436\02-06-03\GIS\WMP\Ch8\Figure 8-7_ExistingPH_PZ475.mxd




LEGEND:

- Pressure < 40 psi
- 40 ≤ Pressure < 50 psi
- 50 ≤ Pressure < 60 psi
- 60 ≤ Pressure < 70 psi
- Pressure ≥ 70 psi
- HL/1000 < 10 ft/kft
- HL/1000 ≥10 ft/kft
- Street

N

0 0.05 0.1 0.2

Scale in Miles

**FIGURE 8-8**

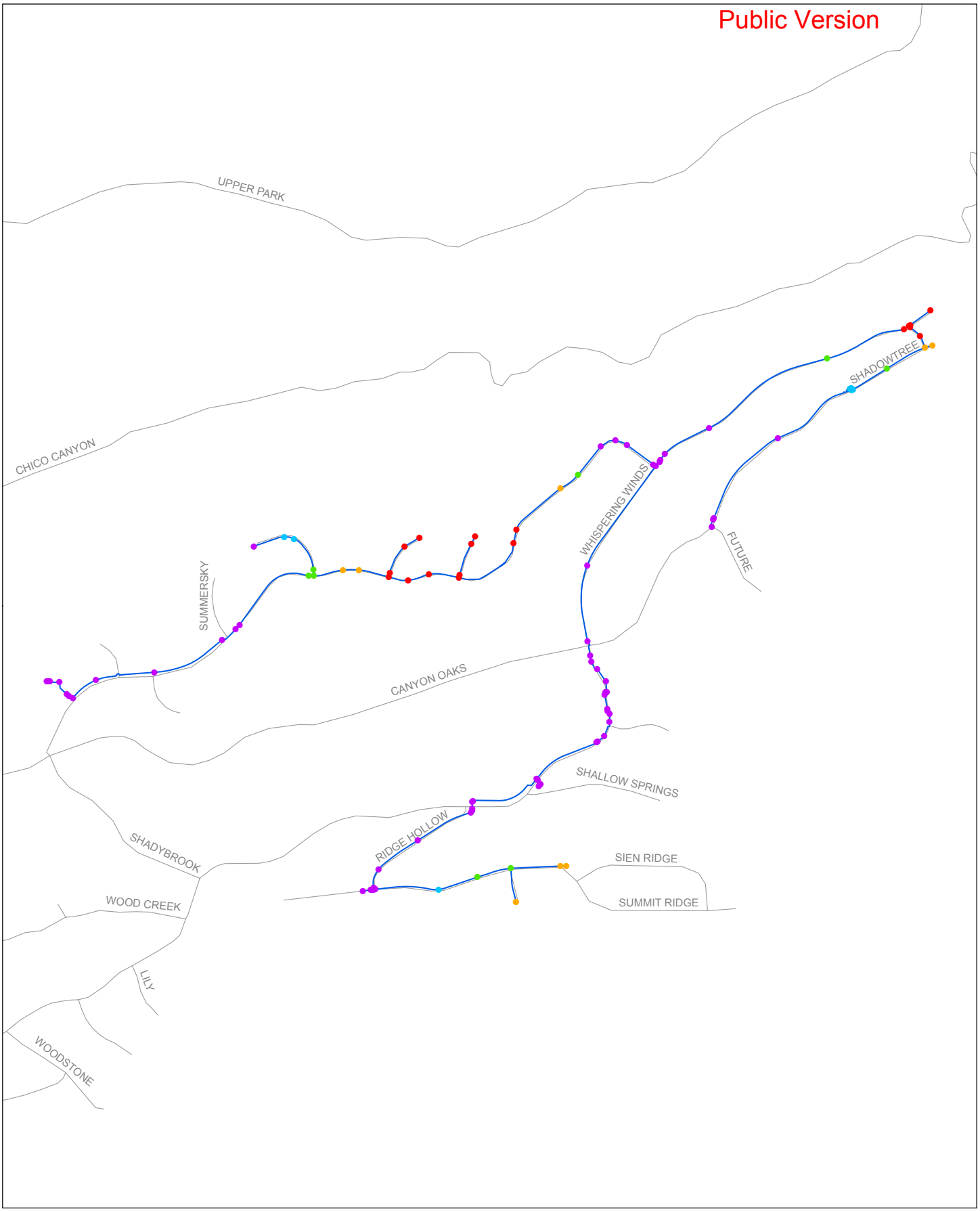
**California Water Service Company**
**Chico-Hamilton District Water**
**Supply and Facilities Master Plan**

**PRESSURE ZONE 635**
**PEAK HOUR ANALYSIS**

WEST YOST ASSOCIATES Consulting Engineers

o:\c\436\02-06-03\GIS\WMP\Ch8\Figure 8-8_ExistingPH_PZ635.mxd

Public Version




LEGEND:

- Pressure < 40 psi
- 40 ≤ Pressure < 50 psi
- 50 ≤ Pressure < 60 psi
- 60 ≤ Pressure < 70 psi
- Pressure ≥ 70 psi

- HL/1000 < 10 ft/kft
- HL/1000 ≥10 ft/kft
- Street

N

0 0.04 0.08 0.16

Scale in Miles

**FIGURE 8-9**

**California Water Service Company**
**Chico-Hamilton District Water**
**Supply and Facilities Master Plan**

**PRESSURE ZONE 795**
**PEAK HOUR ANALYSIS**

WEST YOST ASSOCIATES Consulting Engineers

o:\c\436\02-06-03\GIS\WMP\Ch8\Figure 8-9_ExistingPH_PZ795.mxd

Public Version

LEGEND:

- Pressure < 40 psi
- 40 ≤ Pressure < 50 psi
- 50 ≤ Pressure < 60 psi
- 60 ≤ Pressure < 70 psi
- Pressure ≥ 70 psi

- HL/1000 < 10 ft/kft
- HL/1000 ≥10 ft/kft
- Street

N

0 0.03 0.06 0.12

Scale in Miles

**FIGURE 8-10**

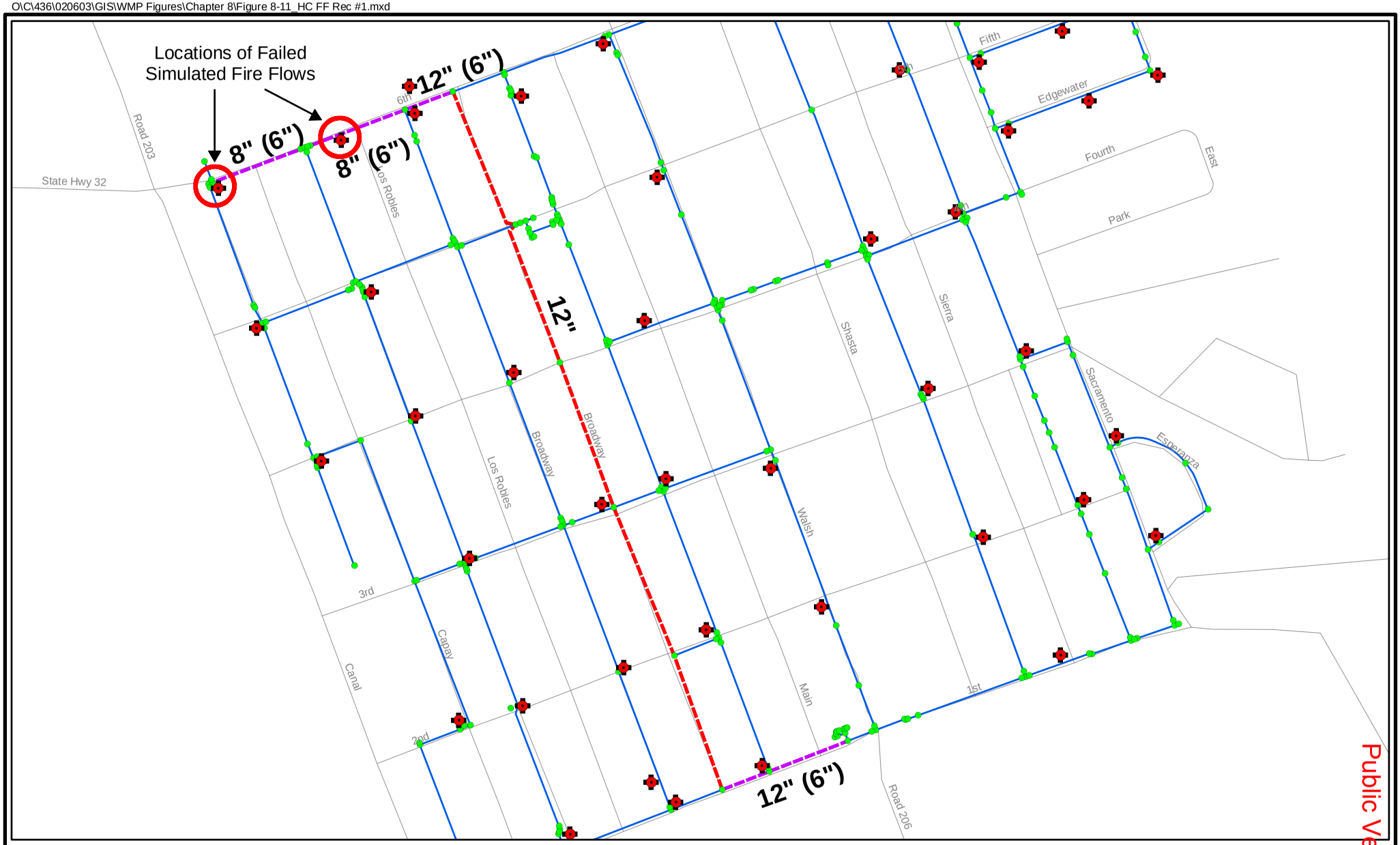
**California Water Service Company**
**Chico-Hamilton District Water**
**Supply and Facilities Master Plan**

**HAMILTON CITY**
**PEAK HOUR ANALYSIS**

WEST YOST ASSOCIATES Consulting Engineers

o:\c436\02-06-03\GIS\WMP\Ch8\Figure 8-10_ExistingPH_PZHC.mxd

O\C\436\020603\GIS\WMP Figures\Chapter 8\Figure 8-11_HC FF Rec #1.mxd




LEGEND:

- Hydrant
- Existing Pipeline
- Increased Pipeline Diameter
- Proposed Pipeline
- Street

8" (2") Recommended (Existing) Diameters

N

0 175 350 700

Scale in Feet

**FIGURE 8-11**

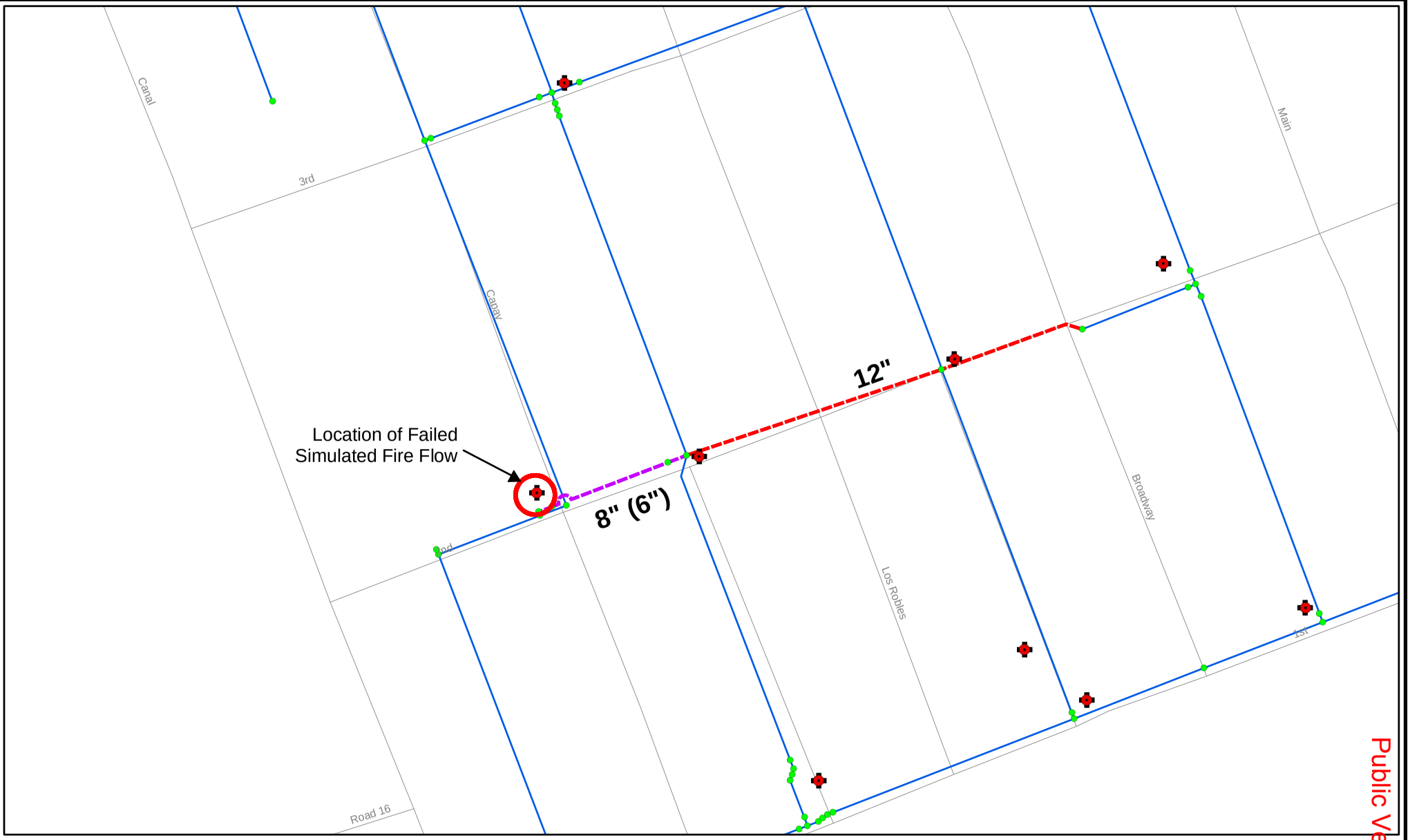
**California Water Service Company**
**Chico-Hamilton District Water**
**Supply and Facilities Master Plan**

**HAMILTON CITY**
**FIRE FLOW RECOMMENDATION #1**

WEST YOST ASSOCIATES Consulting Engineers

Public Version

O\C\436\020603\GIS\WMP Figures\Chapter 8\Figure 8-12_HC FF Rec #2.mxd




LEGEND:

- Hydrant
- Existing Pipeline
- Increased Pipeline Diameter
- Proposed Pipeline
- Street

8" (2") Recommended (Existing) Diameters

N

0 75 150 300

Scale in Feet

**FIGURE 8-12**

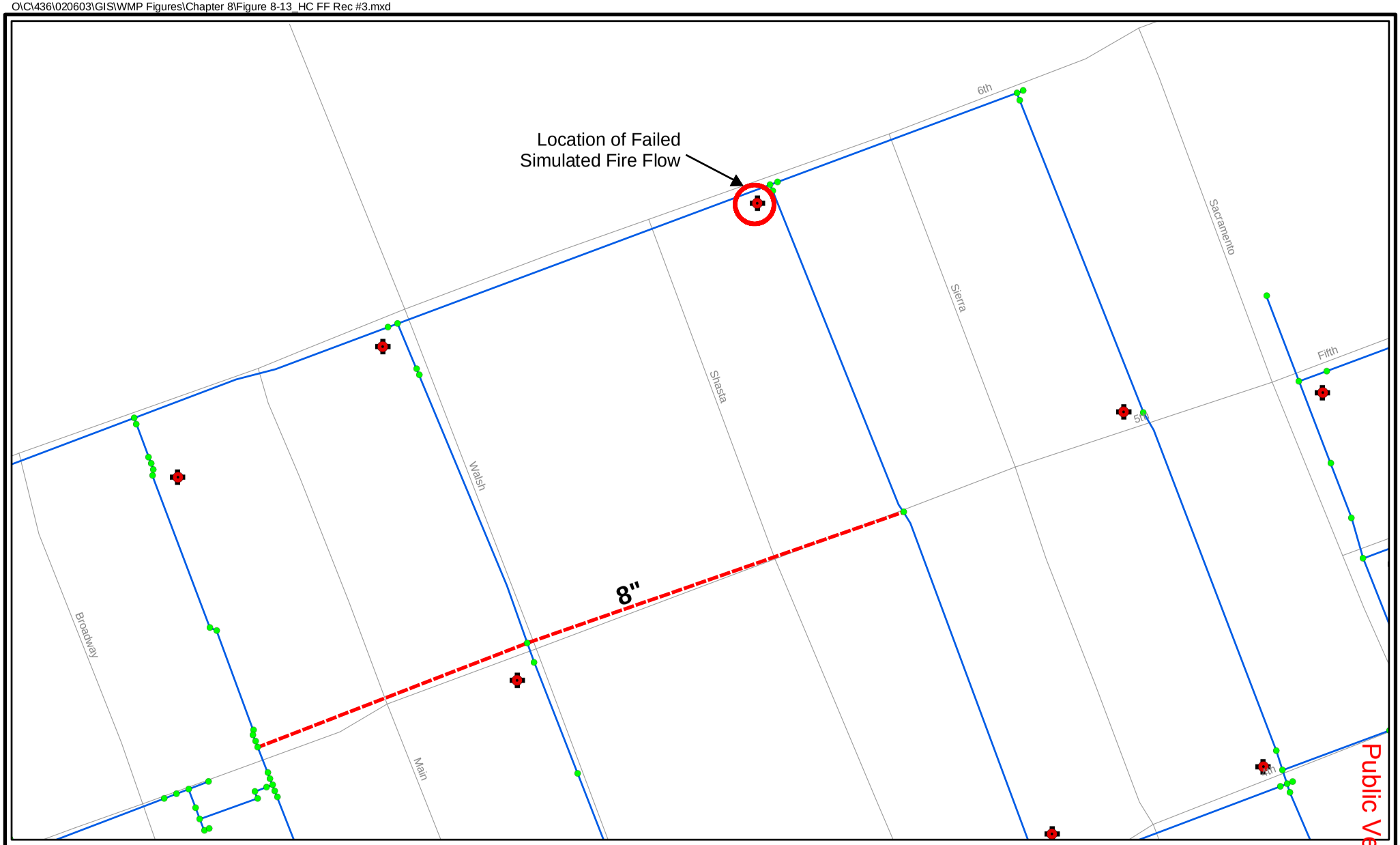
**California Water Service Company**
**Chico-Hamilton District Water**
**Supply and Facilities Master Plan**

**HAMILTON CITY**
**FIRE FLOW RECOMMENDATION #2**

WEST YOST ASSOCIATES Consulting Engineers

Public Version

O\C\436\020603\GIS\WMP Figures\Chapter 8\Figure 8-13_HC FF Rec #3.mxd




LEGEND:

- Hydrant
- Existing Pipeline
- Proposed Pipeline
- Street
- 8" (2") Recommended (Existing) Diameters

N

0 75 150 300

Scale in Feet

**FIGURE 8-13**

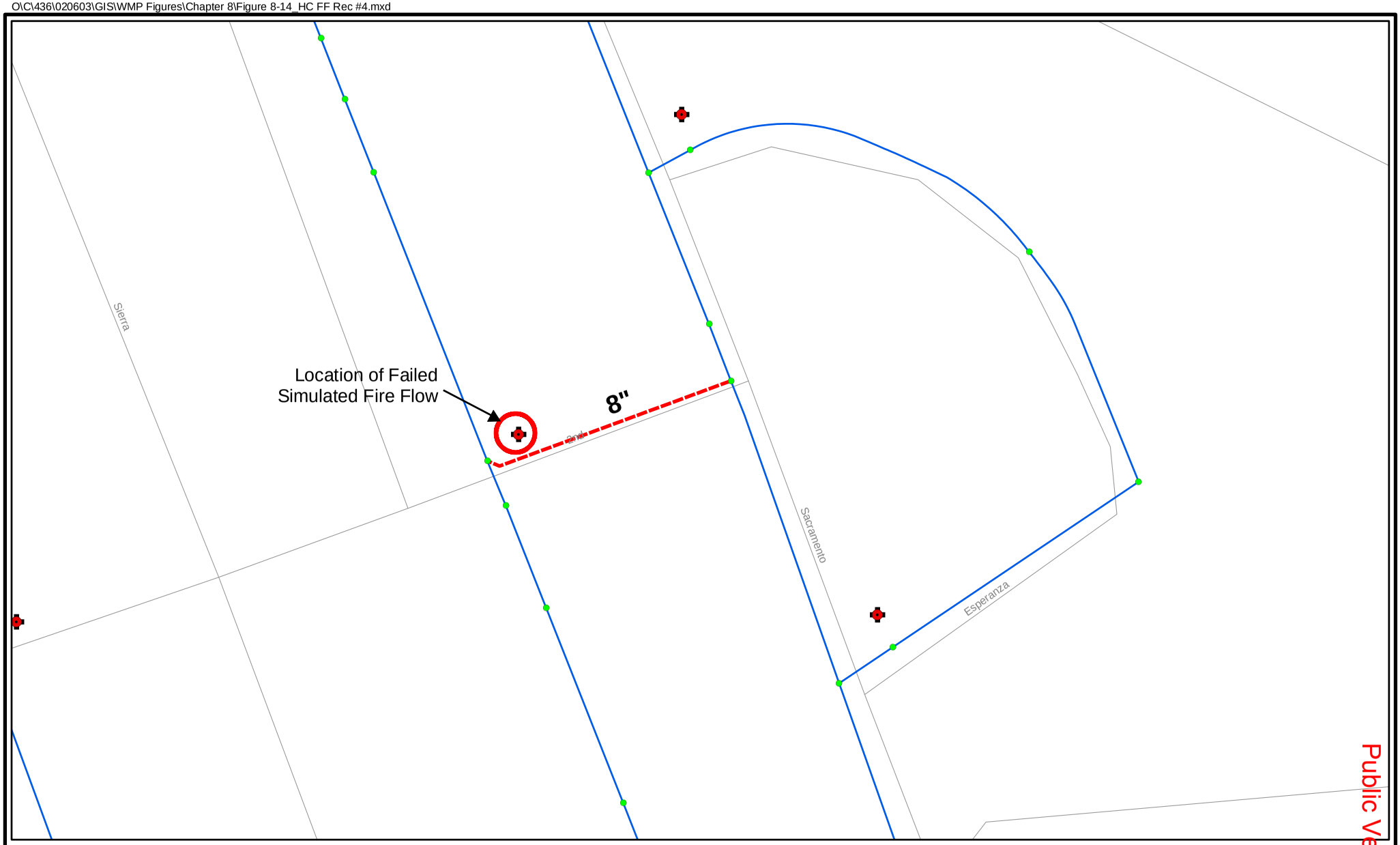
**California Water Service Company**
**Chico-Hamilton District Water**
**Supply and Facilities Master Plan**

**HAMILTON CITY**
**FIRE FLOW RECOMMENDATION #3**

WEST YOST ASSOCIATES Consulting Engineers

Public Version

O\C\436\020603\GIS\WMP Figures\Chapter 8\Figure 8-14_HC FF Rec #4.mxd




LEGEND:

- Hydrant
- Existing Pipeline
- Proposed Pipeline
- Street
- 8" (2") Recommended (Existing) Diameters

N

0 35 70 140

Scale in Feet

**FIGURE 8-14**

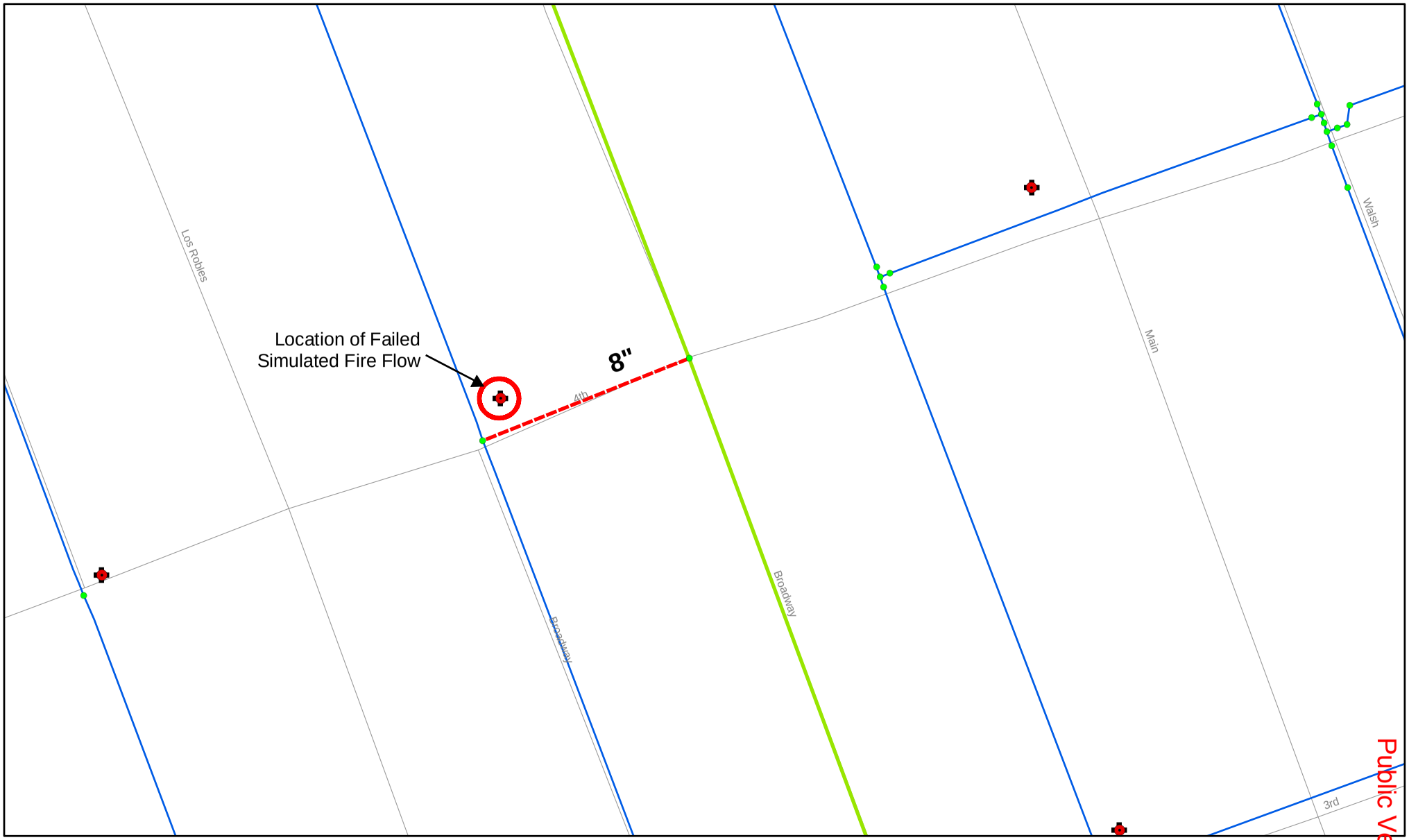
**California Water Service Company**
**Chico-Hamilton District Water**
**Supply and Facilities Master Plan**

**HAMILTON CITY**
**FIRE FLOW RECOMMENDATION #4**

WEST YOST ASSOCIATES Consulting Engineers

Public Version

O\C\436\020603\GIS\WMP Figures\Chapter 8\Figure 8-15_HC FF Rec #5.mxd




LEGEND:

- Hydrant
- Existing Pipeline
- Proposed Pipeline
- Proposed Pipeline from Recommendation #1
- Street
- 8" (2") Recommended (Existing) Diameters

N

0 45 90 180

Scale in Feet

**FIGURE 8-15**

**California Water Service Company**
**Chico-Hamilton District Water**
**Supply and Facilities Master Plan**

**HAMILTON CITY**
**FIRE FLOW RECOMMENDATION #5**

WEST YOST ASSOCIATES Consulting Engineers

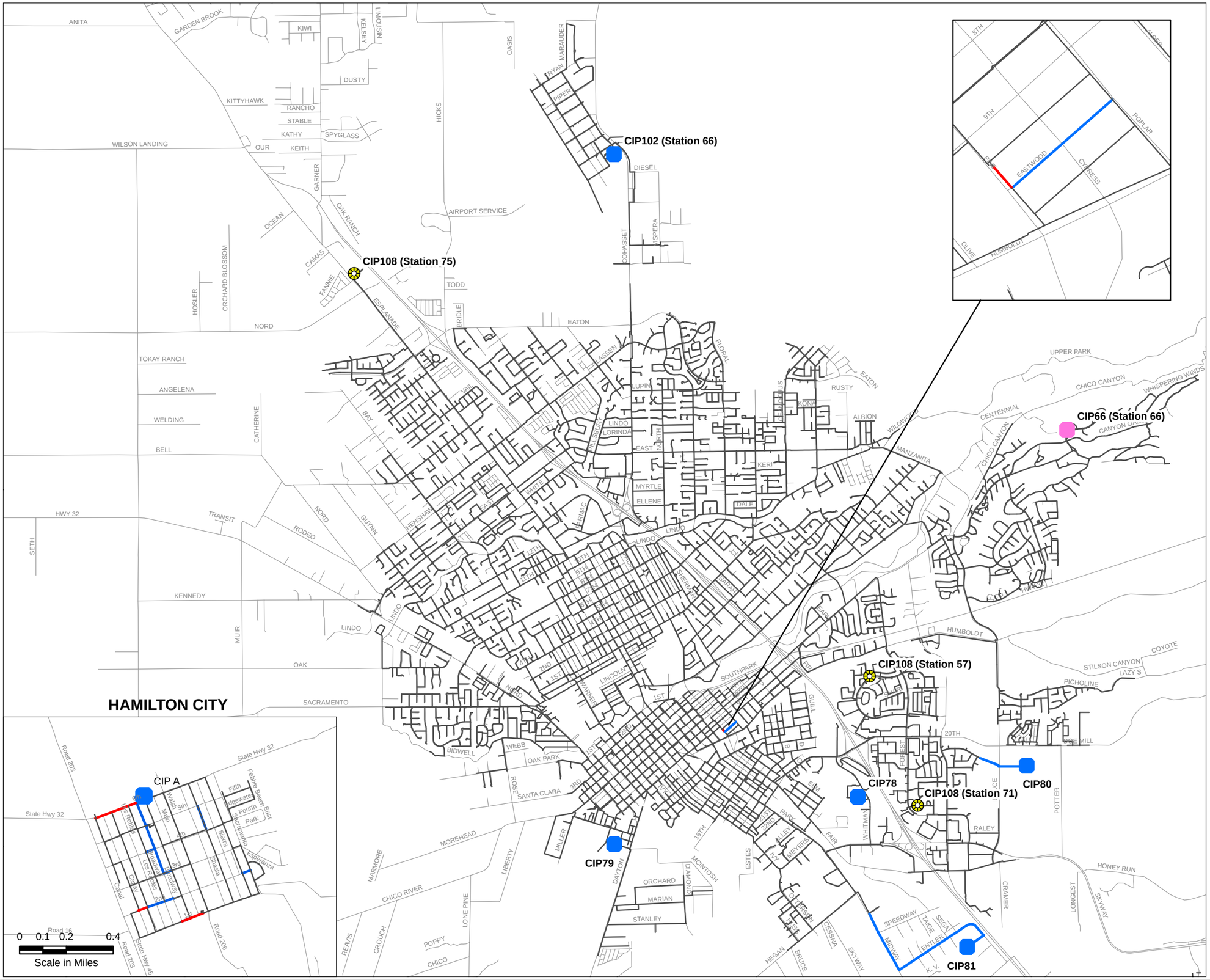
Public Version

Public Version

# FIGURE 8-16

## California Water Service Company Chico - Hamilton City District Water Supply and Facilities Master Plan

## RECOMMENDED EXISTING IMPROVEMENTS




N

0 0.15 0.3 0.6

Scale in Miles

NOTES:

LEGEND:

- Required Auxiliary Power
- Recommended Pumped Storage
- Upgrade Booster Pump Station
- Recommended New Pipelines
- Street
- Existing Pipes
- Recommended Pipeline Replacements

o:\c\436\02-06-03\GIS\WMP\Ch10\Figure 8-16_CWSCIP.mxd

# Chapter 9: Evaluation of Future Potable Water System

## Chapter Contents:


- Buildout Water Demands
- Buildout System Evaluation Methodology
  - ❖Water Storage Capacity Evaluation
  - ❖Pumping Capacity Evaluation
  - ❖Water Distribution System Analysis
- Evaluation Results
- Summary of Recommended Improvements for Buildout of the Water System


## Chapter Highlights:

This chapter summarizes an evaluation of the Chico-Hamilton City District's water system and identifies the improvements to existing water system infrastructure that will be required to support the water demands generated by the buildout of the existing water system (see Figure 9-1). The evaluation includes an analysis of water storage capacity, pumping capacity, and the existing distribution system's ability to meet recommended operational and design criteria under future maximum day demand plus fire flow and peak hour demand conditions.

The buildout system analysis was conducted by WYA using a model developed after the existing system deficiencies were identified (see Chapter 8) and improvements needed to eliminate these deficiencies were incorporated into the model.

The evaluations, findings, and recommendations for addressing the identified water system deficiencies at buildout are organized by pressure zone. A description of the recommended CIP to implement the recommended improvements, including an estimate of probable construction costs, is provided in Chapter 10.

## Summary of Future Water System Recommendations:

### Pressure Zone

- Create new Pressure Zone 570 located south of Southgate.

### Pipelines

- Install ~3,545 ft of new 12-inch diameter pipeline in Pressure Zone 350.
- Upsize 8-inch diameter pipeline to 12-inch diameter pipeline (~454 ft) in Pressure Zone 350.
- Upsize 6-inch diameter pipeline to an 8-inch diameter pipeline (~289 ft) in Pressure Zone 400.

### Pump Stations

- 17 new groundwater wells (nine in Pressure Zone 350 and eight in Pressure Zone 570).
- Two new 8.0 mgd pump stations in Pressure Zone 350.
- Upsize the Pressure Zone 400 pump station recommended in Chapter 8 located at Station 44 from 6.84 mgd to 7.53 mgd
- Two new 7.5 mgd pump stations in Pressure Zone 570.
- A new 3.17 mgd pump station in Pressure Zone 635.

### Storage Facilities

- An additional 9 MG of storage in Pressure Zone 350.
- Upsize the Pressure Zone 400 storage tank recommended in Chapter 8 located at Station 44 from 1.0 MG to 1.2 MG.
- A new 2.1 MG storage tank in Pressure Zone 475.
- Two new 2.5 MG storage tanks in Pressure Zone 570.
- A new 1.2 MG storage tank in Pressure Zone 635.
- A new 1.3 MG storage tank in Pressure Zone 795.
- Upsize the Hamilton City storage tank recommended in Chapter 8 from 1.0 MG to 1.1 MG.

### Miscellaneous Improvements

- Three new pressure reducing valves and one isolation valve in Pressure Zone 570.
- Altitude valves should be installed at all new storage tanks.

# CHAPTER 9. EVALUATION OF FUTURE WATER SYSTEM

This chapter summarizes an evaluation of the Chico-Hamilton City District's water system and identifies the improvements to existing water system infrastructure that will be required to support the water demands generated by the buildout of the existing water system (see Figure 9-1). The evaluation includes an analysis of water storage capacity, pumping capacity, and the existing distribution system's ability to meet recommended operational and design criteria under future maximum day demand plus fire flow and peak hour demand conditions.

The buildout system analysis was conducted by WYA using a model developed after the existing system deficiencies were identified (see Chapter 8) and improvements needed to eliminate these deficiencies were incorporated into the model.

The evaluations, findings, and recommendations for addressing the identified water system deficiencies at buildout are organized by pressure zone. A description of the recommended CIP to implement the recommended improvements, including an estimate of probable construction costs, is provided in Chapter 10.

## BUILDOUT WATER DEMANDS

The potable water demands at buildout for the Chico-Hamilton City District were estimated based on the projected buildout land use information (see Figure 9-2) provided by the City of Chico and Glenn County, and estimated water duties as described in Chapter 3. These projected demands were entered into the model using $H_2$OMAP Demand Allocation/Pro™. Table 9-1 summarizes the buildout demands for each of the Chico-Hamilton City District's pressure zones. A new pressure zone, Pressure Zone 570, has been added to the buildout system to serve a new area located south of Southgate. The hydraulic grade line of this new service area ranges from 280 to 540 feet.

**Table 9-1. Buildout Potable Demands for the Chico-Hamilton City District[a]**

| Pressure Zone | Average Day Demand[a], gpm | Maximum Day Demand[b], gpm | Peak Hour Demand[c], gpm |
|---|---|---|---|
| Chico | | | |
| 350 | 23,287 | 46,574 | 69,861 |
| 400 | 309 | 618 | 927 |
| 475 | 2,968 | 5,936 | 8,904 |
| 570[d] | 5,402 | 10,804 | 16,206 |
| 635 | 694 | 1,388 | 2,082 |
| 795 | 486 | 972 | 1,458 |
| Chico Total | 33,146 | 66,292 | 99,438 |
| Hamilton City | | | |
| Hamilton | 458 | 917 | 1,375 |
| Hamilton Total | 458 | 917 | 1,375 |
| District Total | 33,604 | 67,209 | 100,813 |

(a) Based on projected demands in Chapter 3 (Table 3-13).
(b) Maximum day demand is 2.0 times the average day demand.
(c) Peak hour demand is 3.0 times the average day demand.
(d) Pressure zone serves new area located southwest of Southgate.

## BUILDOUT SYSTEM EVALUATION METHODOLOGY

### Water Storage Capacity Evaluation

Storage facilities were evaluated to determine whether they have sufficient capacity to provide total future required operational, fire flow and emergency storage using the District's current design criteria. The volumes required for each of these three storage components are detailed below:

- Operational Storage: 25 percent of maximum day demand (equivalent to fifty percent of average day demand);
- Emergency Storage: 50 percent of maximum day demand (equivalent to one average day demand); and
- Fire Flow Storage: The required fire flow times the fire flow duration period, as required by the Chico-Hamilton City Fire Department. The highest Chico-Hamilton City District fire flow of 4,000 gpm for a duration of 4 hours was assumed for this analysis.

Because of the District's available wells, groundwater storage can account for a portion of the required water storage. The emergency storage credit reflects only that groundwater supply which can be reliably accessed when needed (i.e., only wells equipped with auxiliary power). The operational storage credit assumes that 50 percent of the firm groundwater supply (assumes

10 percent of the groundwater production capacity (for Pressure Zone 350 which has numerous wells) or the largest well (in the other pressure zones)) is out of service for maintenance or other water quality issues) in excess of what is required to meet maximum day demand, is available for operational use.

The storage facilities were evaluated to determine whether they have sufficient capacity to provide the required future operational, fire flow, and emergency storage. The Chico-Hamilton District currently has 2.4 MG of storage. As discussed in Chapter 8, as a result of the existing system evaluation, an additional 7.7 MG of storage was recommended as follows:

- An additional 5.7 MG of storage (in four separate storage tanks, one 2.7 MG tank and three 1.0 MG tanks) in Pressure Zone 350 to alleviate operational and fire flow storage deficiencies,
- An additional 1.0 MG of storage in Pressure Zone 400 to alleviate fire flow storage deficiencies, and
- An additional 1.0 MG of storage in Hamilton City to alleviate fire flow storage requirements.

As shown in Table 9-2, the exiting and planned storage facilities were evaluated to determine whether they have sufficient capacity to provide the required operational, fire flow, and emergency storage for buildout.

**Pumping Capacity Evaluation**

The Chico-Hamilton City District's pumping capacity has been evaluated to assess its ability to deliver a firm, reliable capacity to the buildout service area. At each of BPSs, the firm booster pumping capacity is defined as the total pump station installed capacity with the largest pump out of service. To ensure pumping capacity reliability, each BPS should have at least two pumps, a lead pump and a standby pump, to use in the event of a mechanical failure. All of Chico-Hamilton City District's booster pump stations meet this criterion. The firm groundwater pumping capacity is defined as 90 percent of total groundwater pumping capacity (assumes 10 percent of total groundwater pumping capacity is not available due to maintenance requirements or other issues, e.g. water quality) for Pressure Zone 350 which has numerous wells. For the other pressure zones which have fewer wells, the firm groundwater pumping capacity is defined as the groundwater pumping capacity assuming the largest well is not available due to maintenance requirements or other issues, e.g., water quality.

The pumping capacity criterion for the water system requires that there be sufficient total pumping capacity to meet maximum day plus fire flow demand or peak hour demand, whichever is greater, within each pressure zone, or any pressure zone located above that pressure zone which the pump station is serving. Details of the capacity of each pump are provided in Table 9-3. In addition, all critical pumping facilities should be equipped with an on-site, standby power generator. Critical pumping facilities are defined as those facilities that provide service to pressure zones and/or service areas without sufficient emergency storage and that meet the following criteria:

## Table 9-2. Summary of Buildout Storage Requirements

| Pressure Zone | Chico-Hamilton City District Station | Existing Reservoir Capacity, MG | Required Storage Capacity: Operational, MG[a] | Required Storage Capacity: Fire Flow, MG[b] | Required Storage Capacity: Emergency, MG[c] | Total Required Storage, MG | Additional Required Storage, MG |
|---|---|---|---|---|---|---|---|
| Zone 350 | 001-T1 | 0.10 | | | | | |
| | 001-T2 | 0.15 | | | | | |
| | 003-T4 | 0.30 | | | | | |
| | 008-T1 | 0.30 | | | | | |
| | CIP-78 (see Chapter 8) | 2.70 | | | | | |
| | CIP-79 (see Chapter 8) | 1.00 | | | | | |
| | CIP-80 (see Chapter 8) | 1.00 | | | | | |
| | CIP-81 (see Chapter 8) | 1.00 | | | | | |
| | Subtotal Pressure Zone 350 | 6.55 | 16.77 | 0.96 | 33.53 | | |
| | Groundwater Storage Credits [d] | | 0.00 | 0.00 | (24.39) | | |
| | Required Storage | | 16.77 | 0.96 | 9.14 | 26.87 | 20.32 |
| Zone 400 | CIP-105 (see Chapter 8) | 1.00 | | | | | |
| | Subtotal Pressure Zone 400 | 1.00 | 0.22 | 0.96 | 0.44 | | |
| | Groundwater Storage Credits [d] | | (0.06) | 0.00 | (2.23) | | |
| | Required Storage | | 0.16 | 0.96 | 0.00 | 1.12 | 0.12 |
| Zone 475 | 066-T1 | 0.50 | | | | | |
| | 066-T2 | 0.50 | | | | | |
| | Subtotal Pressure Zone 475 | 1.00 | 2.14 | 0.96 | 4.27 | | |
| | Groundwater Storage Credits [d] | | 0.00 | 0.00 | (5.40) | | |
| | Required Storage | | 2.14 | 0.96 | 0.00 | 3.10 | 2.10 |
| Zone 570 [e] | None | - | | | | | |
| | Subtotal Pressure Zone 570 | 0.00 | 3.89 | 0.96 | 7.78 | | |
| | Groundwater Storage Credits [d] | | 0.00 | 0.00 | 0.00 | | |
| | Required Storage | | 3.89 | 0.96 | 7.78 | 12.63 | 12.63 |
| Zone 635 | 074-T1 | 0.50 | | | | | |
| | Subtotal Pressure Zone 635 | 0.50 | 0.50 | 0.18 | 1.00 | | |
| | Groundwater Storage Credits [d] | | 0.00 | 0.00 | 0.00 | | |
| | Required Storage | | 0.50 | 0.18 | 1.00 | 1.68 | 1.18 |
| Zone 795 | None | - | | | | | |
| | Subtotal Pressure Zone 795 | 0.00 | 0.35 | 0.18 | 0.70 | | |
| | Groundwater Storage Credits [d] | | 0.00 | 0.00 | 0.00 | | |
| | Required Storage | | 0.35 | 0.18 | 0.70 | 1.23 | 1.23 |
| Hamilton City | T1-01 | 0.02 | | | | | |
| | CIP-A (see Chapter 8) | 1.00 | | | | | |
| | Subtotal Hamilton City | 1.02 | 0.33 | 0.96 | 0.66 | | |
| | Groundwater Storage Credits [d] | | (0.17) | 0.00 | (2.88) | | |
| | Required Storage | | 0.16 | 0.96 | 0.00 | 1.12 | 0.10 |

[a] Based on 25 percent of a maximum day demand.

[b] Fire flows based on 2 hr duration x 1,500 gpm or 4 hr duration x 4,000 gpm for residential and school/industrial land uses, respectively.

[c] Based on 50 percent of a maximum day demand (equivalent to one average day demand).

[d] Emergency storage credit is equal to 100% of the total pumping capacity for active wells with backup power. Operational storage credit is equal to 50% of the difference between the firm groundwater pumping capacity and the maximum day demand.

[e] This pressure zone is located on the southwest of Southgate. Because this area is non-designated development, a 4,000 gpm for 4 hour duration fire flow is used to calculate the fire flow storage required for this area.

Public Version

**Table 9-3. Summary of Capacity Requirements of Pumping Facilities at Buildout**

| Service Area | Pump Station | Total Capacity, gpm | Firm Capacity, gpm[a] | Backup Power | Buildout Average Day Demand | Buildout Maximum Day Demand[b] | Buildout Maximum Day Demand plus Fire Flow | Buildout Peak Hour Demand [c] | Required Additional Pumping Capacity, gpm |
|---|---|---|---|---|---|---|---|---|---|
| Chico | | | | | | | | | |
| Zone 350 [e] | 001-4 | 500 | 42,544 | | 23,287 | 46,574 | 50,574 | 69,861 | 13,577 |
| | 003-3 | 400 | | | | | | | |
| | 005-02 | 610 | | Natural Gas | | | | | |
| | 007-04 | 880 | | | | | | | |
| | 008-01 | 900 | | | | | | | |
| | 011-01 | 600 | | | | | | | |
| | 012-01 | 600 | | | | | | | |
| | 014-01 | 550 | | | | | | | |
| | 016-01 | 900 | | | | | | | |
| | 017-01 | 900 | | | | | | | |
| | 018-01 | 900 | | | | | | | |
| | 019-01 | 700 | | | | | | | |
| | 020-01 | 900 | | | | | | | |
| | 021-01 | 850 | | | | | | | |
| | 022-01 | 800 | | | | | | | |
| | 023-01 | 1,350 | | Diesel Generator | | | | | |
| | 024-01 | 750 | | | | | | | |
| | 025-01 | 1,000 | | Diesel Generator | | | | | |
| | 026-01 | 850 | | | | | | | |
| | 027-01 | 1,000 | | | | | | | |
| | 028-01 | 800 | | | | | | | |
| | 029-01 | 1,000 | | | | | | | |
| | 030-01 | 1,000 | | | | | | | |
| | 031-01 | 950 | | | | | | | |
| | 032-01 | 950 | | Diesel Generator | | | | | |
| | 034-01 | 1,200 | | Gas Engine, DD | | | | | |
| | 035-01 | 1,000 | | | | | | | |
| | 037-01 | 900 | | | | | | | |
| | 038-01 | 850 | | | | | | | |
| | 039-01 | 1,000 | | Natural Gas, DD | | | | | |
| | 041-01 | 1,100 | | | | | | | |
| | 042-01 | 850 | | Gas Generator | | | | | |
| | 046-01 | 500 | | | | | | | |
| | 047-01 | 711 | | Natural Gas, DD | | | | | |
| | 048-01 | 900 | | | | | | | |
| | 049-01 | 900 | | | | | | | |
| | 051-01 | 1,100 | | | | | | | |
| | 052-01 | 1,100 | | Diesel Engine, DD | | | | | |
| | 053-01 | 1,100 | | Diesel Engine, DD | | | | | |
| | 054-01 | 1,770 | | Backup Power (see Ch 8) | | | | | |
| | 056-01 | 900 | | Diesel Engine, DD | | | | | |
| | 057-01 | 1,000 | | | | | | | |
| | 059-01 | 1,100 | | Diesel Engine, DD | | | | | |
| | 061-01 | 1,100 | | | | | | | |
| | 062-01 | 1,000 | | | | | | | |
| | 063-01 | 1,050 | | | | | | | |
| | 068-01 | 1,200 | | | | | | | |
| | 069-01 | 1,000 | | | | | | | |
| | 071-01 | 1,500 | | Backup Power (see Ch 8) | | | | | |
| | 075-01 | 1,800 | | Backup Power (see Ch 8) | | | | | |
| | CIP81PS (see Chapter 8) | 3,150 | 2,100 | Diesel Generator | | | | | |
| | CIP80PS (see Chapter 8) | 4,400 | 3,300 | Diesel Generator | | | | | |
| | CIP78PS (see Chapter 8) | 5,200 | 3,900 | Diesel Generator | | | | | |
| | CIP79PS (see Chapter 8) | 2,250 | 1,500 | Diesel Generator | | | | | |
| | Subtotal | 62,271 | 53,344 | | | | | | |
| Zone 400 | 044-01 | 700 | 700 | Diesel Generator | 309 | 618 | 4,618 | 927 | 358 |
| | 064-01 | 850 | | Diesel Generator | | | | | |
| | CIP102PS (see Chapter 8) | 4,750 | 3,560 | Diesel Generator | | | | | |
| | Subtotal | 6,300 | 4,260 | | | | | | |
| Zone 475 [f] | 033-01 | 600 | 5,750 | Gas Engine, DD | 4,148 | 5,936 | 7,436 | 8,904 | 0 |
| | 050-01 | 850 | | | | | | | |
| | 065-01 | 1,150 | | | | | | | |
| | 067-01 | 1,200 | | Diesel Generator | | | | | |
| | 070-01 | 950 | | Diesel Generator | | | | | |
| | 072-01 | 1,000 | | Diesel Generator | | | | | |
| | 076-01 | 1,300 | | | | | | | |
| | Subtotal | 7,050 | 5,750 | | | | | | |
| Zone 570 | None | | | | 5,402 | 10,804 | 14,804 | 16,206 | 16,206 |
| | Subtotal | 0 | 0 | | | | | | |
| Zone 635 [g] | 66 | 1,000 | 500 | | 694 | 1,388 | 2,888 | 2,082 | 349 |
| | 73 | 1,200 | 600 | | | | | | |
| | Subtotal | 2,200 | 1,100 | | | | | | |
| Zone 795 [h] | 66 | 800 | 400 | | 486 | 972 | 2,472 | 1,458 | 0 |
| | CIP66PS (see Chapter 8) [d] | 1,695 | 1,130 | | | | | | |
| | Subtotal | 2,495 | 1,530 | | | | | | |
| **Chico Pumping Capacity, gpm** | | **80,316** | **65,984** | | **34,326** | **66,292** | **82,792** | **99,438.0** | **30,490** |
| **Chico Pumping Capacity, mgd** | | **115.66** | **95.02** | | **49.43** | **95.46** | **119.22** | **143.2** | **43.91** |
| Hamilton City | | | | | | | | | |
| HC | 001-01 | 600 | 1,150 | Diesel Generator | 458 | 917 | 4,917 | 1,375 | 157 |
| | 002-01 | 850 | | Diesel Generator | | | | | |
| | 002-02 | 550 | | Diesel Generator | | | | | |
| | CIPAPS (see Chapter 8) | 4,810 | 3,610 | | | | | | |
| | Subtotal | 6,810 | 4,760 | | | | | | |
| **Hamilton City Pumping Capacity, gpm** | | **6,810** | **4,760** | | **458** | **917** | **4,917** | **1,375** | **157** |
| **Hamilton City Pumping Capacity, mgd** | | **9.81** | **6.85** | | **0.66** | **1.32** | **7.08** | **1.98** | **0.23** |
| **Total Pumping Capacity, gpm** | | **87,126** | **70,744** | | **34,784** | **67,209** | **87,709** | **100,813** | **30,647** |
| **Total Pumping Capacity, mgd** | | **125.46** | **101.87** | | **50.09** | **96.78** | **126.30** | **145.17** | **44.13** |

[a] Firm capacity for booster pump stations is defined as pumping capacity with the largest pump out of service and/or single pump with backup generator. Firm groundwater pumping capacity is equal to 90% of the total groundwater pumping capacity for Pressure Zone 350 which has numerous wells (assumes 10 percent of wells lost for reasons other than power loss,e.g. well maintenance or water quality). For the other pressure zones with fewer wells, the firm groundwater pumping capacity is defined as the pumping capacity with the largest pump of of service.

[b] Maximum day demand equals 2.0 times average day demand.

[c] Peak hour demand equals 3.0 times average day demand.

[d] Assumes CIP recommendation (see Chapter 8) to increase pumping capacity to serve maximum day plus fire flow demands in Pressure Zone 795 at Station 66 is constructed.

[e] Includes use of 182 gpm from Station 1 tanks and 2,758 gpm from Pressure Zone 475.

[f] Includes use of 1,673 gpm from Station 66 and 3,566 gpm from new storage tank in Pressure Zone 475.

[g] Includes use of 1,439 gpm from Station 74.

[h] Includes use of 2,475 gpm from new tank.

Public Version

- The largest facility that provides water to a particular pressure zone and/or service area;
- A facility that provides the sole source of water to single or multiple pressure zones and/or service areas; and
- A facility that provides water from key groundwater supply wells (depends on capacity, quality, and location) into a pressure zone and/or service area.

**Water Distribution System Analysis**

Steady state hydraulic analyses using the updated model were conducted to identify areas of the water system at buildout that do not meet the recommended system performance criteria. The results of the evaluation of the water distribution system are presented below for the following buildout demand scenarios:

- Peak Hour Demand—peak hour demands are met by either the combined flows from supply sources and storage reservoirs, or from the pump stations and storage reservoirs. A peak hour flow condition was simulated for the buildout distribution facilities to evaluate their capability to meet this peak hour demand condition.
- Maximum Day Demand plus Fire Flow—to evaluate the system under the maximum day demand plus fire flow condition, a two-step analysis was performed. The first step used the $H_2$OMAP "Available Fire Flow Analysis" option to determine if the minimum pressure and required fire flow could be met with the existing domestic water facilities. Fire flow demands were assigned and simulated at selected nodes. These selected nodes were determined based on critical criteria including nodes located at high elevations, high demands, and/or in areas at the extremities of the existing pressure zone. If the analysis indicated that the system failed to meet the minimum requirements for pressure and flow, a second analysis was performed. The second analysis involved running the model with pipeline improvements/system modifications added to the distribution system to eliminate previously identified deficiencies.

As shown in Table 9-1, the total Chico-Hamilton City District potable service area peak hour demand at buildout was calculated to be 100,813 gpm (145.2 mgd). This peak hour demand represents a peaking factor of 3.0 times the average day demand. During a peak hour condition, a minimum pressure of 40 psi must be maintained throughout the system. Maximum head loss per thousand feet of distribution main should not exceed 10 ft/kft and maximum velocities should not exceed 7 fps.

The buildout peak hour demand condition was simulated in the model. Details of system pressures in each of the Chico-Hamilton City District's pressure zones under the buildout peak hour demand condition are discussed below.

Fire flow demands were simulated at various locations within the Chico-Hamilton City District's service area to determine whether or not the minimum residual pressure criterion of 20 psi within the pressure zone could be met during a maximum day demand condition at buildout concurrent with a fire flow. Table 9-4 presents fire flow demand requirements based on land use categories; this data is also illustrated on Figure 9-3.

**Table 9-4. Chico-Hamilton City District Fire Flow Demand Requirements[(a)]**

| Land Use | Fire Flow, gpm | Duration, hours |
|---|---|---|
| Residential | 1,500 | 2 |
| Multiple Residencies | 2,500 | 2 |
| Commercial | 3,000 | 3 |
| Industrial | 4,000 | 4 |
| Government | 4,000 | 4 |

(a) Specific fire flows were determined from Table A-III-A-1 of the 2001 CFC, and depend on construction type and fire area. These fire flow requirements are based on buildings being fully sprinkled.

Pipelines are typically designed to deliver peak hour flows and maximum day demands plus fire flows within acceptable pressure, velocity, and head loss ranges as stated in Chapter 5. System improvements needed to comply with operational and design criteria were added to the system and are also described below.

## EVALUATION RESULTS

The following describes the evaluation of water storage capacity, pumping capacity, and water distribution system by individual pressure zone.

### Pressure Zone 350

Water Storage Capacity

Table 9-5 presents a summary of the operational, fire flow, and emergency storage requirements for Pressure Zone 350.

**Table 9-5. Pressure Zone 350 Storage Requirements**

| Storage Component | Criteria | Pressure Zone 350 Storage Required, MG |
|---|---|---|
| Operational | 25% of max day demand | 16.77 |
| Operational Storage Credit | 50% of excess of groundwater supply[(a)] | (0) |
| | Operational Storage Required | 16.77 |
| Fire Flow | 4,000 gpm for 4 hours | 0.96 |
| Emergency | 50% of max day demand (100% of average day demand) | 33.53 |
| Emergency Storage Credit | 100% of wells with auxiliary power | (24.39)[(b)] |
| | Emergency Storage Required | 9.14 |
| | Total Storage Requirement | 26.87 |
| | Existing Storage Available | 0.85 |
| | Additional Storage Recommended for Existing System (see Chapter 8) | 5.70 |
| | Projected Storage Deficiency | 20.32 |

(a) Excess groundwater supply is defined as the difference between the firm groundwater pumping capacity and the maximum day demands.

(b) Includes all stations with backup power, including Stations 54, 71, and 75 for which backup power was recommended as part of the existing system evaluation (see Chapter 8).

As shown in Table 9-5, there is 20.32 MG storage deficiency in Pressure Zone 350. In order to minimize the amount of new storage facilities in Pressure Zone 350, it is recommended that nine new wells be constructed in Pressure Zone 350. These new wells, if they are equipped with backup power, would contribute to both the operational and emergency storage credits, in addition to providing additional pumping capacity in Pressure Zone 350 (see discussion below). It is recommended that each new well have a total capacity of 1,845 gpm (2.66 mgd). Together these nine new wells would provide an operational storage credit of 7.86 mgd and an additional emergency storage credit of 23.91 mgd. However, there would still be a storage deficiency of 9.87 MG (operational storage deficiency = 16.77 MG – 7.86 MG; fire flow storage deficiency = 0.96 MG). It is assumed that the fire flow storage requirement in Pressure Zone 350 can be met using storage from Pressure Zone 400. However, to alleviate the future operational storage deficiency (8.91 MG), it is recommended that an additional 1.0 MG of storage be added at each of the three 1.0 MG tank sites recommended in Chapter 8 and that two new 3.0 MG tanks be constructed in Pressure Zone 350. It is recommended that one of the new 3.0 MG storage tanks be located at a vacant parcel located southeast of the intersection of Forest Avenue and Baney Lane. The other new 3.0 MG storage tank should be located at Station 47 along Guynn Avenue between Mathews Drive and St. Clair Drive. Both new tanks will require booster pumps (8.0 mgd; total capacity 5,560 gpm; firm capacity 4,170 gpm).

Pumping Capacity

Table 9-6 provides a summary of the evaluation of the wells and pump stations serving Pressure Zone 350.

**Table 9-6. Summary of Pressure Zone 350 Pumping Capacity**

| | Pressure Zone 350 |
|---|---|
| Wells and Pump Stations Serving Pressure Zone | 1, 3, 5, 7, 8, 11, 12, 14, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 34, 35, 37, 38, 39, 41, 42, 46, 47, 48, 49, 51, 52, 53, 54, 56, 57, 59, 61, 62, 63, 68, 69, 71, 75, CIP78, CIP79, CIP80, CIP81 |
| Firm groundwater pumping capacities, gpm[(a)] | 42,544 |
| Firm booster pumping capacities, gpm[(b)] | 10,800 |
| Average day demand in pressure zone, gpm | 23,287 |
| Maximum day demand plus fire flow in pressure zone, gpm[(c)] | 50,574 |
| Peak hour demand in pressure zone, gpm[(d)] | 69,861 |
| Reliability: At least two pumps (1 duty pump and 1 standby pump) to use in the event of mechanical failure | Yes[(e)] |
| Backup power provided | Yes[(f)] |
| Adequate capacity during maximum day plus fire flow demand | Yes |
| Adequate capacity during peak hour demand | No |
| Additional capacity required, gpm | 13,577[(g)] |

(a) All well pumps have only one pump. The total groundwater pumping capacity assumes 10% of wells can be out service for maintenance or other issues (e.g., water quality). Therefore, the firm groundwater pumping capacity is 42,544 gpm (90% of 47,271 gpm).

(b) Includes the firm pumping capacity of booster pump facilities recommended as part of the existing system evaluation (See Chapter 8).

(c) Maximum day demand equals 2.0 times average day demand. Fire flow demand is 4,000 gpm for 4 hours.

(d) Peak hour demand equals 3.0 times average day demand.

(e) All storage pump station will have a standby pump.

(f) Assumes backup power provided at all new booster pump stations.

(g) The hydraulic model indicates that approximately 182 gpm can be supplied from Station 1 tanks during a peak hour demand condition. There is also additional flow of 2,758 gpm which can be conveyed from Pressure Zone 475 to Pressure Zone 350 through four Pressure Reducing Valves (PRV) which include two existing PRVs located at Manzanita and East Avenue and at Hooker Oak, and two new PRVs located at Bruce and Parkhurst and at Morrow and Skyway. Additional capacity required is Peak hour demand (69,861 gpm) – Firm groundwater pumping capacity (42,544 gpm) – Firm booster pumping capacity (10,800 gpm) – Station 1 tanks (182 gpm) – PZ475 (2,758 gpm) = 13,577 gpm.

As shown in Table 9-6, the pumping capacity of groundwater and booster pumps in Pressure Zone 350 is not adequate to meet the peak hour demand, even if an additional 2,758 gpm which can be conveyed from Pressure Zone 475 to Pressure Zone 350 through four existing PRVs is included to meet the Pressure Zone 350 peak hour demand. The additional pumping capacity required is 13,577 gpm (19.6 mgd). To meet this additional pumping requirement, it is recommended that nine new wells be constructed (as discussed above for the storage analysis), each with a total pumping capacity of 1,845 gpm. This would provide an additional firm pumping capacity of 14,944 gpm (21.5 mgd) (9 wells x 1,845 gpm x 90% firm capacity). Also, the recommended booster pumps at the new 3.0 MG storage tanks will also provide additional pumping capacity in Pressure Zone 350.

Water Distribution System

*Peak Hour*

During a peak hour demand condition, results indicate that the buildout system in Pressure Zone 350 could adequately deliver peak hour demands under the Chico-Hamilton City District's minimum pressure criteria of 40 psi (see Figure 9-4). Pressures ranged from 46 to 85 psi.

As illustrated on Figure 9-4, overall velocities in the pipelines in Pressure Zone 350 meet the Chico-Hamilton City District's maximum criteria of 7 fps. A few pipelines did not meet either of the maximum velocity and maximum head loss criteria of 10 ft/kft. The majority of those that failed to meet velocity and head loss criterion are located near the downstream side of supply facilities (i.e., Stations 1, 21, 31, 34, 35, 39, 49, 52, 59, and 69), and also located near pressure reducing stations at Ceanothus and Eaton, at East and Manzanita and at Hooker Oak. In addition, there are a few pipelines that failed to meet the velocity and head loss criterion pipelines because they are undersized, these pipelines include:

- 6-inch diameter pipeline (approximately 210 feet) along Pomona Avenue, west of Elmer Street. Pipeline head losses range from 51 to 56 ft/kft, and velocities are within 9 fps.
- 2-inch diameter pipeline (approximately 5 feet) along 12$^{th}$ Street, east of Zuni Avenue. Pipeline head loss is above 100 ft/kft and velocity is approximately 10 fps.
- 8-inch diameter pipeline (approximately 1,485 feet) along Manzanita Avenue, between Marigold Avenue and Cactus Avenue. Pipeline head losses range from 29 to 39 ft/kft and velocities range from 9 to 10 fps.
- 4-inch diameter pipeline (approximately 10 feet) on 11$^{th}$ Street near Broadway Street. Pipeline head loss is 87 ft/kft and velocity is 9 fps.
- 4-inch diameter pipeline (approximately 47 feet) on Elm Street near 18$^{th}$ Street. Pipeline head loss is above 100 ft/kft and velocity is 11 fps.
- 4-inch diameter pipeline (approximately 14 feet) on Arbutus Avenue near 5$^{th}$ Avenue. Pipeline head loss is above 100 ft/kft and velocity is 9 fps.
- 8-inch diameter pipeline (approximately 92 feet) on 23$^{rd}$ Street near Elm Street. Pipeline head loss is 26 ft/kft and velocity is 8 fps.

- 4-inch diameter pipeline (approximately 27 feet) on Bartlett Street near 10th Street. Pipeline head losses range from 64 to 85 ft/kft and velocities range from 7 to 8 fps.
- 8-inch diameter pipeline (approximately 499 feet) on Viceroy Drive near Shallowtail Way. Pipeline head losses range from 30 to 31 ft/kft and velocities are 9 fps.

However, because pressures under peak hour demand conditions are above 40 psi, no improvements are recommended for the pipelines exceeding the velocity and head loss criteria,

*Maximum Day plus Fire Flow Demand*

The fire flow simulation results show that two future areas in Pressure Zone 350 cannot maintain minimum system pressure under the required fire flow. The areas where fire flow requirements could not be met are discussed below.

A fire flow of 3,000 gpm was simulated on a node located east of Thorntree Drive. The future land use type for this area is commercial-preserve. Modeling results indicate the existing 8-inch diameter pipeline along Thorntree Drive, east of Contractors Drive, experienced high head loss in supplying the required fire flow to this area. The recommended improvement is shown on Figure 9-5, and includes replacement of the existing 8-inch diameter pipeline (approximately 454 feet) along Thorntree Drive, west of Contractors Drive, with a 12-inch diameter pipeline.

A fire flow of 1,500 gpm was simulated on a node located on Old Chico Way. Modeling results indicate the system could not provide the required 20 psi minimum residual pressure at the nearby hydrant. The recommended improvement includes installation of a 12-inch diameter pipeline (approximately 3,545 feet) along Mcintosh Avenue, from downstream of Dayton PRV/PSV station to Diamond Avenue. The recommended improvement is shown on Figure 9-6.

**Pressure Zone 400**

Water Storage Capacity

Table 9-7 presents a summary of the operational, fire flow, and emergency storage requirements for Pressure Zone 400.

**Table 9-7. Pressure Zone 400 Storage Requirements**

| Storage Component | Criteria | Pressure Zone 400 Storage Required, MG |
|---|---|---|
| Operational | 25% of max day demand | 0.22 |
| Operational Storage Credit | 50% of excess of groundwater supply[(a)] | (0.06) |
| | Operational Storage Required | 0.16 |
| Fire Flow | 4,000 gpm for 4 hours | 0.96 |
| Emergency | 50% of max day demand (100% of average day demand) | 0.44 |
| Emergency Storage Credit | 100% of wells with auxiliary power | (2.23) |
| | Emergency Storage Required | 0 |
| | Total Storage Requirement | 1.12 |
| | Existing Storage Available | 0 |
| | Additional Storage Recommended for Existing System (see Chapter 8) | 1.0 |
| | Projected Storage Deficiency | 0.12 |

(a) Excess groundwater supply is defined as the difference between the firm groundwater pumping capacity and the maximum day demands.

As shown in Table 9-7, there is a 0.12 MG storage deficiency in Pressure Zone 400. As described in Chapter 8, under existing conditions there was a storage deficiency of 0.96 MG for fire flow, so a new 1.0 MG storage tank was recommended at Station 44. To meet the additional storage required for buildout in Pressure Zone 400, it is recommended that the 1.0 MG storage tank recommended in Chapter 8 be upsized to 1.2 MG.

Pumping Capacity

Table 9-8 provides a summary of the evaluation of the wells and pump station serving Pressure Zone 400.

**Table 9-8. Summary of Pressure Zone 400 Pumping Capacity**

| | Pressure Zone 400 |
|---|---|
| Wells and Pump Stations Serving Pressure Zone | 44, 64 and CIP102 |
| Firm groundwater pumping capacities, gpm[(a)] | 700 |
| Firm booster pumping capacities, gpm[(b)] | 3,560[(e)] |
| Average day demand in pressure zone, gpm | 309 |
| Maximum day plus fire flow demand in pressure zone, gpm[(c)] | 4,618 |
| Peak hour demand in pressure zone, gpm[(d)] | 927 |
| Reliability: At least two pumps (1 duty pump and 1 standby pump) to use in the event of mechanical failure | Yes[(b)] |
| Backup power provided | Yes[(f)] |
| Adequate capacity during maximum day plus fire flow demand | No |
| Adequate capacity during peak hour demand | Yes |
| Additional capacity required, gpm | 358[(g)] |

(a) All well pumps have only one pump. Because there are only two wells in Pressure Zone 400, the firm groundwater pumping capacity assumes that the largest well is out of service for maintenance or other issues (e.g., water quality). Therefore, the firm groundwater pumping capacity is 700 gpm (1,550 gpm – 850 gpm for largest well).

(b) The recommended new booster pump station (CIP102) in Chapter 8 has 1 duty pump and 1 standby pump. Firm capacity assumes largest pump is out of service.

(c) Maximum day demand equals 2.0 times average day demand. Fire flow demand is 4,000 gpm for 4 hours.

(d) Peak hour demand equals 3.0 times average day demand.

(e) Capacity includes the new booster pump station based on the Chapter 8 recommendation.

(f) Firm capacity of these pumps with backup power is 4,260 gpm.

(g) The hydraulic model indicates that approximately 1,824 gpm can be supplied from Station 64 hydropneumatic tank during maximum day plus fire flow conditions. However, this hydropneumatic tank could only supply water during a fire flow event for 3 minutes. The additional pumping capacity required is Max day Plus Fire flow (4,618 gpm) – Firm groundwater pumping capacity (700 gpm) – Firm booster pumping capacity (3,560 gpm) = 358 gpm.

As shown in Table 9-8, there is a firm pumping capacity deficiency of 358 gpm in Pressure Zone 400. A new pump station was recommended at Station 44 in Chapter 8 to meet existing pumping deficiencies. In order to meet the additional future pumping deficiency, it is recommended that the pump station recommended for the existing system be upsized from 6.84 mgd to 7.53 mgd (total capacity of 5,230 gpm; firm capacity of 3,920 gpm).

Water Distribution System

*Peak Hour*

During a peak hour demand condition, results indicate that the buildout system in Pressure Zone 400 could adequately deliver peak hour demands (see Figure 9-7). Pressures ranged from 56 to 84 psi.

As illustrated on Figure 9-7, velocities and head losses throughout the pipelines in Pressure Zone 400 could meet the Chico-Hamilton City District's maximum velocity and head loss criteria, which are 7 fps and 10 ft/kft, respectively.

*Maximum Day plus Fire Flow Demand*

A fire flow of 4,000 gpm was simulated on Fortress Street, northwest of Ryan Avenue. Results indicate that the existing 6-inch diameter pipeline along Fortress Street was not able to meet fire flow requirements at the hydrant located on Ryan Avenue and Crusader Court due to high head loss. The replacement of the 6-inch diameter pipeline (approximately 289 feet) with an 8-inch diameter pipeline (see Figure 9-8) is recommended to meet the minimum 20 psi required residual pressure during maximum day plus fire flow demand conditions.

**Pressure Zone 475**

Water Storage Capacity

Table 9-9 presents a summary of the operational, fire flow, and emergency storage requirements for Pressure Zone 475.

**Table 9-9. Pressure Zone 475 Storage Requirements**

| Storage Component | Criteria | Pressure Zone 475 Storage Required, MG |
|---|---|---|
| Operational | 25% of max day demand | 2.14 |
| Operational Storage Credit | 50% of excess of groundwater supply[(a)] | 0 |
| | Operational Storage Required | 2.14 |
| Fire Flow | 4,000 gpm for 4 hours | 0.96 |
| Emergency | 50% of max day demand (100% of average day demand) | 4.27 |
| Emergency Storage Credit | 100% of wells with auxiliary power | (5.40) |
| | Emergency Storage Required | 0 |
| | Total Storage Requirement | 3.10 |
| | Existing Storage Available | 1.0 |
| | Projected Storage Deficiency | 2.1 |

(a) Excess groundwater supply is defined as the difference between the firm groundwater pumping capacity and the maximum day demands.

As shown in Table 9-9, there is a storage deficiency of 2.1 MG in Pressure Zone 475. To meet this storage deficiency it is recommended that a new 2.1 MG storage tank be constructed between Humboldt Drive and Coyote Way. This storage tank will provide additional storage supply to Pressure Zone 475 and/or to Pressure Zone 635 through booster pump stations. This new storage tank will be filled by existing groundwater wells in this pressure zone during the off-peak operation time which should provide some savings in pump energy for the District.

Pumping Capacity

Table 9-10 provides a summary of the evaluation of the wells serving Pressure Zone 475.

**Table 9-10. Summary of Pressure Zone 475 Pumping Capacity**

| | Pressure Zone 475 |
|---|---|
| Wells Serving Pressure Zone | 33, 50, 65, 67, 70, 72 and 76 |
| Firm groundwater pumping capacity, gpm [(a)] | 5,750 |
| Average day demand in pressure zone, gpm[(b)] | 4,148 |
| Maximum day plus fire flow demand in pressure zone, gpm[(b, c)] | 7,436 |
| Peak hour demand in pressure zone, gpm[(b,d)] | 8,904 |
| Reliability: At least two pumps (1 duty pump and 1 standby pump) to use in the event of mechanical failure | No |
| Backup power provided | [(e)] |
| Adequate capacity during maximum day plus fire flow demand | Yes |
| Adequate capacity during peak hour demand | Yes |
| Additional capacity required, gpm | 0[(f)] |

(a) There are only wells serving Pressure Zone 475. All well pumps have only one pump. Because there are only seven wells in Pressure Zone 475, the firm groundwater pumping capacity assumes that the largest well is out of service for maintenance or other issues (e.g., water quality). Therefore, the firm groundwater pumping capacity is 5,750 gpm (7,050 gpm – 1,300 gpm for largest well)

(b) Includes demand required to be conveyed through a booster pump station to the upper pressure zones.

(c) Maximum day demand equals 2.0 times average day demand. Fire flow demand is 1,500 gpm for 2 hours.

(d) Peak hour demand equals 3.0 times average day demand.

(e) Only 4 groundwater wells in Pressure Zone 475 have backup power.

(f) The hydraulic model indicates that approximately 1,673 gpm can be supplied from storage tanks located at Station 66, and 3,566 gpm can be supplied from the new 2.1 MG storage tank located at BCIP-82 (between Humboldt Road and Coyote Way) (see Water Storage Capacity discussion above) during either a maximum day plus fire flow or peak hour demand condition. Based on this, the additional pumping capacity required is Peak hour (8,904 gpm) – Firm groundwater capacity (5,750 gpm) - Station 66 (1,673 gpm) – New Storage Tank in Pressure Zone 475 (3,566 gpm) = 0 gpm.

As shown in Table 9-10, with the supply from recommended new storage tank in Pressure Zone 475, no additional pumping capacity is required in Pressure Zone 475.

Water Distribution System

*Peak Hour*

During a peak hour demand condition, results indicate that the buildout system in Pressure Zone 475 could deliver peak hour demands under the Chico-Hamilton City District's minimum pressure criteria of 40 psi (see Figure 9-9), except for some areas along Sparrow Hawk Lane, Humboldt Road, near Station 66, Delaney Drive, and Peninsula Drive.

The low pressures range from 34 to 37 psi near Sparrow Hawk Lane, which is located above the Pressure Zone 475 service elevation. Based on the specific locations along Sparrow Hawk Lane, it will be difficult to adjust pressure without affecting those areas which already have adequate pressure. WYA recommends that Cal Water evaluate whether the customers in this area are willing to sign a low pressure agreement, and request individual customers to install small booster pump systems to increase pressure in the homes. No mitigation is recommended at this time.

The low pressures near Station 66, Delaney Drive (near Station 73), Humboldt Road, and Peninsula Drive reflected pressures near operated facilities. Since there would not be any service connection near these areas, no mitigation is recommended at this time.

Head losses and velocities in Pressure Zone 475 are adequate to meet the Chico-Hamilton City District maximum design criteria of 10 ft/kft and 7 fps as shown on Figure 9-9.

*Maximum Day plus Fire Flow Demand*

A fire flow demand of 1,500 gpm was simulated in Pressure Zone 475. Results indicate that the buildout system in Pressure Zone 475 is able to meet the required fire flow demand.

**Pressure Zone 570**

As previously mentioned, this new pressure zone, Pressure Zone 570, has been created to serve the new development area south of Southgate. The storage, pumping, and distribution system needs for this new pressure zone are discussed below.

Water Storage Capacity

Table 9-11 presents a summary of the operational, fire flow, and emergency storage requirements for Pressure Zone 570.

**Table 9-11. Pressure Zone 570 Storage Requirements**

| Storage Component | Criteria | Pressure Zone 570 Storage Required, MG |
|---|---|---|
| Operational | 25% of max day demand | 3.89 |
| Operational Storage Credit | 50% of excess of groundwater supply[(a)] | 0 |
| | Operational Storage Required | 3.89 |
| Fire Flow | 4,000 gpm for 4 hours | 0.96 |
| Emergency | 50% of max day demand (100% of average day demand) | 7.78 |
| Emergency Storage Credit | 100% of wells with auxiliary power | 0 |
| | Emergency Storage Required | 7.78 |
| | Total Storage Requirement | 12.63 |
| | Existing Storage Available | 0 |
| | Total Storage Deficiency | 12.63 |

(a) Excess groundwater supply is defined as the difference between the firm groundwater pumping capacity and the maximum day demands.

This new pressure zone is hydraulically separated from the main system. As shown in Table 9-11, there is a total storage deficiency (need) of 12.63 MG. To meet the emergency storage required, it is recommended that eight new wells equipped with backup power (two 1,300 gpm wells and six 1,650 gpm wells) be constructed to provide an emergency storage credit of 18 MG. To meet the required operational and fire flow storage, two new 2.5 MG storage tanks are recommended in Pressure Zone 570. It is recommended that one of the tanks be located just south of Skyway Avenue and the other be located south of Nance Canyon. Both storage tanks will require booster pumps (7.5 mgd; total capacity 5,205 gpm; firm capacity 3,470 gpm).

Pumping Capacity

Table 9-12 provides a summary of the evaluation of the wells and pump stations serving Pressure Zone 570.

**Table 9-12. Summary of Pressure Zone 570 Pumping Capacity**

| | Pressure Zone 570 |
|---|---|
| Pump Stations Serving Pressure Zone | None (new pressure zone) |
| Firm groundwater pumping capacities, gpm [(a)] | 0 |
| Firm booster pumping capacities, gpm [(a)] | 0 |
| Average day demand in pressure zone, gpm | 5,402 |
| Maximum day plus fire flow demand in pressure zone, gpm[(b)] | 14,804 |
| Peak hour demand in pressure zone, gpm[(c)] | 16,206 |
| Reliability: At least two pumps (1 duty pump and 1 standby pump) to use in the event of mechanical failure[(a)] | No |
| Backup power provided[(a)] | No |
| Adequate capacity during maximum day plus fire flow demand | Yes |
| Adequate capacity during peak hour demand | Yes |
| Additional capacity required, gpm | 16,206[(d)] |

(a) New pressure zone with no existing facilities.
(b) Maximum day demand equals 2.0 times average day demand. Fire flow is 4,000 gpm for 4 hours.
(c) Peak hour demand equals 3.0 times average day demand.
(d) Peak hour condition controls.

As shown in Table 9-12, the required firm pumping capacity in Pressure Zone 570 is 16,206 gpm (23.3 mgd). As discussed above, eight new wells (two 1,300 gpm wells and six 1,650 gpm wells) are recommended in Pressure Zone 570. These new wells would provide a firm groundwater pumping capacity of 10,850 gpm. Also, in conjunction with the new storage tanks recommended in Pressure Zone 570, two new 7.5 mgd booster pumps are recommended (each with a total pumping capacity of 5,205 gpm and a firm pumping capacity of 3,470 gpm).

Water Distribution System

*Peak Hour*

During a peak hour demand condition, results indicate that the buildout system in Pressure Zone 570 could deliver peak hour demands under the Chico-Hamilton City District's minimum pressure criteria of 40 psi (see Figure 9-10). System pressures in Pressure Zone 570 range from 50 to 104 psi.

Due to wide range of elevations in this pressure zone, three pressure reducing valves are recommended to prevent high pressure in the lower elevations.

Head losses and velocities in Pressure Zone 570 are adequate to meet the Chico-Hamilton City District maximum design criteria of 10 ft/kft and 7 fps as shown on Figure 9-10.

*Maximum Day plus Fire Flow Demand*

A fire flow demand of 4,000 gpm was simulated in Pressure Zone 570, and results indicate that the buildout system in Pressure Zone 570 is able to meet the required residual pressure.

**Pressure Zone 635**

Water Storage Capacity

Table 9-13 presents a summary of the operational, fire flow, and emergency storage requirements for Pressure Zone 635.

**Table 9-13. Pressure Zone 635 Storage Requirements**

| Storage Component | Criteria | Pressure Zone 635 Storage Required, MG |
|---|---|---|
| Operational | 25% of max day demand | 0.50 |
| Operational Storage Credit | 50% of excess of groundwater supply[(a)] | 0 |
| | Operational Storage Required | 0.50 |
| Fire Flow | 1,500 gpm for 2 hours | 0.18 |
| Emergency | 50% of max day demand (100% of average day demand) | 1.00 |
| Emergency Storage Credit | 100% of wells with auxiliary power | 0 |
| | Emergency Storage Required | 1.00 |
| | Total Storage Requirement | 1.68 |
| | Existing Storage Available | 0.5 |
| | Projected Storage Deficiency | 1.18 |

(a) Excess groundwater supply is defined as the difference between the firm groundwater pumping capacity and the maximum day demands.

As shown in Table 9-13, there is a storage deficiency of 1.18 MG in Pressure Zone 635. In order to correct his deficiency, a new 1.2 MG storage tank is recommended to provide additional storage capacity to serve the future growth in this pressure zone. The proposed location for this new storage tank is between Humboldt Road and Highway 32.

Pumping Capacity

Table 9-14 provides a summary of the evaluation of the pump stations serving Pressure Zone 635.

**Table 9-14. Summary of Pressure Zone 635 Pumping Capacity**

| | Pressure Zone 635 |
|---|---|
| Pump Stations Serving Pressure Zone | 66 and 73 |
| Firm booster pumping capacity, gpm | 1,100 |
| Average day demand in pressure zone, gpm | 694 |
| Maximum day plus fire flow demand in pressure zone, gpm[(a)] | 2,888 |
| Peak hour demand in pressure zone, gpm[(b)] | 2,082 |
| Reliability: At least two pumps (1 duty pump and 1 standby pump) to use in the event of mechanical failure | Yes |
| Backup power provided | Yes |
| Adequate capacity during maximum day plus fire flow demand | No |
| Adequate capacity during peak hour demand | No |
| Additional capacity required, gpm | 349[(c)] |

(a) Maximum day demand equals 2.0 times average day demand. Fire flow demand is 1,500 gpm for 2 hours.
(b) Peak hour demand equals 3.0 times average day demand.
(c) The hydraulic model indicates that approximately 1,439 gpm can be supplied from Station 74 tank and/or 2,078 gpm can be supplied from new storage tank (BCIP-84) located between Humboldt Road and Highway 32 during a maximum day plus fire flow demand condition. Additional capacity required is Max Day plus fire flow (2,888 gpm) – Firm capacity (1,100 gpm) – Station 74 (1,439 gpm) = 349 gpm.

As shown in Table 9-14, an additional pumping capacity of 349 gpm is required within Pressure Zone 635. A new 3.17 mgd (total capacity 2,200 gpm; firm capacity 1,100 gpm) booster pump station is recommended in conjunction with the recommended new 1.2 MG storage tank discussed above.

Water Distribution System

*Peak Hour*

During a peak hour demand condition, results indicate that the buildout system in Pressure Zone 635 could adequately deliver peak hour demands to most areas in this pressure zone under the Chico-Hamilton City District's minimum pressure criteria of 40 psi (see Figure 9-11). Pressures ranged between 40 and 133 psi. Low pressures (10 to 17 psi), as shown on Figure 9-11, are located near supply facilities (Stations 66 and 74). Because there is no service connection at these locations, no mitigation is recommended.

As illustrated on Figure 9-11, velocities and head losses throughout the pipelines in Pressure Zone 635 meet the Chico-Hamilton City District's maximum velocity and head loss criteria which are 7 fps and 10 ft/kft, respectively.

*Maximum Day plus Fire Flow Demand*

Fire flow demands of 1,500 gpm were simulated in Pressure Zone 635. Results indicate that the buildout system in Pressure Zone 635 is able to meet the required residual pressure.

**Pressure Zone 795**

Water Storage Capacity

Table 9-15 presents a summary of the operational, fire flow, and emergency storage requirements for Pressure Zone 795.

**Table 9-15. Pressure Zone 795 Storage Requirements**

| Storage Component | Criteria | Pressure Zone 795 Storage Required, MG |
|---|---|---|
| Operational | 25% of max day demand | 0.35 |
| Operational Storage Credit | 50% of excess of groundwater supply[(a)] | 0 |
| | Operational Storage required | 0.35 |
| Fire Flow | 1,500 gpm for 2 hours | 0.18 |
| Emergency | 50% of max day demand (100% of average day demand) | 0.70 |
| Emergency Storage Credit | 100% of wells with auxiliary power | 0 |
| | Emergency Storage Required | 0.70 |
| | Total Storage Requirement | 1.23 |
| | Existing Storage Available | 0 |
| | Total Storage Deficiency | 1.23 |

(a) Excess groundwater supply is defined as the difference between the firm groundwater pumping capacity and the maximum day demands.

As shown in Table 9-15, there is a storage deficiency in Pressure Zone 795 of 1.23 MG. To correct this deficiency, a new 1.3 MG storage tank is recommended to provide additional storage capacity in Pressure Zone 795. The proposed location is at the southeast intersection of Shadowtree Lane and Whispering Winds Lane.

Pumping Capacity

Table 9-16 provides a summary of the evaluation of the pump stations serving Pressure Zone 795.

**Table 9-16. Summary of Pressure Zone 795 Pumping Capacity**

| | Pressure Zone 795 |
|---|---|
| Pump Station(s) Serving Pressure Zone | 66 |
| Firm booster pumping capacity, gpm | 1,530[c] |
| Average day demand in pressure zone, gpm | 486 |
| Maximum day plus fire flow demand in pressure zone, gpm[a] | 2,472 |
| Peak hour demand in pressure zone, gpm[c] | 1,458 |
| Reliability: At least two pumps (1 duty pump and 1 standby pump) to use in the event of mechanical failure | Yes |
| Backup power provided | No |
| Adequate capacity during maximum day plus fire flow demand | No |
| Adequate capacity during peak hour demand | Yes |
| Additional capacity required, gpm | 0[d] |

(a) Maximum day demand equals 2.0 times average day demand. Fire flow demand is 1,500 gpm for 2 hours.
(b) Peak you demand equals 3.0 times average day demand
(c) Includes additional pumping capacity required for existing system (see Chapter 8).
(d) The hydraulic model indicates that approximately 2,952 gpm can be supplied from the new storage tank (Station BCIP-85) located southeast of Shadowtree Lane (see discussion above) during a maximum day plus fire flow demand condition. Additional capacity required is Max Day Plus Fire Flow (2,475 gpm) – Firm Capacity (1,530 gpm) – New tank (2,952 gpm) = 0 gpm.

As shown in Table 9-16, there is no additional pumping capacity required within Pressure Zone 795.

Water Distribution System

*Peak Hour*

During a peak hour demand condition, results indicate that the buildout system in Pressure Zone 795 could not deliver peak hour demands under the Chico-Hamilton City District's minimum pressure criteria of 40 psi (see Figure 9-12). System pressures in Pressure Zone 795 range from 29 to 190 psi. There is one area where pressures range between 29 to 30 psi. This area is located at elevation 771 feet which is higher than the service elevation for Pressure Zone 795. Since the new storage tank is recommended to be constructed on the highest elevation available (812 feet) on the open parcel for future growth, it is not possible to serve this low pressure area to meet the District's minimum pressure criteria of 40 psi. It is recommended that the new development be limited to ground elevation of 720 feet.

The high pressure area was simulated at one area located along Whispering Wind Lane, south of Canyon Oaks Terrace. There is no customer connection along this pipeline; therefore, no recommendation is required.

Head losses and velocities in Pressure Zone 795 are adequate to meet the Chico-Hamilton City District's maximum design criteria of 10 ft/kft and 7 fps as shown on Figure 9-12.

*Maximum Day plus Fire Flow Demand*

Fire flow demands of 1,500 gpm were simulated in Pressure Zone 795. Results indicate that the buildout system in Pressure Zone 795 is adequate to meet the required residual pressure.

**Hamilton City**

Water Storage Capacity

Table 9-17 presents a summary of the operational, fire flow, and emergency storage requirements for Hamilton City.

**Table 9-17. Hamilton City Storage Requirements**

| Storage Component | Criteria | Hamilton City Storage Required, MG |
|---|---|---|
| Operational | 25% of max day demand | 0.33 |
| Operational Storage Credit | 50% of excess of groundwater supply[(a)] | (0.17) |
| | Operational Storage Required | 0.16 |
| Fire Flow | 4,000 gpm for 4 hours | 0.96 |
| Emergency | 50% of max day demand (100% of average day demand) | 0.66 |
| Emergency Storage Credit | 100% of wells with auxiliary power | (2.88) |
| | Emergency Storage Required | 0 |
| | Total Storage Requirement | 1.12 |
| | Existing Storage Available[(b)] | 0.02 |
| | Additional Storage Recommended for Existing System (see Chapter 8) | 1.00 |
| | Total Storage Deficiency | 0.10 |

(a) Excess groundwater supply is defined as the difference between the firm groundwater pumping capacity and the maximum day demands.

(b) Includes recommended new storage with pump station based on additional pumping capacity required to meet existing system requirement during maximum day plus fire flow conditions (see Chapter 8).

As shown in Table 9-17, there is a storage deficiency at buildout of 0.10 MG in Hamilton City. In Chapter 8, a new 1.0 MG storage tank was recommended. To meet the additional storage required for buildout, it is recommended that the 1.0 MG storage tank recommended in Chapter 8 be upsized to 1.1 MG.

Pumping Capacity

Table 9-18 provides a summary of the evaluation of the wells and pump stations serving Hamilton City.

**Table 9-18. Summary of Hamilton City Pumping Capacity**

| | Hamilton City |
|---|---|
| Wells and Pump Stations Serving Pressure Zone | 1-01, 2-01, 2-02, and CIPA |
| Firm groundwater pumping capacities, gpm [(a)] | 1,150 |
| Firm booster pumping capacities, gpm | 3,610[(d)] |
| Average day demand in pressure zone, gpm | 458 |
| Maximum day plus fire flow demand in pressure zone, gpm[(b)] | 4,917 |
| Peak hour demand in pressure zone, gpm[(c)] | 1,375 |
| Reliability: At least two pumps (1 duty pump and 1 standby pump) to use in the event of mechanical failure | Yes |
| Backup power provided | Yes |
| Adequate capacity during maximum day plus fire flow demand | No |
| Adequate capacity during peak hour demand | Yes |
| Additional capacity required, gpm | 157[(e)] |

(a) All well pumps have only one pump. The total firm groundwater pumping capacity assumes the largest well is out of service for maintenance or other issues (e.g., water quality). Therefore, the firm groundwater pumping capacity is 1,150 gpm (2,000 gpm – 850 gpm for largest well).

(b) Maximum day demand equals 2.0 times average day demand. Fire flow demand is 4,000 gpm for 4 hours.

(c) Peak hour demand equals 3.0 times average day demand.

(d) Included additional pumping capacity recommended for existing system in Chapter 8.

(e) Although the hydraulic model indicates that approximately 1,088 gpm can be supplied from Stations 1 and 2 hydropneumatic tanks, no storage credit is given because the size of each tank is only 10,000 gallons. Additional capacity required is Max day plus fire flow (4,917 gpm) – Firm groundwater capacity (1,150 gpm) – Firm booster pumping capacity (3,610 gpm) = 157 gpm.

As shown in Table 9-18, there is a slight additional pumping capacity required within Hamilton City of 157 gpm. However, because the deficiency is so slight (only about 3 percent of the firm groundwater pumping capacity), additional pumping capacity is not recommended.

Water Distribution System

*Peak Hour*

During a peak hour demand condition, results indicate that the buildout system in Hamilton City could deliver peak hour demands under the Chico-Hamilton City District's minimum pressure criteria of 40 psi (see Figure 9-13). System pressures in Hamilton City range from 61 to 70 psi.

Most pipelines meet the District's maximum head loss and velocity criteria as shown in Figure 9-13. However, there are pipelines with head loss above the District's maximum design criteria of 10 ft/kft. These pipelines meet the maximum design velocity criteria of 7 fps, therefore, there is no recommendation for upsizing.

*Maximum Day plus Fire Flow Demand*

A fire flow demand of 4,000 gpm was simulated in Hamilton City. Results indicate that the buildout system in Hamilton City is able to meet the required residual pressure.

## SUMMARY OF RECOMMENDED IMPROVEMENTS FOR BUILDOUT OF THE POTABLE WATER SYSTEM

The recommended improvements needed to eliminate deficiencies identified in the analysis of the buildout distribution systems are summarized below and are shown on Figure 9-14. The estimated costs for these recommended improvements are discussed in Chapter 10.

### Pipelines

- To alleviate head loss and velocity problems in Pressure Zone 350 during maximum day demand plus fire flow, it is recommended to upsize the 8-inch diameter main (approximately 454 feet) along Thorntree Drive, west of Contractors Drive to a 12-inch diameter main and install a 12-inch diameter main (approximately 3,545 feet) along Mcintosh Avenue, from downstream of Dayton PRV/PSV station to Diamond Avenue.
- To alleviate head loss and velocity problems in Pressure Zone 400 during maximum day demand plus fire flow, it is recommended to upsize the 6-inch diameter main (approximately 289 feet) along Fortress Street, between Ryan Avenue and Crusader Court with an 8-inch diameter pipeline.

### Pump Stations

Pressure Zone 350

- 9 new groundwater wells should be constructed to provide additional supply to Pressure Zone 350 to meet increasing demand under buildout conditions. The total capacity of each groundwater shall be 2.66 mgd (1,850 gpm).

- Booster pumps will be required at each of the two new 3.0 MG tanks. Each will need to have a pumping capacity of 8.0 mgd (total capacity 5,560 gpm; firm capacity 4,170 gpm).

Pressure Zone 400

- The new pump station recommended for the existing system at Station 44 (see Chapter 8) should be upsized from 6.84 mgd to 7.53 mgd (total capacity of 5,230 gpm; firm capacity of 3,920 gpm) to meet future pumping requirements during maximum day plus fire flow conditions.

Pressure Zone 570

- 8 new groundwater wells should be constructed to provide supply to the new Pressure Zone 570 located southeast of the Chico District. These groundwater wells include:
  - Six 2.38 mgd (1,650 gpm) groundwater wells
  - Two 1.87 mgd (1,300 gpm) groundwater wells
- New 7.5 mgd booster pump stations (each with a total capacity of 5,205 gpm and firm capacity of 3,470 gpm) booster pump station should be constructed at each of the new 2.5 MG storage tanks in Pressure Zone 570.

Pressure Zone 635

- A new 3.17 mgd (total capacity of 2,200 gpm; firm capacity of 1,100 gpm) (TDH of 320 feet) booster pump station should be constructed to convey water from Pressure Zone 475 to Pressure Zone 635, and to fill the new 1.2 MG storage tank located in Pressure Zone 635.

**Storage Facilities**

Pressure Zone 350

- To meet future operational storage requirements in Pressure Zone 350, the following additional storage facilities should be constructed:
  - An additional 1.0 MG storage tank at Mcintosh Avenue, west of Dayton Road
  - An additional 1.0 MG storage tank between Bruce Road and Potter Road
  - An additional 1.0 MG storage tank southwest of Highway 99 and Entler Avenue
  - Two new 3.0 MG storage tanks in Pressure Zone 350 (one southeast of Forest Avenue and Baney Lane and one at Station 47 along Guynn Avenue)

Pressure Zone 400

- To meet future operational storage requirements in Pressure Zone 400, the new storage tank recommended for the existing system at Station 44 (see Chapter 8) should be upsized from 1.0 MG to 1.2 MG

Pressure Zone 475

- To serve new growth in Pressure Zone 475 and to provide the required storage capacity, a 2.1 MG storage tank should be constructed between Humboldt Road and Coyote Way.

Pressure Zone 570

- To serve new growth in Pressure Zone 570 and to provide the required storage capacity, two new 2.5 MG storage tanks should be constructed in Pressure Zone 570 (one south of Skyway and one south of Nance Canyon).

Pressure Zone 635

- To serve new growth in Pressure Zone 635 and to provide the required storage capacity, a 1.2 MG storage tank should be constructed between Humboldt Road and Highway 32.

Pressure Zone 795

- To serve new growth in Pressure Zone 795 and to provide the required storage capacity, a 1.3 MG storage tank should be constructed on a future parcel at the southeast intersection of Shadowtree Lane and Whispering Winds Lane.

Hamilton City

- To meet future operational storage requirements in Hamilton City, the new storage tank recommended for the existing system (see Chapter 8) should be upsized from 1.0 MG to 1.1 MG.

**Pressure Reducing Stations and Isolation Valves**

Pressure Zone 570

- Because of the wide range in elevations throughout Pressure Zone 570, three pressure reducing valves and one isolation valve should be constructed to eliminate excessive pressure in the lower elevations of Pressure Zone 570.

**Altitude Valves**

- Altitude valves should be installed at all new storage tanks to provide the ability to fill the tank when the pump station is not operating.

***

Public Version

**FIGURE 9-1**

**California Water Service Company Chico - Hamilton City District Water Supply and Facilities Master Plan**

**BUILDOUT WATER SYSTEM**

N

0 0.25 0.5 1

Scale in Miles

NOTES:

LEGEND:

- Station
- Recommended Facilities
- Cal Water Service Area
- Existing Pipes
- Buildout Pipes

**Pressure Zone**

- 350
- 400
- 475
- 635
- 795
- Street

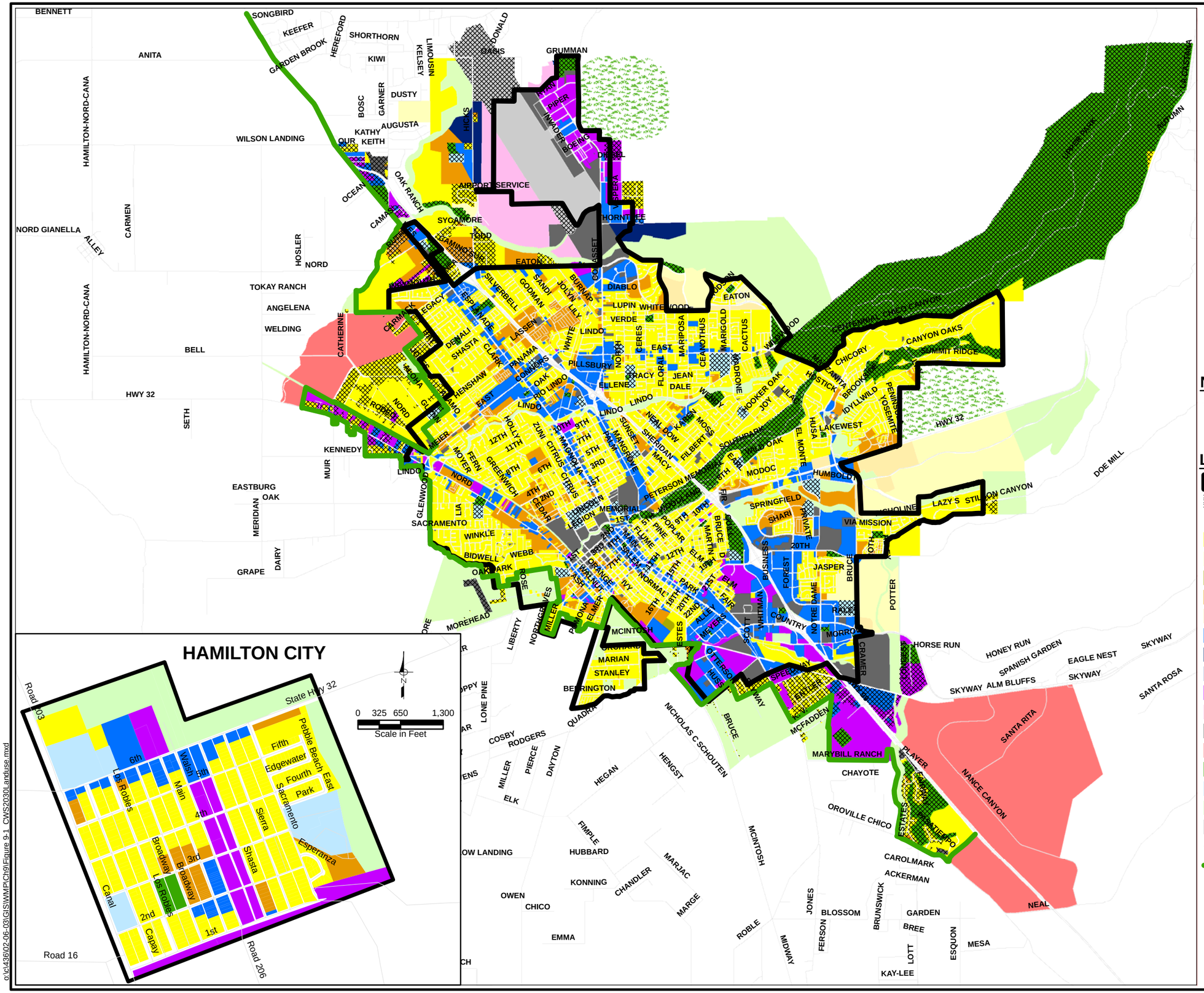
o:\c436\02-06-03\GIS\WMP\Ch8\Figure 9-1_CWSBuildoutSys.mxd

Public Version

# FIGURE 9-2

## California Water Service Company Chico-Hamilton District Water Supply and Facilities Master Plan

## FUTURE LANDUSE




0 0.5 1 2

Scale in Miles

## NOTES:

Greenline is an urban growth boundary adopted by Butte County in 1982.

## LEGEND:

- Water Service Area
- Assumed Served by a Private Well
- No Development Planned
- Residential
- Residential - Preserve
- Residential - Multiple Residences
- Multiple Residences
- Multiple Residences - Preserve
- Commercial
- Commercial - Preserve
- Commercial - Multiple Residences
- Industrial
- Industrial - Preserve
- Government
- Non-Designated Development
- Parks & Recreation
- School
- Open Space/Agriculture
- No Water Demand - Runway
- Streets
- Greenline

CALIFORNIA WATER SERVICE CO.

WEST YOST ASSOCIATES Consulting Engineers

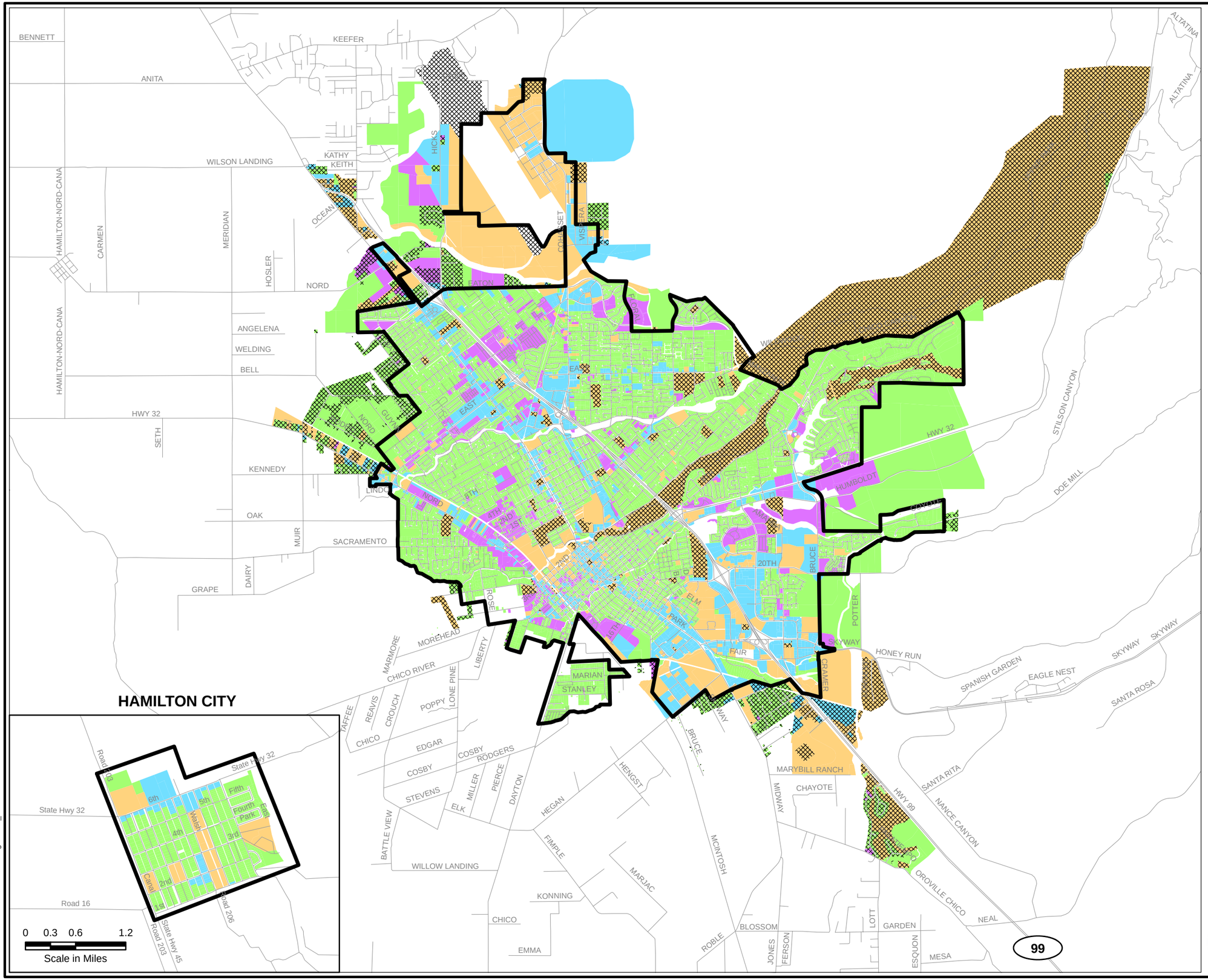
o:\c\436\02-06-03\GIS\WMP\Ch9\Figure 9-1_CWS2030Landuse.mxd

Public Version

# FIGURE 9-3

## California Water Service Company Chico-Hamilton District Water Supply and Facilities Master Plan

## FIRE FLOW DEMANDS




NOTES:

LEGEND:

- Cal Water Service Area
- Assumed Served by Private Well
- Street

**Fire Flow Demand**

- 1,500 gpm for 2 hours
- 2,500 gpm for 2 hours
- 3,000 gpm for 3 hours
- 4,000 gpm for 4 hours

N

0 0.5 1 2

Scale in Miles

CALIFORNIA WATER SERVICE CO.

WEST YOST ASSOCIATES Consulting Engineers

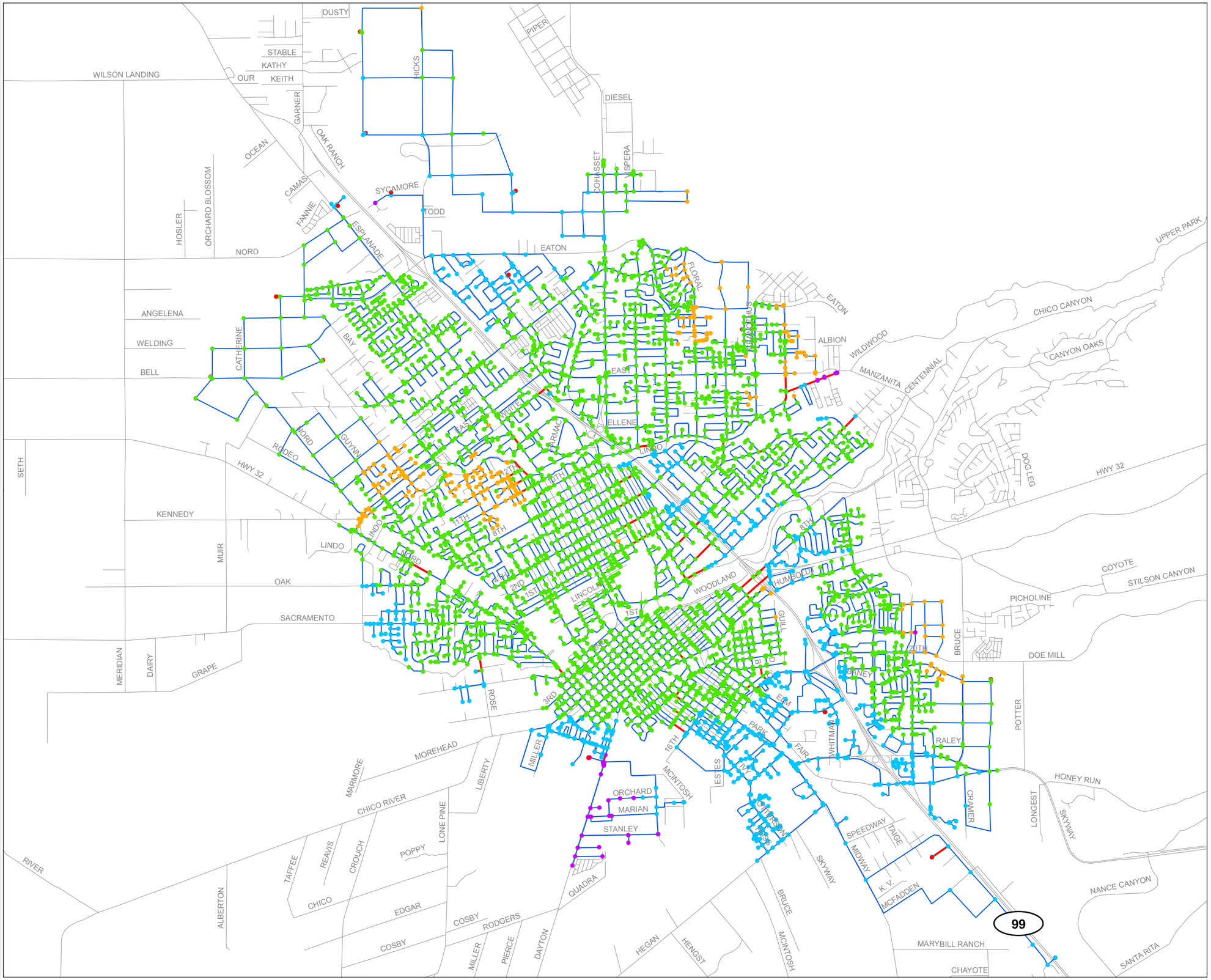
o:\c\436\02-06-03\GIS\WMP\Ch9\Figure 9-3_FireDemands.mxd

Public Version

**FIGURE 9-4**

**California Water Service Company**
**Chico-Hamilton District Water Supply and Facilities Master Plan**

# PRESSURE ZONE 350 PEAK HOUR ANALYSIS




NOTES:

LEGEND:

- Pressure < 40 psi
- 40 ≤ Pressure < 50 psi
- 50 ≤ Pressure < 60 psi
- 60 ≤ Pressure < 70 psi
- Pressure ≥ 70 psi
- HL/1000 < 10 ft/kft
- HL/1000 ≥10 ft/kft
- Street

N

0 0.3 0.6 1.2

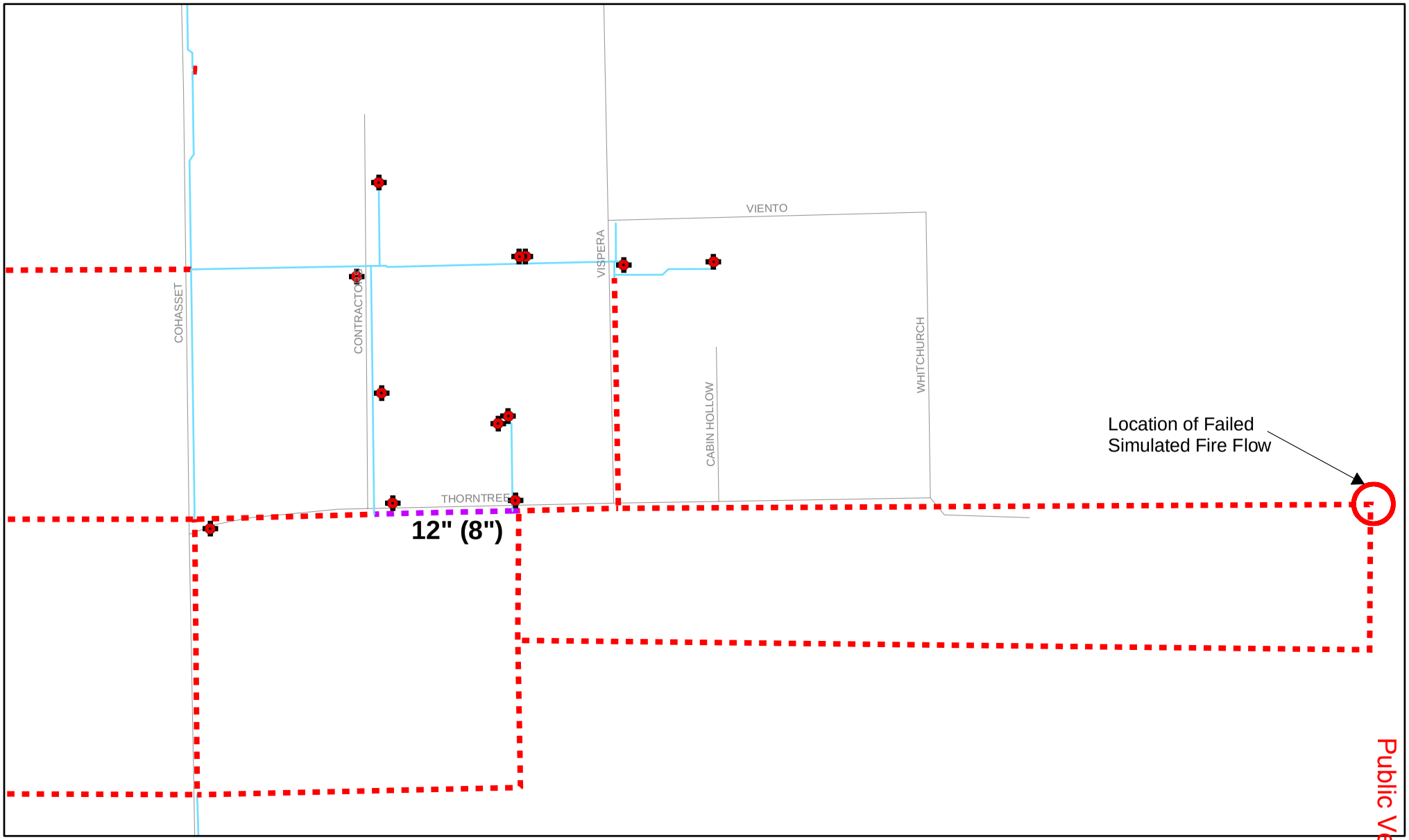
Scale in Miles

CALIFORNIA WATER SERVICE CO.

WEST YOST ASSOCIATES Consulting Engineers

o:\c\436\02-06-03\GIS\WMP\Ch9\Figure 9-4_BuildoutPH_PZ350.mxd

O\C\436\020603\GIS\WMP Figures\C9\Figure 9-5_PZ350 FF Rec1.mxd




LEGEND:

- Hydrant
- Street
- Exisitng Pipeline
- Buildout Pipeline
- Replacement Pipeline

12" (8") Recommended (Existing) Diameters

N

0 150 300 600

Scale in Feet

**FIGURE 9-5**

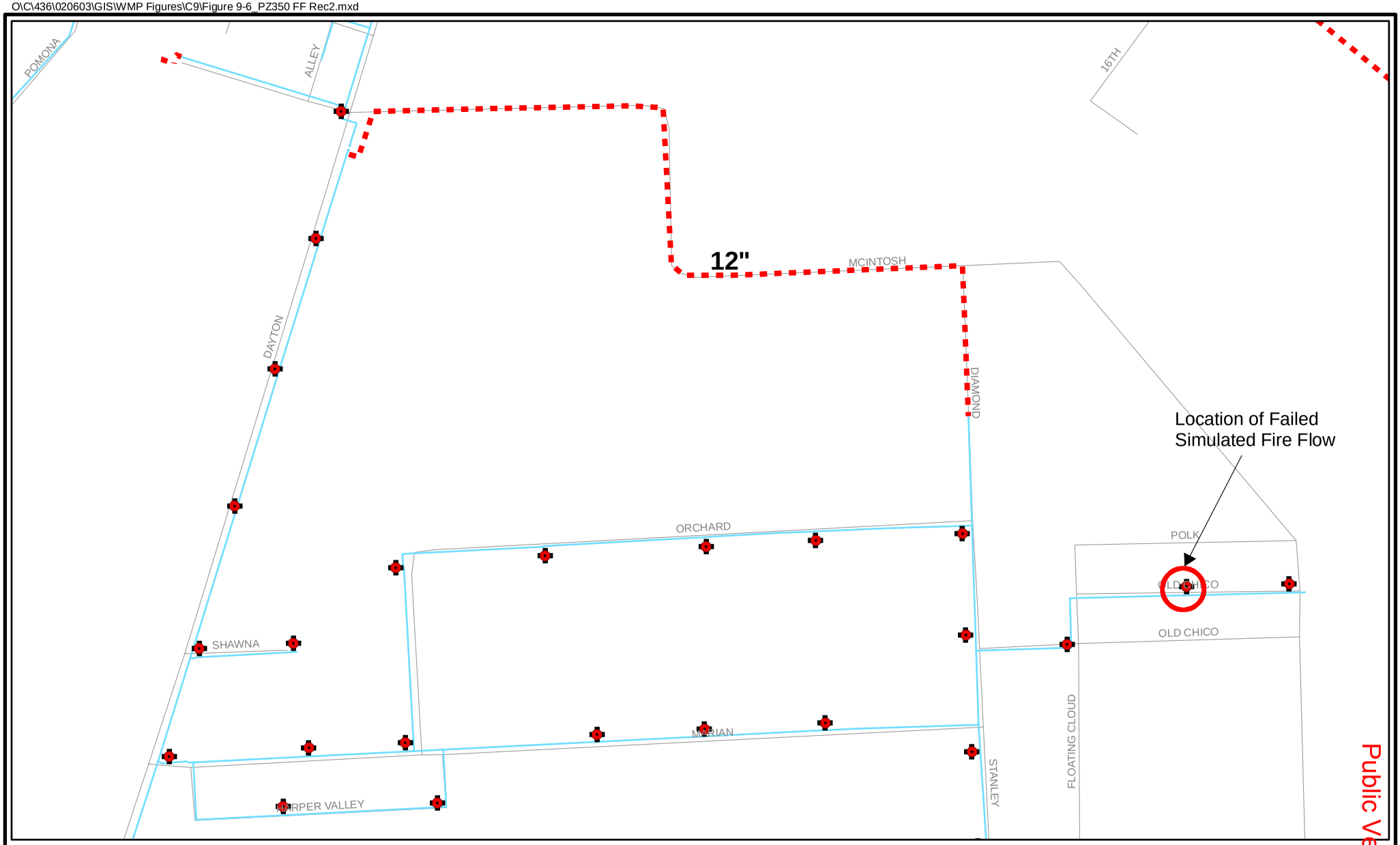
**California Water Service Company**
**Chico-Hamilton District Water**
**Supply and Facilities Master Plan**

**PRESSURE ZONE 350**
**FIRE FLOW RECOMMENDATION**

WEST YOST ASSOCIATES Consulting Engineers

Public Version

O\C\436\020603\GIS\WMP Figures\C9\Figure 9-6_PZ350 FF Rec2.mxd




Public Version

LEGEND:

- Hydrant
- Street
- Exisitng Pipeline
- Buildout Pipeline
- Replacement Pipeline
- 12" (8") Recommended (Existing) Diameters

N

0 170 340 680

Scale in Feet

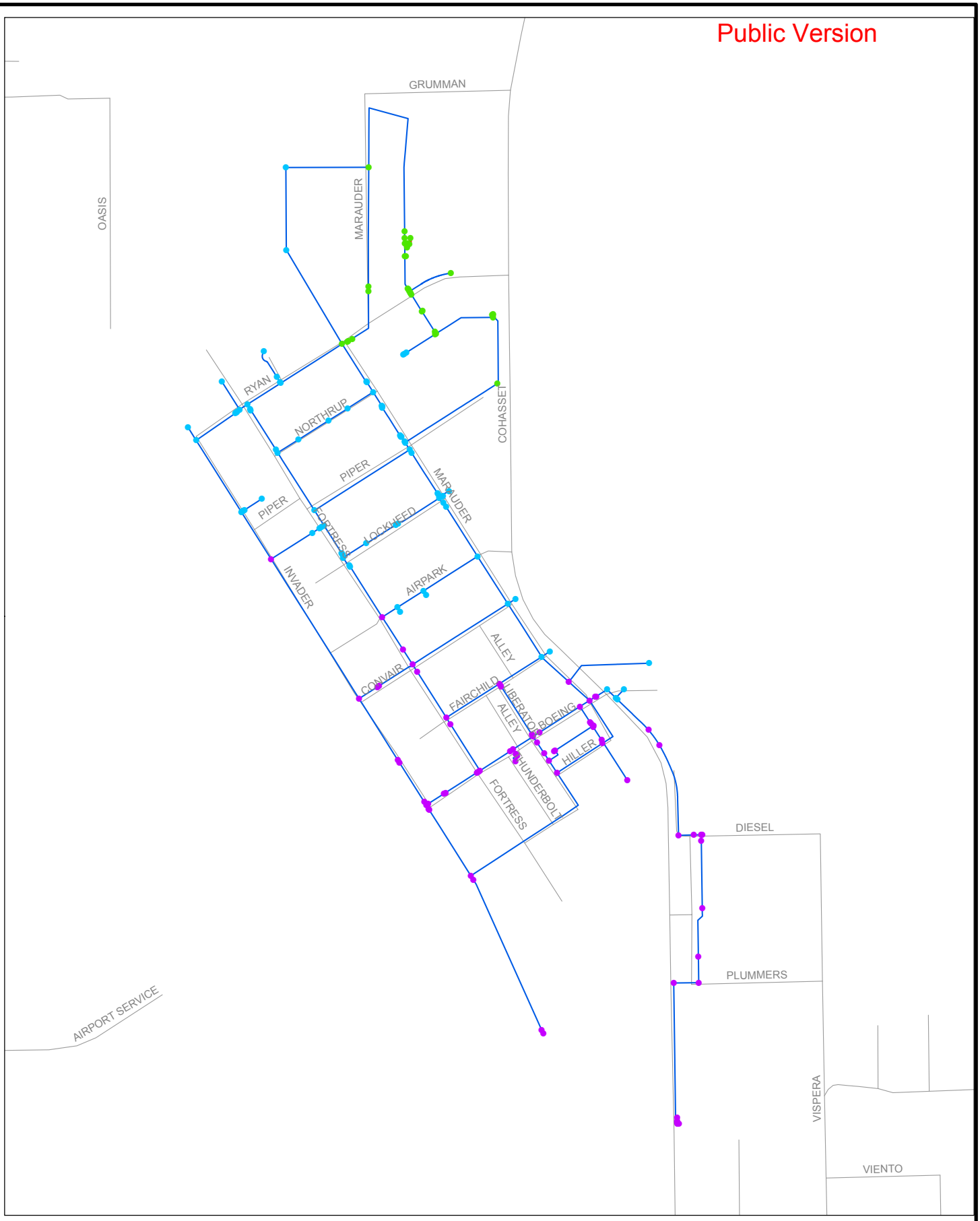
**FIGURE 9-6**

**California Water Service Company**
**Chico-Hamilton District Water**
**Supply and Facilities Master Plan**

**PRESSURE ZONE 350**
**FIRE FLOW RECOMMENDATION**

WEST YOST ASSOCIATES
Consulting Engineers

Public Version




LEGEND:

- Pressure < 40 psi
- 40 ≤ Pressure < 50 psi
- 50 ≤ Pressure < 60 psi
- 60 ≤ Pressure < 70 psi
- Pressure ≥ 70 psi

- HL/1000 < 10 ft/kft
- HL/1000 ≥10 ft/kft
- Street

N

0 0.045 0.09 0.18

Scale in Miles

**FIGURE 9-7**

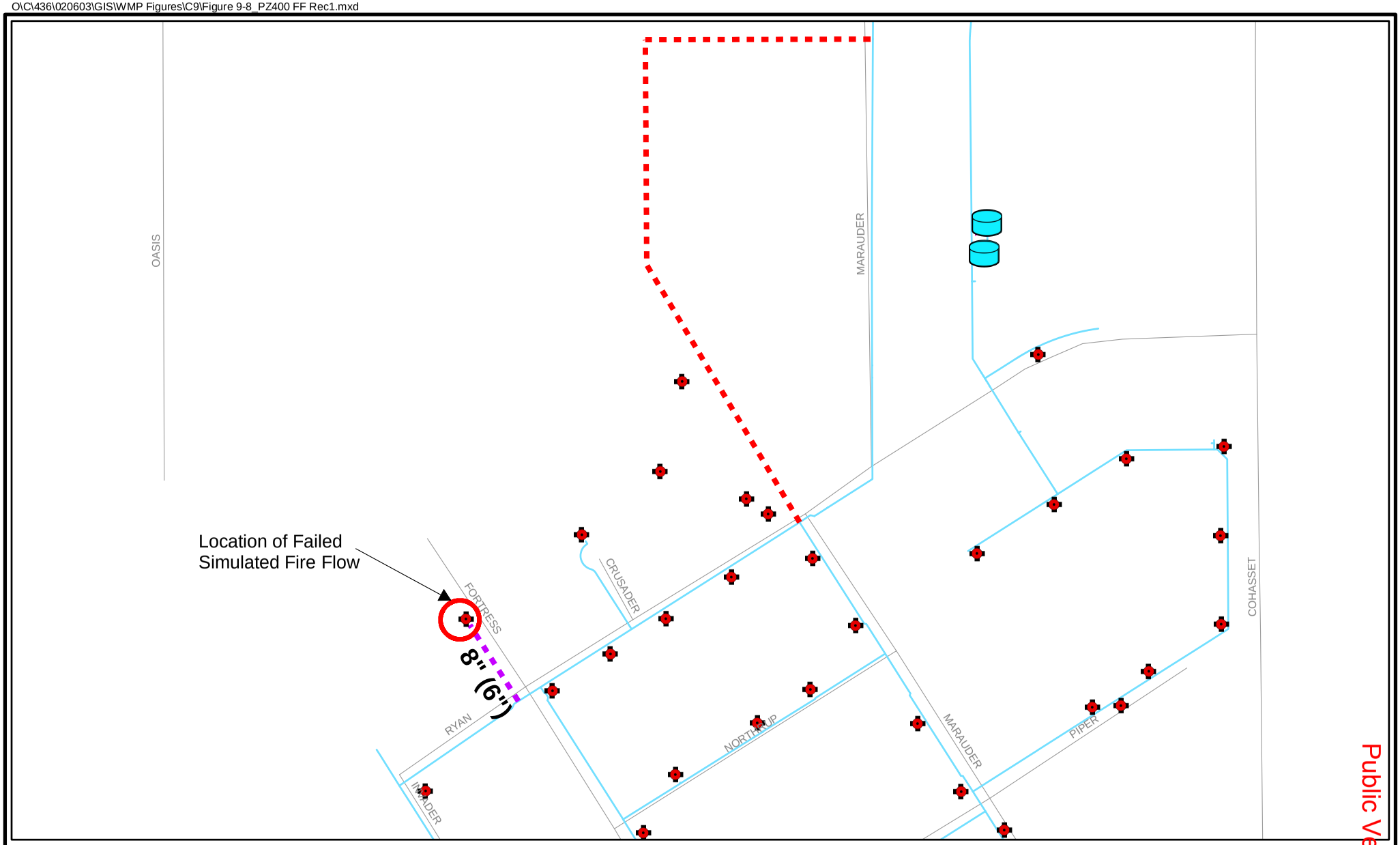
**California Water Service Company**
**Chico-Hamilton District Water**
**Supply and Facilities Master Plan**

**PRESSURE ZONE 400**
**PEAK HOUR ANALYSIS**

WEST YOST ASSOCIATES Consulting Engineers

o:\c\436\02-06-03\GIS\WMP\Ch9\Figure 9-7_BuildoutPH_PZ400.mxd

O\C\436\020603\GIS\WMP Figures\C9\Figure 9-8_PZ400 FF Rec1.mxd




LEGEND:

- Hydrant
- Street
- Exisitng Pipeline
- Buildout Pipeline
- Replacement Pipeline

12" (8") Recommended (Existing) Diameters

N

0 150 300 600

Scale in Feet

**FIGURE 9-8**

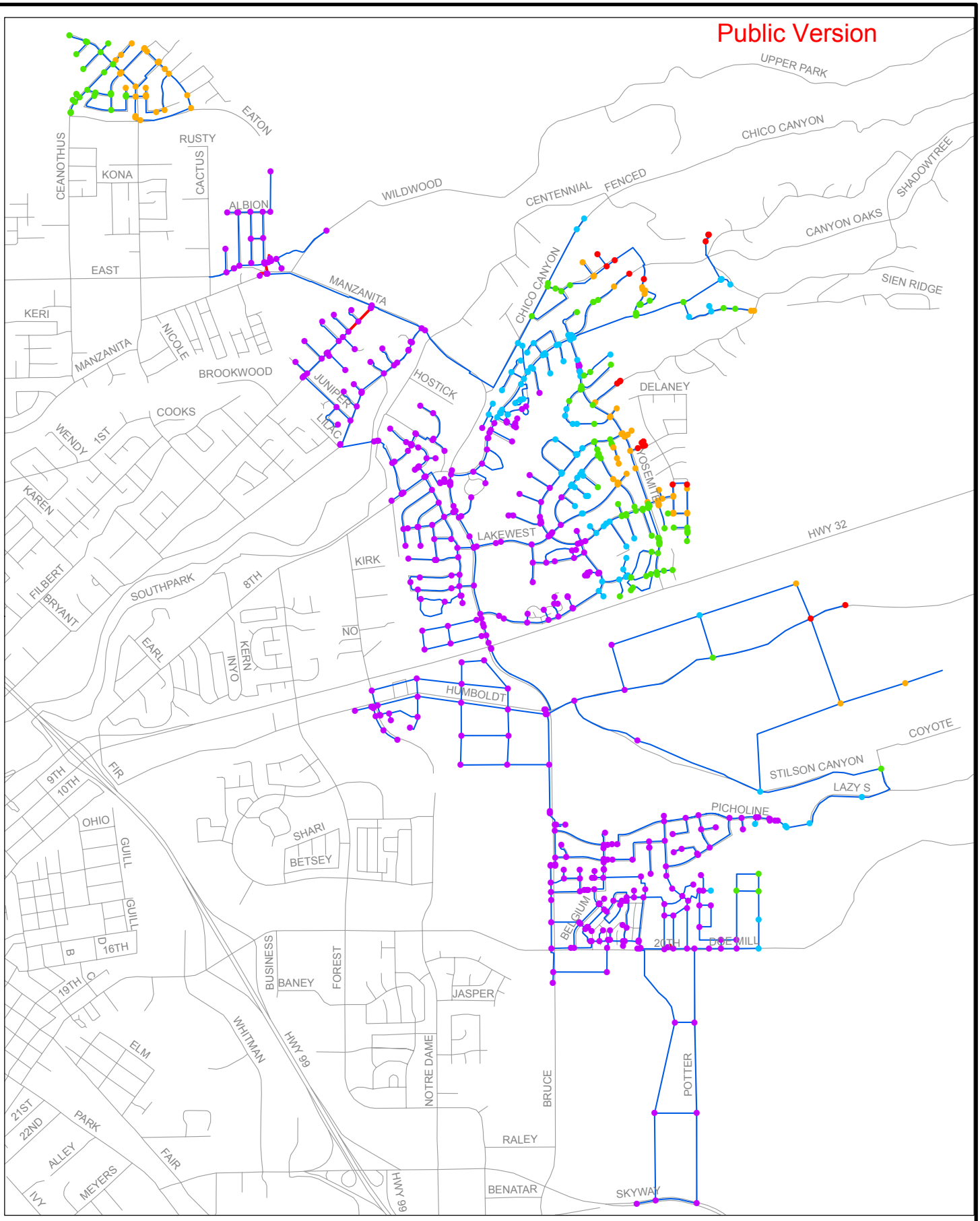
**California Water Service Company**
**Chico-Hamilton District Water**
**Supply and Facilities Master Plan**

**PRESSURE ZONE 400**
**FIRE FLOW RECOMMENDATION**

WEST YOST ASSOCIATES Consulting Engineers

Public Version

Public Version




LEGEND:

- Pressure < 40 psi
- 40 ≤ Pressure < 50 psi
- 50 ≤ Pressure < 60 psi
- 60 ≤ Pressure < 70 psi
- Pressure ≥ 70 psi

- HL/1000 < 10 ft/kft
- HL/1000 ≥10 ft/kft
- Street

N

0 0.1 0.2 0.4

Scale in Miles

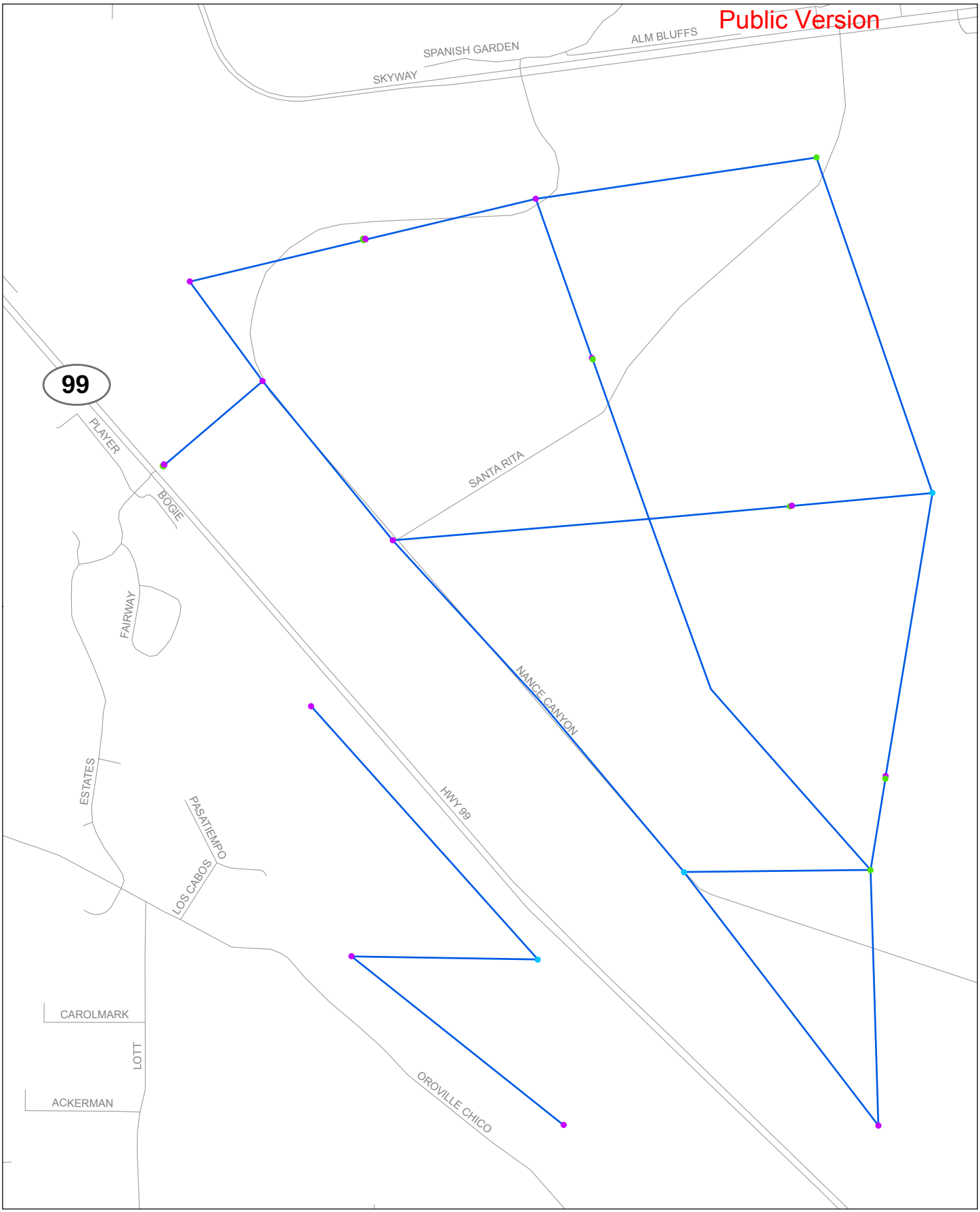
**FIGURE 9-9**

**California Water Service Company**
**Chico-Hamilton District Water**
**Supply and Facilities Master Plan**

**PRESSURE ZONE 475**
**PEAK HOUR ANALYSIS**

WEST YOST ASSOCIATES Consulting Engineers

o:\c\436\02-06-03\GIS\WMP\Ch9\Figure 9-9_BuildoutPH_PZ475.mxd




LEGEND:

- Pressure < 40 psi
- 40 ≤ Pressure < 50 psi
- 50 ≤ Pressure < 60 psi
- 60 ≤ Pressure < 70 psi
- Pressure ≥ 70 psi

- HL/1000 < 10 ft/kft
- HL/1000 ≥ 10 ft/kft
- Street

N

0 0.050.1 0.2

Scale in Miles

**FIGURE 9-10**

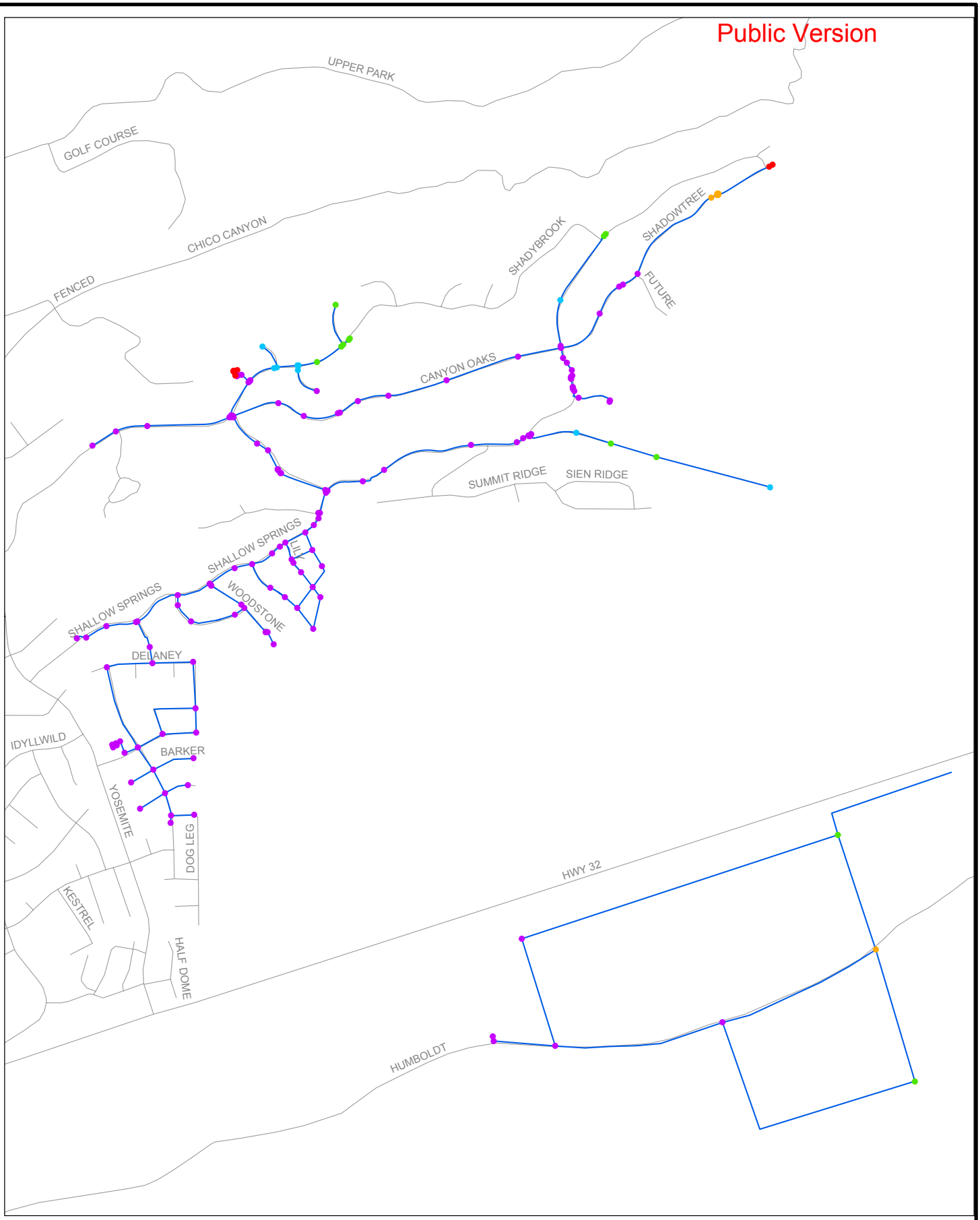
**California Water Service Company**
**Chico-Hamilton City District Water Supply and Facilities Master Plan**

**PRESSURE ZONE 570**
**PEAK HOUR ANALYSIS**

WEST YOST ASSOCIATES Consulting Engineers

o:\c\438\02-06-03\GIS\WMP\Ch9\Figure 9-10_BuildoutPH_PZ570.mxd

Public Version




LEGEND:

- Pressure < 40 psi
- 40 ≤ Pressure < 50 psi
- 50 ≤ Pressure < 60 psi
- 60 ≤ Pressure < 70 psi
- Pressure ≥ 70 psi

- HL/1000 < 10 ft/kft
- HL/1000 ≥10 ft/kft
- Street

N

0 0.03 0.075 0.15

Scale in Miles

**FIGURE 9-11**

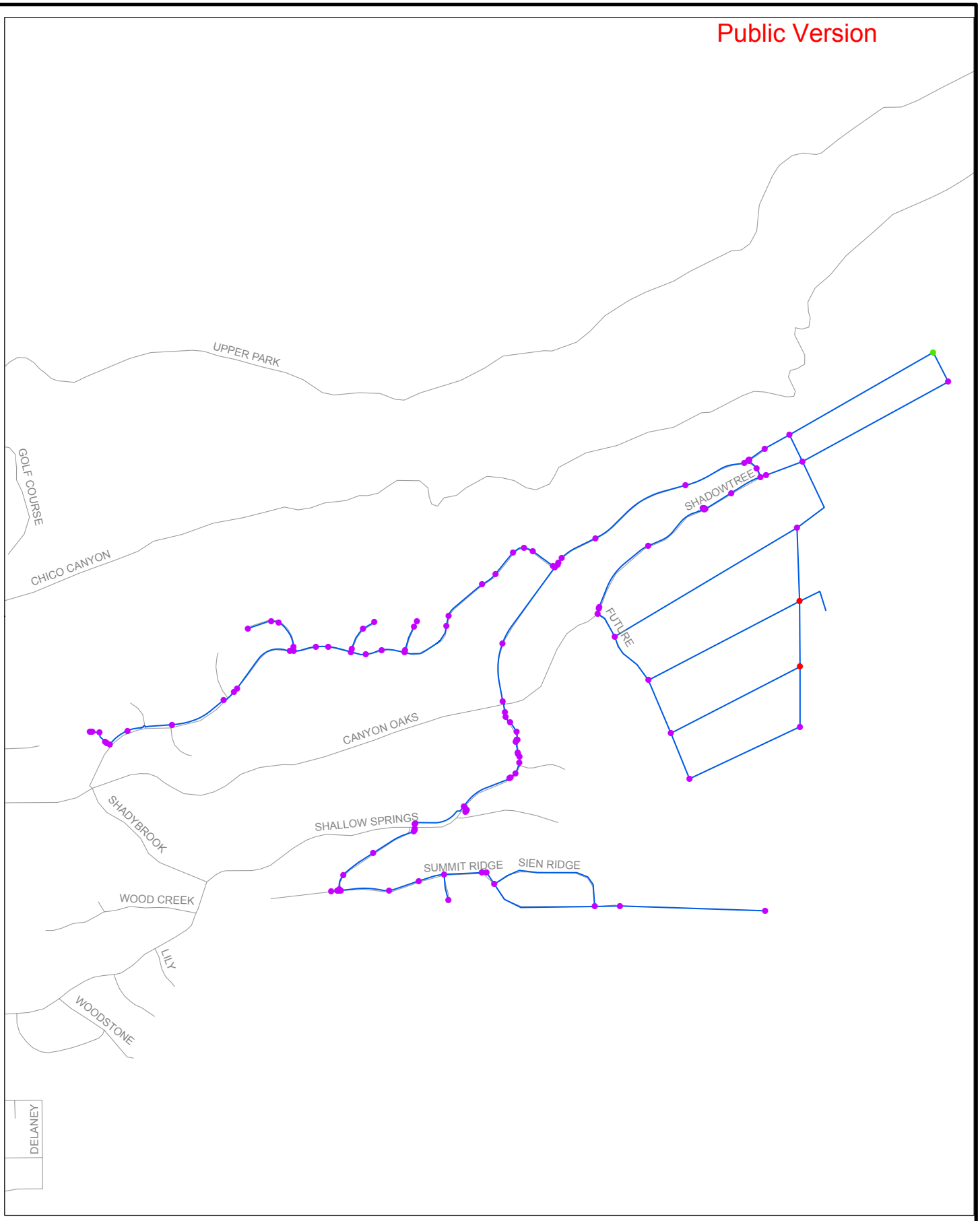
**California Water Service Company**
**Chico-Hamilton District Water**
**Supply and Facilities Master Plan**

**PRESSURE ZONE 635**
**PEAK HOUR ANALYSIS**

WEST YOST ASSOCIATES Consulting Engineers

o:\c\436\02-06-03\GIS\WMP\Ch9\Figure 9-11_BuildoutPH_PZ635.mxd

Public Version




LEGEND:

- Pressure < 40 psi
- 40 ≤ Pressure < 50 psi
- 50 ≤ Pressure < 60 psi
- 60 ≤ Pressure < 70 psi
- Pressure ≥ 70 psi

- HL/1000 < 10 ft/kft
- HL/1000 ≥10 ft/kft
- Street

N

0 0.045 0.09 0.18

Scale in Miles

**FIGURE 9-12**

**California Water Service Company**
**Chico-Hamilton District Water**
**Supply and Facilities Master Plan**

**PRESSURE ZONE 795**
**PEAK HOUR ANALYSIS**

WEST YOST ASSOCIATES Consulting Engineers

o:\c\436\02-06-03\GIS\WMP\Ch9\Figure 9-12_BuildoutPH_PZ795.mxd

Public Version

LEGEND:

- Pressure < 40 psi
- 40 ≤ Pressure < 50 psi
- 50 ≤ Pressure < 60 psi
- 60 ≤ Pressure < 70 psi
- Pressure ≥ 70 psi

- HL/1000 < 10 ft/kft
- HL/1000 ≥10 ft/kft
- Street

N

0 0.03 0.06 0.12

Scale in Miles

**FIGURE 9-13**

**California Water Service Company**
**Chico-Hamilton District Water**
**Supply and Facilities Master Plan**

**HAMILTON CITY**
**PEAK HOUR ANALYSIS**

WEST YOST ASSOCIATES Consulting Engineers

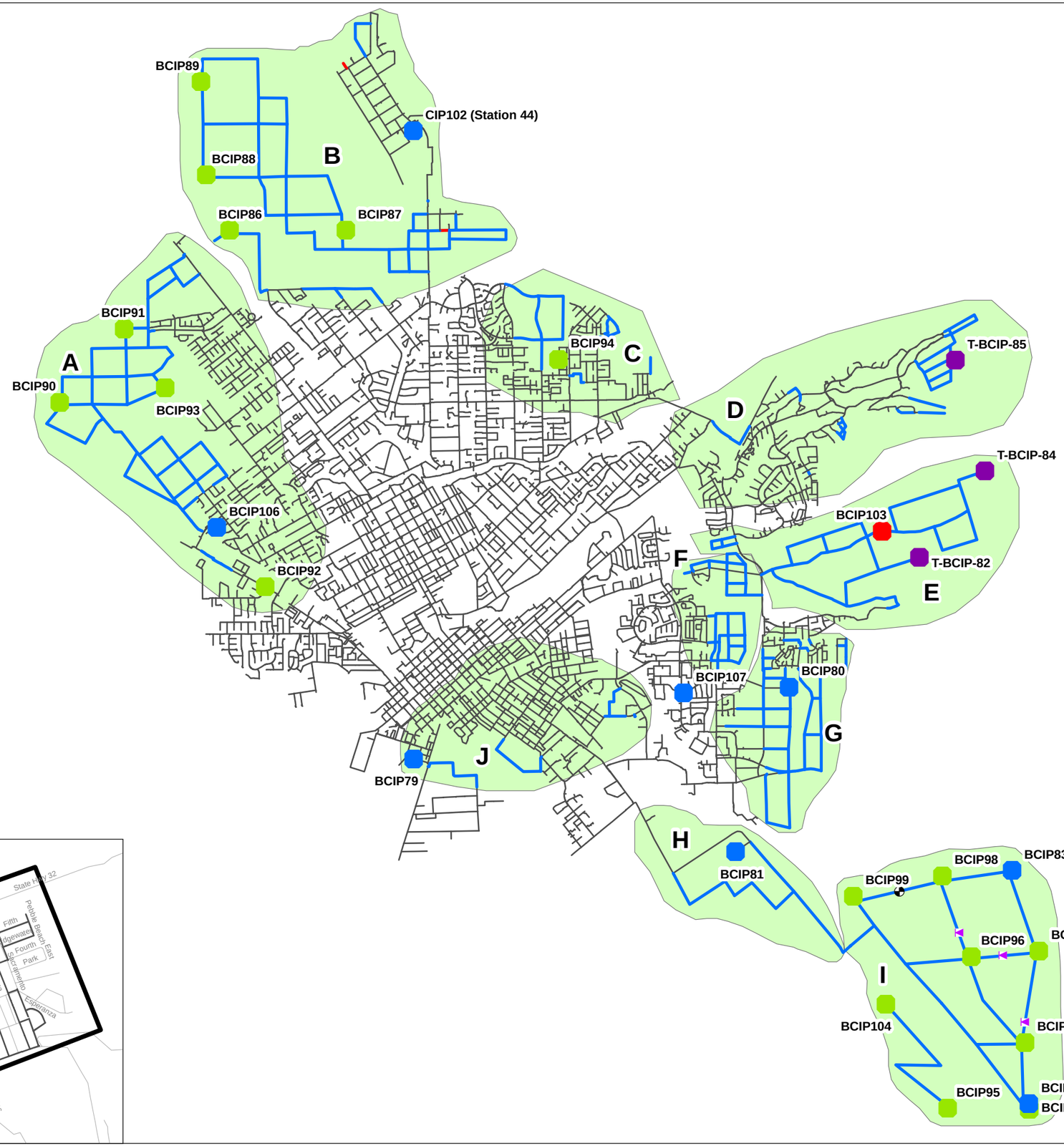
o:\c436\02-06-03\GIS\WMP\Ch9\Figure 9-13_BuildoutPH_PZHC.mxd

Public Version

**FIGURE 9-14**

**California Water Service Company**
**Chico - Hamilton City District Water Supply and Facilities Master Plan**

## RECOMMENDED BUILDOUT IMPROVEMENTS




0 0.25 0.5 1
Scale in Miles

NOTES:

LEGEND:

- New Booster Pump Station
- New Pumped Storage
- New Groundwater Well
- New Gravity Tanks
- New Closed Gate Valve
- New Pressure Reducing Station
- Existing Pipes
- Recommended New Pipeline
- Recommended Pipeline Replacement
- A CIP Development Area

o:\c\436\02-06-03\GIS\WMP\Ch9\Figure 9-14_CWSCIP.mxd

# Chapter 10: Recommended Capital Improvement Program

*Chapter Contents:*


- Recommended Capital Improvement Program
  - ❖Existing Water System Improvements
  - ❖Buildout Water System Improvements
  - ❖Recommended CIP Costs
- Capital Improvement Program Implementation


*Chapter Highlights:*

This chapter presents the recommended CIP for the Chico-Hamilton City District's existing and buildout water system. Several recommendations for improvements to the existing and buildout water system were described previously in Chapters 8 and 9, respectively. This chapter provides descriptions of the recommended CIP program, along with estimates of probable construction costs.

Costs are presented in May 2008 dollars based on an ENR CCI of 8141 (20 Cities Average). Total CIP costs include the following contingencies and cost allowances:

- Construction Contingency: 20 percent
- Project Cost Allowances:
  - ❖Planning, Engineering and Environmental Studies: 10 percent
  - ❖Construction Management: 10 percent
  - ❖Program Implementation: 8 percent

A complete description of the assumptions used in developing the estimates of probable construction costs is provided in Appendix R.

*Summary of CIP and R&R Costs:*

| *Recommended Improvements* | *Existing System* | *Buildout System* | *Totals* |
|---|---|---|---|
| Pipeline Improvements | $4.61 M | $89.89 M | $94.50 M |
| Pump Station Improvements | $15.71 M | $19.43 M | $35.14 M |
| Storage Improvements | $11.50 M | $29.51 M | $41.01 M |
| Emergency Generators | $0.83 M | -- | $0.83 M |
| Groundwater Well Improvements | $0 M | $39.61 M | $39.61 M |
| New Pressure Reducing Stations | $0 M | $0.06 M | $0.06 M |
| R&R Costs | $53.53 M | $31.71 M | $85.24 M |
| *Totals* | *$86.18 M* | *$210.21 M* | *$296.39 M* |

# CHAPTER 10. RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

This chapter presents the recommended CIP for the Chico-Hamilton District's existing and buildout water system. Several recommendations for improvements to the existing and buildout water system were described previously in Chapters 8 and 9, respectively. This chapter provides descriptions of the recommended CIP program, along with estimates of probable construction costs.

Costs are presented in May 2008 dollars based on an Engineering News Record Construction Cost Index (ENR CCI) of 8141 (20 Cities Average). Total CIP costs include the following contingencies and project cost allowances:

- Construction Contingency: 20 percent
- Project Cost Allowances:
  - Design: 10 percent
  - Construction Management: 10 percent
  - Administration: 8 percent

A complete description of the assumptions used in developing the estimates of probable construction costs is provided in Appendix R.

## RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

### Existing Water System Improvements

Chapter 8 provided a description of the evaluation of the Chico-Hamilton District's existing water system and its ability to meet the established operational and design criteria described in Chapter 5. Based on the evaluation, several improvements to the existing system were recommended to eliminate existing deficiencies, as listed in Table 10-1. In addition, Chapter 7 provided a suggested R&R schedule (0 to 5 years) for many of the existing facilities. These have been grouped into several recommended CIP projects, and include the following:

<u>Existing Improvements</u>

*Pressure Zone 350*

- A new 2.7 MG storage tank and 7.49 mgd booster pump station located at Silver Dollar Way to provide storage in Pressure Zone 350 (CIP 78).
- A new 1.0 MG storage tank and 3.24 mgd booster pump station located at Mcintosh Avenue (west of Dayton Road) to provide storage in Pressure Zone 350 (CIP 79).

- A new 1.0 MG storage tank and 6.34 mgd booster pump station located between Bruce Road and Potter Road (south of East 20th Street) to provide storage in Pressure Zone 350 (CIP 80). CIP 80 also includes approximately 840 ft of 8-inch-diameter pipeline and 1,254 ft of 12-inch diameter pipeline to connect the new storage tank to the existing distribution system.
- A new 1.0 MG storage tank and 4.54 mgd booster pump station located southwest of Highway 99 and Entler Avenue (west of Norfield Avenue) to provide storage in Pressure Zone 350 (CIP 81). CIP 81 includes approximately 8,004 ft of 12-inch-diameter pipeline to connect the new storage tank to the existing distribution system.
- Standby generators at Stations 54, 71, and 75 in Pressure Zone 350 (CIP 108).

*Pressure Zone 400*

- A new 1.0 MG storage tank and 6.84 mgd pump station at Station 44 in Pressure Zone 400 (CIP 102).

*Pressure Zone 795*

- Additional 2.44 mgd pumping capacity at Station 66 for Pressure Zone 795 to meet maximum day plus fire flow demand condition pressure requirements (CIP 66).

*Hamilton City*

- A new 1.0 MG storage tank and 6.93 mgd pump station located north of Broadway Avenue and 6th Street to provide storage in Hamilton City (CIP A).

Pipeline improvements to meet existing maximum day demand plus fire flow demand conditions in Pressure Zone 350 and Hamilton City (pipeline locations, lengths, and sizes are listed in Table 10-1).

**Table 10-1. Recommended Pipeline CIP for Existing System to Meet Maximum Day plus Fire Flow Demand Conditions**

| CIP ID[(a)] | Pressure Zone | Description of Location | Length, feet | Diameter, inches | |
|---|---|---|---|---|---|
| | | | | Existing | Recommended |
| FF10 | Pressure Zone 350 | Along Eastwood Avenue | 645 | NA | 8 |
| FF11 | Pressure Zone 350 | Along Pine Street | 167 | 2 | 8 |
| FF01 | Hamilton City | Along 6th Street between Broadway Avenue and alley located southwest of Capay Avenue | 196 | 6 | 12 |
| FF02 | Hamilton City | Along 6th Street between alley of Broadway Avenue and Los Robles, and alley located west of Capay Avenue | 762 | 6 | 8 |
| FF03 | Hamilton City | Along 1st Street between Station 1 and Broadway Avenue | 515 | 6 | 8 |
| FF04 | Hamilton City | Along Broadway Avenue between 1st Street and 6th Street | 2,892 | NA | 12 |
| FF05 | Hamilton City | Along 2nd Street between Broadway Avenue and alley of Los Robles Avenue and Capay Avenue | 630 | NA | 12 |
| FF06 | Hamilton City | Along 2nd Street between alley of Los Robles Avenue and Capay Avenue, and Capay Avenue | 250 | 6 | 8 |
| FF07 | Hamilton City | Along 5th Street between Station 2 and alley between Shasta Avenue and Sierra Avenue | 1,048 | NA | 8 |
| FF08 | Hamilton City | Along 2nd Street between Sacramento Avenue and alley of Sacramento Avenue and Sierra Avenue | 198 | NA | 8 |
| FF09 | Hamilton City | Along 4th Street between Broadway Avenue and alley of Broadway Avenue and Los Robles Avenue | 208 | NA | 8 |

(a) The "FF" in the CIP ID stands for fire flow and "PH" stands for peak hour. This means the CIP is either fire flow or peak hour related.

Renewal and Replacement (0 to 5 Years)

- Groundwater Production Wells[1]
  - Chico Stations 1, 3, 4, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 44
  - Hamilton City Station 1
- Well Pumps
  - Chico Stations 1, 4, 5, 8, 11, 16, 21, 22, 23, 25, 27, 29, 30, 32, 33, 35, 40, 42, 47, 50, 51, 52, 53, 54, 56, 58
- Well Pump Motors
  - Chico Stations 1, 4, 5, 8, 11, 18, 19, 20, 22, 23, 24, 25, 26, 27, 29, 30, 32, 33, 39, 40, 42, 46, 47, 49, 50, 51, 52, 53, 54, 55, 56, 58
- Tanks
  - Station 1 Tanks 1 and 2
  - Station 3 Tank 4
  - Station 8 Tank 3
  - Station 44 Pressurized Tank
- Booster Pump Stations
  - Station 16 (motor)
  - Station 50A
- SCADA
  - Chico Stations 24, 33, 44, 49, 53, 64, 65, 66D, 67, 68, 69, 70, 71, 72
  - Hamilton City Stations 1, 2-1 and 2-2

The locations of the recommended existing system CIP projects are shown on Figure 10-1. Details of the recommended existing system CIP projects are provided in Chapter 8 and R&R projects in Chapter 7.

**Buildout Water System Improvements**

Chapter 9 provided a description of the evaluation of the District's buildout water system and its ability to meet the established operational and design criteria described in Chapter 5. Based on the evaluation, several improvements were recommended for the District's water system to meet buildout demands.. In addition, Chapter 7 provided a suggested R&R schedule (5 years to 25 years) for many of the existing facilities. These have been grouped into recommended Buildout CIP (BCIP) projects, and include the following:

[1] Only includes drilling and developing of new well. Does not include mechanical pumping equipment, electrical pumping equipment, land acquisition, building and fencing.

Future Improvements

*Pressure Zone 350*

- Nine groundwater wells to provide additional supply to Pressure Zone 350. Each well should have a rated capacity of approximately 2.66 mgd (1,850 gpm) (BCIP 86-94)
- Another new 1.0 MG storage tank located at Mcintosh Avenue (west of Dayton Road) to provide additional storage in Pressure Zone 350 (same site as CIP 79 discussed in Chapter 8) (BCIP 79).
- Another new 1.0 MG storage tank located between Bruce Road and Potter Road (south of East 20th Street) to provide additional storage in Pressure Zone 350 (same site as CIP 80 discussed in Chapter 8) (BCIP 80).
- Another new 1.0 MG storage tank located southwest of Highway 99 and Entler Avenue (west of Norfield Avenue) to provide additional storage in Pressure Zone 350 (same site as CIP 81 discussed in Chapter 8) (BCIP 81).
- A new 3.0 MG storage tank with an 8.0 mgd booster pump located in Pressure Zone 350 located southeast of Forest Avenue and Baney Lane (BCIP 106).
- A new 3.0 MG storage tank with an 8.0 mgd booster pump located in Pressure Zone 350 located at Station 47 along Guynn Avenue (BCIP 107).

*Pressure Zone 400*

- Upsize the new 1.0 MG storage tank at Station 44 in Pressure Zone 400 (see Chapter 8) to 1.2 MG to meet future needs and upsize the new 6.84 mgd pump station at Station 44 in Pressure Zone 400 (see Chapter 8) to 7.53 mgd to increase pumping capacity in Pressure Zone 400 during future maximum day plus fire flow demands (CIP 102).

*Pressure Zone 475*

- A new 2.1 MG storage tank located between Humboldt Road and Coyote Way to provide additional storage in Pressure Zone 475 (BCIP 82).

*Pressure Zone 570*

- Eight groundwater wells to provide supply to the new Pressure Zone 570 located southeast of Chico District (BCIP 95-101 and 104).
  - Six 2.38 mgd (1,650 gpm) groundwater wells
  - Two 1.87 mgd (1,300 gpm) groundwater wells
- Two new 2.5 MG storage tanks, each with a 7.5 mgd booster pump, located in Pressure Zone 570 (one south of Skyway and one south of Nance Canyon) (BCIP 83A and 83C),.
- Three pressure reducing stations in Pressure Zone 570.

*Pressure Zone 635*

- A new 1.2 MG storage tank located between Humboldt Road and Highway 32 to provide additional storage in Pressure Zone 635 (BCIP 84).
- A new 3.17 mgd booster pump station located along Humboldt Road to convey water from Pressure Zone 475 to Pressure Zone 635 (BCIP 103).

*Pressure Zone 795*

- A new 1.3 MG storage tank located southeast intersection of Shadowtree Lane and Whispering Winds Lane to provide additional storage in Pressure Zone 795 (BCIP 85).

*Hamilton City*

- Upsize the new 1.0 MG storage tank located north of Broadway Avenue and 6th Street to 1.1 MG to provide storage in Hamilton City (see Chapter 8)(CIP A).

Pipeline improvements to meet head loss and velocity criteria during buildout maximum day demand plus fire flow plus fire flow demand conditions (pipeline locations, lengths, and sizes are listed on Table 10-2).

**Table 10-2. Recommended Pipelines CIP for Buildout System to Meet Maximum Day plus Fire Flow Demands Conditions**

| CIP ID[(a)] | Pressure Zone | Description | Length, feet | Diameter, inches | |
|---|---|---|---|---|---|
| | | | | Existing | Recommended |
| BFF01 | 350 | Along Thorntree Drive, west of Contractors Drive | 454 | 8 | 12 |
| BFF02 | 350 | Mcintosh Avenue from discharge side of Dayton PRV/PSV station to Diamond Avenue | 3,545 | NA | 12 |
| BFF03 | 400 | Along Fortress Street between Ryan Avenue and Crusader Court | 289 | 6 | 8 |

(a) The "BFF" or "BPH" designation in the CIP ID corresponds to buildout fire flow or buildout peak hour requirements, respectively. This means the CIP is related to maintaining either the fire flow or peak hour criteria.

Renewal & Replacement (5 to 25 Years)

- Groundwater Production Wells[2]
  - Stations 5, 38, 39, 40, 41, 42, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 58 and 59
- Well Pumps
  - Chico Stations 3, 7, 9, 12, 14, 15, 17, 18, 19, 20, 24, 26, 28, 31, 32, 34, 37, 38, 39, 41, 44, 46, 48, 49, 55, 57, 59, 61, 62, 63, 64, 65, 67, 68, 69, 70, 71, 72
  - Hamilton City Stations 1, 2-1 and 2-2
- Well Pump Motors
  - Chico Stations 3, 7, 9, 12, 14, 15, 16, 17, 21, 28, 31, 34, 35, 37, 38, 41, 44, 48, 57, 59, 61, 62, 63, 64, 65, 67, 68, 69, 70, 71, 72
  - Hamilton City Stations 1, 2-1 and 2-2
- Tanks
  - Station 50A Pressurized Tank
  - Station 66 Pressurized Tank
- Booster Pump Stations
  - Station 16
  - Station 66 A, B, C, D
  - Station 73 A, B
- SCADA
  - Chico Stations 1, 3, 4, 5, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 37, 38, 39, 40, 41, 42, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72 and 73
  - Hamilton City Station 1, 2-1 and 2-2

The locations of the recommended buildout system CIP projects are shown on Figure 10-2. Details of the recommended buildout CIP projects are provided in Chapter 9.

**Recommended CIP Costs**

The recommended existing system CIP and the R&R Projects are presented in Table 10-3 and Table 10-4, respectively, along with their probable construction costs. The buildout system CIP projects are presented in Table 10-5, along with their probable construction costs. As shown, the existing system CIP and the five years R&R costs are estimated to be $86.18 million. The buildout system and the 5 to 25 years R&R CIP cost are estimated to be $210.21 million.

[2] Only includes drilling and developing of new well. Does not include mechanical pumping equipment, electrical pumping equipment, land acquisition, building and fencing.

Public Version

**Table 10-3. Summary of Probable Construction Costs for Existing CIP[a]**

| Pressure Zone | Improvement Type | Improvement Description | CIP ID | Quantity | 2008-2010 Estimated Construction Cost | 2008-2010 Total CIP Cost (including contingency and cost allowances) | 2011 - 2015 Estimated Construction Cost | 2011 - 2015 Total CIP Cost (including contingency and cost allowances) | 2016 - 2020 Estimated Construction Cost | 2016 - 2020 Total CIP Cost (including contingency and cost allowances) | 2021 - 2025 Estimated Construction Cost | 2021 - 2025 Total CIP Cost (including contingency and cost allowances) | 2026 - Buildout Estimated Construction Cost | 2026 - Buildout Total CIP Cost (including contingency and cost allowances) | Total Cost for Existing and Future CIP by Pressure Zone |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EXISTING CAPITAL IMPROVEMENTS** | | | | | | | | | | | | | | | |
| HC | Pipeline Improvement | 12-inch diameter, 196 lf | FF01 | 196 lf | $ 36,000 | $ 55,000 | | | | | | | | | |
| HC | Pipeline Improvement | 8-inch diameter, 762 lf | FF02 | 762 lf | $ 100,000 | $ 154,000 | | | | | | | | | |
| HC | Pipeline Improvement | 12-inch diameter, 515 lf | FF03 | 515 lf | $ 94,000 | $ 144,000 | | | | | | | | | |
| HC | Pipeline Improvement | 12-inch diameter, 2892 lf | FF04 | 2892 lf | $ 527,000 | $ 810,000 | | | | | | | | | |
| HC | Pipeline Improvement | 12-inch diameter, 630 lf | FF05 | 630 lf | $ 115,000 | $ 177,000 | | | | | | | | | |
| HC | Pipeline Improvement | 8-inch diameter, 250 lf | FF06 | 250 lf | $ 33,000 | $ 51,000 | | | | | | | | | $ 6,172,000 |
| HC | Pipeline Improvement | 8-inch diameter, 1048 lf | FF07 | 1048 lf | $ 138,000 | $ 212,000 | | | | | | | | | |
| HC | Pipeline Improvement | 8-inch diameter, 198 lf | FF08 | 198 lf | $ 26,000 | $ 40,000 | | | | | | | | | |
| HC | Pipeline Improvement | 8-inch diameter, 208 lf | FF09 | 208 lf | $ 27,000 | $ 41,000 | | | | | | | | | |
| HC | Pump Station | New 6.93 mgd Pump Station | CIPA | 6.93 mgd | $ 1,780,000 | $ 2,734,000 | | | | | | | | | |
| HC | Storage Tank | New 1.1 MG Storage Tank [b] | CIPA | 1.1 MG | $ 1,142,000 | $ 1,754,000 | | | | | | | | | |
| 350 | Pipeline Improvement | 8-inch diameter, 645 lf | FF10 | 645 lf | $ 85,000 | $ 131,000 | | | | | | | | | |
| 350 | Pipeline Improvement | 8-inch diameter, 167 lf | FF11 | 167 lf | $ 22,000 | $ 34,000 | | | | | | | | | |
| 350 | Pump Station | New 7.49 mgd Pump Station | CIP78 | 7.49 mgd | $ 1,907,000 | $ 2,929,000 | | | | | | | | | |
| 350 | Storage Tank | New 2.7 MG Storage Tank | CIP78 | 2.7 MG | $ 1,791,000 | $ 2,751,000 | | | | | | | | | |
| 350 | Pump Station | New 3.24 mgd Pump Station | CIP79 | 3.24 mgd | $ 978,000 | $ 1,502,000 | | | | | | | | | |
| 350 | Storage Tank | New 1.0 MG Storage Tank | CIP79 | 1.0 MG | $ 1,136,000 | $ 1,745,000 | | | | | | | | | |
| 350 | Pump Station | New 6.34 mgd Pump Station | CIP80 | 6.34 mgd | $ 1,646,000 | $ 2,528,000 | | | | | | | | | |
| 350 | Storage Tank | New 1.0 MG Storage Tank | CIP80 | 1.0 MG | $ 1,136,000 | $ 1,745,000 | | | | | | | | | $ 20,616,000 |
| 350 | New Pipeline Improvement | 8-inch diameter, 840 lf | CIP80 | 840 lf | $ 110,000 | $ 169,000 | | | | | | | | | |
| 350 | New Pipeline Improvement | 12-inch diameter, 1254 lf | CIP80 | 1254 lf | $ 228,000 | $ 350,000 | | | | | | | | | |
| 350 | Pump Station | New 4.54 mgd Pump Station | CIP81 | 4.54 mgd | $ 1,247,000 | $ 1,915,000 | | | | | | | | | |
| 350 | Storage Tank | New 1.0 MG Storage Tank | CIP81 | 1.0 MG | $ 1,136,000 | $ 1,745,000 | | | | | | | | | |
| 350 | New Pipeline Improvement | 12-inch diameter, 8004 lf | CIP81 | 8004 lf | $ 1,457,000 | $ 2,238,000 | | | | | | | | | |
| 350 | Auxiliary Power | Standby Generator at Stations 54, 71 and 75 | CIP108 | 3 | $ 543,000 | $ 834,000 | | | | | | | | | |
| 400 | Pump Station | New 7.53 mgd Pump Station [c] | CIP102 | 7.53 mgd | $ 1,916,000 | $ 2,943,000 | | | | | | | | | $ 4,706,000 |
| 400 | Storage Tank | New 1.2 MG Storage Tank [d] | CIP102 | 1.2 MG | $ 1,148,000 | $ 1,763,000 | | | | | | | | | |
| 795 | Upgrade Pump Station | Pump Station Upgrade | CIP66 | 2.44mgd | $ 755,000 | $ 1,160,000 | | | | | | | | | $ 1,160,000 |
| | | | **Totals** | | **$ 21,259,000** | **$ 32,654,000** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ -** | **$ 32,654,000** |
| | | | Construction Contingency (20%) | | $ 4,252,000 | | $ - | | $ - | | $ - | | $ - | | |
| | | | **Total Construction Cost** | | **$ 25,511,000** | | **$ -** | | **$ -** | | **$ -** | | **$ -** | | |
| | | | Engineering (10%) | | $ 2,551,000 | | $ - | | $ - | | $ - | | $ - | | |
| | | | Construction Management (10%) | | $ 2,551,000 | | $ - | | $ - | | $ - | | $ - | | |
| | | | Program Implementation (8%) | | $ 2,041,000 | | $ - | | $ - | | $ - | | $ - | | |
| | | | **Total CIP Cost** | | **$ 32,654,000** | | **$ -** | | **$ -** | | **$ -** | | **$ -** | | |

[a] Costs shown based on May 2008 dollars and an ENR CCI of 8,141 (20 Cities Average).

[b] 1.0 MG storage tank is required to meet the storage capacity under existing condition, and the remaining 0.1 MG storage tank is required to meet the storage capacity under buildout condition.

[c] 6.84 mgd pump station is required under existing condition, and additional 0.69 mgd (7.53 mgd - 6.84 mgd) pumping capacity is required under buildout condition.

[d] 1.0 MG storage tank is required to meet the storage capacity under existing condition, and the remaining 0.2 MG storage tank is required to meet the storage capacity under buildout condition.

**Table 10-4. Summary of Probable Construction Costs for Renewal and Replacement CIP**

| Pressure Zone | Improvement Type | Improvement Description | CIP ID | Quantity | 2008-2010 Estimated Construction Cost | 2008-2010 Total CIP Cost (including contingency and cost allowances) | 2011 - 2015 Estimated Construction Cost | 2011 - 2015 Total CIP Cost (including contingency and cost allowances) | 2016 - 2020 Estimated Construction Cost | 2016 - 2020 Total CIP Cost (including contingency and cost allowances) | 2021 - 2025 Estimated Construction Cost | 2021 - 2025 Total CIP Cost (including contingency and cost allowances) | 2026 - Buildout Estimated Construction Cost | 2026 - Buildout Total CIP Cost (including contingency and cost allowances) | Total Cost for Existing and Future CIP by Pressure Zone |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0 to 5 YEARS RENEWAL AND REPLACEMENT** | | | | | | | | | | | | | | | |
| 350 | Renewal and Replacement | Replace Station 1 Well | R&R-STA1 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 3 Well | R&R-STA3 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 4 Well | R&R-STA4 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 7 Well | R&R-STA7 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 8 Well | R&R-STA8 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 9 Well | R&R-STA9 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 11 Well | R&R-STA11 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 12 Well | R&R-STA12 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 13 Well | R&R-STA13 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 14 Well | R&R-STA14 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 15 Well | R&R-STA15 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 16 Well | R&R-STA16 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 17 Well | R&R-STA17 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 18 Well | R&R-STA18 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 19 Well | R&R-STA19 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 20 Well | R&R-STA20 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 21 Well | R&R-STA21 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 22 Well | R&R-STA22 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 23 Well | R&R-STA23 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 24 Well | R&R-STA24 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 25 Well | R&R-STA25 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 26 Well | R&R-STA26 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 27 Well | R&R-STA27 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 28 Well | R&R-STA28 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 29 Well | R&R-STA29 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 30 Well | R&R-STA30 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 31 Well | R&R-STA31 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 32 Well | R&R-STA32 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 34 Well | R&R-STA34 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 35 Well | R&R-STA35 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 1 Well Pump and Motor | R&R-STA1 | | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 4 Well Pump and Motor | R&R-STA4 | | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 5 Well Pump and Motor | R&R-STA5 | | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 8 Well Pump and Motor | R&R-STA8 | | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 11 Well Pump and Motor | R&R-STA11 | | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 16 Well Pump | R&R-STA16 | | $ 12,000 | $ 18,400 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 18 Well Motor | R&R-STA18 | | $ 12,000 | $ 18,400 | | $ - | | $ - | | $ - | | $ - | $ 48,496,000 |
| 350 | Renewal and Replacement | Replace Station 19 Well Motor | R&R-STA19 | | $ 12,000 | $ 18,400 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 20 Well Motor | R&R-STA20 | | $ 12,000 | $ 18,400 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 21 Well Pump | R&R-STA21 | | $ 12,000 | $ 18,400 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 22 Well Pump and Motor | R&R-STA22 | | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 23 Well Pump and Motor | R&R-STA23 | | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 24 Well Motor | R&R-STA24 | | $ 12,000 | $ 18,400 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 25 Well Pump and Motor | R&R-STA25 | | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 26 Well Motor | R&R-STA26 | (a) | $ - | $ - | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 27 Well Pump and Motor | R&R-STA27 | | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 29 Well Pump and Motor | R&R-STA29 | | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 30 Well Pump and Motor | R&R-STA30 | | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 32 Well Motor | R&R-STA32 | (a) | $ - | $ - | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 35 Well Pump | R&R-STA35 | | $ 12,000 | $ 18,400 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 39 Well Motor | R&R-STA39 | (a) | $ - | $ - | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 40 Well Pump and Motor | R&R-STA40 | | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 42 Well Pump and Motor | R&R-STA42 | | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 46 Well Motor | R&R-STA46 | | $ 12,000 | $ 18,400 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 47 Well Pump and Motor | R&R-STA47 | | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 49 Well Motor | R&R-STA49 | | $ 12,000 | $ 18,400 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 51 Well Pump and Motor | R&R-STA51 | | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | | $ - | |

Public Version

| Pressure Zone | Improvement Type | Improvement Description | CIP ID | Quantity | 2008-2010 Estimated Construction Cost | 2008-2010 Total CIP Cost (including contingency and cost allowances) | 2011 - 2015 Estimated Construction Cost | 2011 - 2015 Total CIP Cost (including contingency and cost allowances) | 2016 - 2020 Estimated Construction Cost | 2016 - 2020 Total CIP Cost (including contingency and cost allowances) | 2021 - 2025 Estimated Construction Cost | 2021 - 2025 Total CIP Cost (including contingency and cost allowances) | 2026 - Buildout Estimated Construction Cost | 2026 - Buildout Total CIP Cost (including contingency and cost allowances) | Total Cost for Existing and Future CIP by Pressure Zone |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 350 | Renewal and Replacement | Replace Station 52 Well Pump and Motor | R&R-STA52 | | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 53 Well Pump and Motor | R&R-STA53 | | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 54 Well Pump and Motor | R&R-STA54 | | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 55 Well Motor | R&R-STA55 | | $ 12,000 | $ 18,400 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 56 Well Pump and Motor | R&R-STA56 | | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 58 Well Pump and Motor | R&R-STA58 | | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 1 Tanks | R&R-STA1 | each | $ 300,000 | $ 460,800 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 3 Tank | R&R-STA3 | each | $ 300,000 | $ 460,800 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 8 Tank | R&R-STA8 | each | $ 300,000 | $ 460,800 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 16 Booster Pump Motor | R&R-STA16 | | $ 12,000 | $ 18,400 | | $ - | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Install SCADA at Station 24 | R&R-STA24 | each | $ 5,000 | $ 7,700 | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | |
| 350 | Renewal and Replacement | Install SCADA at Station 49 | R&R-STA49 | each | $ 5,000 | $ 7,700 | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | |
| 350 | Renewal and Replacement | Install SCADA at Station 53 | R&R-STA53 | each | $ 5,000 | $ 7,700 | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | |
| 350 | Renewal and Replacement | Install SCADA at Station 68 | R&R-STA68 | each | $ 5,000 | $ 7,700 | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | |
| 350 | Renewal and Replacement | Install SCADA at Station 69 | R&R-STA69 | each | $ 5,000 | $ 7,700 | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | |
| 350 | Renewal and Replacement | Install SCADA at Station 71 | R&R-STA71 | each | $ 5,200 | $ 8,000 | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | |
| 400 | Renewal and Replacement | Replace Station 44 Well | R&R-STA44 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 400 | Renewal and Replacement | Replace Station 44 Pressure Tank | R&R-STA44 | each | $ 100,000 | $ 153,600 | | $ - | | $ - | | $ - | | $ - | $ 1,720,000 |
| 400 | Renewal and Replacement | Install SCADA at Station 44 | R&R-STA44 | each | $ 5,000 | $ 7,700 | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | |
| 400 | Renewal and Replacement | Install SCADA at Station 64 | R&R-STA64 | each | $ 5,000 | $ 7,700 | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | |
| 475 | Renewal and Replacement | Replace Station 33 Well | R&R-STA33 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| 475 | Renewal and Replacement | Replace Station 33 Well Pump and Motor | R&R-STA33 | | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | | $ - | |
| 475 | Renewal and Replacement | Replace Station 50 Well Pump and Motor | R&R-STA50 | | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | | $ - | |
| 475 | Renewal and Replacement | Replace Station 50 Booster Pump | R&R-STA50 | | $ 12,000 | $ 18,400 | | $ - | | $ - | | $ - | | $ - | |
| 475 | Renewal and Replacement | Install SCADA at Station 33 | R&R-STA33 | each | $ 5,000 | $ 7,700 | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 1,705,000 |
| 475 | Renewal and Replacement | Install SCADA at Station 65 | R&R-STA65 | each | $ 5,000 | $ 7,700 | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | |
| 475 | Renewal and Replacement | Install SCADA at Station 67 | R&R-STA67 | each | $ 5,000 | $ 7,700 | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | |
| 475 | Renewal and Replacement | Install SCADA at Station 70 | R&R-STA70 | each | $ 5,000 | $ 7,700 | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | |
| 475 | Renewal and Replacement | Install SCADA at Station 72 | R&R-STA72 | each | $ 5,000 | $ 7,700 | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | |
| 795 | Renewal and Replacement | Install SCADA at Station 66D | R&R-STA66 | each | $ 5,000 | $ 7,700 | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 15,000 |
| HC | Renewal and Replacement | Replace Station 1 Well | R&R-STA1 | each | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | | $ - | |
| HC | Renewal and Replacement | Install SCADA at Station 1 | R&R-STA1 | each | $ 5,000 | $ 7,700 | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 1,582,000 |
| HC | Renewal and Replacement | Install SCADA at Station 2-1 | R&R-STA2-1 | each | $ 5,000 | $ 7,700 | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | |
| HC | Renewal and Replacement | Install SCADA at Station 2-2 | R&R-STA2-2 | each | $ 5,000 | $ 7,700 | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | |
| **5 TO 25 YEARS RENEWAL AND REPLACEMENT** | | | | | | | | | | | | | | | |
| 350 | Renewal and Replacement | Replace Station 5 Well | R&R-STA5 | each | | $ - | | $ - | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 38 Well | R&R-STA38 | each | | $ - | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 39 Well | R&R-STA39 | each | | $ - | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 40 Well | R&R-STA40 | each | | $ - | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 41 Well | R&R-STA41 | each | | $ - | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 42 Well | R&R-STA42 | each | | $ - | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 46 Well | R&R-STA46 | each | | $ - | | $ - | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 47 Well | R&R-STA47 | each | | $ - | | $ - | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 48 Well | R&R-STA48 | each | | $ - | | $ - | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 49 Well | R&R-STA49 | each | | $ - | | $ - | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 51 Well | R&R-STA51 | each | | $ - | | $ - | | $ - | $ 1,000,000 | $ 1,536,000 | | $ - | |
| 350 | Renewal and Replacement | Replace Station 52 Well | R&R-STA52 | each | | $ - | | $ - | | $ - | $ 1,000,000 | $ 1,536,000 | | $ - | |
| 350 | Renewal and Replacement | Replace Station 53 Well | R&R-STA53 | each | | $ - | | $ - | | $ - | $ 1,000,000 | $ 1,536,000 | | $ - | |
| 350 | Renewal and Replacement | Replace Station 54 Well | R&R-STA54 | each | | $ - | | $ - | | $ - | $ 1,000,000 | $ 1,536,000 | | $ - | |
| 350 | Renewal and Replacement | Replace Station 55 Well | R&R-STA55 | each | | $ - | | $ - | | $ - | $ 1,000,000 | $ 1,536,000 | | $ - | |
| 350 | Renewal and Replacement | Replace Station 56 Well | R&R-STA56 | each | | $ - | | $ - | | $ - | $ 1,000,000 | $ 1,536,000 | | $ - | |
| 350 | Renewal and Replacement | Replace Station 58 Well | R&R-STA58 | each | | $ - | | $ - | | $ - | | $ - | $ 1,000,000 | $ 1,536,000 | |
| 350 | Renewal and Replacement | Replace Station 59 Well | R&R-STA59 | each | | $ - | | $ - | | $ - | | $ - | $ 1,000,000 | $ 1,536,000 | |
| 350 | Renewal and Replacement | Replace Station 3 Well Pump and Motor | R&R-STA3 | | | $ - | | $ - | | $ - | $ 24,000 | $ 36,900 | | $ - | |
| 350 | Renewal and Replacement | Replace Station 7 Well Pump and Motor | R&R-STA7 | | | $ - | | $ - | | $ - | $ 24,000 | $ 36,900 | | $ - | |
| 350 | Renewal and Replacement | Replace Station 9 Well Pump and Motor | R&R-STA9 | | | $ - | | $ - | | $ - | $ 24,000 | $ 36,900 | | $ - | |
| 350 | Renewal and Replacement | Replace Station 12 Well Pump and Motor | R&R-STA12 | | | $ - | | $ - | | $ - | $ 24,000 | $ 36,900 | | $ - | |
| 350 | Renewal and Replacement | Replace Station 14 Well Pump and Motor | R&R-STA14 | | | $ - | | $ - | $ 24,000 | $ 36,900 | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 15 Well Pump and Motor | R&R-STA15 | | | $ - | | $ - | | $ - | $ 24,000 | $ 36,900 | | $ - | |
| 350 | Renewal and Replacement | Replace Station 16 Well Motor | R&R-STA16 | | | $ - | | $ - | | $ - | | $ - | $ 12,000 | $ 18,400 | |
| 350 | Renewal and Replacement | Replace Station 17 Well Pump and Motor | R&R-STA17 | | | $ - | | $ - | | $ - | $ 24,000 | $ 36,900 | | $ - | |
| 350 | Renewal and Replacement | Replace Station 18 Well Pump | R&R-STA18 | | | $ - | | $ - | | $ - | $ 12,000 | $ 18,400 | | $ - | |

Public Version

| Pressure Zone | Improvement Type | Improvement Description | CIP ID | Quantity | 2008-2010 | | 2011 - 2015 | | 2016 - 2020 | | 2021 - 2025 | | 2026 - Buildout | | Total Cost for Existing and Future CIP by Pressure Zone |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Estimated Construction Cost | Total CIP Cost (including contingency and cost allowances) | Estimated Construction Cost | Total CIP Cost (including contingency and cost allowances) | Estimated Construction Cost | Total CIP Cost (including contingency and cost allowances) | Estimated Construction Cost | Total CIP Cost (including contingency and cost allowances) | Estimated Construction Cost | Total CIP Cost (including contingency and cost allowances) | |
| 350 | Renewal and Replacement | Replace Station 19 Well Pump | R&R-STA19 | | | $ - | | $ - | | $ - | $ 12,000 | $ 18,400 | | $ - | |
| 350 | Renewal and Replacement | Replace Station 20 Well Pump | R&R-STA20 | | | $ - | | $ - | | $ - | $ 12,000 | $ 18,400 | | $ - | |
| 350 | Renewal and Replacement | Replace Station 21 Well Motor | R&R-STA21 | | | $ - | | $ - | $ 12,000 | $ 18,400 | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 24 Well Pump | R&R-STA24 | | | $ - | | $ - | $ 12,000 | $ 18,400 | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 26 Well Pump | R&R-STA26 | | | $ - | $ 12,000 | $ 18,400 | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 28 Well Pump and Motor | R&R-STA28 | | | $ - | | $ - | | $ - | $ 24,000 | $ 36,900 | | $ - | |
| 350 | Renewal and Replacement | Replace Station 31 Well Pump and Motor | R&R-STA31 | | | $ - | | $ - | | $ - | $ 24,000 | $ 36,900 | | $ - | |
| 350 | Renewal and Replacement | Replace Station 32 Well Pump | R&R-STA32 | | | $ - | | $ - | | $ - | $ 12,000 | $ 18,400 | | $ - | |
| 350 | Renewal and Replacement | Replace Station 34 Well Pump and Motor | R&R-STA34 | | | $ - | | $ - | | $ - | $ 24,000 | $ 36,900 | | $ - | |
| 350 | Renewal and Replacement | Replace Station 35 Well Motor | R&R-STA35 | | | $ - | | $ - | | $ - | $ 12,000 | $ 18,400 | | $ - | |
| 350 | Renewal and Replacement | Replace Station 37 Well Pump and Motor | R&R-STA37 | | | $ - | | $ - | | $ - | | $ - | $ 24,000 | $ 36,900 | |
| 350 | Renewal and Replacement | Replace Station 38 Well Pump and Motor | R&R-STA38 | | | $ - | | $ - | | $ - | $ 24,000 | $ 36,900 | | $ - | |
| 350 | Renewal and Replacement | Replace Station 39 Well Pump | R&R-STA39 | | | $ - | | $ - | $ 12,000 | $ 18,400 | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 41 Well Pump and Motor | R&R-STA41 | | | $ - | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 46 Well Pump | R&R-STA46 | | | $ - | | $ - | $ 12,000 | $ 18,400 | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 48 Well Pump and Motor | R&R-STA48 | | | $ - | | $ - | | $ - | $ 24,000 | $ 36,900 | | $ - | |
| 350 | Renewal and Replacement | Replace Station 49 Well Pump | R&R-STA49 | | | $ - | | $ - | | $ - | | $ - | $ 12,000 | $ 18,400 | |
| 350 | Renewal and Replacement | Replace Station 55 Well Pump | R&R-STA55 | | | $ - | | $ - | | $ - | | $ - | $ 12,000 | $ 18,400 | |
| 350 | Renewal and Replacement | Replace Station 57 Well Pump and Motor | R&R-STA57 | | | $ - | | $ - | | $ - | | $ - | $ 24,000 | $ 36,900 | |
| 350 | Renewal and Replacement | Replace Station 59 Well Pump and Motor | R&R-STA59 | | | $ - | | $ - | | $ - | $ 24,000 | $ 36,900 | | $ - | |
| 350 | Renewal and Replacement | Replace Station 61 Well Pump and Motor | R&R-STA61 | | | $ - | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 62 Well Pump and Motor | R&R-STA62 | | | $ - | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 63 Well Pump and Motor | R&R-STA63 | | | $ - | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | |
| 350 | Renewal and Replacement | Replace Station 68 Well Pump and Motor | R&R-STA68 | | | $ - | | $ - | | $ - | $ 24,000 | $ 36,900 | | $ - | |
| 350 | Renewal and Replacement | Replace Station 69 Well Pump and Motor | R&R-STA69 | | | $ - | | $ - | | $ - | $ 24,000 | $ 36,900 | | $ - | $ 29,484,000 |
| 350 | Renewal and Replacement | Replace Station 71 Well Pump and Motor | R&R-STA71 | | | $ - | | $ - | | $ - | | $ - | $ 24,000 | $ 36,900 | |
| 350 | Renewal and Replacement | Install SCADA at Station 1 | R&R-STA1 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 3 | R&R-STA3 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 4 | R&R-STA4 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 5 | R&R-STA5 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 7 | R&R-STA7 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 8 | R&R-STA8 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 9 | R&R-STA9 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 11 | R&R-STA11 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 12 | R&R-STA12 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 13 | R&R-STA13 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 14 | R&R-STA14 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 15 | R&R-STA15 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 16 | R&R-STA16 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 17 | R&R-STA17 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 18 | R&R-STA18 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 19 | R&R-STA19 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 20 | R&R-STA20 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 21 | R&R-STA21 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 22 | R&R-STA22 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 23 | R&R-STA23 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 25 | R&R-STA25 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 26 | R&R-STA26 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 27 | R&R-STA27 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 28 | R&R-STA28 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 29 | R&R-STA29 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 30 | R&R-STA30 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 31 | R&R-STA31 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 32 | R&R-STA32 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 34 | R&R-STA34 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 35 | R&R-STA35 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 37 | R&R-STA37 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 38 | R&R-STA38 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 39 | R&R-STA39 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 40 | R&R-STA40 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 41 | R&R-STA41 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 42 | R&R-STA42 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 45 | R&R-STA45 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |

Public Version

| Pressure Zone | Improvement Type | Improvement Description | CIP ID | Quantity | 2008-2010 | | 2011 - 2015 | | 2016 - 2020 | | 2021 - 2025 | | 2026 - Buildout | | Total Cost for Existing and Future CIP by Pressure Zone |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Estimated Construction Cost | Total CIP Cost (including contingency and cost allowances) | Estimated Construction Cost | Total CIP Cost (including contingency and cost allowances) | Estimated Construction Cost | Total CIP Cost (including contingency and cost allowances) | Estimated Construction Cost | Total CIP Cost (including contingency and cost allowances) | Estimated Construction Cost | Total CIP Cost (including contingency and cost allowances) | |
| 350 | Renewal and Replacement | Install SCADA at Station 46 | R&R-STA46 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 47 | R&R-STA47 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 48 | R&R-STA48 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 51 | R&R-STA51 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 52 | R&R-STA52 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 54 | R&R-STA54 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 55 | R&R-STA55 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 56 | R&R-STA56 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 57 | R&R-STA57 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 58 | R&R-STA58 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 59 | R&R-STA59 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 61 | R&R-STA61 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 62 | R&R-STA62 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 350 | Renewal and Replacement | Install SCADA at Station 63 | R&R-STA63 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 400 | Renewal and Replacement | Replace Station 44 Well Pump | R&R-STA44 | | | $ - | | $ - | | $ - | | $ - | $ 12,000 | $ 18,400 | |
| 400 | Renewal and Replacement | Replace Station 44 Well Motor | R&R-STA44 | | | $ - | | $ - | | $ - | $ 12,000 | $ 18,400 | | $ - | $ 74,000 |
| 400 | Renewal and Replacement | Replace Station 64 Well Pump and Motor | R&R-STA64 | | | $ - | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | |
| 475 | Renewal and Replacement | Replace Station 50 Well | R&R-STA50 | each | | $ - | | $ - | $ 1,000,000 | $ 1,536,000 | | $ - | | $ - | |
| 475 | Renewal and Replacement | Replace Station 65 Well Pump and Motor | R&R-STA65 | | | $ - | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | |
| 475 | Renewal and Replacement | Replace Station 67 Well Pump and Motor | R&R-STA67 | | | $ - | | $ - | $ 24,000 | $ 36,900 | | $ - | | $ - | |
| 475 | Renewal and Replacement | Replace Station 70 Well Pump and Motor | R&R-STA70 | | | $ - | | $ - | | $ - | | $ - | $ 24,000 | $ 36,900 | $ 1,853,000 |
| 475 | Renewal and Replacement | Replace Station 72 Well Pump and Motor | R&R-STA72 | | | $ - | | $ - | | $ - | | $ - | $ 24,000 | $ 36,900 | |
| 475 | Renewal and Replacement | Replace Station 50 Pressure Tank | R&R-STA50 | | | $ - | | $ - | | $ - | | $ - | $ 100,000 | $ 153,600 | |
| 475 | Renewal and Replacement | Install SCADA at Station 50 | R&R-STA50 | each | | $ - | | $ - | $ 5,000 | $ 7,700 | | $ - | $ 5,000 | $ 7,700 | |
| 635 | Renewal and Replacement | Replace Station 66 Pressure Tank | R&R-STA66 | | | $ - | | $ - | | $ - | $ 100,000 | $ 153,600 | | $ - | |
| 635 | Renewal and Replacement | Replace Station 66 AB Booster Pump | R&R-STA66AB | | | $ - | $ 24,000 | $ 36,900 | | $ - | | $ - | | $ - | $ 243,000 |
| 635 | Renewal and Replacement | Replace Station 73 AB Booster Pump | R&R-STA73AB | | | $ - | | $ - | | $ - | | $ - | $ 24,000 | $ 36,900 | |
| 635 | Renewal and Replacement | Install SCADA at Station 73 | R&R-STA73 | each | | $ - | $ 5,160 | $ 7,900 | | $ - | $ 5,160 | $ 7,900 | | $ - | |
| HC | Renewal and Replacement | Replace Station 1 Well Pump | R&R-STA1 | | | $ - | | $ - | $ 12,000 | $ 18,400 | | $ - | | $ - | |
| HC | Renewal and Replacement | Replace Station 2-1 Well Pump | R&R-STA2-1 | | | $ - | | $ - | $ 12,000 | $ 18,400 | | $ - | | $ - | $ 55,000 |
| HC | Renewal and Replacement | Replace Station 2-2 Well Pump | R&R-STA2-2 | | | $ - | | $ - | | $ - | $ 12,000 | $ 18,400 | | $ - | |
| | | | **Totals** | | **$ 34,757,200** | **$ 53,390,000** | **$ 5,185,000** | **$ 7,960,000** | **$ 6,380,000** | **$ 9,800,000** | **$ 6,610,000** | **$ 10,150,000** | **$ 2,552,000** | **$ 3,920,000** | **$ 85,230,000** |
| | | | Construction Contingency (20%) | | $ 6,951,000 | | $ 1,037,000 | | $ 1,276,000 | | $ 1,322,000 | | $ 510,000 | | |
| | | | **Total Construction Cost** | | **$ 41,708,200** | | **$ 6,222,000** | | **$ 7,656,000** | | **$ 7,932,000** | | **$ 3,062,000** | | |
| | | | Engineering (10%) | | $ 4,171,000 | | $ 622,000 | | $ 766,000 | | $ 793,000 | | $ 306,000 | | |
| | | | Construction Management (10%) | | $ 4,171,000 | | $ 622,000 | | $ 766,000 | | $ 793,000 | | $ 306,000 | | |
| | | | Program Implementation (8%) | | $ 3,340,000 | | $ 498,000 | | $ 612,000 | | $ 635,000 | | $ 245,000 | | |
| | | | **Total CIP Cost** | | **$ 53,390,000** | | **$ 7,960,000** | | **$ 9,800,000** | | **$ 10,150,000** | | **$ 3,920,000** | | |

[a] Cost has been allocated by Cal Water in their Draft Preliminary Advance GRC Capital Budget (2007 to 2009).

Public Version

**Table 10-5. Summary of Probable Construction Costs for Buildout CIP[a]**

| Pressure Zone | Improvement Type[b] | Improvement Descriptior | CIP ID | Quantity | 2008-2010 Estimated Construction Cost | 2008-2010 Total CIP Cost (including contingency and cost allowances) | 2011 - 2015 Estimated Construction Cost | 2011 - 2015 Total CIP Cost (including contingency and cost allowances) | 2016 - 2020 Estimated Construction Cost | 2016 - 2020 Total CIP Cost (including contingency and cost allowances) | 2021 - 2025 Estimated Construction Cost | 2021 - 2025 Total CIP Cost (including contingency and cost allowances) | 2026 - Buildout Estimated Construction Cost | 2026 - Buildout Total CIP Cost (including contingency and cost allowances) | Total Cost for Existing and Future CIP by Pressure Zone |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BUILDOUT CAPITAL IMPROVEMENTS** | | | | | | | | | | | | | | | |
| 350 | Pipeline Improvement | 12-inch diameter, 454 lf | BFF01 | 454 lf | | $ - | | $ - | $ 68,900 | $ 106,000 | | $ - | | $ - | |
| 350 | Pipeline Improvement | 12-inch diameter, 3,545 lf | BFF02 | 3545 lf | | $ - | | $ - | $ 537,800 | $ 826,000 | | $ - | | $ - | |
| 350 | New Pipeline | 8-inch diameter, 29,365 lf | Group A | 29365 lf | | $ - | | $ - | $ 3,266,700 | $ 5,018,000 | | $ - | | $ - | |
| 350 | New Pipeline | 12-inch diameter, 36,708 lf | Group A | 36708 lf | | $ - | | $ - | $ 5,568,400 | $ 8,553,000 | | $ - | | $ - | |
| 350 | New Pipeline | 8-inch diameter, 27,285 lf | Group B | 27285 lf | | $ - | | $ - | | $ - | $ 3,035,300 | $ 4,662,000 | | $ - | |
| 350 | New Pipeline | 12-inch diameter, 41,403 lf | Group B | 41403 lf | | $ - | | $ - | | $ - | $ 6,280,700 | $ 9,647,000 | | $ - | |
| 350 | New Pipeline | 16-inch diameter, 6,588 lf | Group B | 6588 lf | | $ - | | $ - | | $ - | $ 1,265,900 | $ 1,944,000 | | $ - | |
| 350 | New Pipeline | 8-inch diameter, 1,174 lf | Group C | 1174 lf | | $ - | | $ - | $ 130,600 | $ 201,000 | | $ - | | $ - | |
| 350 | New Pipeline | 12-inch diameter, 10,758 lf | Group C | 10758 lf | | $ - | | $ - | $ 1,631,900 | $ 2,507,000 | | $ - | | $ - | |
| 350 | New Pipeline | 8-inch diameter, 2,709 lf | Group F | 2709 lf | | $ - | | $ - | $ 301,400 | $ 463,000 | | $ - | | $ - | |
| 350 | New Pipeline | 12-inch diameter, 13,004 lf | Group F | 13004 lf | | $ - | | $ - | $ 1,972,700 | $ 3,030,000 | | $ - | | $ - | |
| 350 | New Pipeline | 8-inch diameter, 12,901 lf | Group G | 12901 lf | | $ - | | $ - | $ 1,435,200 | $ 2,204,000 | | $ - | | $ - | |
| 350 | New Pipeline | 12-inch diameter, 7,815 lf | Group G | 7815 lf | | $ - | | $ - | $ 1,185,500 | $ 1,821,000 | | $ - | | $ - | |
| 350 | New Pipeline | 16-inch diameter, 67 lf | Group G | 67 lf | | $ - | | $ - | $ 12,900 | $ 20,000 | | $ - | | $ - | |
| 350 | New Pipeline | 12-inch diameter, 15,272 lf | Group H | 15272 lf | | $ - | | $ - | | $ - | | $ - | $ 2,316,700 | $ 3,558,000 | |
| 350 | New Pipeline | 12-inch diameter, 483 lf | Group I | 483 lf | | $ - | | $ - | | $ - | | $ - | $ 73,300 | $ 113,000 | $ 85,792,000 |
| 350 | New Pipeline | 8-inch diameter, 1,938 lf | Group J | 1938 lf | | $ - | | $ - | $ 215,600 | $ 331,000 | | $ - | | $ - | |
| 350 | New Pipeline | 12-inch diameter, 5,484 lf | Group J | 5484 lf | | $ - | | $ - | $ 831,900 | $ 1,278,000 | | $ - | | $ - | |
| 350 | Groundwater Well | 2.66 mgd Groundwater Well | BCIP89W | 2.66 mgd | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | | $ - | |
| 350 | Groundwater Well | 2.66 mgd Groundwater Well | BCIP86W | 2.66 mgd | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | | $ - | |
| 350 | Groundwater Well | 2.66 mgd Groundwater Well | BCIP90W | 2.66 mgd | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | | $ - | | $ - | |
| 350 | Groundwater Well | 2.66 mgd Groundwater Well | BCIP91W | 2.66 mgd | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | | $ - | | $ - | |
| 350 | Groundwater Well | 2.66 mgd Groundwater Well | BCIP92W | 2.66 mgd | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | | $ - | | $ - | |
| 350 | Groundwater Well | 2.66 mgd Groundwater Well | BCIP93W | 2.66 mgd | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | | $ - | | $ - | |
| 350 | Groundwater Well | 2.66 mgd Groundwater Well | BCIP94W | 2.66 mgd | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | | $ - | | $ - | |
| 350 | Groundwater Well | 2.66 mgd Groundwater Well | BCIP87W | 2.66 mgd | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | | $ - | |
| 350 | Groundwater Well | 2.66 mgd Groundwater Well | BCIP88W | 2.66 mgd | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | | $ - | |
| 350 | Storage Tank | New 1.0 MG Storage Tank | BCIP80 | 1.0 MG | | $ - | | $ - | $ 1,135,700 | $ 1,744,000 | | $ - | | $ - | |
| 350 | Storage Tank | New 1.0 MG Storage Tank | BCIP81 | 1.0 MG | | $ - | | $ - | | $ - | | $ - | $ 1,213,600 | $ 1,864,000 | |
| 350 | Storage Tank | New 1.0 MG Storage Tank | BCIP79 | 1.0 MG | | $ - | | $ - | $ 1,135,700 | $ 1,744,000 | | $ - | | $ - | |
| 350 | Storage Tank | New 3.0 MG Storage Tank | BCIP106 | 3.0 MG | | | | | | | $ 2,270,400 | $ 3,487,000 | | $ - | |
| 350 | Pump Station | New 8.0 mgd Pump Station | BCIP106 | 8.0 mgd | | | | | | | $ 2,022,800 | $ 3,107,000 | | $ - | |
| 350 | Storage Tank | New 3.0 MG Storage Tank | BCIP107 | 3.0 MG | | | | | | | | $ - | $ 2,270,400 | $ 3,487,000 | |
| 350 | Pump Station | New 8.0 mgd Pump Station | BCIP107 | 8.0 mgd | | | | | | | | $ - | $ 2,022,800 | $ 3,107,000 | |
| 400 | Pipeline Improvement | 8-inch diameter, 289 lf | BFF03 | 289 lf | | $ - | | $ - | $ 32,100 | $ 49,000 | | $ - | | $ - | $ 612,000 |
| 400 | New Pipeline | 12-inch diameter, 2,418 lf | Group B | 2418 lf | | $ - | | $ - | | $ - | $ 366,800 | $ 563,000 | | $ - | |
| 475 | New Pipeline | 12-inch diameter, 3,586 lf | Group C | 3586 lf | | $ - | | $ - | $ 544,000 | $ 836,000 | | $ - | | $ - | |
| 475 | New Pipeline | 12-inch diameter, 3,826 lf | Group D | 3826 lf | | $ - | | $ - | | $ - | | $ - | $ 580,400 | $ 891,000 | |
| 475 | New Pipeline | 8-inch diameter, 835 lf | Group E | 835 lf | | $ - | | $ - | | $ - | $ 92,900 | $ 143,000 | | $ - | |
| 475 | New Pipeline | 12-inch diameter, 21,563 lf | Group E | 21563 lf | | $ - | | $ - | | $ - | $ 3,271,000 | $ 5,024,000 | | $ - | |
| 475 | New Pipeline | 16-inch diameter, 6,702 lf | Group E | 6702 lf | | $ - | | $ - | | $ - | $ 1,287,800 | $ 1,978,000 | | $ - | $ 18,939,000 |
| 475 | New Pipeline | 8-inch diameter, 2,968 lf | Group F | 2968 lf | | $ - | | $ - | $ 330,200 | $ 507,000 | | $ - | | $ - | |
| 475 | New Pipeline | 12-inch diameter, 10,771 lf | Group F | 10771 lf | | $ - | | $ - | $ 1,633,900 | $ 2,510,000 | | $ - | | $ - | |
| 475 | New Pipeline | 8-inch diameter, 7,442 lf | Group G | 7442 lf | | $ - | | $ - | $ 827,900 | $ 1,272,000 | | $ - | | $ - | |
| 475 | New Pipeline | 12-inch diameter, 13,199 lf | Group G | 13199 lf | | $ - | | $ - | $ 2,002,200 | $ 3,075,000 | | $ - | | $ - | |
| 475 | Storage Tank | New 2.1 MG Storage Tank | BCIP82 | 2.1 MG | | $ - | | $ - | | $ - | $ 1,759,800 | $ 2,703,000 | | $ - | |
| 570 | New Pipeline | 12-inch diameter, 56,092 lf | Group I | 56092 lf | | $ - | | $ - | | $ - | | $ - | $ 8,508,900 | $ 13,070,000 | |
| 570 | New Pipeline | 16-inch diameter, 20,733 lf | Group I | 20733 lf | | $ - | | $ - | | $ - | | $ - | $ 3,983,800 | $ 6,119,000 | |
| 570 | Pressure Reducing Station | Pressure Reducing Station | | 3 | | $ - | | $ - | | $ - | | $ - | $ 38,800 | $ 60,000 | |
| 570 | Groundwater Well | 1.87 mgd Groundwater Well | BCIP95W | 1.87 mgd | | $ - | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | |
| 570 | Groundwater Well | 2.38 mgd Groundwater Well | BCIP96W | 2.38 mgd | | $ - | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | |
| 570 | Groundwater Well | 2.38 mgd Groundwater Well | BCIP100W | 2.38 mgd | | $ - | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | |
| 570 | Groundwater Well | 2.38 mgd Groundwater Well | BCIP101W | 2.38 mgd | | $ - | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | |
| 570 | Groundwater Well | 2.38 mgd Groundwater Well | BCIP97W | 2.38 mgd | | $ - | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | $ 60,561,000 |
| 570 | Groundwater Well | 2.38 mgd Groundwater Well | BCIP98W | 2.38 mgd | | $ - | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | |
| 570 | Groundwater Well | 2.38 mgd Groundwater Well | BCIP99W | 2.38 mgd | | $ - | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | |
| 570 | Groundwater Well | 1.87 mgd Groundwater Well | BCIP104W | 1.87 mgd | | $ - | | $ - | | $ - | | $ - | $ 1,517,000 | $ 2,330,000 | |
| 570 | Storage Tank | New 2.5 MG Storage Tank | BCIP83A | 2.5 MG | | $ - | | $ - | $ 1,780,400 | $ 2,735,000 | | $ - | $ 1,780,400 | $ 2,735,000 | |
| 570 | Pump Station | New 7.5 mgd Pump Station | BCIP83APS | 7.5 mgd | | $ - | | $ - | $ 1,909,300 | $ 2,933,000 | | $ - | $ 1,909,300 | $ 2,933,000 | |
| 570 | Storage Tank | New 2.5 MG Storage Tank | BCIP83C | 2.5 MG | | $ - | | $ - | $ 1,780,400 | $ 2,735,000 | | $ - | $ 1,780,400 | $ 2,735,000 | |
| 570 | Pump Station | New 7.5 mgd Pump Station | BCIP83CPS | 7.5 mgd | | $ - | | $ - | $ 1,909,300 | $ 2,933,000 | | $ - | $ 1,909,300 | $ 2,933,000 | |
| 635 | New Pipeline | 8-inch diameter, 273 lf | Group D | 273 lf | | $ - | | $ - | | $ - | | $ - | $ 30,400 | $ 47,000 | |
| 635 | New Pipeline | 12-inch diameter, 5,039 lf | Group D | 5039 lf | | $ - | | $ - | | $ - | | $ - | $ 764,400 | $ 1,174,000 | |
| 635 | New Pipeline | 8-inch diameter, 9,686 lf | Group E | 9686 lf | | $ - | | $ - | | $ - | $ 1,077,500 | $ 1,655,000 | | $ - | $ 7,412,000 |
| 635 | New Pipeline | 12-inch diameter, 5,541 lf | Group E | 5541 lf | | $ - | | $ - | | $ - | $ 840,500 | $ 1,291,000 | | $ - | |
| 635 | Storage Tank | New 1.2 MG Storage Tank | BCIP84 | 1.2 MG | | $ - | | $ - | | $ - | $ 1,148,100 | $ 1,764,000 | | $ - | |
| 635 | Pump Station | New 3.17 mgd Pump Station | BCIP103PS | 3.17 mgd | | $ - | | $ - | | $ - | $ 963,500 | $ 1,481,000 | | $ - | |
| 795 | New Pipeline | 8-inch diameter, 4,654 lf | Group D | 4654 lf | | $ - | | $ - | | $ - | | $ - | $ 517,700 | $ 795,000 | |
| 795 | New Pipeline | 12-inch diameter, 10,733 lf | Group D | 10733 lf | | $ - | | $ - | | $ - | | $ - | $ 1,628,100 | $ 2,501,000 | $ 5,174,000 |
| 795 | New Pipeline | 16-inch diameter, 355 lf | Group D | 355 lf | | $ - | | $ - | | $ - | | $ - | $ 68,200 | $ 105,000 | |
| 795 | Storage Tank | New 1.3 MG Storage Tank | BCIP85 | 1.3 MG | | $ - | | $ - | | $ - | | $ - | $ 1,154,300 | $ 1,773,000 | |
| | | | **Totals** | | **$ -** | **$ -** | **$ -** | **$ -** | **$ 39,766,000** | **$ 61,081,000** | **$ 31,751,000** | **$ 48,769,000** | **$ 44,687,000** | **$ 68,640,000** | **$ 178,490,000** |
| | | | Construction Contingency (20% | | $ - | | $ - | | $ 7,953,000 | | $ 6,350,000 | | $ 8,937,000 | | |
| | | | **Total Construction Cost** | | **$ -** | | **$ -** | | **$ 47,719,000** | | **$ 38,101,000** | | **$ 53,624,000** | | |
| | | | Engineering (10%) | | $ - | | $ - | | $ 4,772,000 | | $ 3,810,000 | | $ 5,362,000 | | |
| | | | Construction Management (10% | | $ - | | $ - | | $ 4,772,000 | | $ 3,810,000 | | $ 5,362,000 | | |
| | | | Program Implementation (8% | | $ - | | $ - | | $ 3,818,000 | | $ 3,048,000 | | $ 4,290,000 | | |
| | | | **Total CIP Cost** | | **$ -** | | **$ -** | | **$ 61,081,000** | | **$ 48,769,000** | | **$ 68,640,000** | | |

[a] Costs shown based on May 2008 dollars and an ENR CCI of 8141 (20 Cities Average).

[b] Cal Water funds all supply related improvements. All other improvements are typically funded by development community.

**Recommended CIP by Project Types**

A summary of the costs of the recommended CIP by project type and location is provided in Table 10-6. As shown in Table 10-6, the total estimated recommended CIP and R&R cost for Chico system is $288.58 million and the total estimated recommended CIP and R&R cost for the Hamilton City system is $7.81 million.

**Table 10-6. Estimated Cost of Recommended CIP by Project Type and Location**

| CIP/R&R Project Type | Existing System CIP and R&R Projects[(a)] | | Future System CIP and R&R Projects[(b)] | |
|---|---|---|---|---|
| | Chico | Hamilton City | Chico | Hamilton City |
| Pipelines | $2.93 million | $1.68 million | $89.89 million | - |
| Storage Facilities | $9.75 million | $1.75 million | $29.51 million | - |
| Pump Stations | $12.97 million | $2.74 million | $19.43 million | - |
| Emergency Generators | $0.83 million | - | - | - |
| Pressure Reducing Stations | - | - | $0.06 million | - |
| Groundwater Wells | - | - | $39.61 million | - |
| **Total CIP Cost** | **$26.48 million** | **$6.17 million** | **$178.50 million** | **$0** |
| R&R Groundwater Wells | $49.15 million | $1.54 million | $29.18 million | - |
| R&R Pump Facilities | $1.03 million | - | $1.35 million | $0.05 million |
| R&R Storage Facilities | $1.54 million | - | $0.31 million | - |
| R&R SCADA | $0.22 million | $0.05 million | $0.82 million | - |
| **Total R&R Cost** | **$51.94 million** | **$1.59 million** | **$31.66 million** | **$0.05 million** |
| **Total** | **$78.42 million** | **$7.76 million** | **$210.16 million** | **$0.05 million** |
| | **$86.18 million** | | **$210.21 million** | |

(a) Includes 0 to 5 Years R&R.
(b) Includes 5 to 25 Years R&R.

## CAPITAL IMPROVEMENT PROGRAM IMPLEMENTATION

As shown in Tables 10-3 and 10-5, several improvement projects are recommended for the existing system and the buildout system. The recommended improvements for the existing system should be completed within the next five years. Figure 10-3 presents a five-year schedule starting in 2008 for the construction of the recommended capital improvement projects to eliminate deficiencies in the existing system.

The construction of the improvements for the buildout system should be coordinated with the proposed schedules of future development to ensure that the required infrastructure will be in place to serve future customers. However, they are based on addressing deficiencies in fire flows, emergency storage, or reliability issues, and therefore should be completed in the next 10 years. As illustrated on Figures 10-3 and 10-4, all the required improvements are shown to be completed by end of 2030 (includes R&R recommendations).

For the pump station upgrades, probable construction costs have been estimated based on the ultimate, additional pumping capacity required. For each of the pump station upgrades, and the other recommended improvements, costs should be appropriately allocated to existing and/or future users, as shown in Tables 10-3 and 10-5.

***

Public Version

**FIGURE 10-1**

**California Water Service Company**
**Chico - Hamilton City District Water Supply and Facilities Master Plan**

## EXISTING IMPROVEMENTS AND 0 TO 5 YEARS R&R

N

0 0.150.3 0.6

Scale in Miles

NOTES:

LEGEND:

- Required Auxiliary Power
- 0 to 5 Years Renewal and Replacement
- Recommended Pumped Storage
- Upgrade Booster Pump Station
- Recommended New Pipelines
- Street
- Existing Pipes
- Recommended Pipeline Replacements

o:\c\436\02-06-03\GIS\WMP\Ch10\Figure 10-1_CWS0-5CIP.mxd

***

Public Version

## FIGURE 10-2

**California Water Service Company**
**Chico - Hamilton City District Water Supply and Facilities Master Plan**

## BUILDOUT IMPROVEMENTS AND 5 TO 25 YEARS R&R

N

0 0.25 0.5 1

Scale in Miles

NOTES:

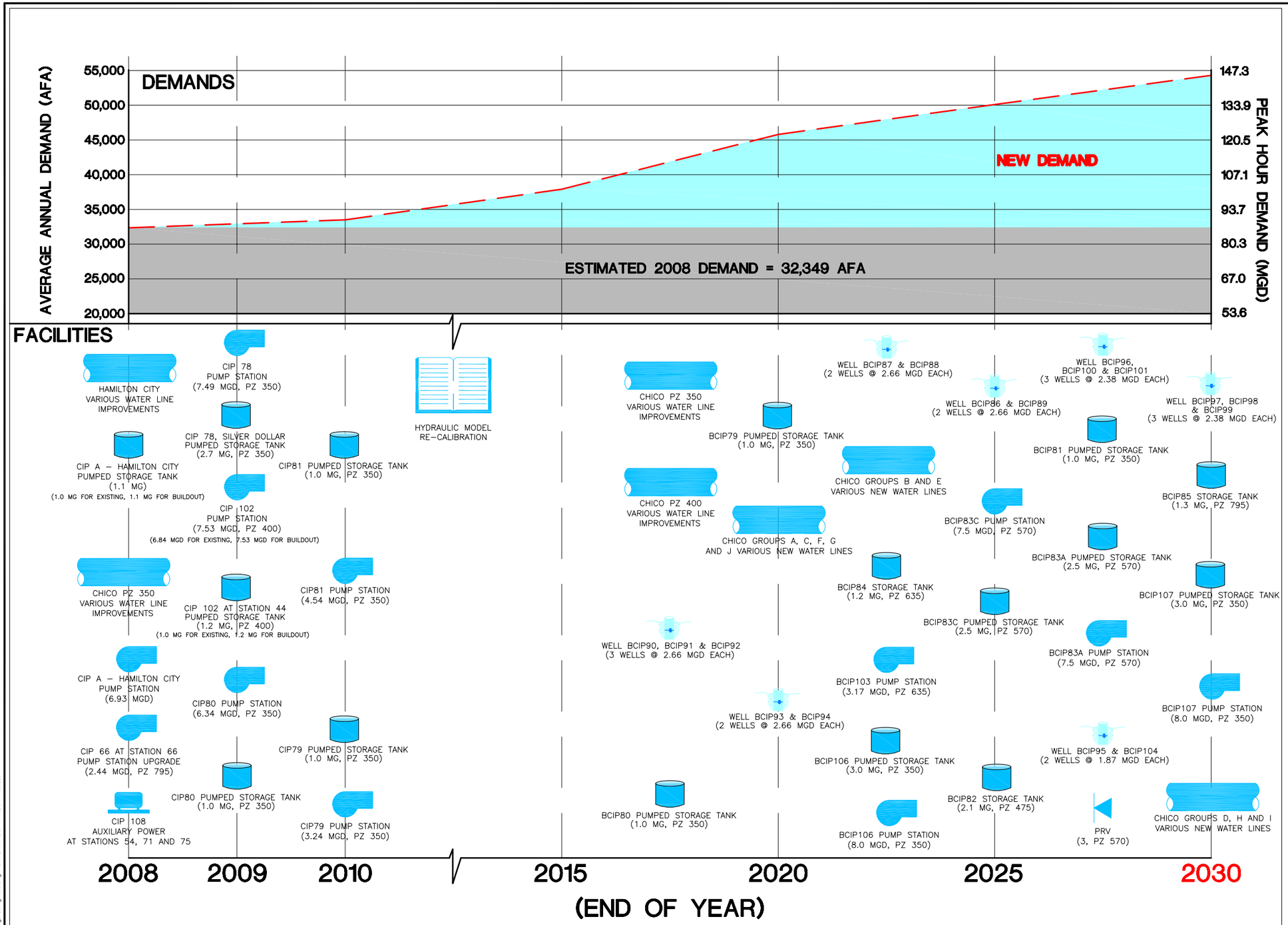
LEGEND:

- **New Booster Pump Station**
- **New Pumped Storage**
- **New Groundwater Well**
- **New Gravity Tanks**
- **5 to 25 Years R&R**
- New Closed Gate Valve
- New Pressure Reducing Station
- **Existing Pipes**
- **Recommended New Pipeline**
- **Recommended Pipeline Replacement**
- **A CIP Development Area**

WEST YOST ASSOCIATES Consulting Engineers

o:\c\436\02-06-03\GIS\WMP\Ch10\Figure 10-2_CWS5-25CIP.mxd

Public Version




# FIGURE 10-3

**California Water Service Company**
**Chico-Hamilton City District Water Supply and Facilities Master Plan**

## TIMING OF MAJOR WATER SUPPLY AND DISTRIBUTION FACILITIES

N

0 – –
NO SCALE

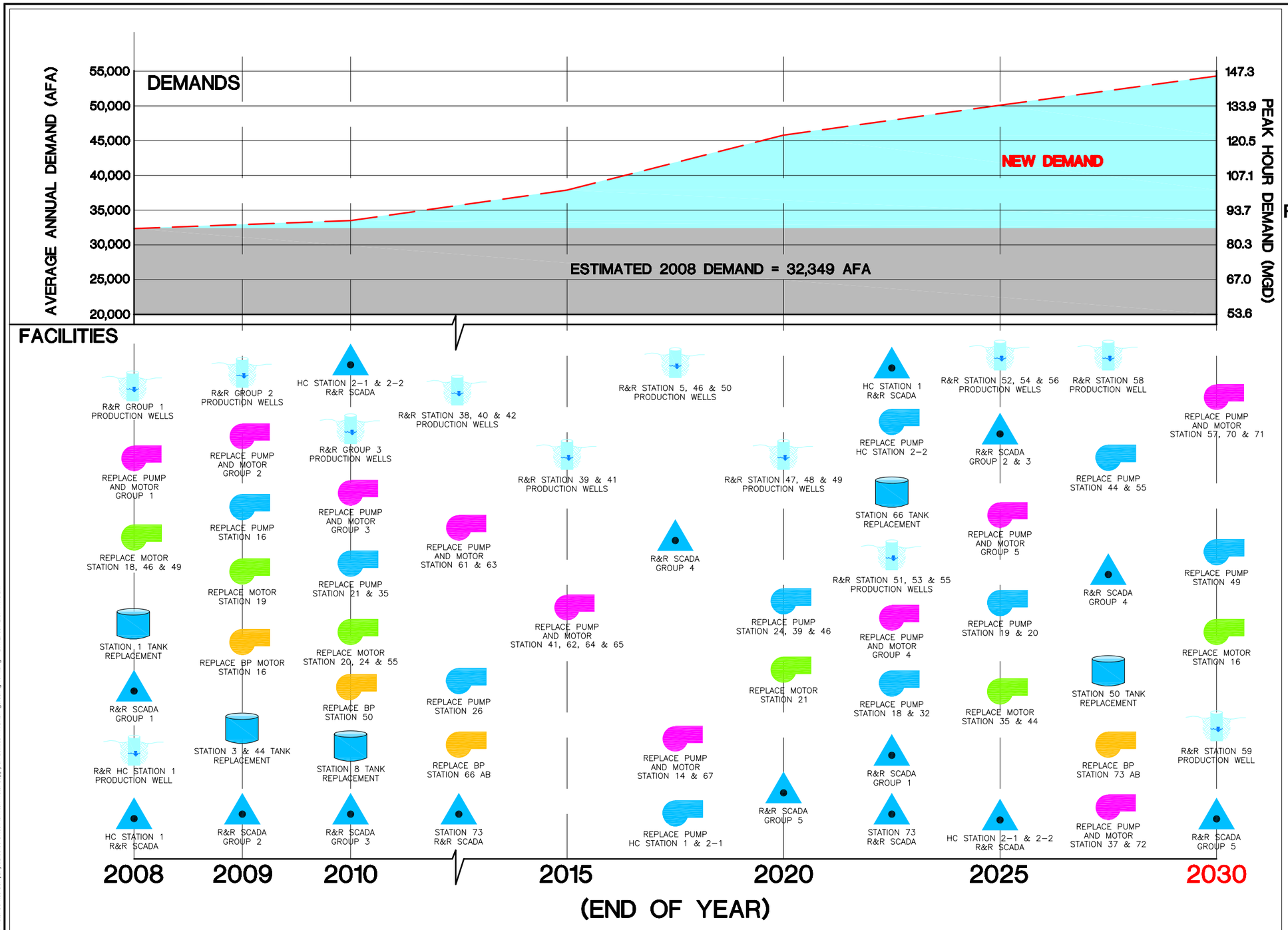
NOTES:

LEGEND:

CAD FILE: O:\C436\02-06-03\CAD\Figures\Fig 10-3.dwg DATE:09-12-07 11:12 am lsuroso

WEST YOST ASSOCIATES
Consulting Engineers

Public Version




# FIGURE 10-4

**California Water Service Company**
**Chico-Hamilton City District Water Supply and Facilities Master Plan**

## TIMING OF RENEWAL AND REPLACEMENT OF WATER SUPPLY AND DISTRIBUTION FACILITIES

N

0 NO SCALE

NOTES:

1. Replace Well:
   Group 1:
   - Stations 1, 7, 12, 15, 18, 22, 25, 28, 31, 33, 34
   Group 2:
   - Stations 3, 9, 13, 16, 19, 23, 26, 29, 32, 44
   Group 3:
   - Stations 4, 8, 11, 14, 17, 20, 21, 24, 27, 30, 35
2. Replace Pump and Motor:
   Group 1:
   - Stations 1, 22, 25, 33, 52
   Group 2:
   - Stations 5, 23, 29, 40, 47, 53, 56
   Group 3:
   - Stations 4, 8, 11, 27, 30, 42, 50, 51, 54, 58
   Group 4:
   - Stations 3, 9, 15, 28, 34, 48, 68
   Group 5:
   - Stations 7, 12, 17, 31, 38, 59, 69
3. R&R SCADA:
   Group 1:
   - Stations 33, 49, 64, 66D
   Group 2:
   - Stations 44, 53, 65, 67, 68, 70
   Group 3:
   - Stations 24, 69, 71, 72
   Group 4:
   - Stations 1, 4, 7, 9, 12, 14, 16, 18, 20, 22, 25, 27, 29, 31, 34, 37, 39, 41, 45, 47, 51, 54, 56, 58, 61, 63
   Group 5:
   - Stations 3, 5, 8, 11, 13, 15, 17, 19, 21, 23, 26, 28, 30, 32, 35, 38, 40, 42, 46, 48, 50, 52, 55, 57, 59, 62

CALIFORNIA WATER SERVICE CO.

WEST YOST ASSOCIATES
Consulting Engineers

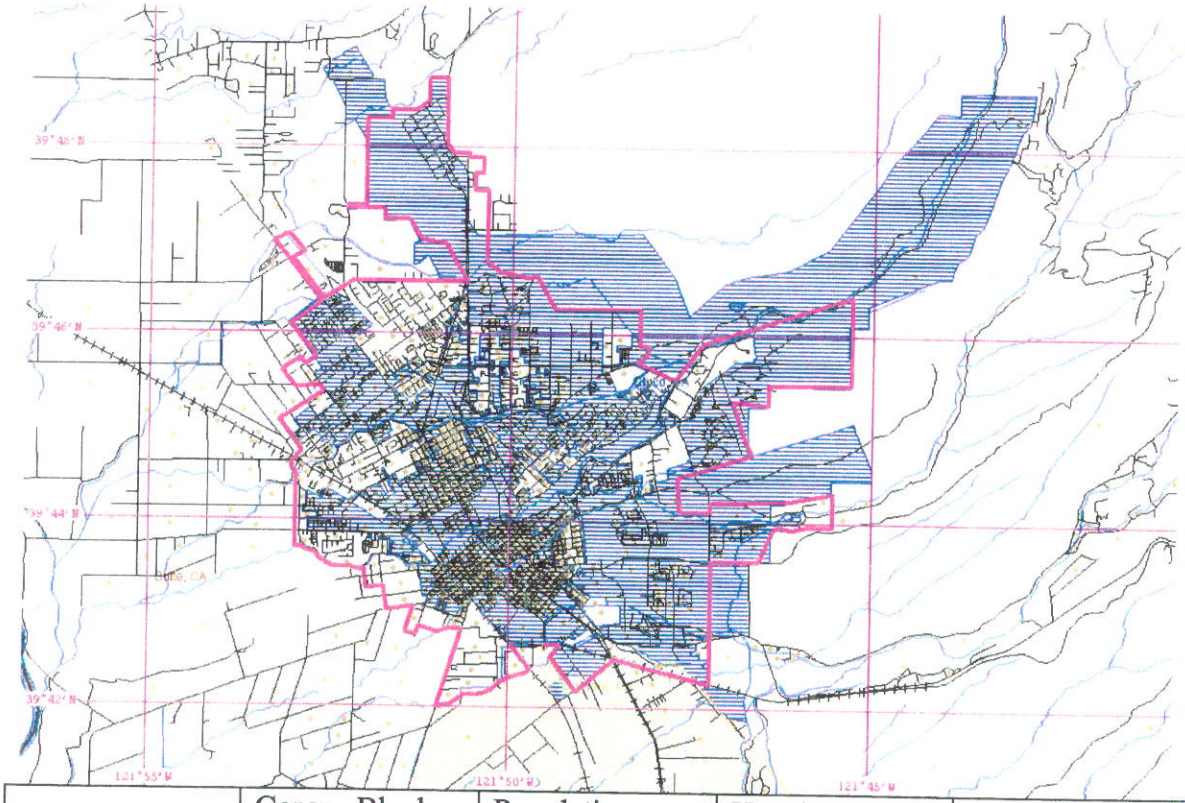
CAD FILE: Cir/Clients/436 California Water Service Company/02-06-03 Chico-Hamilton Water Supply & Facilities MP/CAD/Figures/Fig 10-4.dwg DATE: 09-12-07 11:10 am

# APPENDIX A

## Chico and Hamilton City Population Estimates

Public Version

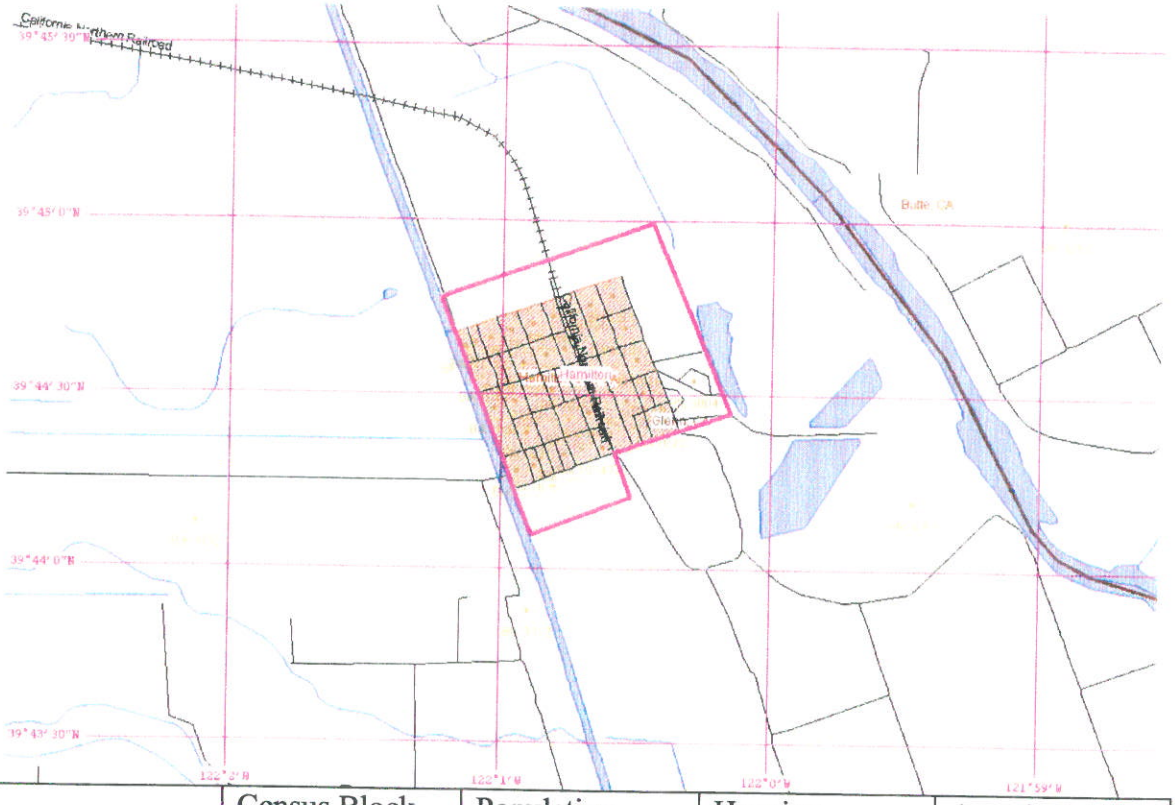
# Chico Population Estimate (2000 Census Data)



| | Census Block | Population | Housing | Area (sq. mi.) |
|---|---|---|---|---|
| City | 711 | 59,954 | 24,386 | 27.70 |
| District | 1,040 | 83,005 | 34,460 | 25.89 |

Public Version

# Hamilton City Population Estimate (2000 Census Data)




| | Census Block | Population | Housing | Area (sq. mi.) |
|---|---|---|---|---|
| City | 33 | 1,903 | 543 | 0.31 |
| District | 35 | 2,066 | 589 | 0.56 |

# APPENDIX B

## Conversion of Existing and Future Land Use Designations

**Table B-1. Conversion of Existing Landuse Designations**

| Assigned Revenue Class | City of Chico Existing Land Use Designation |
|---|---|
| Residential | Single_Family |
| | Single_FamilySingle_Family |
| Multiple Residences | Singlefamily_w/2nd Unit |
| | Multi-Family_Res |
| | Manufactured_Home_Park |
| Commercial | Retail_Trade |
| | Services |
| Industrial | Manufacturing_Processing |
| Government | Public/quasi public services |
| | Med_Services |
| | Education_Assembly |
| | Common_Area |
| Partially Served | School |
| | Parks |
| | Recreation |
| Open Space/Agriculture | Agricultural |
| | Open space |
| | Water_Drainage |
| | Railroad |
| Vacant | Undetermined |
| | Vacant |

**Table B-2. Conversion of Future Landuse Designations**

| Assigned Revenue Class | Acronym/Designation | Description |
|---|---|---|
| Residential | RR_OSEC/S | Rural Residential & Preserve |
| | VLDR_none | Very Low Density Residential |
| | VLDR_OSEC/S | Very Low Density Residential & Preserve |
| | LDR_MHDR | Low Density & Medium High Density Residential |
| | LDR_none | Low Density Residential |
| | LDR_OSEC/S | Low Density Residential & Preserve |
| | Single_Family | Single_Family |
| | Single_FamilySingle_Family | Single_FamilySingle_Family |
| Multiple Residences | Singlefamily_w/2nd Unit | Singlefamily_w/2nd Unit |
| | Manufactured_Home_Park | Manufactured Home Park |
| | MDR_MHDR | Medium & Medium High Density Residential |
| | MDR_none | Medium Density Residential |
| | MDR_OSEC/S | Medium Density Residential & Preserve |
| | MHDR_none | Medium High Density Residential |
| | MHDR_OSEC/S | Medium High Density Residential & Preserve |
| | Multi-Family_Res | Multiple Family Residential |
| | HDR_none | High Density Residential |
| | HDR_OSEC/S | High Density Residential & Preserve |
| Commercial | CC_HDR | Community Commercial & High Density Residential |
| | CC_none | Community Commercial |
| | CC_OFF | Community Commercial & Offices |
| | CS_none | Commercial Services |
| | D_none | Downtown |
| | IP_OSEC/S | Industrial Park & Preserve |
| | MUNC_none | Mixed Use Neighborhood Core |
| | Retail_Trade | Retail Trade |
| | Services | Services |
| | OFF_none | Offices |
| Industrial | M&W_none | Manufacturing and Warehousing |
| | M&W_OSEC/S | Manufacturing and Warehousing & Preserve |
| | Manufacturing_Processing | Manufactoring Processing |
| Government | Common_Area | Common Area |
| | Education_Assembly | Education Assembly |
| | Med_Services | Medical Services |
| | PF&S_none | Public Facilities & Services |
| | Public/quasi public services | Public/quasi public services |
| Not Served | School | School |
| | P_none | Parks |
| | Parks | Parks |
| | Recreation | Recreation |
| Open Space/Agriculture | CG_none | Creekside Greenways |
| | OSA/RM_none | Open Space for Agriculture/Resource Management |
| | OSEC/S_none | Open Space for Environmental Conservation/Safety |
| | Railroad | Railroad |
| | Water_Drainage | Water_Drainage |

Public Version

# APPENDIX C

## Water Conservation Best Management Practices

Public Version

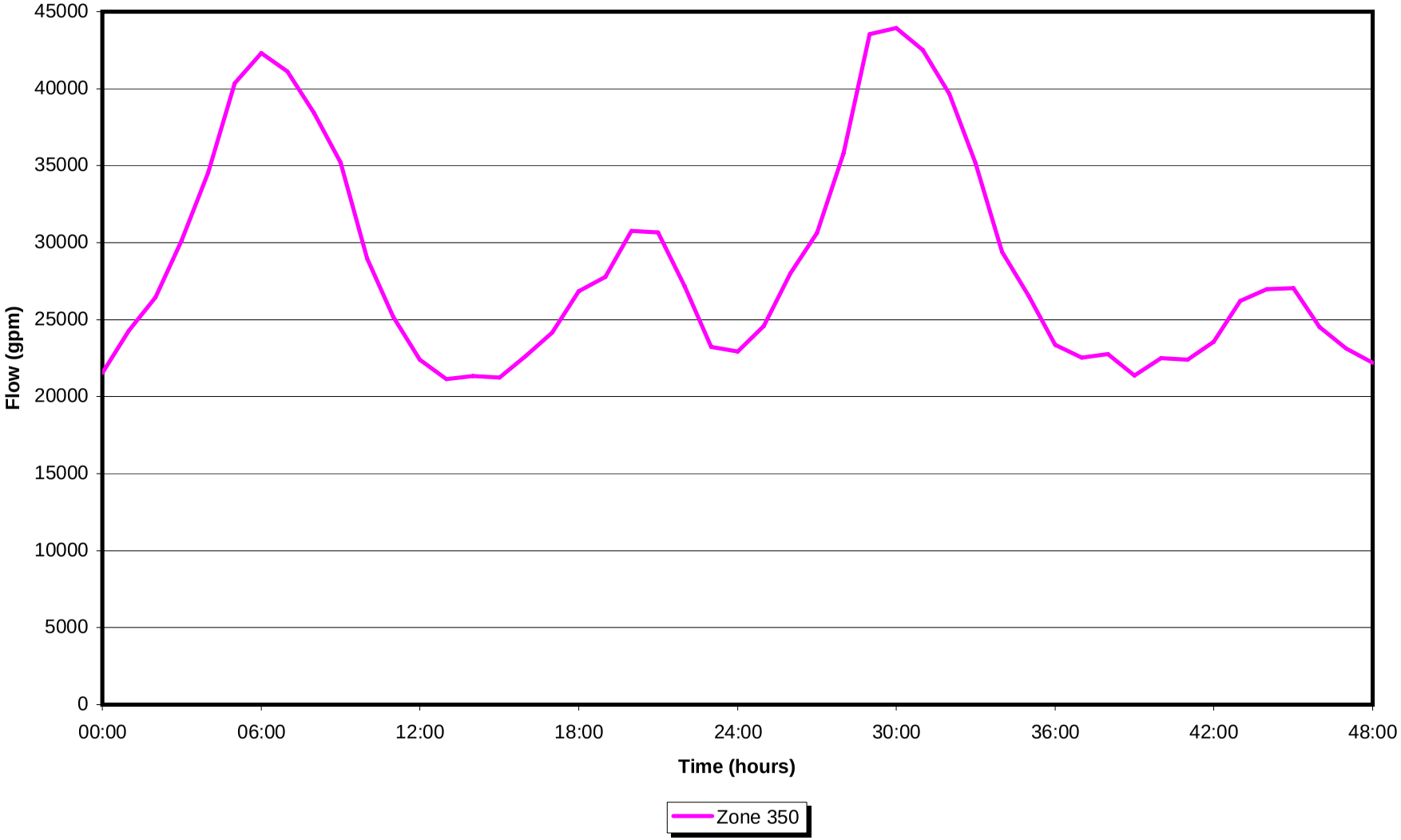


| WATER CONSERVATION BEST MANAGEMENT PRACTICES | |
|---|---|
| No. | BMP Name |
| 1. | Water survey programs for single-family residential and multi-family residential connections. |
| 2. | Residential plumbing retrofit. |
| 3. | System water audits, leak detection and repair. |
| 4. | Metering with commodity rates for all new connections and retrofit of existing connections. |
| 5. | Large landscape conservation programs and incentives. |
| 6. | High efficiency washing machine rebate programs. |
| 7. | Public information programs. |
| 8. | School education programs. |
| 9. | Conservation programs for commercial, industrial, and institutional accounts. |
| 10. | Wholesale agency assistance programs. |
| 11. | Conservation pricing. |
| 12. | Conservation coordinator. |
| 13. | Water waste prohibition. |
| 14. | Residential ULFT replacement programs. |

# APPENDIX D

## Diurnal Curves for Chico-Hamilton City District Pressure Zones

**Figure D-1. Zone 350 Diurnal**
**(07/20/06 to 07/21/06)**

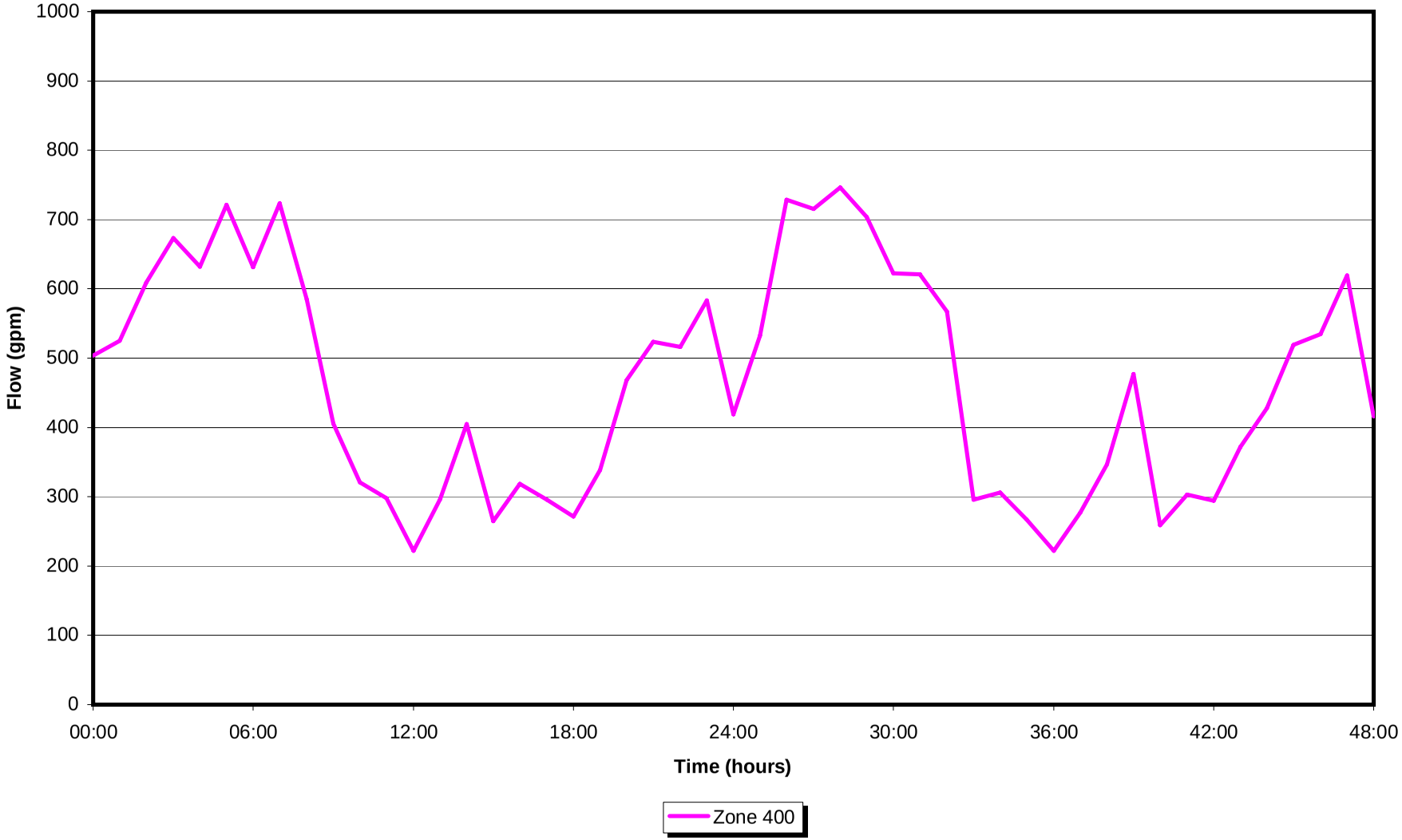



West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350CH350
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

**Figure D-2. Zone 400 Diurnal**
**(07/12/06 to 07/13/06)**

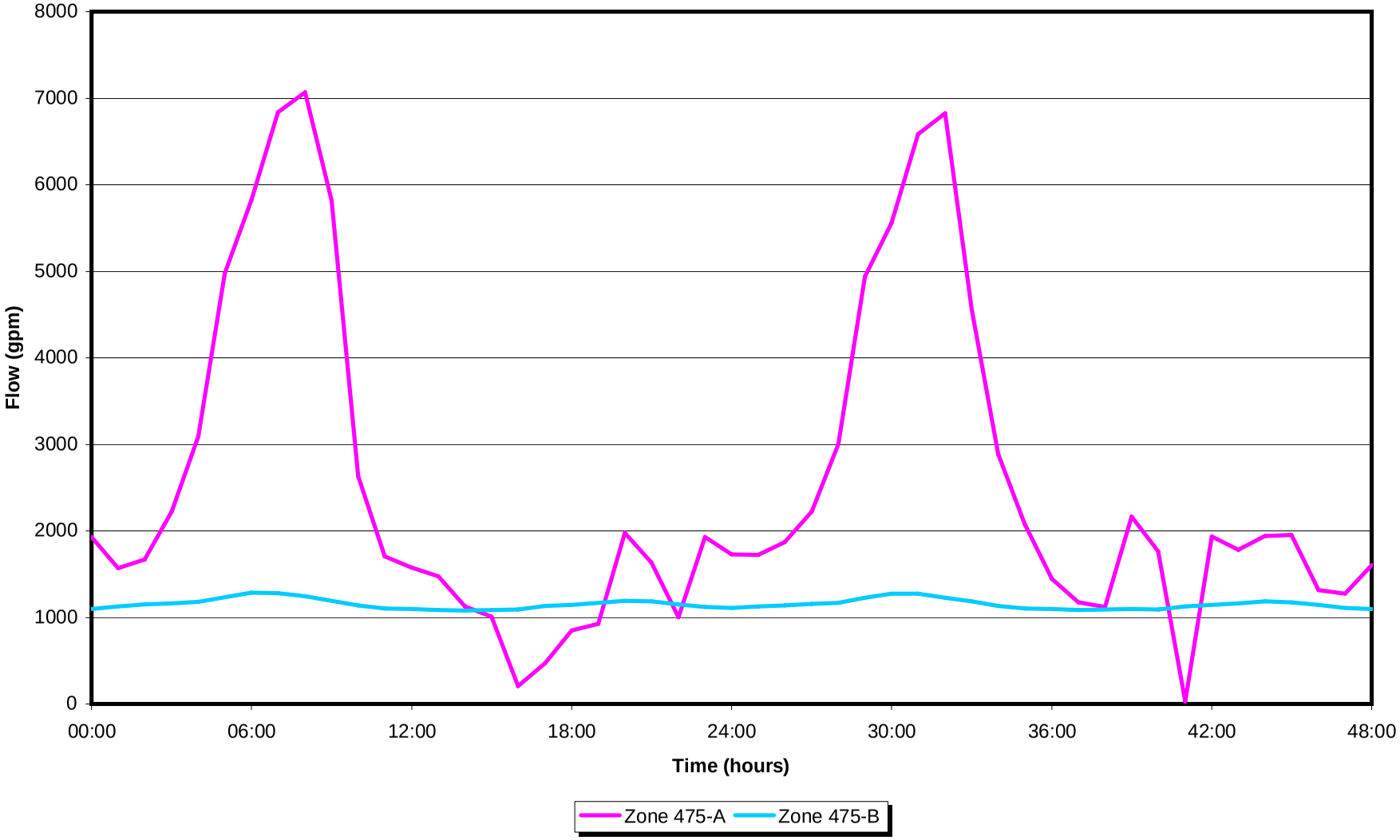



Public Version

West Yost Associates
o:\c\436\02-06-03\E\T4\diurnal\ZONE 400CH400
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

**Figure D-3. Zone 475 Diurnal**
**(07/12/06 to 07/13/06)**

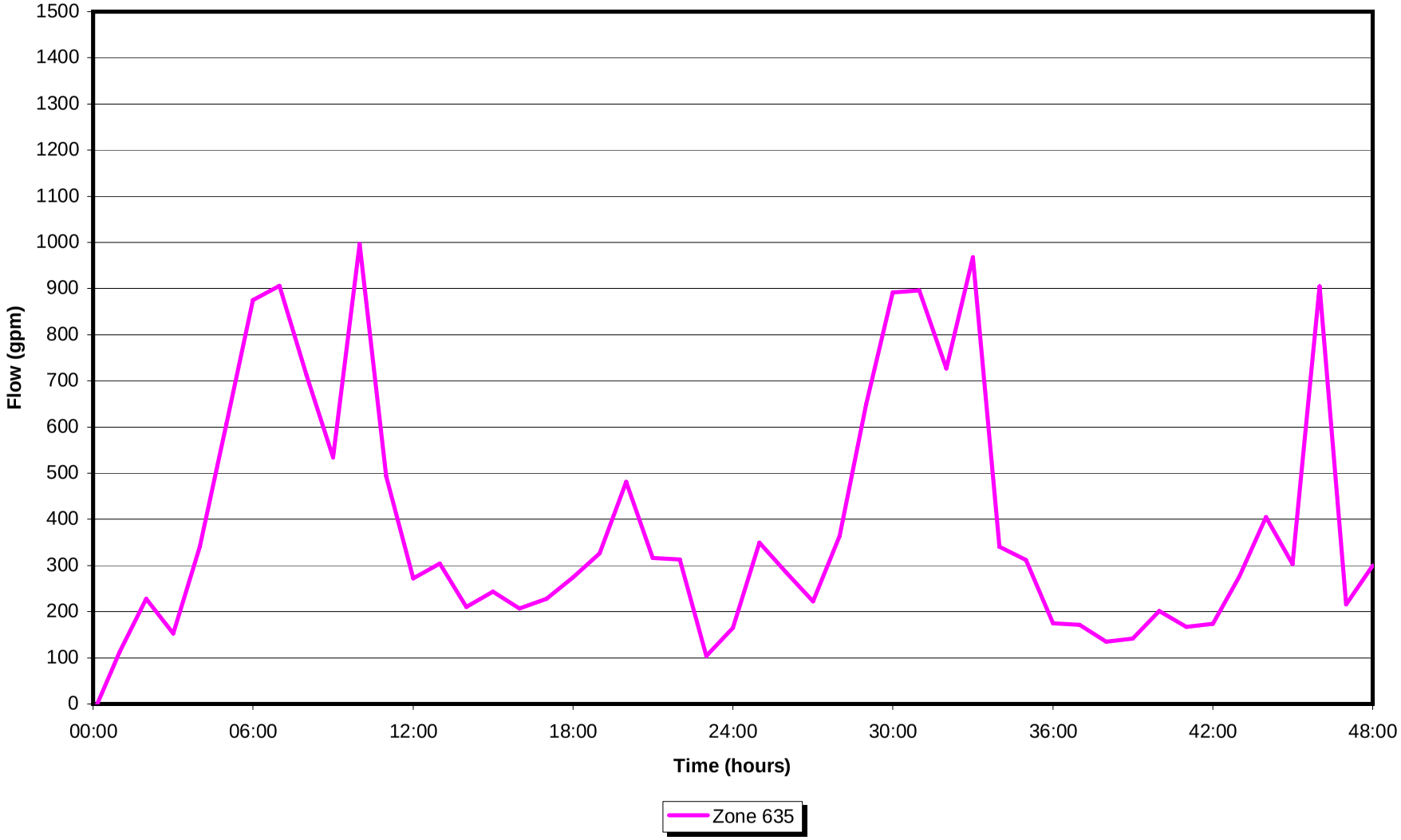



West Yost Associates
o:\c\436\02063\E\4\diur\ZONE 475CH475-48
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

**Figure D-4. Zone 635 Diurnal**
**(07/12/06 to 07/13/06)**

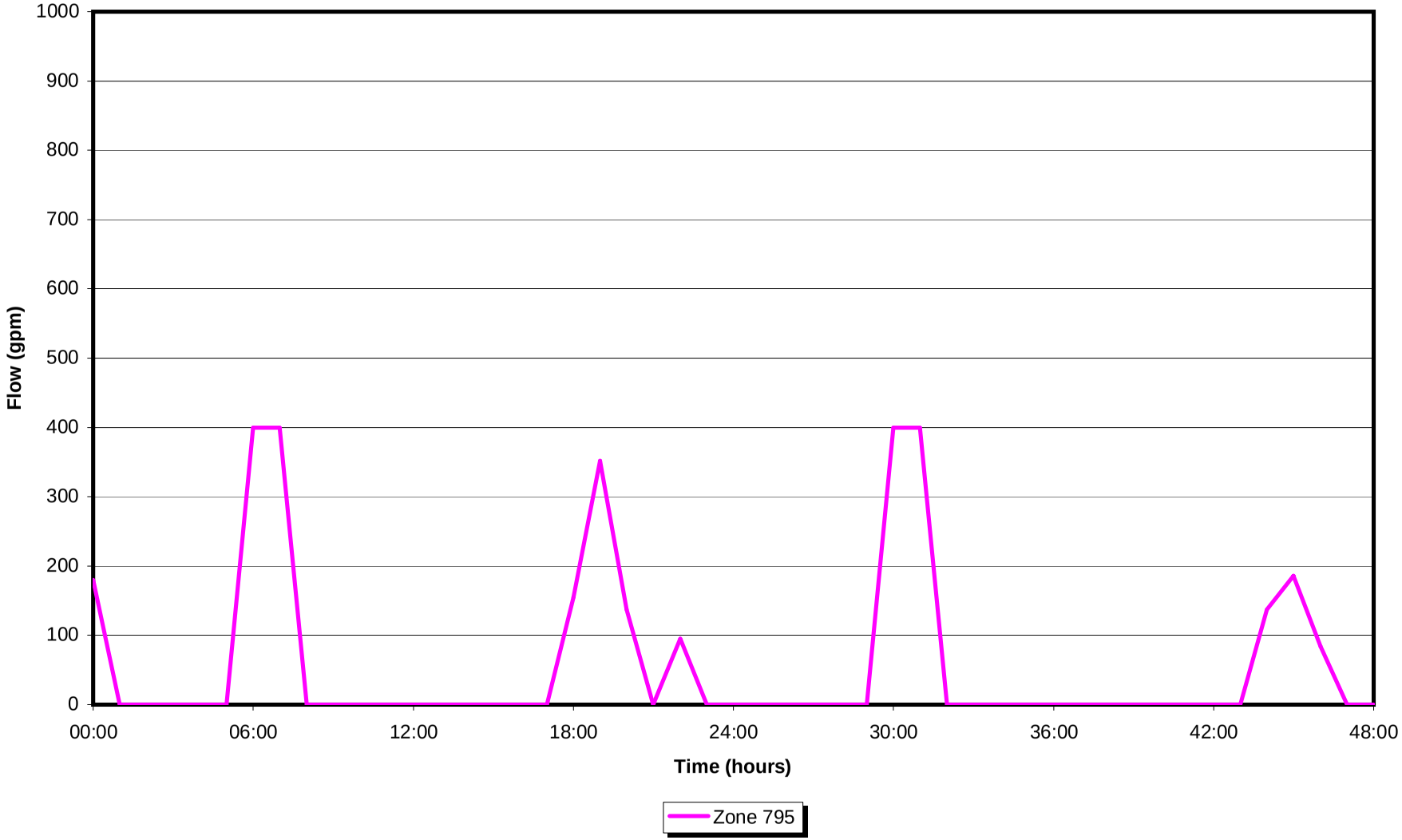



Public Version

West Yost Associates
o:\c\436\02063\E\4\diur\ZONE 635CH635
Last Revised: 06/16/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

**Figure D-5. Zone 795 Diurnal**
**(07/12/06 to 07/13/06)**

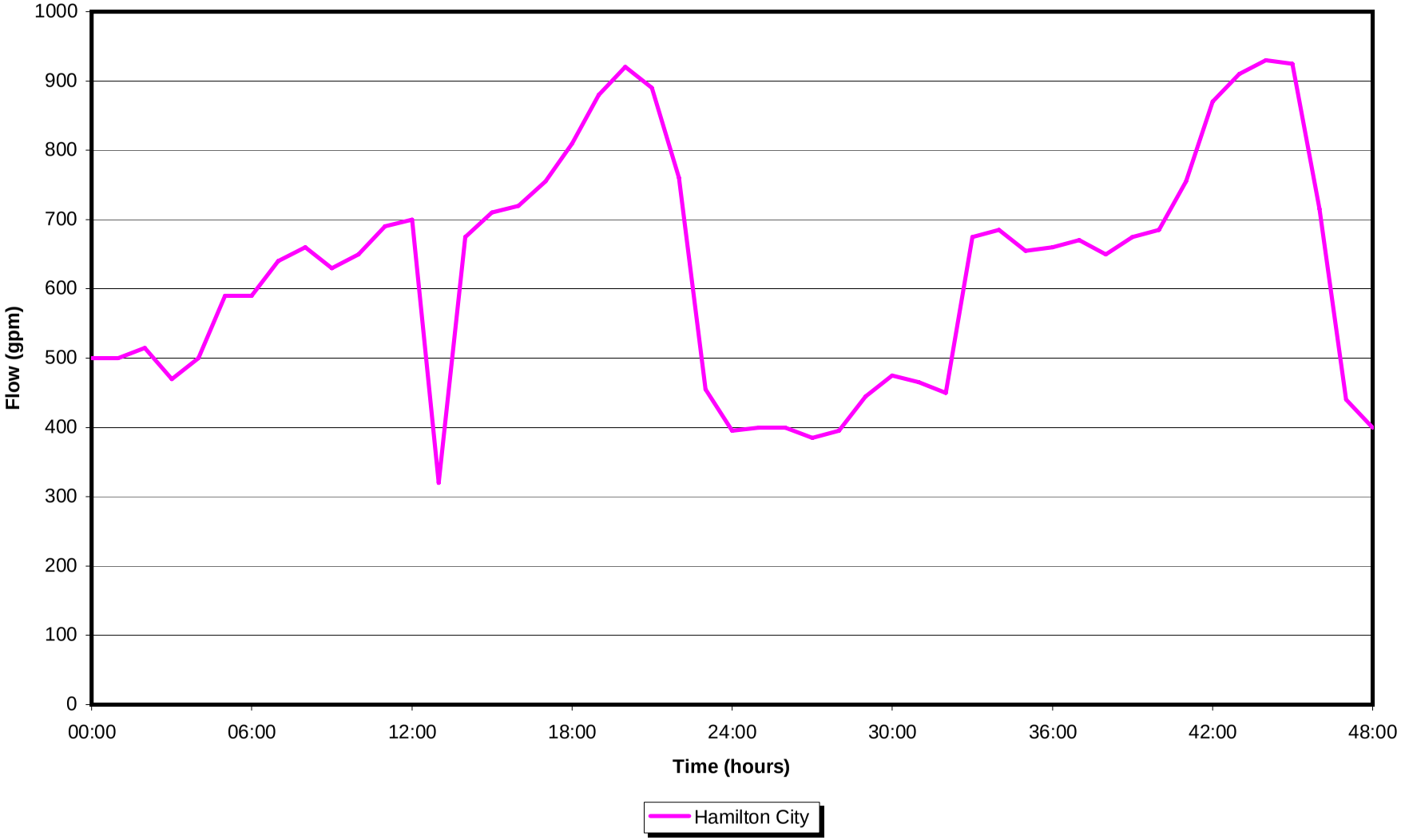



Public Version

West Yost Associates
o:\c\436\02063\E\4\diur\ZONE 635CH795
Last Revised: 06/16/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

**Figure D-6. Hamilton City Diurnal**
**(07/12/06 to 07/13/06)**




West Yost Associates
o:\c\436\02-06-03\E\T4\diurnal\HAMHAM (2)
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# APPENDIX E

## Conversion of Demand Factors in the UWMP

## Table E-1. Conversion of Demand Factors in the UWMP

| Revenue Class[a] | 2005 Existing Area, acres[b] | Number of Services in 2005[c] | Calculated services/acre[d] | Minimum Unit Factor, gal/yr/service[e] | Maximum Unit Factor, gal/yr/service[e] | Minimum Unit Factor, af/acre[f] | Maximum Unit Factor, af/acre[f] |
|---|---|---|---|---|---|---|---|
| Residential | 5,771 | 21,761 | 3.8 | 228,203 | 342,462 | 2.6 | 4.0 |
| Multiple Residences | 824 | 426 | 0.5 | 1,736,822 | 2,106,871 | 2.8 | 3.3 |
| Commercial | 1,518 | 3,216 | 2.1 | 470,141 | 623,568 | 3.1 | 4.1 |
| Industrial | 182 | 35 | 0.2 | 1,033,038 | 3,783,861 | 0.6 | 2.2 |
| Government | 731 | 342 | 0.5 | 1,018,823 | 1,231,038 | 1.5 | 1.8 |

[a] Categories obtained from Cal Water's billing system

[b] Acreage obtained from GIS shapefile of existing landuse provided by City of Chico

[c] Total number of services obtained from Cal Water's UWMP

[d] Number of services per acres calculated by dividing the number of services by the total area

[e] Unit factor in gallons per year per service obtained from data provided by Cal Water

[f] Unit Factor in af/acre calculated by multiplying services per acre times the unit factor in gallons per year per service, then converting to acre-feet

Public Version

Public Version

# APPENDIX F

## Key Portions of Butte County Groundwater Inventory Analysis, Including Plates 1-9

Public Version



# SECTION 2.

# Regional Groundwater Geology

Butte County covers several geologic regions and a wide range of diverse groundwater- bearing units. Discussions of the regional groundwater geology are grouped into areas encompassing the inventory units within the Sacramento Valley, Foothill, and Mountain regions. These regions are shown on the location map, Plate 1, Appendix A.

The major groundwater aquifers in Butte County lie within the larger Sacramento Valley groundwater basin. The basin extends north to south from Red Bluff to the Sacramento-San Joaquin Delta and is bordered by the Coast Ranges to the west and the Cascade Range and Sierra Nevada to the east. It covers an area of 4,900 square miles, which includes all of Sutter County and parts of Butte, Glenn, Tehama, Colusa, Yuba, Yolo, Solano, Placer, and Sacramento counties.

The Sacramento Valley is a structural basin filled with up to 5 miles of sediment. These marine and continentally derived sediments have been deposited almost continuously from the Late Jurassic period to the present. Of these deposits, older sediments in the basin were emplaced in a marine environment and usually contain saline or brackish groundwater. Younger sediments were deposited under continental conditions and generally contain fresh groundwater. Sediments thin near the margins of the basin, exposing older metamorphic and granitic rocks underlying and bounding the Sacramento Valley sediments.

Principal hydrogeologic units of the Sacramento Valley groundwater basin consist of Pliocene sedimentary deposits, such as the Tuscan, Laguna, and Tehama formations, and Quaternary terrace deposits, such as the Riverbank and Modesto formations. The Tuscan, Laguna, and Tehama formations are the source of water for deep irrigation and municipal wells, while the Riverbank and Modesto formations yield water to the shallower domestic wells.

Butte County is composed of a diverse mix of geologic units ranging from very productive water-bearing sedimentary units to nonwater-bearing plutonic and metamorphic rocks. The main hydrogeologic unit and source of groundwater in Butte County is the Tuscan Formation. Other units that supply lesser amounts of groundwater to the county are the Laguna, Riverbank, and Modesto formations.

Groundwater occurs under both unconfined and confined conditions in Butte County. Unconfined conditions are present in the surficial Quaternary deposits and in the Pliocene deposits that are exposed at the surface. Confined conditions usually exist at a depth of 200 feet or more, where a confining layer rests above the underlying aquifer deposits. Although the Tuscan Formation is unconfined where it is exposed near the valley margin, at depth the Tuscan Formation is confined and forms the major aquifer system in Butte County.

The following is a discussion of the geologic units found within the Sacramento Valley, Foothill, and Mountain regions of Butte County and their hydrogeologic properties.

Public Version



## Sacramento Valley Region

The Sacramento Valley Region of Butte County lies within the Sacramento Valley groundwater basin, as shown on Plates 1 and 2, Appendix A. Upland portions of the region range in elevation from 300 to 400 feet above mean sea level (msl). This upland topography consists of low hills, dissected uplands, and alluvial fans of moderate relief. The land surface slopes downward toward the axis of the valley, where the elevation is generally about 70 to 90 feet above msl, with the ground surface elevation decreasing southward toward the Sutter Buttes. The majority of Butte County's groundwater resources come from the Sacramento Valley Region.

A notable feature within this region is the Butte Basin. This area lies south of Chico and west of the Feather River. Characterized by an expansive, flat topography, the Butte Basin was, prior to flood control on the Feather and Sacramento rivers, an area of extensive seasonal flooding. Early reports depict a slow-moving sea of water covering from 30 to nearly 150 square miles (Bryan 1923). This slow-moving floodwater deposited the fine clay that now provides the rich agricultural soil used primarily for rice production.

South of the Butte County line, the Sutter Buttes provide the only significant topographic relief on the Sacramento Valley floor. This small-scale volcanic mountain range intruded the valley sediments during the early Pleistocene (1.2 million years before present (mybp)) epoch. The intrusion buckled the valley sediments upward, forming a barrier to groundwater flow. The Sutter Buttes block the general north-to-south trend of groundwater migration, forcing groundwater to the surface. The upward movement results in a shallow groundwater table and the formation of wetlands along the west side of the Sutter Buttes.

In an effort to better understand the groundwater resources of the Sacramento Valley groundwater basin, DWR developed a series of maps illustrating the surface and subsurface geology of Butte County. The surface geology of the Butte County portion of these maps is shown on Plate 2, Appendix A, and in four geologic cross-sections shown on Plates 4 and 5, Appendix A. The geologic legend for the maps is shown on Plate 3, Appendix A. The cross-sectional maps also illustrate the subsurface geology, base of fresh water, geologic structure, and stratigraphic sequence beneath the Sacramento Valley portion of Butte County.

Following is a discussion of the surface and subsurface geology of Butte County. The major water-bearing units will be discussed in greater detail in the succeeding section entitled "Fresh Groundwater-Bearing Units."

### Surface and Subsurface Geology

The regional structure of the Sacramento Valley groundwater basin consists of an asymmetrical trough tilting to the southwest with a steeply dipping western limb and a gently dipping eastern limb (Page 1986). Older granitic and metamorphic rocks underlie the valley forming the basement bedrock on which younger marine and continentally derived sediments and volcanic rock have been deposited. Along the valley axis and west of the present-day Sacramento River, basement rock is at considerable depth, ranging from 12,000 to 19,000 feet below ground surface. Immediately overlying the basement bedrock is a thick sequence of sandstone, shale, and conglomerate rocks of marine origin, ranging from Jurassic to Eocene in age. Within the Butte County portion of the Sacramento Valley, these sediments are saline or brackish and serve as the base of fresh groundwater.

Public Version



The oldest of the Jurassic to Eocene marine sediments is known as the Great Valley Sequence which is Jurassic to Cretaceous in age. Sediments of the Great Valley Sequence were originally deposited as horizontal layers, but due to compressive stress within the region, the margins of the formation have been folded and faulted upward. Post-depositional erosion cut large-scale valleys into the Great Valley Sequence. Subsequent in-filling of these canyons created wide-scale deposition of the Lower Princeton Submarine Valley fill. This relationship can be seen on all four cross-sections of the Sacramento Valley. Water contained within the Great Valley Sequence is primarily saline.

The Lower Princeton Submarine Valley fill of the Eocene epoch consists of a mixture of marine sediments and continental materials derived from the walls of an eroded submarine canyon that was carved into the Great Valley sediments (Redwine 1972). Groundwater contained within these sediments is almost exclusively saline. The Lower Princeton Submarine Valley fill is one of several formations in the Sacramento Valley Region that exist in the subsurface but are not exposed at the surface. Information on the extent and position of this unit is limited because the majority of data concerning its existence and character come from oil and gas exploration well logs.

In most locations, the Lower Princeton Submarine Valley fill is unconformably overlain by the Eocene Ione Formation or the Miocene Upper Princeton Valley fill, as shown on Plates 4 and 5, Appendix A. The Ione Formation is present in both the surface and subsurface of the Sacramento Valley Region. It is comprised of poorly cemented, easily eroded, deltaic-type deposits of sandstone, siltstone, and conglomerate and is believed to mark a change in the depositional environment (Maps: California 1985). Groundwater within the Ione Formation is primarily saline.

In Butte County, surface exposure of the Ione Formation is limited to areas protected by the overlying Lovejoy Basalt. Exposures of the Ione Formation and the Lovejoy Basalt can be seen at the surface in the Campbell Hills area located northwest of Oroville, as shown on the geologic map and on Cross-section C-C'. The Ione Formation is mapped in the subsurface of all four cross-sections. The Ione Formation underlies the Lovejoy Basalt, the Upper Princeton Valley fill, or the Neroly Formation at various locations within the valley portion of Butte County.

Following deposition of the Ione Formation, several volcanic eruptions in the Cascade Range produced a series of basalt flows that spread across the valley sediments during the Miocene epoch. These flows comprise the hard, black, microcrystalline Lovejoy Basalt. Surface exposures of the basalt can be seen in the Table Mountain and Campbell Hills areas northwest of Oroville. Occurrences of the Lovejoy Basalt are intermittent within the valley and can be seen in the subsurface of all four cross-sections. Groundwater, primarily saline or brackish, is transmitted and stored within the secondary porosity created by the fracturing and jointing of the basalt. Either the Upper Princeton Valley fill or the Neroly Formation overlies the Lovejoy Basalt in most locations. The Lovejoy Basalt can be seen as the cap rock of Table Mountain in Cross-section C-C'.

The Miocene Upper Princeton Valley fill is widespread throughout the Sacramento Valley but present only in the subsurface. Depending on location, the fill may overlie portions of the Lower Princeton Submarine Valley fill, the Ione Formation, or the

Public Version



Lovejoy Basalt. This formation consists primarily of sandstone with interbedded layers of conglomerate. In contrast to the submarine depositional environment of the Lower Princeton Submarine Valley fill, the Upper Princeton Valley fill was deposited by terrestrial rivers draining the valley after the regression of marine waters (Redwine 1972). Water contained within the Upper Princeton Valley fill is primarily saline to brackish. The Upper Princeton Valley fill is overlain by the Neroly Formation in nearly all locations. The position and thickness of the Upper Princeton Valley fill can be seen within Butte County in all four cross-sections of the Sacramento Valley.

Also Miocene in age, the Neroly Formation is the youngest formation in the northern Sacramento Valley that is not exposed at the surface. It is composed of bluish-grey, tuffaceous sandstone with interbeds of light grey tuff and tuffaceous shales with minor beds of conglomerate (Redwine 1972). Sediments of the Neroly Formation most likely represent deposition of eroded materials in a bay or estuary environment. The Neroly Formation is overlain by the Tuscan Formation on the east side of the valley, the Tehama Formation on the west side of the valley, and the Laguna Formation in the southeast portion of the valley. The position of the Neroly Formation can be seen in Butte County in all four cross-sections of the Sacramento Valley.

Overlying the Neroly Formation are the Pliocene Tuscan, Tehama, and Laguna formations, which are the major fresh groundwater-bearing units in the northern Sacramento Valley. Only the Tuscan and Laguna formations are exposed at the surface in Butte County. Surface exposures of the Tehama Formation can be seen along the western side of the Sacramento Valley. Dipping eastward, the Tehama Formation interfingers with the Tuscan Formation in the subsurface along the central north-south axis of the valley.

The Pliocene Tuscan Formation is composed of a series of volcanic mudflows (lahars), tuff breccias, tuffaceous sandstone, and volcanic ash layers. Mudflows originated in the vicinity of present-day Lassen Peak and most likely filled ancient stream channels as they flowed toward the valley. On reaching the valley, the mudflows fanned out across the valley floor. Some larger lahars may have continued to flow southward in the valley, along stream channels. The Tuscan Formation is described as four separate but lithologically similar units, Units A through D, which in some areas are separated by layers of thin tuff or ash units (Maps: California 1985). These units will be discussed in greater detail in the following section.

The Laguna Formation, also of the Pliocene epoch, is composed of continental deposits containing predominantly fine-grained, poorly-bedded, and compacted sediments. These deposits are composed of a heterogeneous mixture of interbedded alluvial silt, clay, and fine sand of granitic and metamorphic origin, with minor conglomerate lenses (Olmsted and Davis 1961). Clay predominates in the fine-grain sediments south of Oroville. The sand is arkosic and contains abundant weathered feldspar, biotite, and angular quartz clasts. Near Oroville, the coarse gravel deposits are of granitic or metamorphic composition and are contained within a silty-to-sandy matrix. The Arroyo Seco gravels are considered by some sources to be part of the Laguna Formation.

West-flowing rivers and streams draining from the Sierra Nevada deposited the Laguna Formation. These rivers and streams spilled over their banks and spread out across the broad floodplains of the valley, depositing eroded materials from the Sierra Nevada. Exposure of the Laguna Formation is discontinuous and extends southward

Public Version



from Oroville to Lodi. The only exposures within Butte County occur to the southwest of Oroville. The position and thickness of the Laguna Formation can be seen in Cross-section D-D'. More recent alluvial fan and terrace deposits overlie the Laguna Formation in the valley portion of Butte County.

The surface geology of the Sacramento Valley portion of Butte County is comprised primarily of alluvial deposits, the source of which is the eroded material derived from surrounding mountain ranges. These sediments were deposited as alluvial fan, terrace, and basin deposits by a network of streams and rivers flowing into the Sacramento Valley. Along the front of the foothills, alluvial fan and terrace deposits of the Riverbank and Modesto formations mark the edge of the valley sedimentary units.

The Pleistocene Riverbank Formation represents the oldest of the alluvial fan and terrace deposits. The Riverbank Formation was formed by streams carrying eroded material from the Cascade Range, Sierra Nevada, and foothill areas to the base of the foothills where it was deposited in wide alluvial fans. It is present in discontinuous surface exposures, primarily from west of Oroville southward. In many places, the Riverbank Formation has been covered by more recent alluvial fan development. The thickness of the formation varies from less than 1 foot to over 200 feet, depending on location (Maps: California 1985). The Riverbank Formation primarily overlies the Laguna Formation in the southern portion of Butte County and the Tuscan Formation in the northern portion of the county. The position and thickness of the Riverbank Formation can be seen in Cross-section B-B' (Plate 4, Appendix A). Overlying the Riverbank Formation in many locations is the Modesto Formation.

The alluvial fans and terrace deposits of the Pleistocene Modesto Formation were deposited in a similar manner to those of the Riverbank Formation but mark a more recent period of erosion and deposition from 42,000 to 14,000 years ago (Marchandt and Allwardt 1981). The terrace deposits of the Modesto Formation are exposed in many of the presently active stream-cut canyons along the foothills. Extending into the valley, Modesto Formation deposits widen into broad fans. As with the Riverbank Formation, the thickness of the Modesto Formation varies from less than 10 feet in many of the terraces to nearly 200 feet across the valley (Maps: California 1985). The extent and thickness of the Modesto Formation can be seen in Butte County on all four cross-sections of the Sacramento Valley. The Modesto Formation overlies the Riverbank Formation or Laguna Formation in the southern portion of Butte County and overlies the Riverbank Formation or Tuscan Formation in the northern portion of the county.

Overlying the alluvial fans of the Riverbank and Modesto formations are the fine silts and clays of the Holocene basin deposits. Basin deposits are the result of sediment-laden floodwater that rose above the natural levees of streams and rivers and spread out across vast low-lying areas. Basin deposits in Butte County are seen primarily in the western and southern portions of the county, forming the highly productive agricultural soils characteristic of these areas. Discontinuous basin deposits are also scattered throughout the northern portion of the Sacramento Valley Region in areas corresponding to the topographic depression of the Modesto Formation (Maps: California 1985).

Thickness of the basin deposits varies generally from less than 10 feet along the margins of the exposure to more than 100 feet in the center of the valley. Basin deposits provide limited quantities of groundwater to shallow wells due to the fine-grained nature of the sediments. The location and thickness of basin deposits in Butte

Public Version



County can be seen on the geologic map as well as on the four cross-sections. Alluvium overlies the basin deposits along presently active stream and river channels.

Holocene alluvium is the youngest of the geologic units present within the Sacramento Valley Region. Alluvium consists of unweathered gravel, sand, and silt that has been transported and deposited by streams and rivers, forming natural levees along the Sacramento and Feather rivers (Maps: California 1985). Also included in the geologic description of alluvium are mine tailings. Mine tailings were deposited as a result of mining operations in the Sierra Nevada. The most obvious occurrence of mine tailings is the sliver in the alluvium northwest of Oroville shown on the geologic map on Plate 2, Appendix A. Mine tailings can also be seen on Cross-section C-C' (Plate 4, Appendix A) between Highway 99 and Highway 70.

Alluvial deposits primarily overlie the Modesto Formation and basin deposits except where the alluvium is comprised of mine tailings. In this case, it is difficult to generalize a stratigraphic relationship between units. Due to its limited extent and thickness, alluvium is not considered a significant water-bearing unit. The position and thickness of alluvium can be seen on all four cross-sections of the Sacramento Valley.

Deformational structures within the Sacramento Valley Region of Butte County include several faults and folds. Offset on the Chico Monocline fault resulted in a monoclinal flexure, the Chico Monocline, that forms the eastern boundary of the region north of Durham. The Chico Monocline is a northwest-trending southwest-facing flexure that roughly follows the northeastern boundary of the Sacramento Valley Region extending from Chico to Red Bluff. North of Chico, the Chico Monocline deforms the Tuscan Formation and has a dip of up to 25 degrees where it becomes the eastward aquifer boundary (CDWR 1978). South of Chico, beds have a gentler slope of approximately 2 to 5 degrees, and evidence of the monocline disappears north of Oroville.

North of the Sutter Buttes, a minor splay fault associated with the Willows fault system is present at depth and displaces only Jurassic to Cretaceous sediments (see Plate 2, Appendix A). In the western portion of Butte County, the Glenn Syncline has produced some minor downward flexure of the deeper sedimentary units, as seen in Cross-section C-C' (Plate 4, Appendix A).

## Fresh Groundwater-Bearing Units

On a regional scale, the base of post-Eocene continental deposits is commonly considered the approximate base of fresh groundwater in the Sacramento Valley (Page 1974). Locally, the base of fresh groundwater fluctuates depending on local changes in the subsurface geology and geologic formational structure.

The approximate base of fresh groundwater is shown on the geologic cross-sections on Plates 4 and 5, Appendix A. The base of fresh groundwater was determined through examination of electric resistivity logs, which were derived from criteria established by C.F. Berkstresser, Jr., in *Base of Fresh Ground Water, Approximately 3,000 Micromos, in the Sacramento Valley and Sacramento-San Joaquin Delta, California*. This 1973 report determined that the base of fresh groundwater is water with a specific conductance of less than 3,000 micromhos per centimeter; water with a specific conductance that exceeds 3,000 micromhos per centimeter is considered to be saline.

Public Version



In the Sacramento Valley Region of Butte County, fresh groundwater-bearing units include the Tuscan, Laguna, Riverbank, and Modesto formations. Groundwater in these formations exists largely within the primary porosity associated with the spaces between the individual sand and gravel deposits and within the secondary porosity associated with fractures and jointing of the more competent volcanic rocks.

A detailed discussion of the major groundwater-bearing formations within the Butte County portion of the Sacramento Valley is presented below. Geologic surface exposures of the water-bearing formations described below are shown on the geologic plan-view map on Plate 2, Appendix A, and on the subsurface maps on Plates 4 and 5, Appendix A.

### Tuscan Formation

**Age and Composition.** The Pliocene Tuscan Formation is composed of a series of volcanic mudflows, tuff breccia, tuffaceous sandstone, and volcanic ash layers. The formation is described as four separate but lithologically similar units, Units A through D, which in some areas are separated by layers of thin tuff or ash units (Maps: California 1985). Stratigraphic position and general lithologic character distinguish each unit. Unit A consists of the oldest deposits of the Tuscan Formation. Units B and C overlie Unit A in most locations in Butte County. Unit D is the youngest unit and is exposed only in localized areas northeast of Red Bluff. Groundwater in the Sacramento Valley portion of Butte County is contained primarily within the two lower units of the Tuscan Formation, Units A and B.

Unit A is the oldest water-bearing unit of the Tuscan Formation. This unit is distinguished from the other units by the presence of metamorphic clasts within the interbedded lahars, volcanic conglomerate, volcanic sandstone, and siltstone. Unit A contains the Nomlaki Tuff, a dacitic pumice tuff, at its base or within the basal portion of the unit. The presence of the Nomlaki Tuff within the basal sections of the Tuscan, Tehama, and Laguna formations indicates simultaneous deposition of these units. Exposures of Unit A are shown on the geologic map of Butte County and in all four cross-sections of the Sacramento Valley.

Unit B is composed of a fairly equal distribution of lahars, tuffaceous sandstone, and conglomerate. These evenly layered, moderately thin beds form the characteristic look of the Tuscan Formation seen in the foothills of Butte County. Extending westward into the subsurface, the sediments of Unit B form a very productive water-bearing system. In most locations, Unit C overlies Unit B. Unit B can be seen on the geologic map of Butte County and in all four cross-sections of the Sacramento Valley.

Unit C consists of massive mudflow, or lahar, deposits with some interbedded volcanic conglomerate sandstone. In the foothills, these lahars are well cemented and form the cap rock for the ridges in Butte County. Evidence of wood fragments found in Unit C suggests fast-moving, massive mudflows at the time of deposition. In the subsurface, these low-permeability lahars form thick, confining layers for groundwater contained in the more permeable sediments of Unit B. Unit C is the youngest unit of the Tuscan Formation in Butte County and can be seen on the geologic map and in all four cross-sections of the Sacramento Valley. Unit C is overlain in some locations by Unit D.

Unit D is the youngest depositional unit and is characterized by large masses of grey hornblende andesite. Exposures of Unit D are found in limited extent northeast of Red Bluff. No exposures of Unit D are mapped at the surface or in the subsurface within Butte County.

Public Version



The Tuscan Formation is overlain by Holocene and Pleistocene alluvial sediments, which include the Modesto and Riverbank formations and younger stream channel and basin deposits. In most places, the Tuscan Formation unconformably overlies either Upper Cretaceous marine sedimentary rocks or the basement complex with angular unconformity (Olmsted and Davis 1961). In other areas, the Tuscan Formation rests unconformably on the Neroly Formation, the Ione Formation, and/or the Lovejoy Basalt.

The volcanic sediments of the Tuscan Formation interfinger with the nonmarine and nonvolcanic sediments of the Tehama Formation in the subsurface (Lydon 1969). This contact is considered to occur at depth in the vicinity west of the Sacramento River. As mentioned previously, the presence of the Nomlaki Tuff at the base of the Tuscan, Tehama, and Laguna formations suggests simultaneous deposition and an age correlation of these units.

**Depositional Environment and Source Area.** The Tuscan was deposited as a series of volcanic lahars over a period of about one million years (Lydon 1969). The source areas of the lahars were eroded volcanoes historically located northwest and south of Lassen Peak. Mudflows most likely followed ancient stream channels and valleys while travelling in a southwestward direction. The flows then fanned out upon reaching the valley floor, causing deposition to vary in thickness and in topographic elevation. As areas of the well-cemented volcanic lahars were eroded and redeposited, aquifer material on the valley floor resulted in a heterogeneous and, in some areas, unconsolidated mass of sediments.

**Extent and Thickness.** The Tuscan Formation extends from east of Redding to west of Oroville and from the base of the Cascade Range and Sierra Nevada into the subsurface about 5 miles west of the Sacramento River (Page 1986). The maximum thickness of the formation ranges from about 1,700 feet in the east, thinning to approximately 300 feet at the westward extent (Lydon 1969). Unit A has an average mapped thickness of 250 feet, and Units B and C each have a mapped thickness of about 600 feet, for a total approximate thickness of about 1,450 feet.

**Water-bearing Properties.** Groundwater in the Sacramento Valley Region is contained primarily within the pore spaces of the reworked sand and gravel layers. Much of the groundwater in the Tuscan Formation is confined under pressure by layers of impermeable clays, lahars, or tuff breccia.

Groundwater encountered within Unit A is associated with primary porosity of the conglomerate and sandstone layers and with secondary porosity associated with the fractured tuff breccia. Within Unit B, the interbedded, permeable layers of reworked sand and gravel become a conduit for groundwater movement, transmitting water into the aquifer from recharge areas in the Cascade foothills. The permeable layers of the Unit B sediments comprise the main aquifer material for groundwater storage in the valley. The fine-grained, consolidated lahars of Unit C form thick, low-permeability, confining layers for groundwater contained in the more permeable sediments of Unit B.

Volcanic sands of the Tuscan Formation yield high amounts of water to wells in many areas of the eastern Sacramento Valley. California Water Service Company (CWSC) wells in the Chico area have well yields that range between 900 and 3,000 gallons per minute (gpm) (CDWR 1978). Three wells at the Chico Airport produce between 900 and 950 gpm with specific capacities between 26 and 45 gpm per foot (gpm/ft) of drawdown (Olmsted and Davis 1961).

Public Version



Well yields and specific capacities for the Sacramento Valley Region were also calculated with data obtained from utility pump tests. Results from 2,662 pump tests on 944 wells showed that average well yields range from a low of 976 gpm in the North Yuba Inventory Unit, to a high of 1,395 gpm in the Vina Inventory Unit. The average specific capacity calculated from 974 pump tests on 433 wells was 78 gpm/ft for the entire Sacramento Valley Region. Specific capacities for the valley inventory units ranged from a low of 48 gpm/ft in the North Yuba Inventory Unit to a high of 87 gpm/ft in the Vina Inventory Unit.

Aquifer performance tests have been conducted in several areas of Butte County. These tests were used to evaluate the water-bearing characteristics of the Tuscan Formation. Transmissivity values within the Butte Basin portion of the East and West Butte inventory units ranged from 97,000 to 182,000 gallons per day per foot (gpd/ft). Storativity values ranged from 0.0003 to 0.0015. Specific capacity measurements made for wells in this study provided a range of 45.7 to 104.7 gpm/ft of drawdown (CDWR 1991).

A similar test was performed on a well located in the West Butte Inventory Unit. The extraction well utilized for this test was designed and constructed to draw water only from the lower confined portion of the Tuscan Formation. Aquifer transmissivity was calculated to be approximately 75,000 gpd/ft. Storativity was estimated between 0.0001 and 0.00001. The specific capacity of the extraction well was measured at 23 gpm/ft of drawdown (CDWR 1995).

### Laguna Formation

**Age and Composition.** The Pliocene Laguna Formation is composed of continental deposits containing predominantly fine-grained, poorly bedded, and compacted sediments. These deposits are composed of a heterogeneous mixture of interbedded alluvial fine sand, silt, and clay of granitic and metamorphic origin with minor conglomerate lenses (Olmsted and Davis 1961). Clay is more predominate in the fine-grain sediments south of Oroville. The sand is arkosic and contains abundant weathered feldspar, biotite, and angular quartz clasts. The Arroyo Seco gravels are considered to be part of the Laguna Formation by some sources. Near Oroville, the gravel deposits are of granitic or metamorphic composition and are contained within a silty-to-sandy matrix.

**Depositional Environment and Source Area.** West-flowing rivers and streams draining the Sierra Nevada deposited the Laguna Formation. Uplift of the Sierra Nevada during their formation increased erosion of the metamorphic and plutonic rocks. Rivers and streams carried these eroded materials to the valley floor, where they overtopped their banks and spread out across the broad floodplains of the valley, depositing eroded materials into broad alluvial fans.

**Extent and Thickness.** Exposure of the Laguna Formation is discontinuous and extends southward from Oroville to Lodi. The only exposures within Butte County occur southwest of Oroville. The thickness of the Laguna Formation is difficult to determine because the base of the unit is rarely exposed. Estimates of the maximum thickness range from 180 feet (Maps: California 1985) to 1,000 feet (Olmsted and Davis 1961).

**Water-bearing Properties.** Quantitative water-bearing data for the Laguna Formation is limited, especially in the Butte County area. Wells completed in the finer-grained sediments of the Laguna Formation yield only moderate quantities of

Public Version



water. Well yield data from the Sacramento-American rivers area indicate yields as high as 1,000 gpm, with specific capacity values ranging between 24 and 42 gpm/ft of drawdown (Olmsted and Davis 1961). In areas where soft, well-sorted granitic sand dominates, well yields are much higher. Some of the sand aquifers are highly permeable, but the average permeability is low to moderate. In the Gridley area, a sand unit that is stratigraphically equivalent to the Laguna Formation was reported to have a specific capacity of 60 gpm/ft of drawdown (Olmsted and Davis 1961).

### Riverbank Formation

**Age and Composition.** The Riverbank Formation was deposited between 450,000 and 130,000 years ago, forming wide alluvial fans and terrace deposits. Stream terrace deposits of the formation appear topographically above the younger Modesto Formation terrace deposits. Due to post-depositional weathering of the Riverbank Formation, deposits exhibit a reddish color. The topographic location and weathered red color distinguish the Riverbank from more recent alluvial fan and terrace deposits (Maps: California 1985).

**Depositional Environment and Source Area.** The Riverbank Formation consists of gravel, sand, and silt eroded from the surrounding Coast, Klamath, and Cascade ranges and the Sierra Nevada and deposited in the Sacramento Valley. The source area determines the mineral constituents of the deposits. Near Sacramento, the deposits are primarily arkosic; however, mafic content of igneous rock fragments increases northward.

**Extent and Thickness.** Exposures of the Riverbank Formation within Butte County are observed primarily west of Oroville and southward. The thickness of the formation ranges from less than 1 foot to over 200 feet, depending on location. More recent depositions of the Modesto Formation and basin deposits have produced the limited surface exposure of this formation.

**Water-bearing Properties.** The thickness of the Riverbank Formation can be a limiting factor to the water-bearing capabilities of the formation. The Riverbank Formation is moderately to highly permeable and yields moderate quantities of water to domestic and shallow irrigation wells. It also provides water to deeper irrigation wells that have multiple zones of perforation. Well yields are higher in areas where concentrations of gravel and sand are present. Groundwater occurs generally under unconfined conditions.

### Modesto Formation

**Age and Composition.** Radiocarbon dating indicates that the Modesto Formation is Pleistocene in age with the upper and lower members dated at 14,000 and 42,000 years old, respectively (Marchandt and Allwardt 1981). The formation consists of tan and light grey, gravelly sand, silt, and clay. Where it overlies the Tuscan Formation, the clasts within the Modesto are distinctly red, brown or black. The upper member shows no indication of weathering, while the lower member shows slight weathering (Maps: California 1985).

**Depositional Environment and Source Area.** The Modesto Formation consists of gravel, sand, and silt eroded from the surrounding Coast, Klamath, and Cascade ranges and the Sierra Nevada and deposited in the Sacramento Valley. The Modesto forms coalescing alluvial fans and streambank terraces. Exposures of the Modesto Formation are present along most of the major streams and rivers within Butte County.

Public Version



**Extent and Thickness.** The Modesto Formation is widespread throughout the Sacramento Valley, occurring from Redding southward into the San Joaquin Valley. The most notable occurrences are found along the Sacramento and Feather rivers. Similar to the Riverbank, the Modesto Formation ranges in thickness from less than 10 feet in many of the terraces and along the margins of the valley to nearly 200 feet across the valley floor (Maps: California 1985).

**Water-bearing Properties.** Like the Riverbank Formation, the thickness of the Modesto Formation limits the water-bearing capabilities of the formation. These deposits provide water to domestic and shallow irrigation wells, as well as to deeper wells with multiple zones of perforations. In locations where gravel and sand predominate, groundwater yields are moderate. Lesser yields are found in areas with high silt and clay content. Groundwater occurs generally under unconfined conditions.

### Movement of Groundwater

Groundwater movement in the Sacramento Valley Region was evaluated utilizing groundwater elevation contours developed for Butte County. The contours shown on Plates 7 and 8, Appendix A, were developed using March 1997 groundwater level data collected by DWR and local cooperators. The flow arrows on Plate 7, Appendix A, indicate the general direction of groundwater movement.

The directional flow arrows illustrate that regional groundwater movement in Butte County is southwestward from the foothills toward the Sacramento River. This indicates that groundwater from the northern and central portions of the county drain to the river. Some localized contour anomalies along the boundary between the West and East Butte inventory units can be attributed to the draining of groundwater toward Butte Creek. The general southwestward flow pattern within Butte County is disrupted in the Chico Urban Area by municipal groundwater extraction. This disruption is indicated on Plate 7, Appendix A, by small-scale, localized groundwater depressions and mounds. A larger-scale groundwater depression is depicted in the southwest portion of the North Yuba inventory unit.

The final notable anomaly is located in the southwest portion of Butte County. In this area, groundwater converges under the Butte Sink and Biggs-West Gridley inventory units. Groundwater from the East Butte Inventory Unit flows southwestward, while groundwater from the Sacramento River flows southeastward and eastward. The Sutter Buttes and the buried Colusa Dome located west of the Sutter Buttes deform the valley sediments, causing this anomalous flow pattern.

Outside of Butte County, a change occurs in the groundwater flow along the Sacramento River near Princeton. North of this location, the groundwater flows toward the Sacramento River, where it drains groundwater from the northern Sacramento Valley. South of Princeton, groundwater flows away from the river, thereby recharging the groundwater system.

## Foothill Region

The Foothill Region of Butte County lies between the Sacramento Valley and Mountain regions. The Foothill Region ranges in elevation from about 100 feet msl at the southwestern margin of the Sacramento Valley, to about 3,500 feet msl north of Sterling City, where it merges into the Mountain Region. Groundwater occurs primarily within the reworked gravels and sands deposited between successive lahar

Public Version



and mudflows of the Tuscan Formation (Slade 2000). Limited amounts of groundwater are also available through secondary porosity associated with fracturing of the geologic formations in the region.

The Foothill Region is a recharge area for the Butte County portion of the Sacramento Valley groundwater basin aquifer. Groundwater recharge occurs in the form of precipitation and deep percolation of runoff from nearby creeks, streams, and reservoirs.

Following is a summary of the surface and subsurface geology in the Foothill Region of Butte County that focuses on the fresh groundwater-bearing units of the region. The description of the surface geology is based on the geologic map of Butte County developed by DWR that is shown on Plate 2, Appendix A. The description of the subsurface geology is based on geologic cross-sections also developed by DWR, which are shown on Plates 4 and 5, Appendix A. Geologic map symbols for Plates 2 through 5, Appendix A, are referenced in parenthesis in Section 3.

## Surface and Subsurface Geology

The Foothill Region occupies the transitional geologic zone between Tertiary sediments in the western part of Butte County and Mesozoic-Paleozoic rocks in the eastern part of the county (see Plates 1 and 2, Appendix A). Mesozoic rocks encompass the Jurassic and Cretaceous rocks ranging in age from 245 to 65 mybp. Older Paleozoic rocks range in age from 544 to 245 mybp.

The eastern Mesozoic-Paleozoic deposits exhibit very little, if any, primary porosity. However, due to secondary porosity, small amounts of water can be found within the fractures and joints of these dense, hard rocks. Jurassic and Cretaceous sedimentary rocks seen in outcrops in the northern Foothill Region tend to contain brackish water and do not contribute to the region's fresh groundwater system. Tertiary sediments (65 to 1.8 mybp) exposed in the northern and western zones of the region tend to contain fresh groundwater mainly through primary porosity. Surficial Quaternary sediments found along a few of the drainages in the Foothill Region supply modest amounts of groundwater to shallow domestic wells.

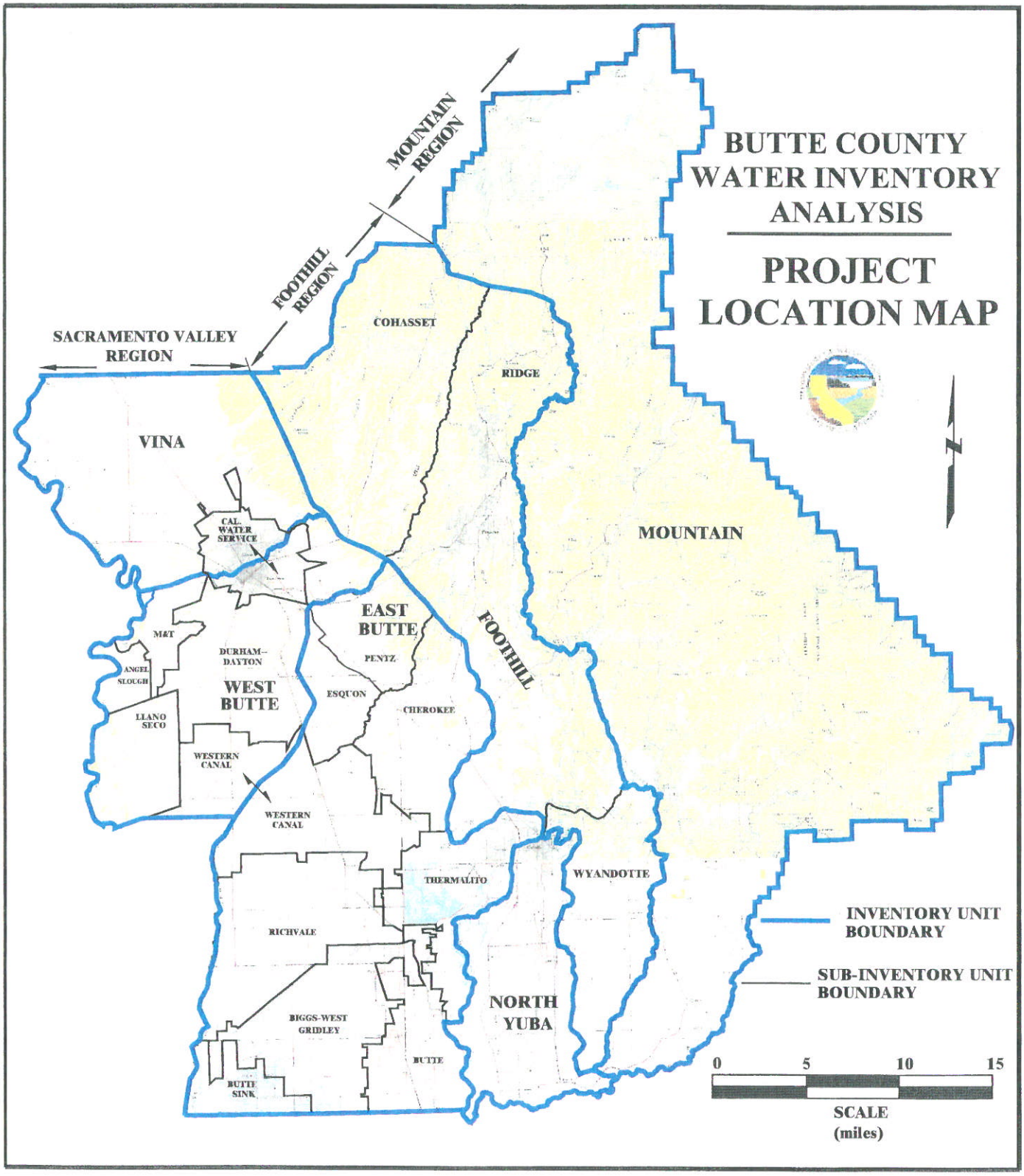
Paleozoic rocks consist of metavolcanic and metasedimentary geologic units. These units, exposed mainly in the eastern and southern margins of the Foothill Region, were deposited during periods of volcanic activity and subsequently metamorphosed due to tectonic compression and contact metamorphism. Metavolcanic rocks consist primarily of breccia and tuff with lesser amounts of greenstone, diabase, and pillow lavas. Metasedimentary rocks are composed of slate, shale, sandstone, chert, conglomerate, limestone, dolomite, marble, phyllite, schist, hornfels, and quartzite. Groundwater found in these areas is associated mainly with secondary porosity.

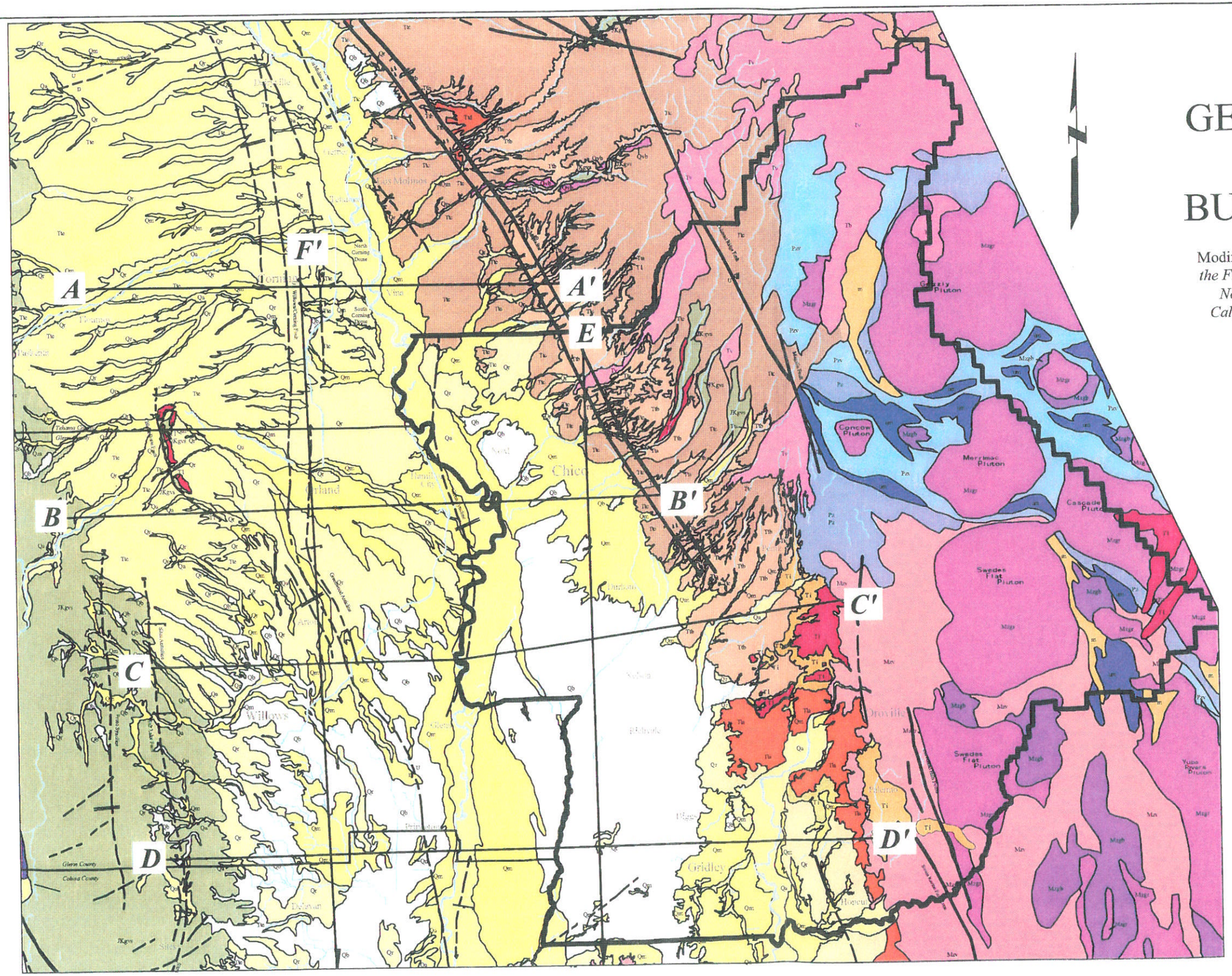
Resting unconformably on top of the Paleozoic deposits are rocks of the Late Mesozoic Era. Late Mesozoic rocks were deposited in a marine forearc-basin setting. After deposition, tectonic stress caused the eastern limb of the Sacramento Valley trough to be uplifted, raising Great Valley sediments to their present elevation above the valley floor. These older sediments are seen in outcrops in Little Chico, Big Chico, and Butte Creek drainages shown on Plate 2, Appendix A. Groundwater in these sediments is usually brackish and does not contribute to the region's fresh groundwater supply.

A series of Tertiary continental deposits unconformably overlie Late Mesozoic marine deposits. The Tuscan Formation, composed of Units A, B, and C, is the major

PLATE 1

Public Version






# GEOLOGIC MAP OF BUTTE COUNTY

Modified from - *Geology and Hydrogeology of the Freshwater Bearing Aquifer Systems of the Northern Sacramento Valley, California, California Department of Water Resources, Bulletin 118-7, 2001.*

## Map Legend

U / D — **Fault** - dashed where location is approximate; U indicates upthrown side and D indicates downthrown side.

**Anticline** - Arrows indicate direction of dip.

**Syncline** - Arrows indicate direction of dip.

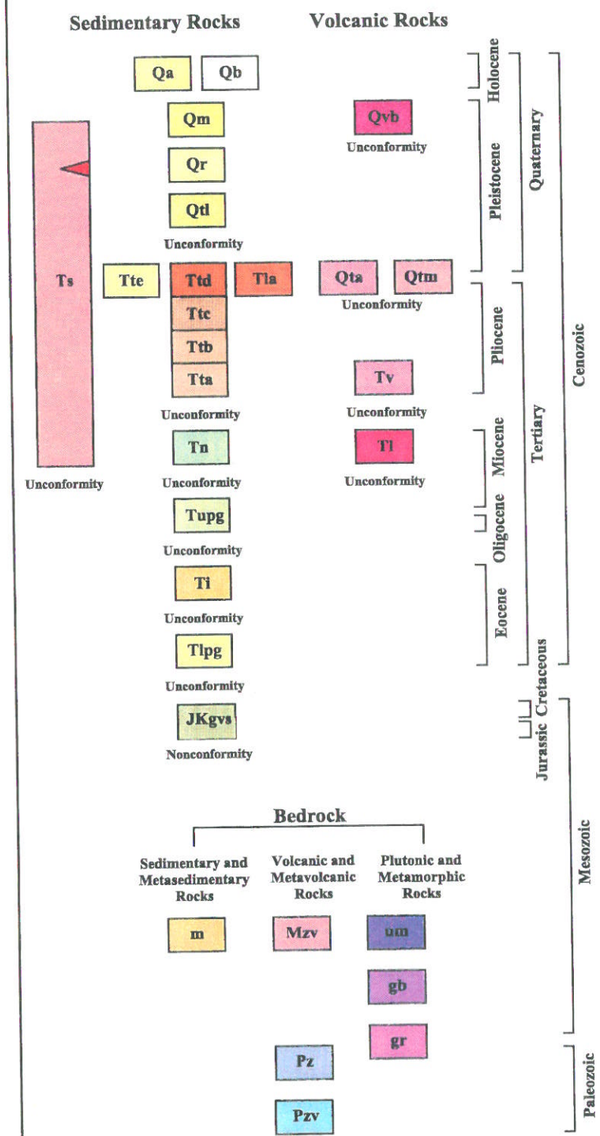
25 — **Monocline** - Arrows indicate direction of dip, number indicates steepness of dip in degrees.

D D' — **Location of Geologic Cross-Sections** - Letters correspond to geologic sections shown in Plates 4 and 5.

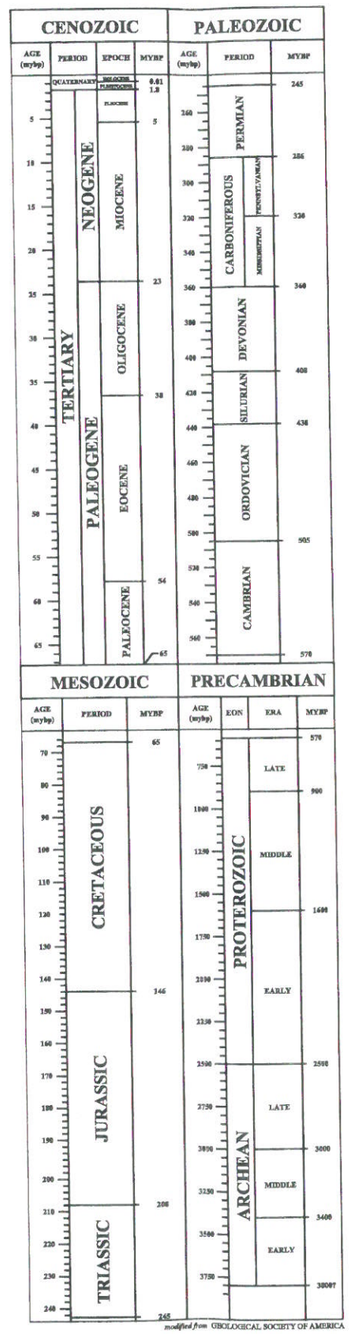
5 0 5 10
MILES

Public Version

## CORRELATION OF MAP UNITS




## NORTH AMERICAN GEOLOGIC TIME SCALE




## DESCRIPTION OF MAP UNITS

**Qa** — **Alluvium** (Holocene)-Includes surficial alluvium and stream channel deposits of unweathered gravel, sand and silt, maximum thickness 80 ft. *(adapted from Helley & Harwood, 1985)*.

**Qb** — **Basin Deposits** (Holocene)-Fine-grained silt and clay derived from adjacent mountain ranges, maximum thickness up to 200 ft. *(adapted from Helley & Harwood, 1985)*.

**Qm** — **Modesto Formation,** undifferentiated (Pleistocene)-Alluvial fan and terrace deposits consisting of unconsolidated weathered and unweathered gravel, sand, silt and clay; maximum thickness approximately 200 ft. *(adapted from Helley & Harwood , 1985).*

**Qr** — **Riverbank Formation**, undifferentiated (Pleistocene)-Alluvial fan and terrace deposits consisting of unconsolidated to semi-consolidated gravel, sand and silt; maximum thickness approximately 200 ft. *(adapted from Helley & Harwood, 1985).*

**Qtl** — **Turlock Lake** (Pleistocene)-Weathered and dissected arkosic gravels with minor amounts of resistant metamorphic rock fragments and quartz pebbles, sand and silt; maximum thickness approximately 100 ft. *(adapted from Helley & Harwood, 1985).*

**Qvb** — **Volcanic Basalts**, undifferentiated (Pleistocene)-Younger basalt flows found primarily on the east side of the Sacramento Valley, includes minor exposures of andesite; maximum thickness 100 ft. *(adapted from Helley & Harwood, 1985).*

**Qtm** — **Tuff Breccia** (Plio-Pleistocene)-Tuff breccia forming outer ring surrounding the Sutter Buttes *(adapted from Helley & Harwood, 1985)*.

**Qta** — **Volcanic Andesites**, undifferentiated (Plio-Pleistocene)-Younger andesites forming the center of the Sutter Buttes *(adapted from Helley & Harwood, 1985).*

**Tte** — **Tehama Formation** (Plio-Pleistocene)-Includes Red Bluff Formation on west side. Pale green, gray and tan sandstone and siltstone with lenses of pebble and cobble conglomerate; maximum thickness 2,000 ft. *(adapted from Helley & Harwood, 1985).*

**Ttd** — **Tuscan Unit D** (Plio-Pleistocene)-Fragmental flow deposits characterized by monolithic masses containing gray hornblende and basaltic andesites and black pumice, maximum thickness 160 ft. *(adapted from Helley & Harwood, 1985).*

**Ttc** — **Tuscan Unit C** (Plio-Pleistocene)-Includes Red Bluff Formation on east side. Volcanic lahars with some interbedded volcanic conglomerate and sandstone, and reworked sediments; maximum thickness 600 ft. *(adapted from Helley & Harwood, 1985, DWR Bulletin 118-7, 2001, draft report).*

**Ttb** — **Tuscan Unit B** (Pliocene)-Layered, interbedded lahars, volcanic conglomerate, volcanic sandstone and siltstone; maximum thickness 600 ft. *(adapted from Helley and Harwood, 1985; DWR Bulletin 118-7, 2001, draft report).*

**Tta** — **Tuscan Unit A** (Pliocene)-Interbedded lahars, volcanic conglomerate, volcanic sandstone, and siltstone containing metamorphic rock fragments; maximum thickness 400 ft. *(adapted from Helley & Harwood, 1985; DWR Bulletin 118-7 (in progress), 2001).*

**Tla** — **Laguna Formation** (Pliocene)-Interbedded alluvial gravel, sand and silt; maximum thickness 450 feet. *(adapted from Helley & Harwood, 1985; Olmsted and Davis, 1961; DWR Bulletin 118-6, 1978).*

**Tv** — **Basalts and Andesites,** undifferentiated (Pliocene)-Older basalts and andesites found on the northeastern portion of the Sacramento Valley and southwest of Winters; maximum thickness up to 230 ft. *(adapted from Helley & Harwood, 1985).*

**Ts** — **Sutter Formation** (Late Miocene to Early Pleistocene)-Volcanic fluvatile sediments with lacustrine deposits; maximum thickness approximately 1,800 ft. *(adapted from Garrison, 1962).*

**Tn** — **Neroly Formation** (Miocene)-Marine to non-marine sediments, tuffaceous andesitic sandstone with interbeds of tuff and tuffaceous shales and occasional conglomerate lenses; max. thickness 500 ft. *(adapted from Redwine, 1972; Wagner and Saucedo, 1990).*

**Tl** — **Lovejoy Basalt** (Miocene)-Black, dense, hard microcrystalline basalt; maximum thickness 65 ft. *(adapted from Helley & Harwood, 1985).*

**Tupg** — **Upper Princeton Valley Fill** (Late Oligocene to Early Miocene)-Non-marine sediments composed of sandstone with interbeds of mudstone and occasional conglomerate and conglomerate sandstone; maximum thickness 1,400 ft. *(adapted from Redwine, 1972).*

**Ti** — **Ione Formation** (Eocene)-Marine to non-marine deltaic sediments, light colored, commonly white conglomerate, sandstone and siltstone, which is soft and easily eroded; max. thickness 650 ft. *(adapted from DWR Bulletin 118-6, 1978; Creely, 1965).*

**Tlpg** — **Lower Princeton Submarine Valley Fill** (Eocene)-includes Capay Formation. Marine sandstone, conglomerate and interbedded silty shale, maximum thickness 2,400 ft. (*adapted from Redwine, 1972*)

**JKgvs** — **Great Valley Sequence** (Late Jurassic to Upper Cretaceous)-Marine clastic sedimentary rock consisting of siltstone, shale, sandstone and conglomerate; maximum thickness 15,000 ft.

**m** — **Mixed Rocks** (pre-Cenozoic)-Undivided metasedimentary and metavolcanic rocks of greatly varying types *(adapted from Jennings, 1977).*

**Mzv** — **Volcanic and Metavolcanic Rocks** (Mesozoic)-Undivided volcanic and metavolcanic rocks, andesite rhyolite flow rocks, greenstone and volcanic breccia *(adapted from Jennings, 1977).*

**um** — **Ultramafic Rocks** (Mesozoic)-Primarily composed of serpentine, with peridotite, gabbro and diabase *(adapted from Jennings, 1977).*

**gb** — **Gabbro** (Mesozoic)-Gabbro and dark diotric rocks *(adapted from Jennings, 1977).*

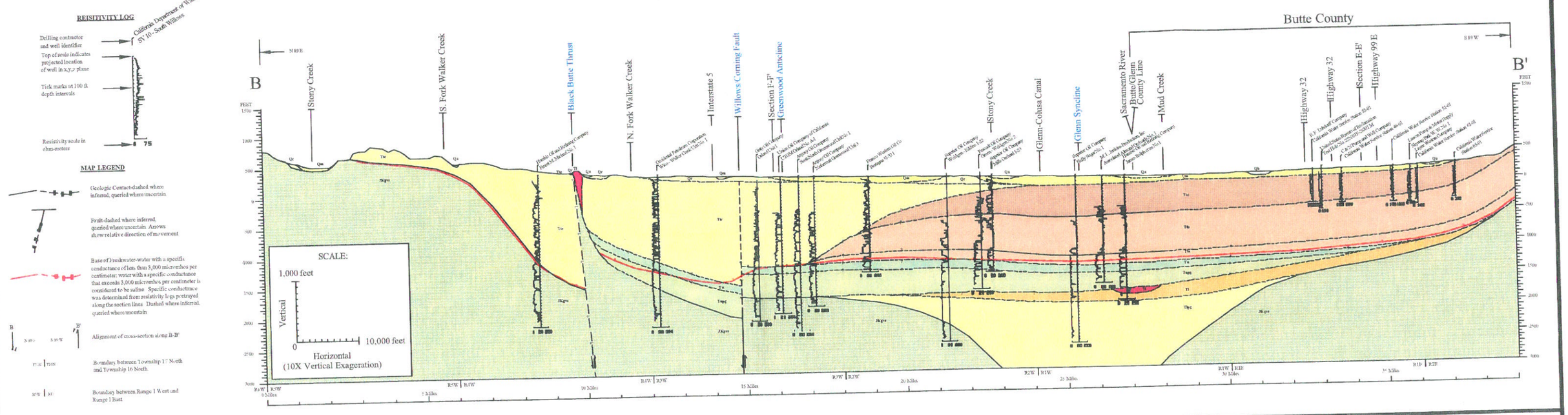
**gr** — **Undifferentiated Granitic Plutons** (Mesozoic-Paleozoic)-Undivided granitic plutons and related rocks *(adapted from Jennings, 1977).*

**Pz** — **Paleozoic Metasedimentary Rocks** (Paleozoic)-Undivided metasedimentary rocks including slate, shale, sandstone, chert, conglomerate, limestone, dolomite, marble, phyllite,schist, hornfels and quartzite *(adapted from Jennings, 1977).*

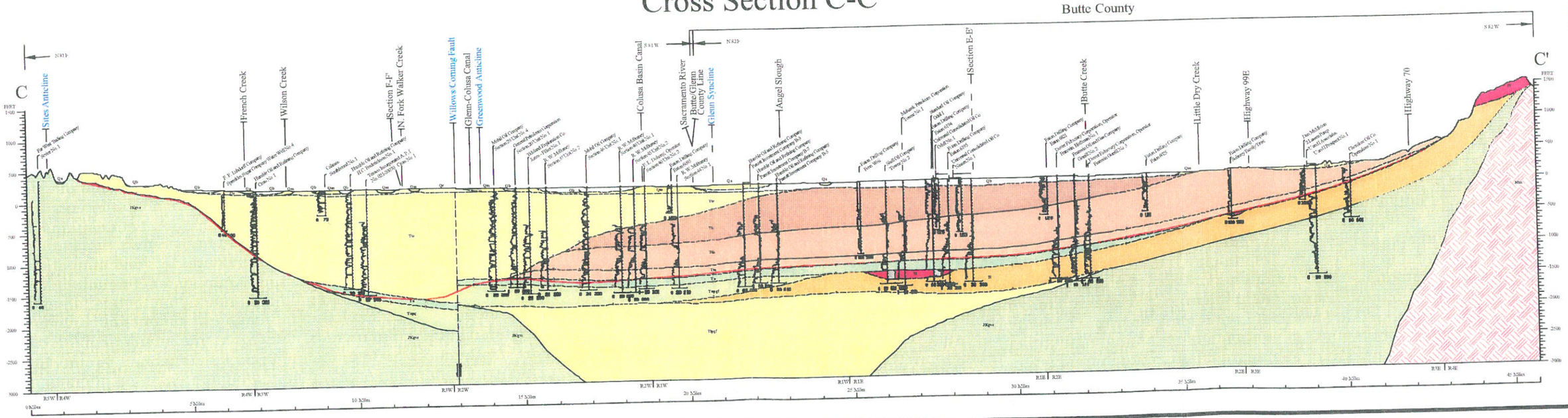
**Pzv** — **Paleozoic Metavolcanic Rocks** (Paleozoic)-Undivided metavolcanic rocks, primarily flows, breccia, and tuff, including greenstone, diabase and pillow lavas *(adapted from Jennings, 1977).*

Public Version

# Cross Section B-B'

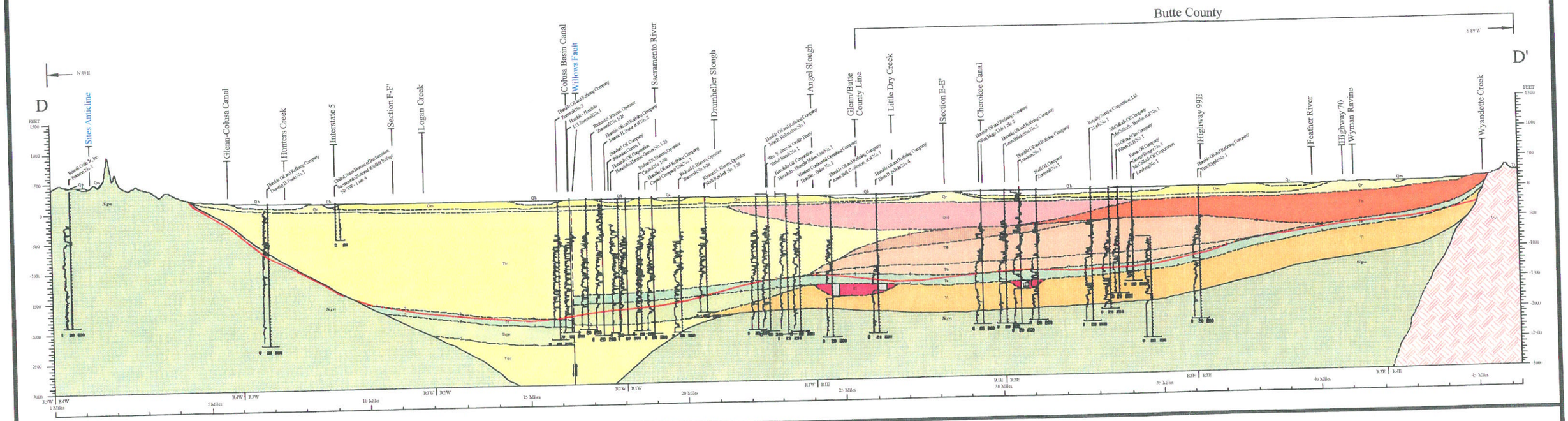



# Cross Section C-C'

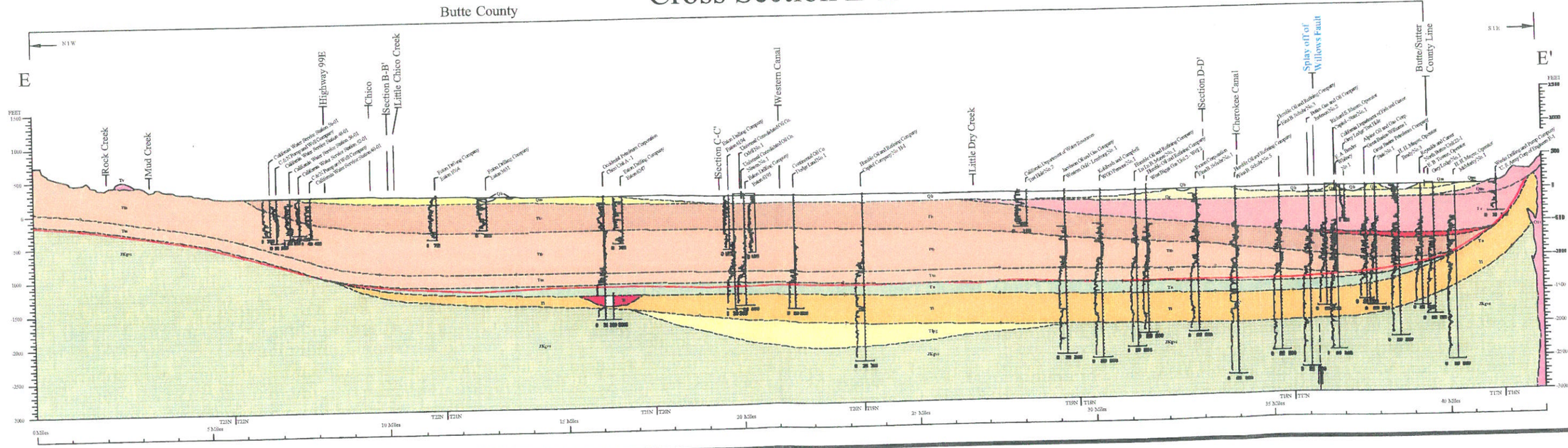



Public Version

# Cross Section D-D'



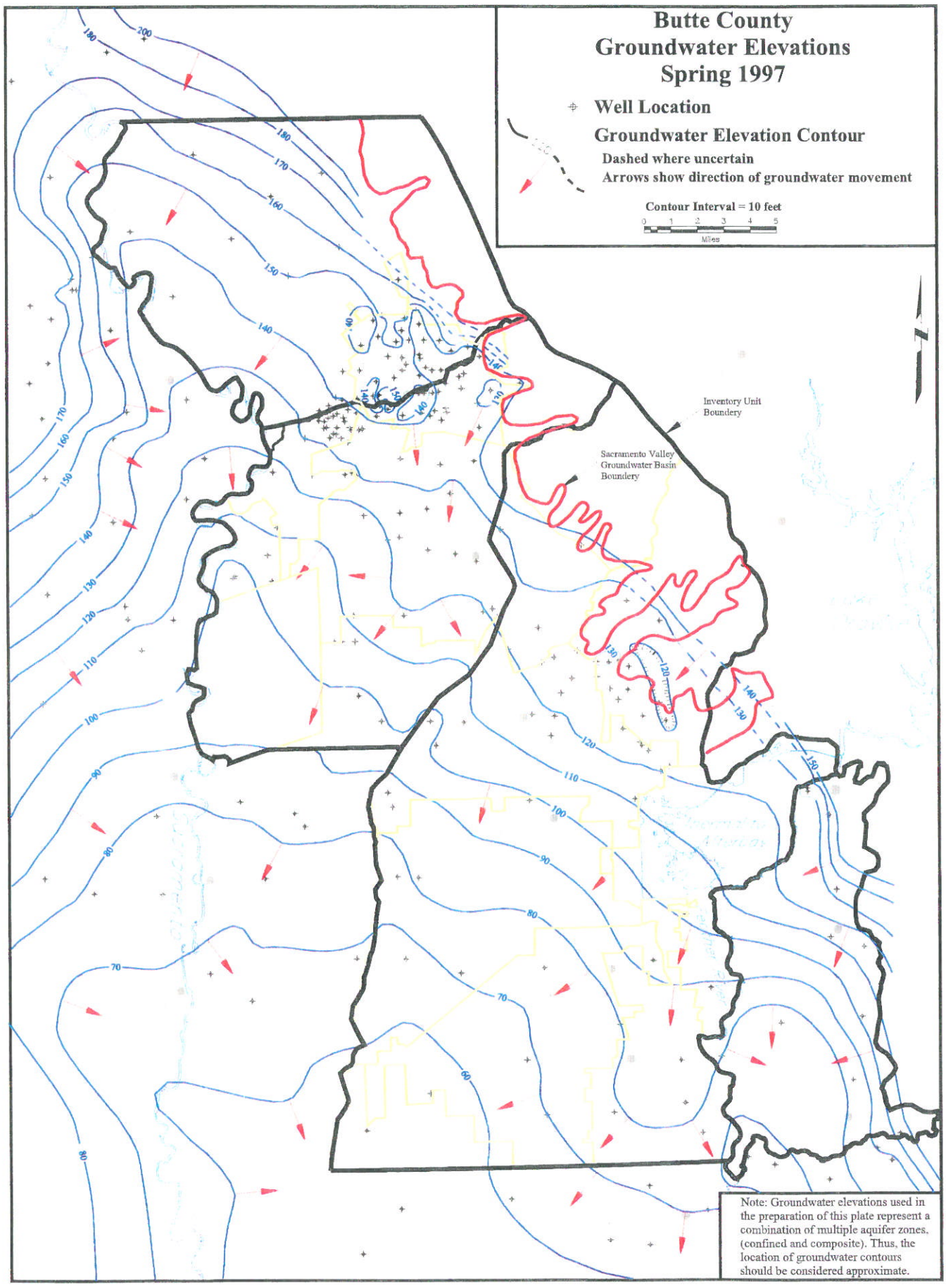

# Cross Section E-E'




Public Version

# PLATE 7

Public Version

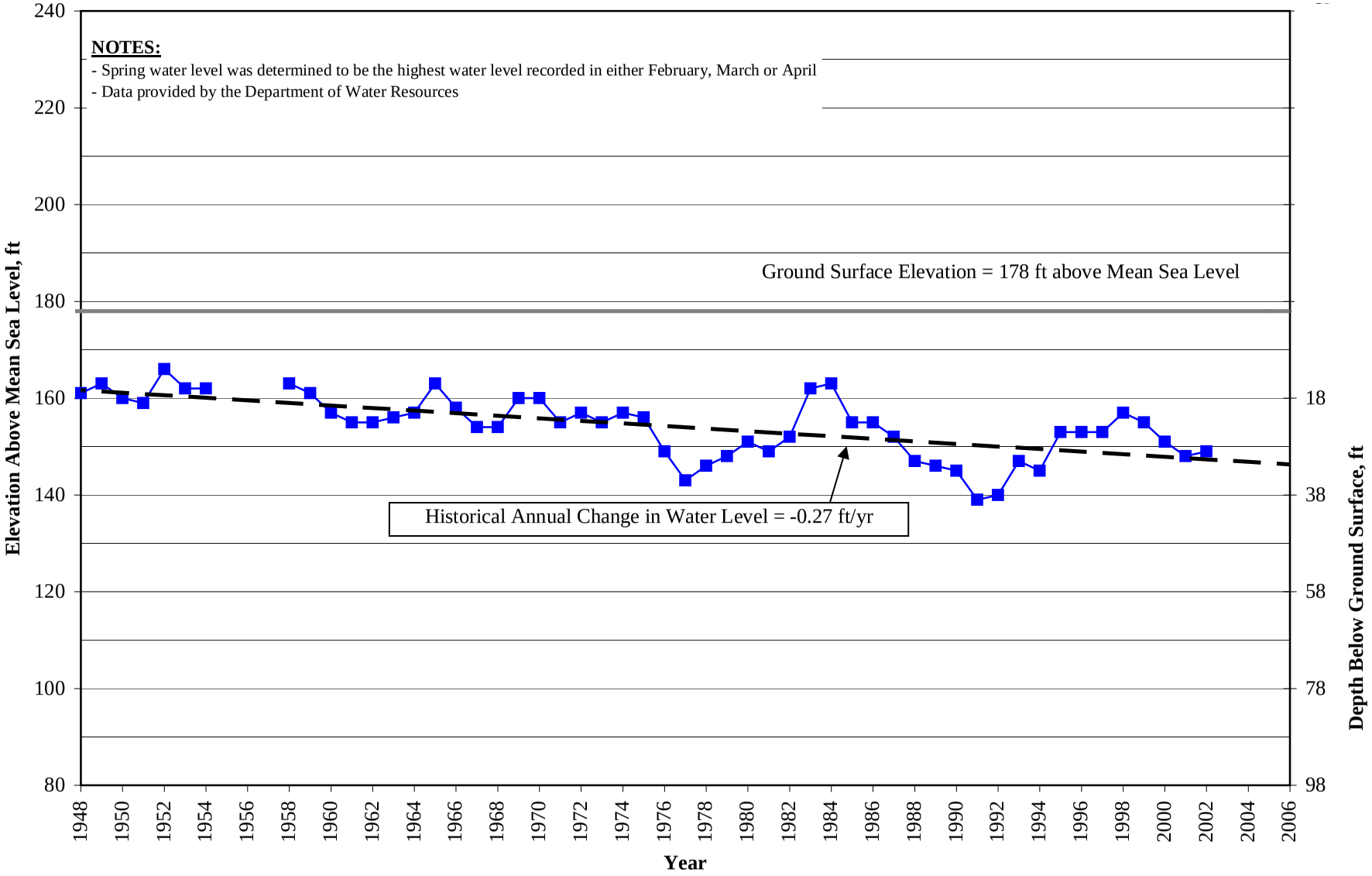


Public Version

# APPENDIX G

## DWR Water Levels

# VINA: DWR Well #22N/1E-09J02M - Spring Groundwater Level Hydrograph

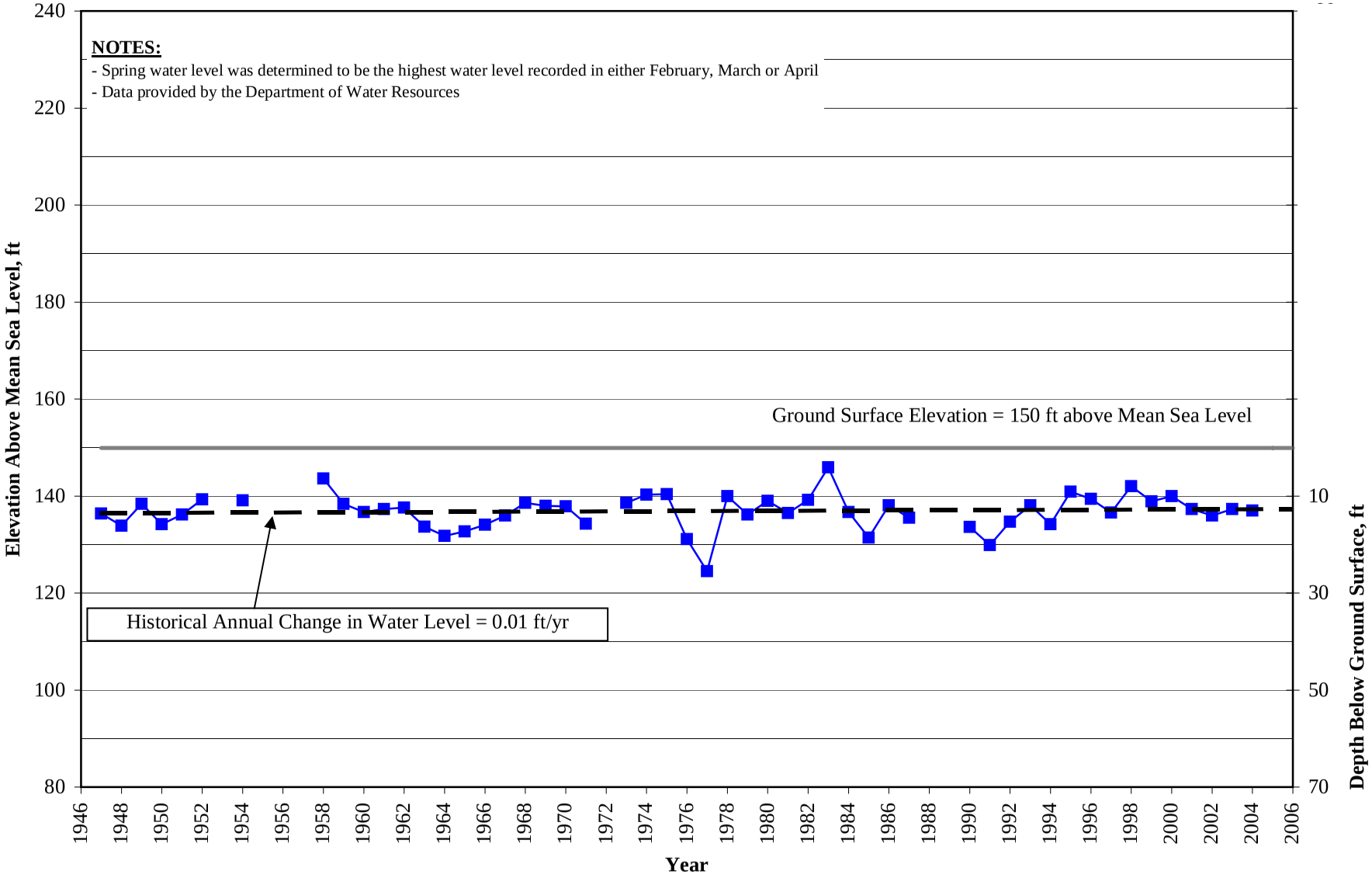



Public Version

West Yost Associates
436\02-06-03\E\2\GW\CHDepthGW\22N1E09J02M
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

# VINA: DWR Well #22N/1W-05M01M - Spring Groundwater Level Hydrograph

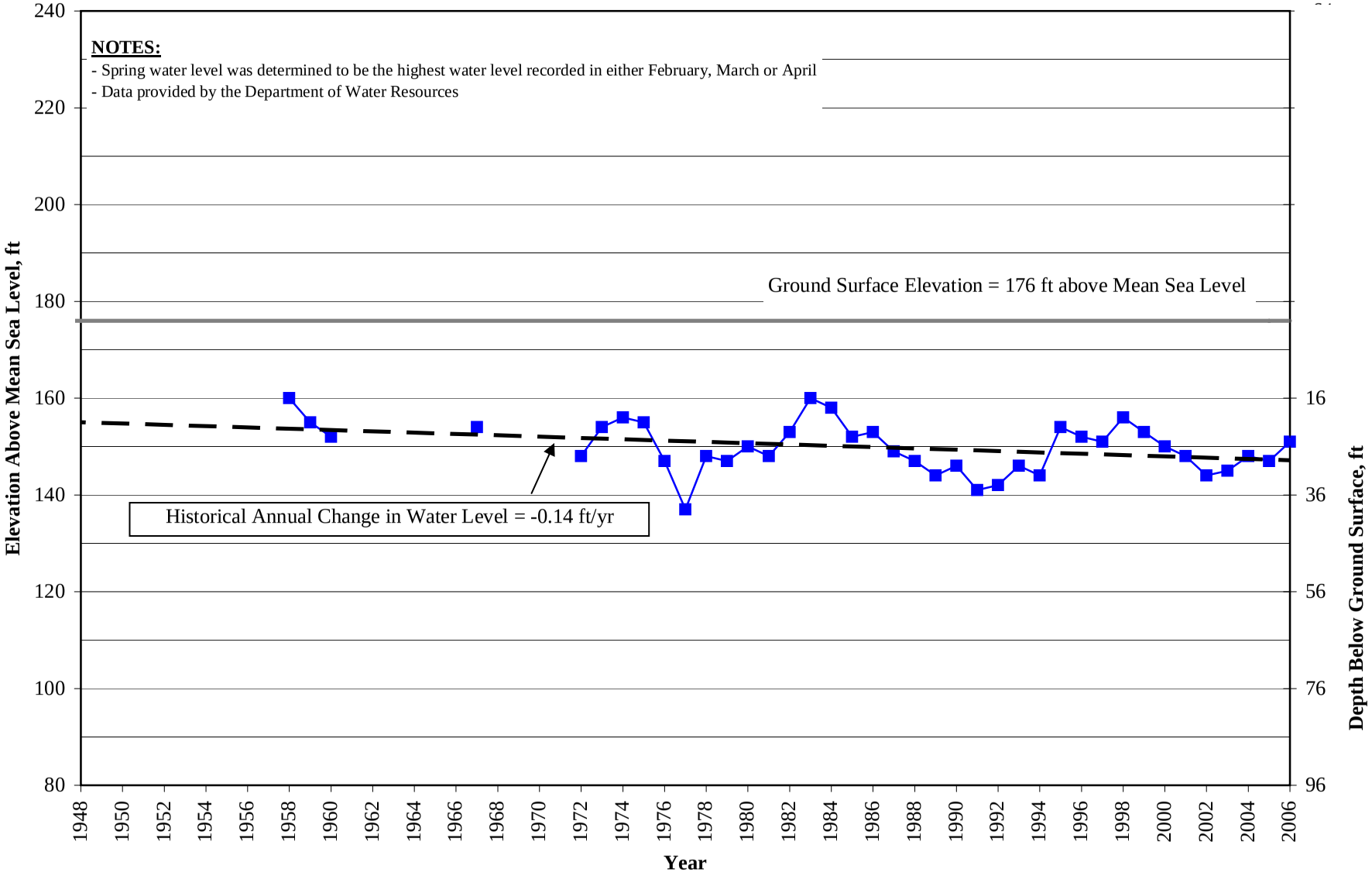



Public Version

West Yost Associates
436\02-06-03\E\2\GW\CHDepthGW\22N1W05M01M
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

# VINA: DWR Well #22N/1E-28J03M - Spring Groundwater Level Hydrograph

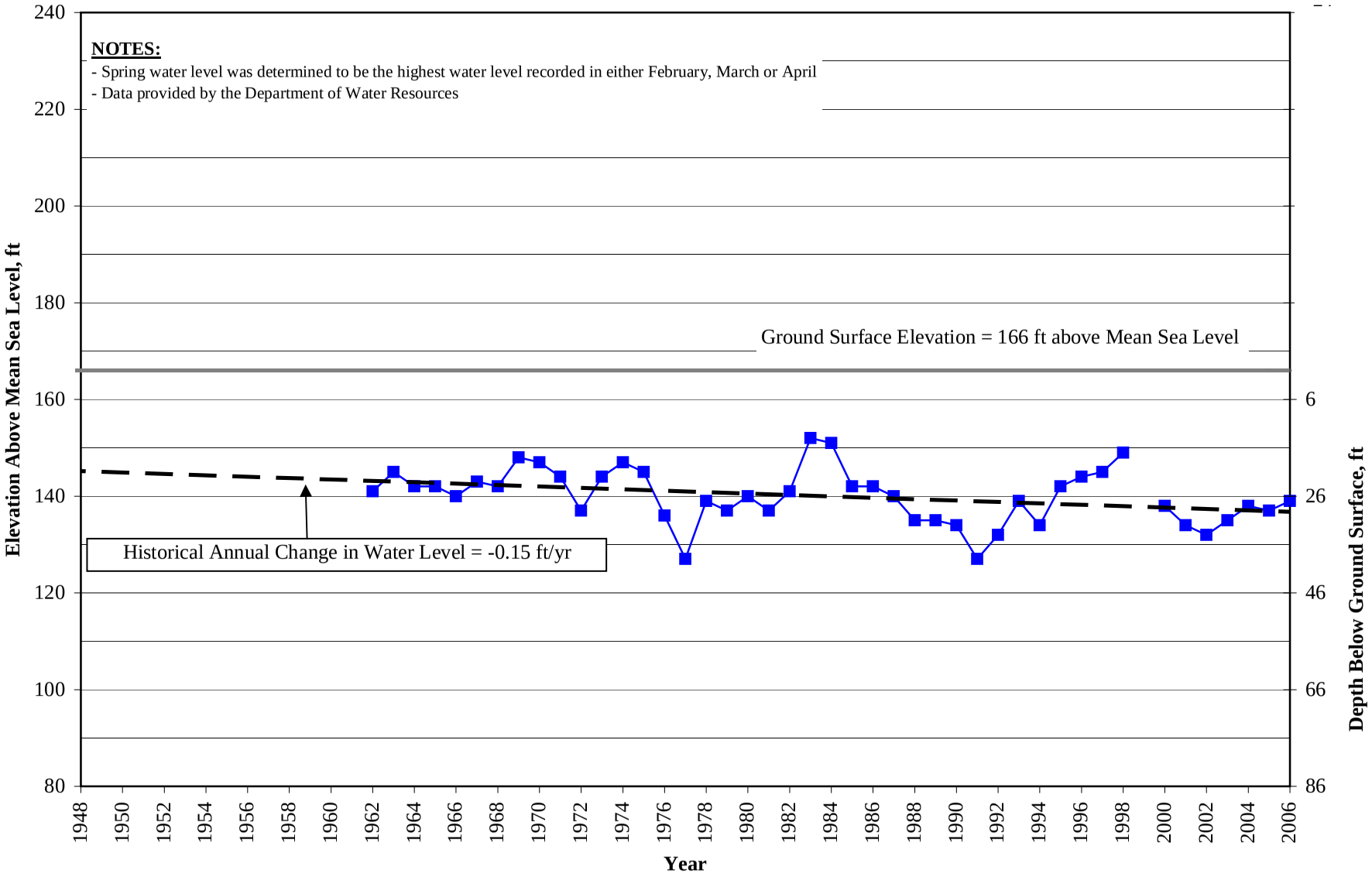



West Yost Associates
436\02-06-03\E\2\GW\CHDepthGW\22N1E28J03M
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# VINA: DWR Well #22N/1E-20K01M - Spring Groundwater Level Hydrograph

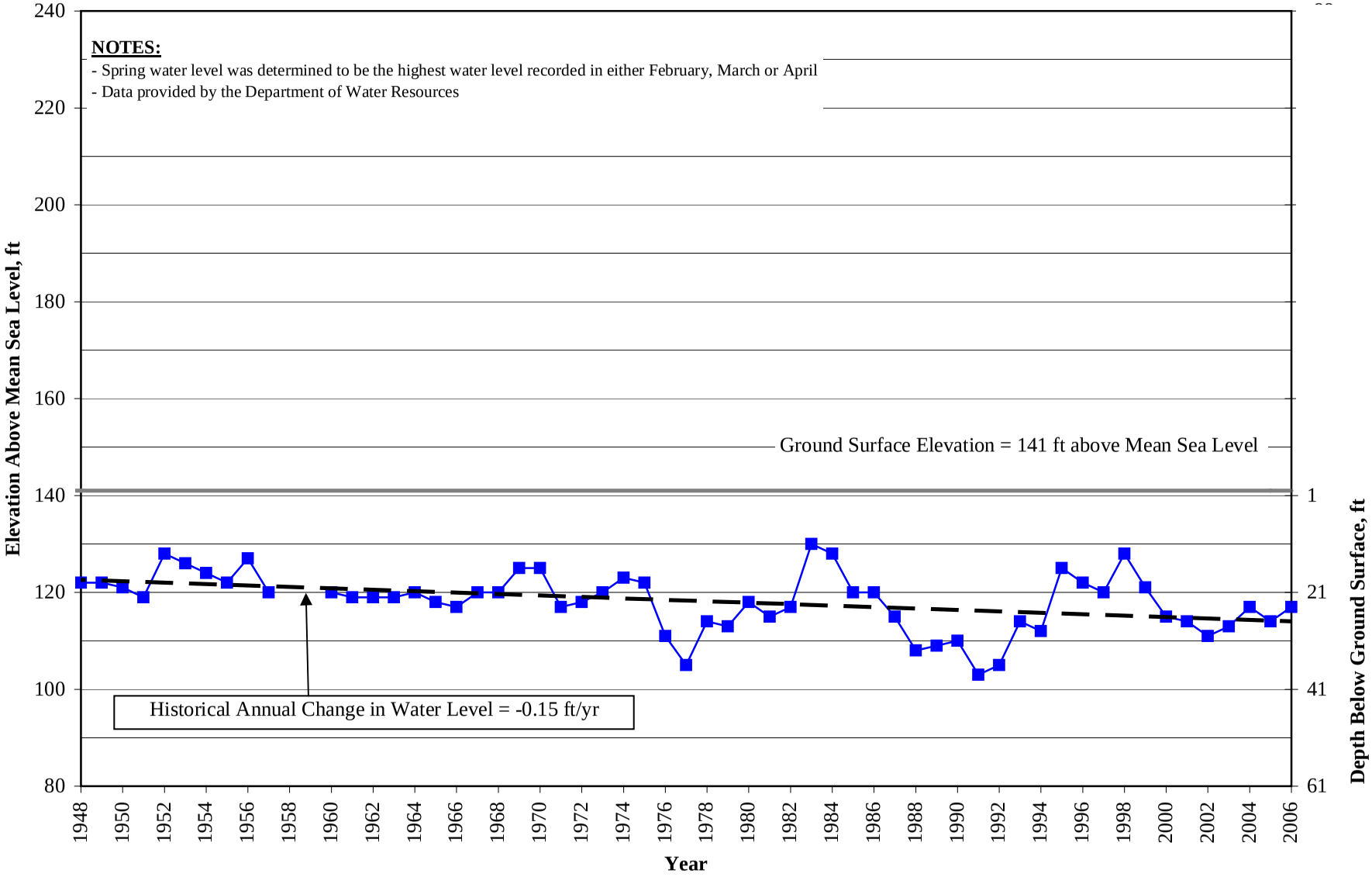



Public Version

West Yost Associates
436\02-06-03\E\2\GW\CHDepthGW\22N1E20K01M
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

# WEST BUTTE: DWR Well #21N/1E-27D01M - Spring Groundwater Level Hydrograph

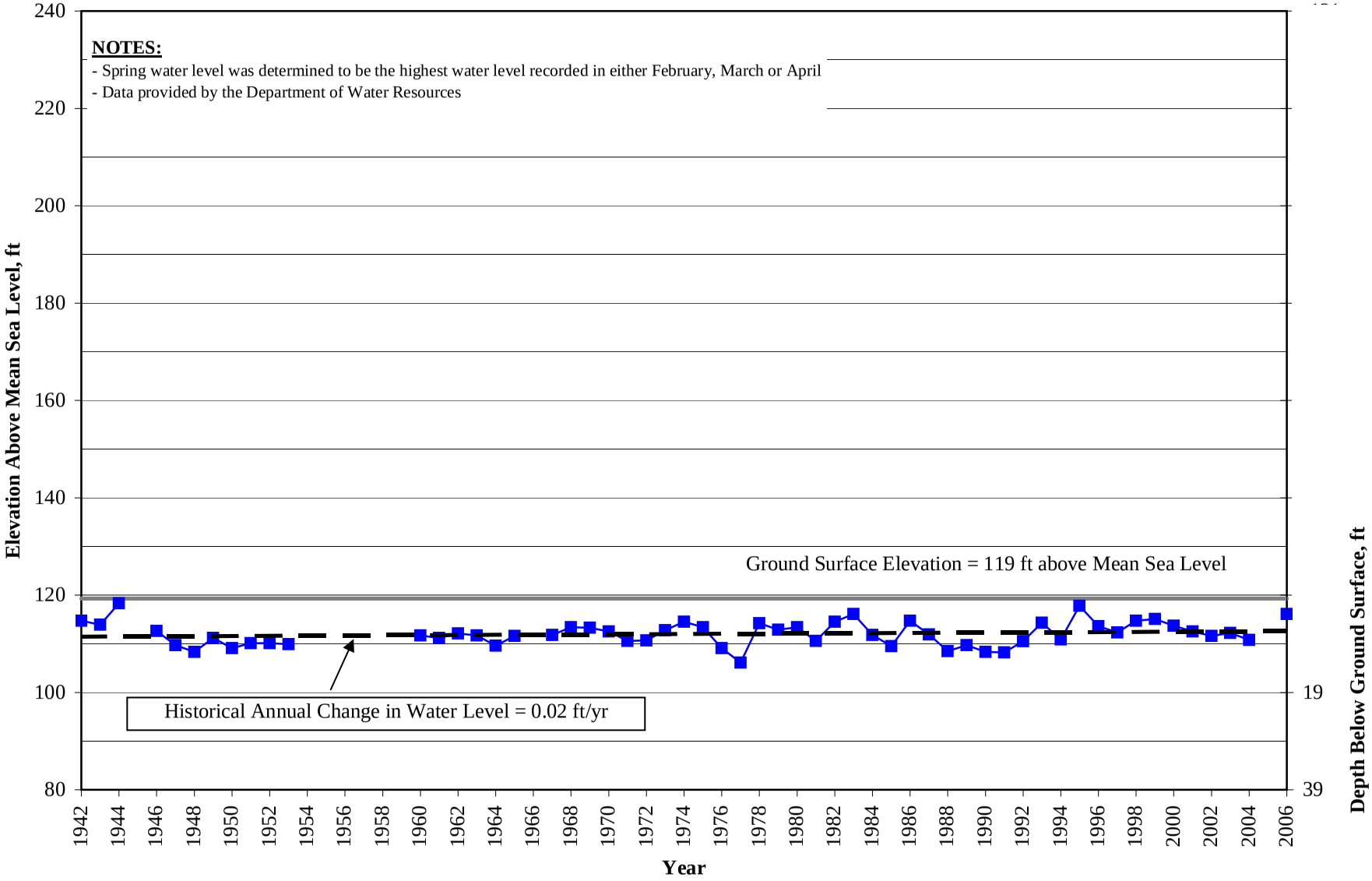



Public Version

West Yost Associates
436\02-06-03\E\2\GW\CHDepthGW\21N1E27D01M
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

# WEST BUTTE: DWR Well #21N/1W-23J01M - Spring Groundwater Level Hydrograph

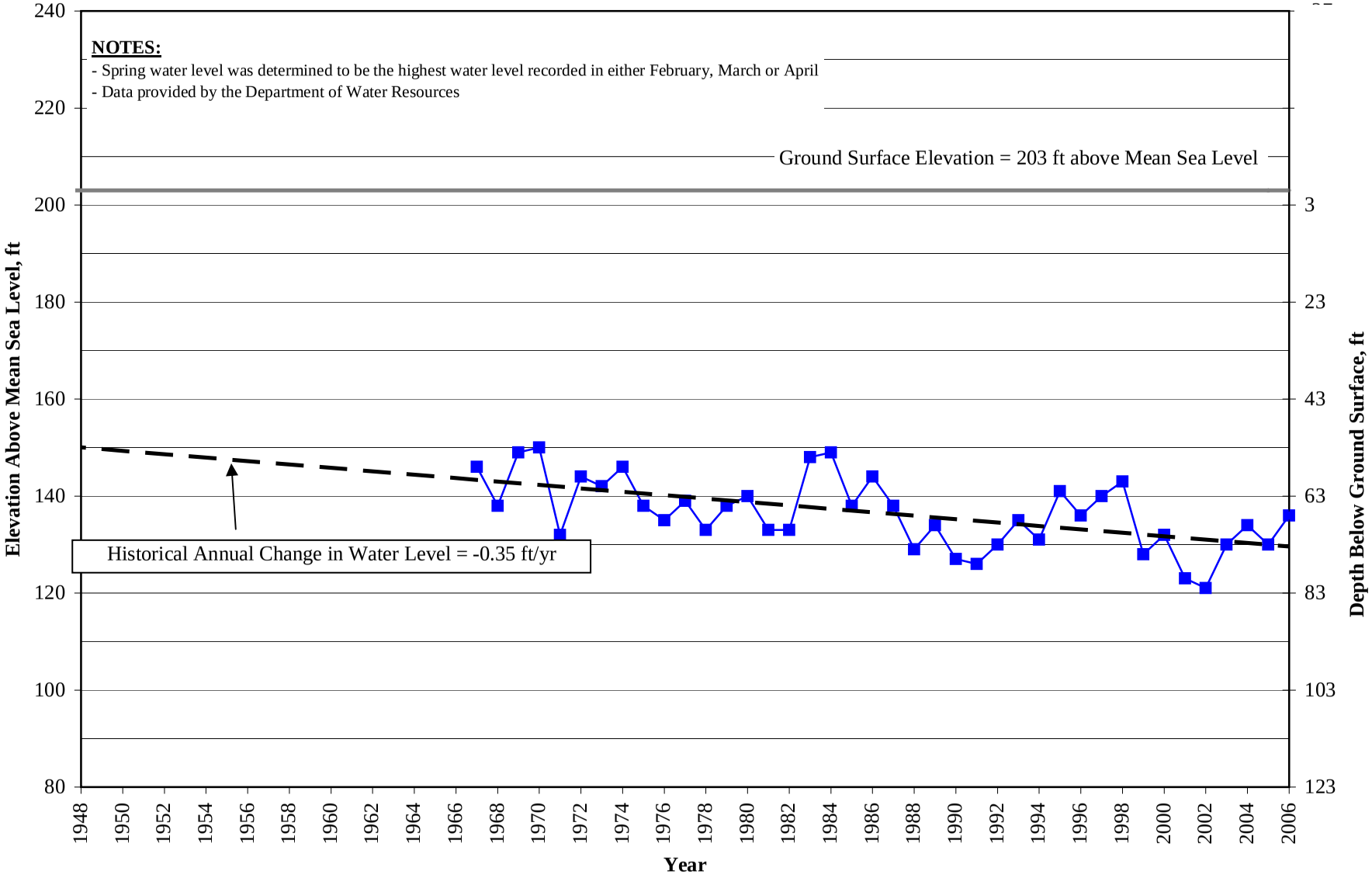



Public Version

West Yost Associates
436\02-06-03\E\2\GW\CHDepthGW\21N1W23J01M
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

# WEST BUTTE: DWR Well #21N/2E-07C01M - Spring Groundwater Level Hydrograph

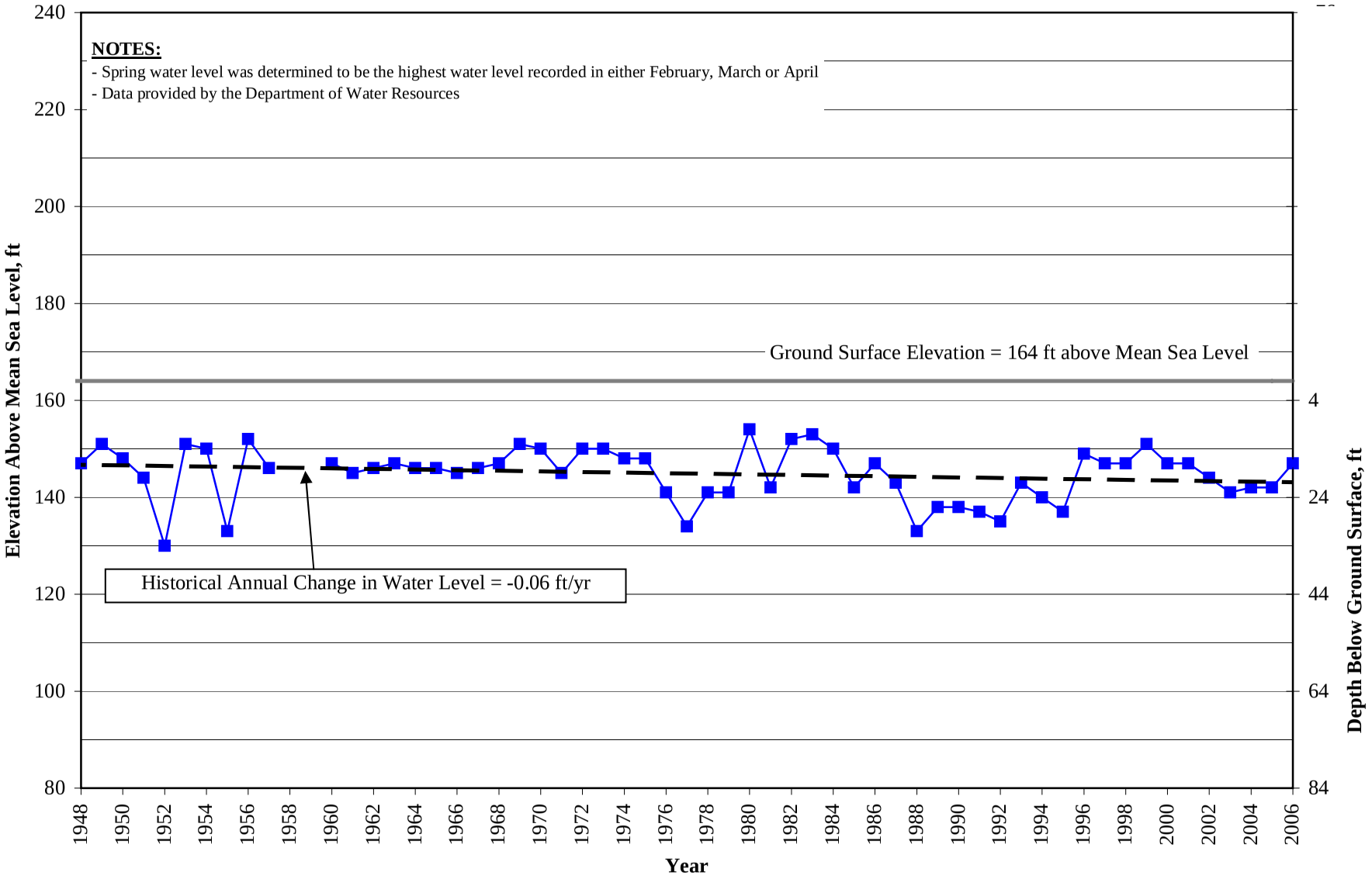



Public Version

West Yost Associates
436\02-06-03\E\2\GW\CHDepthGW\21N2E07C01M
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

# WEST BUTTE: DWR Well #22N/1E-29R01M - Spring Groundwater Level Hydrograph

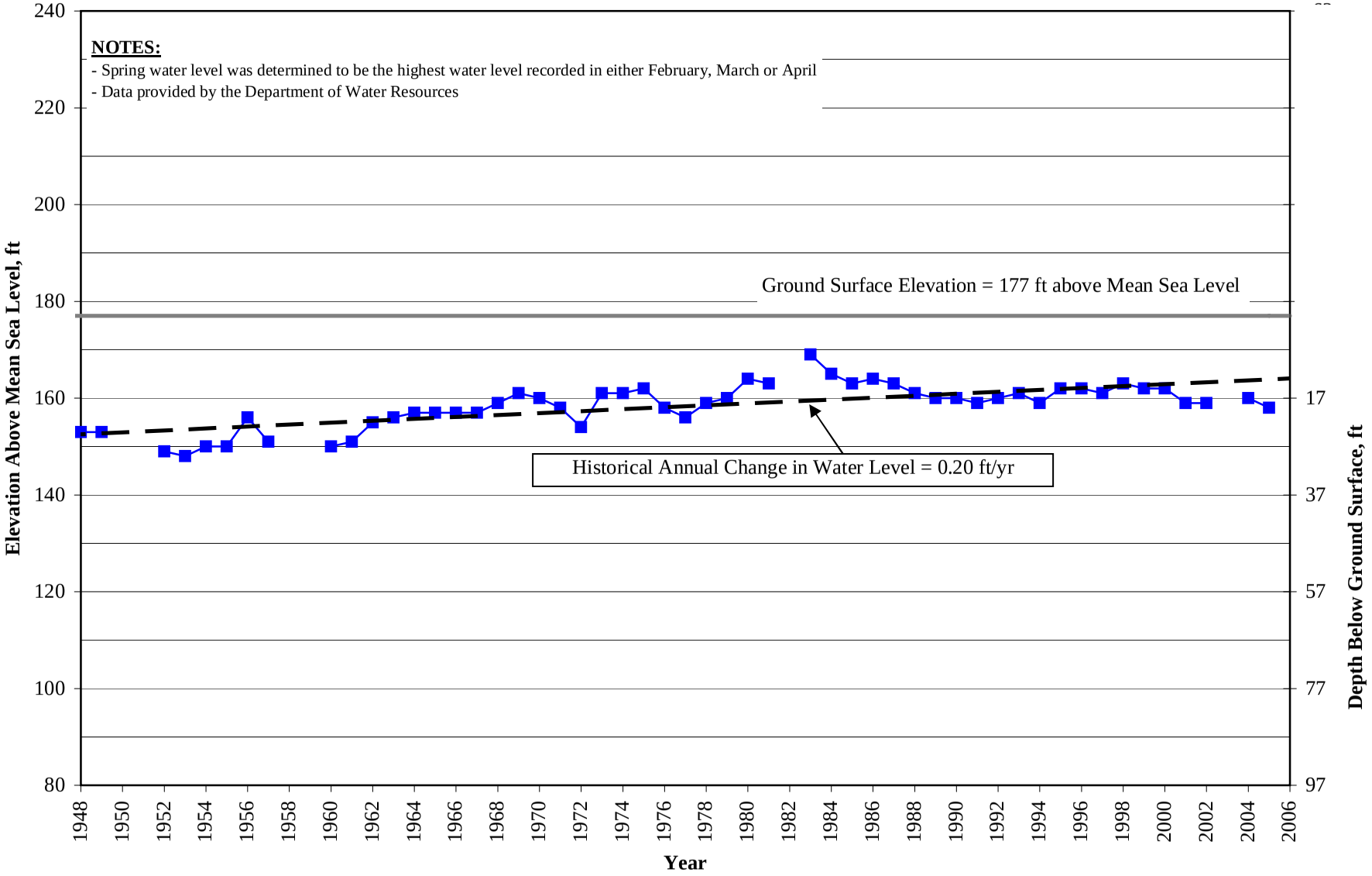



Public Version

West Yost Associates
436\02-06-03\E\2\GW\CHDepthGW\22N1E29R01M
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

# EAST BUTTE: DWR Well #21N/2E-26E02M - Spring Groundwater Level Hydrograph

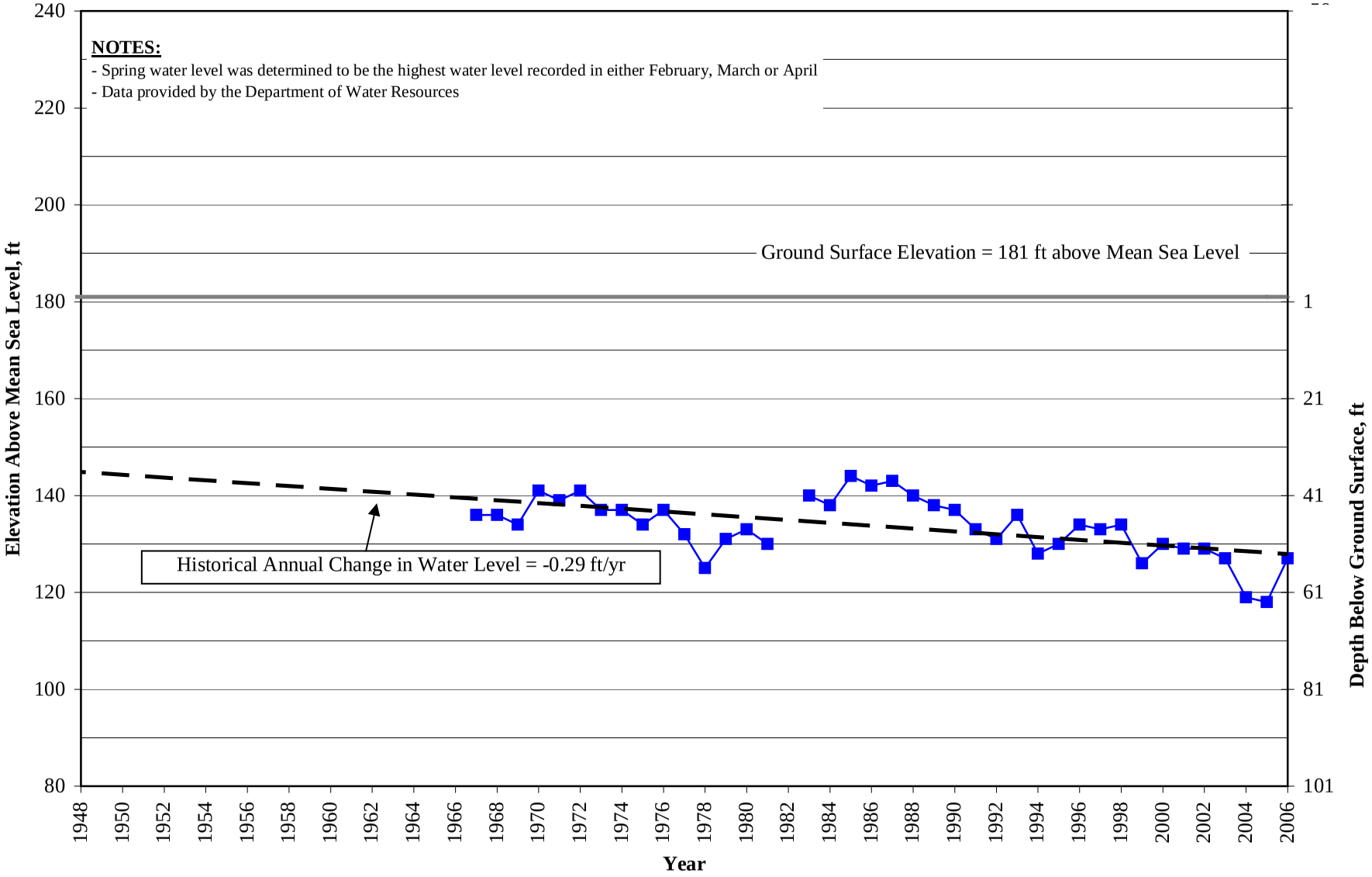



Public Version

West Yost Associates
436\02-06-03\E\2\GW\CHDepthGW\21N2E26E02M
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

# EAST BUTTE: DWR Well #21N/2E-26F01M - Spring Groundwater Level Hydrograph

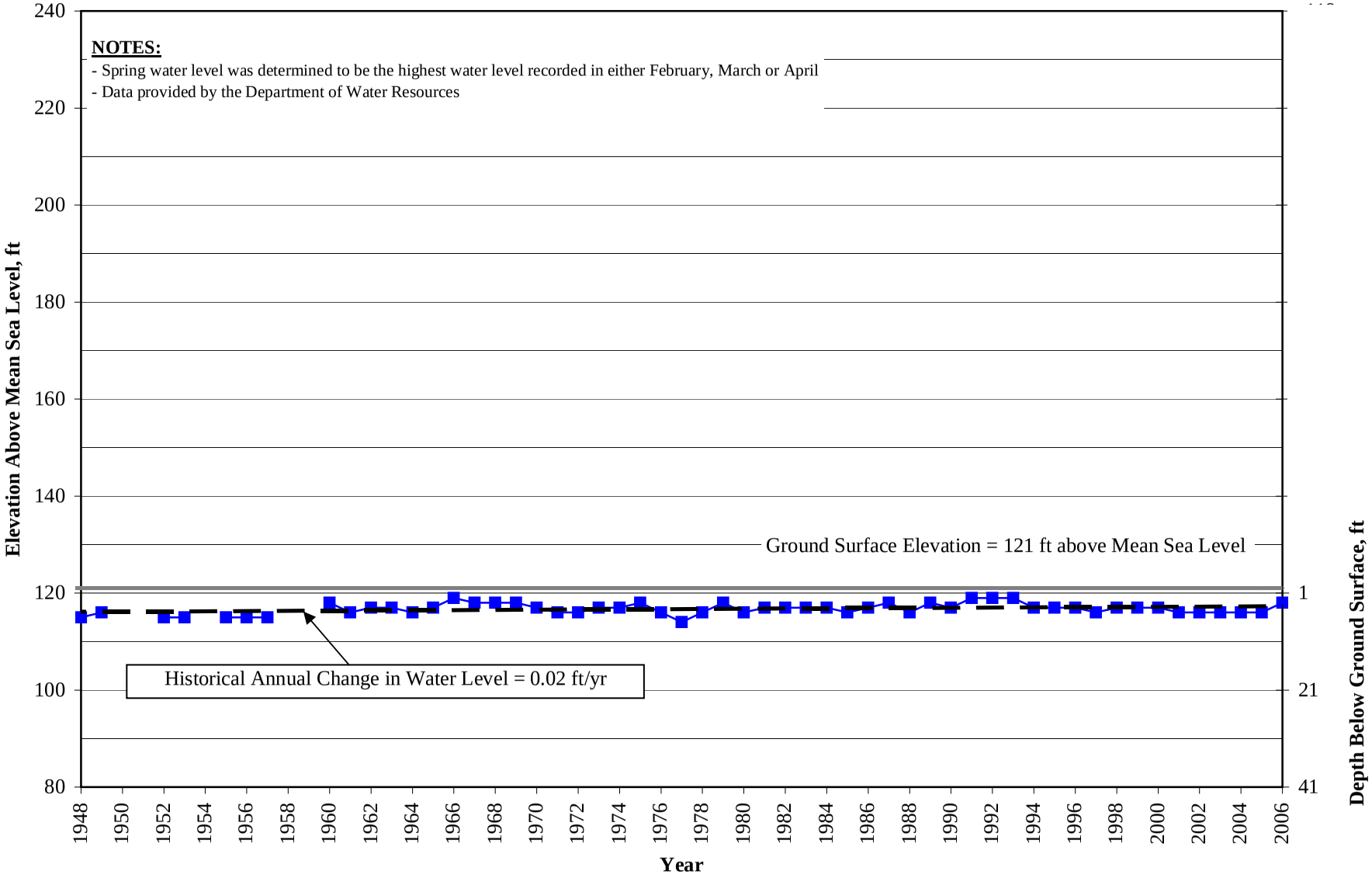



Public Version

West Yost Associates
436\02-06-03\E\2\GW\CHDepthGW\21N2E26F01M
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

# EAST BUTTE: DWR Well #20N/2E-28N01M - Spring Groundwater Level Hydrograph

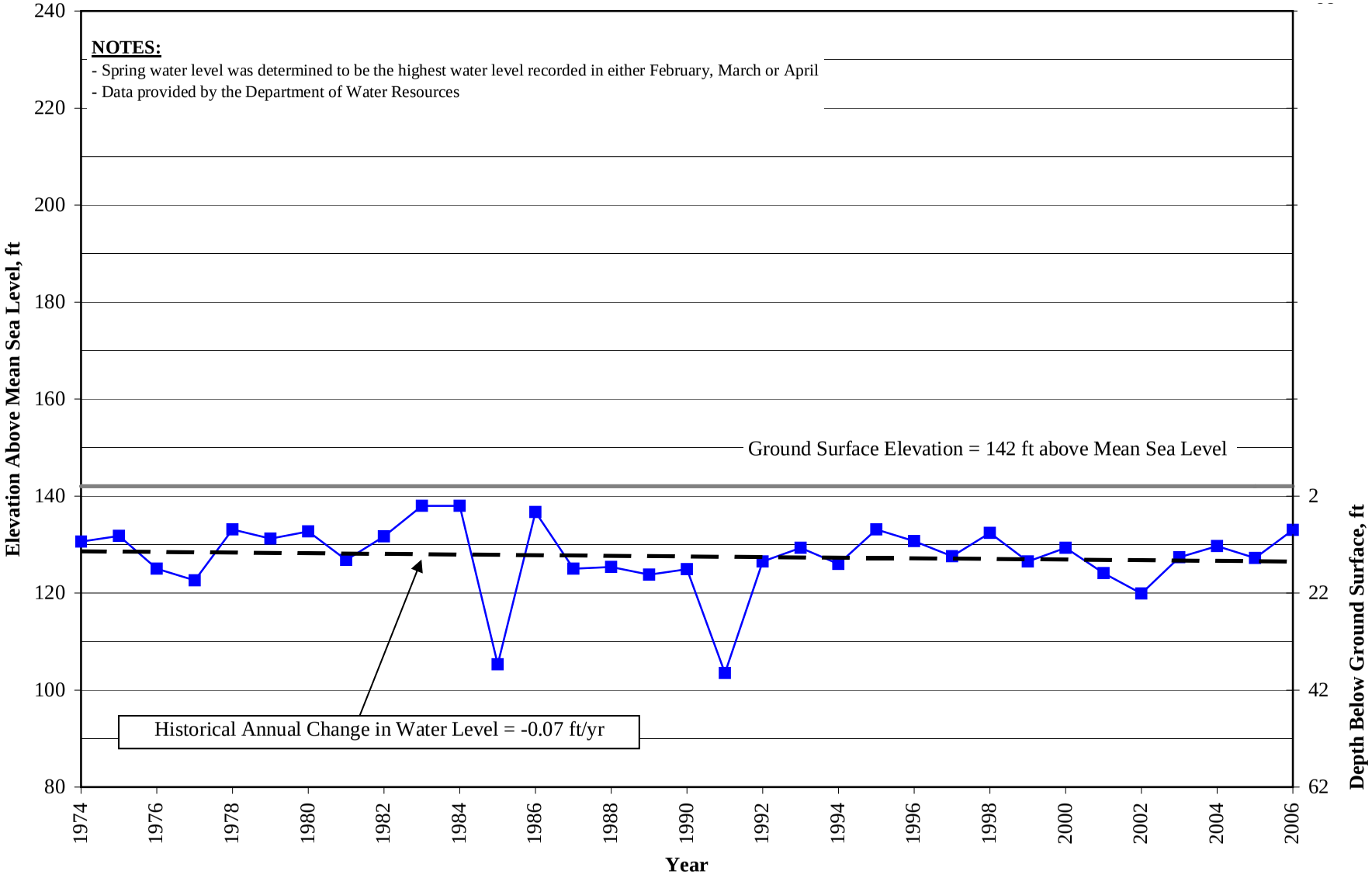



Public Version

West Yost Associates
436\02-06-03\E\2\GW\CHDepthGW\20N2E28N01M
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

# CORNING DWR Well #22N/1W-29K01M - Spring Groundwater Level Hydrograph

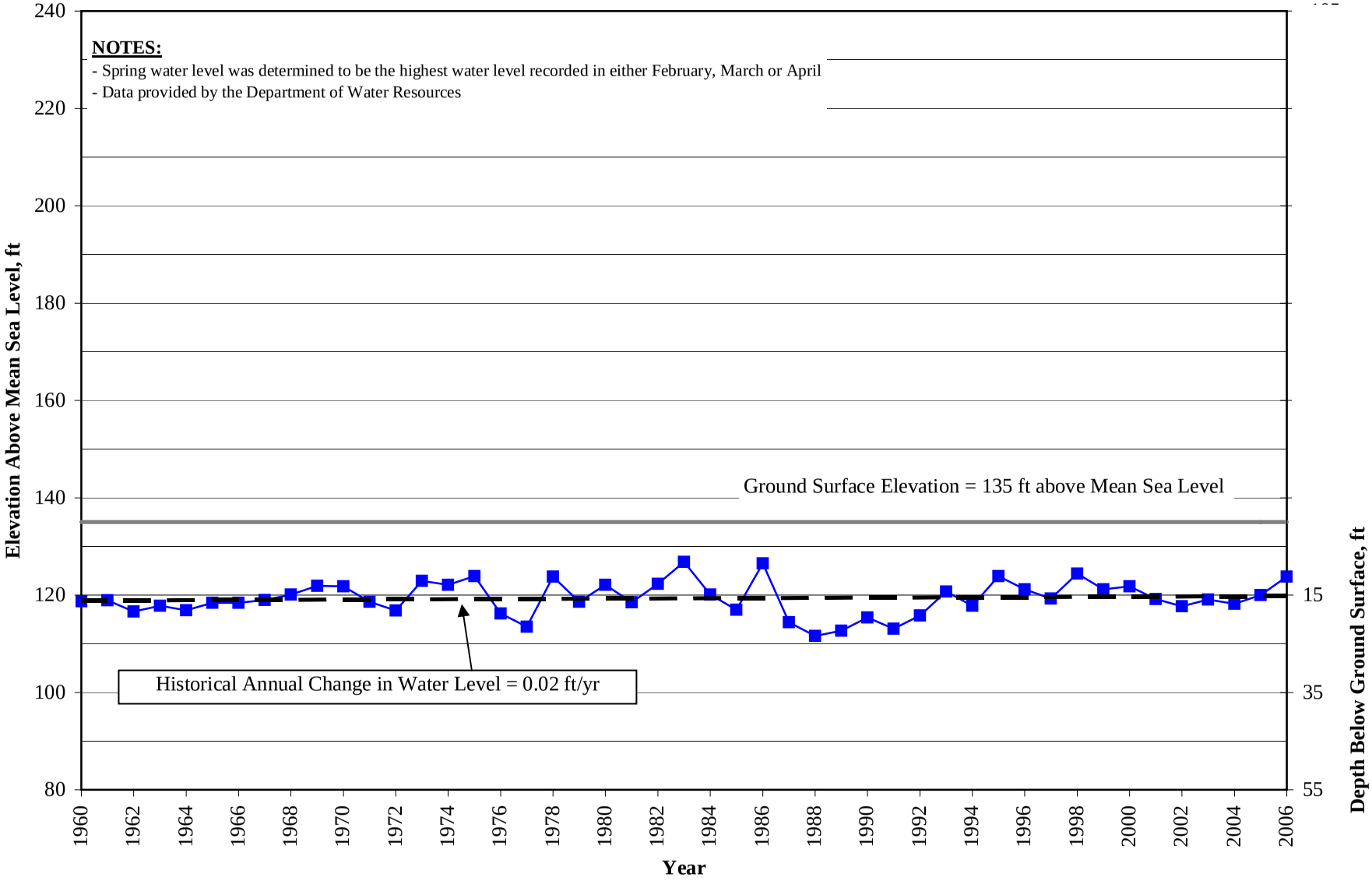



Public Version

West Yost Associates
436\02-06-03\E\2\GW\CHDepthGW\22N1W29K01M
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

# CORNING DWR Well #21N/1W-04N01M - Spring Groundwater Level Hydrograph

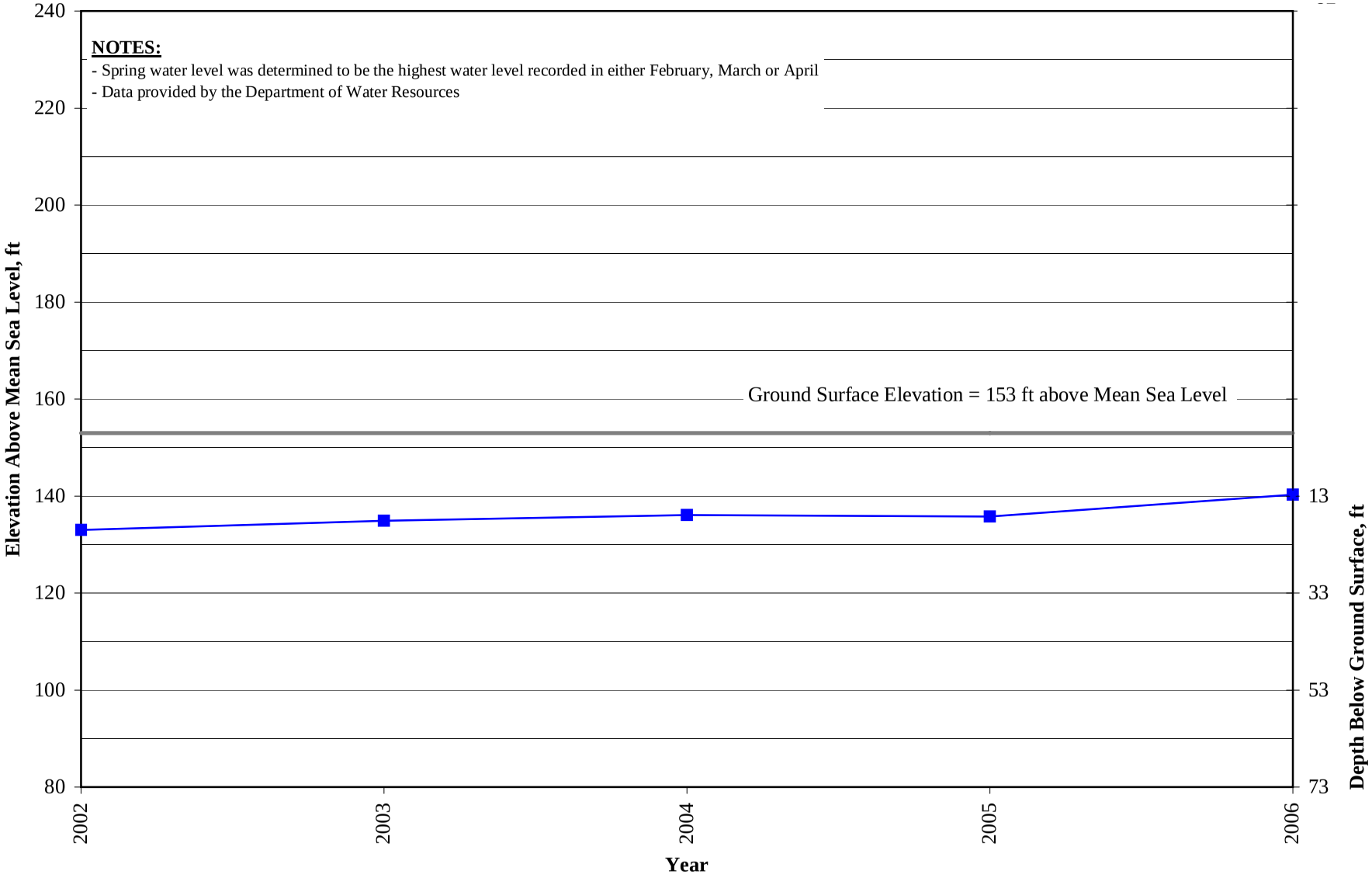



Public Version

West Yost Associates
436\02-06-03\E\2\GW\CHDepthGW\21N1W04N01M
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

# CORNING DWR Well #22N/2W-19E03M - Spring Groundwater Level Hydrograph




Public Version

West Yost Associates
436\02-06-03\E\2\GW\CHDepthGW\22N2W19E03M
Last Revised: 11/17/06

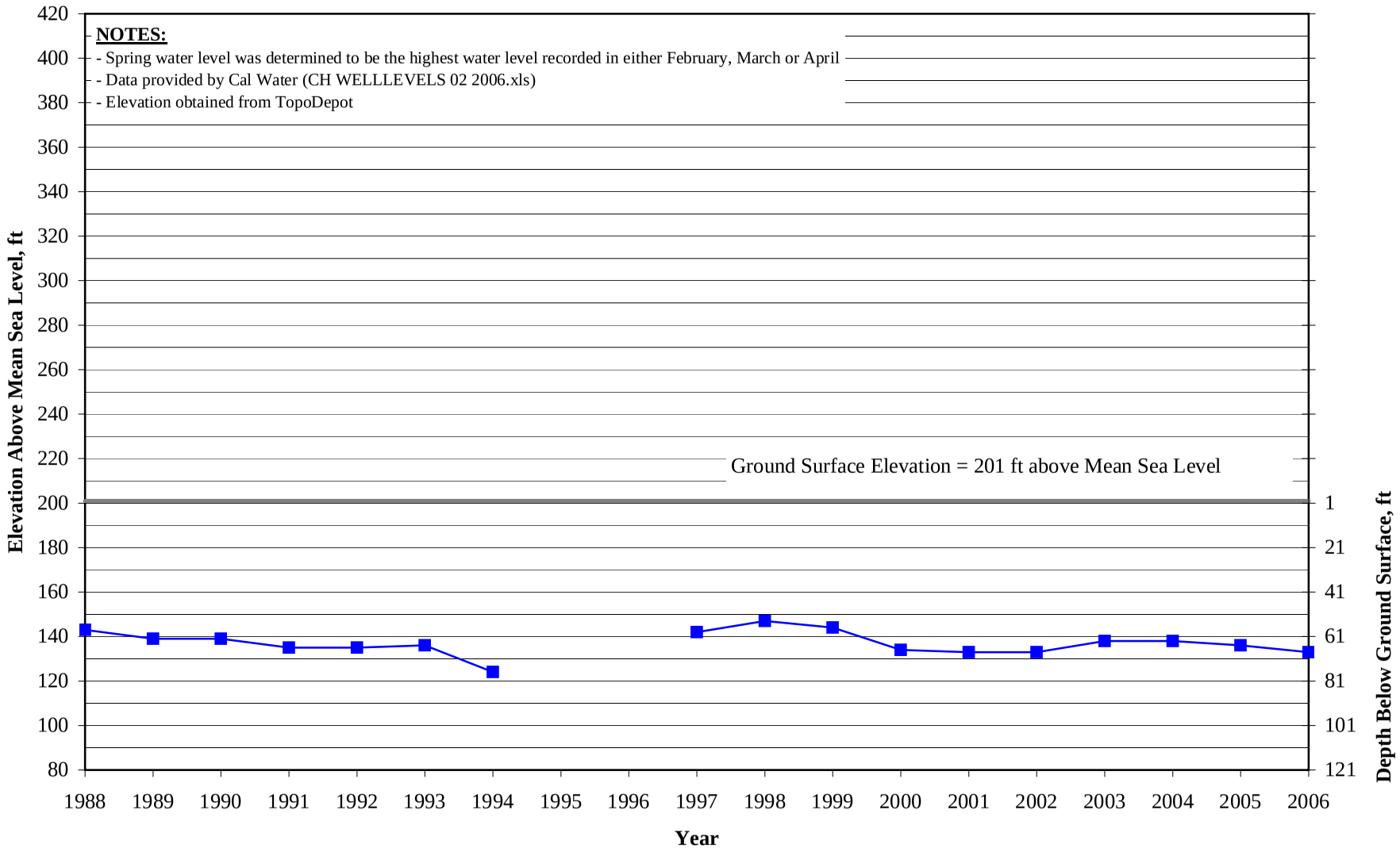
California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# APPENDIX H

## Cal Water Water Levels

# Station 001 - Spring Groundwater Level Hydrograph

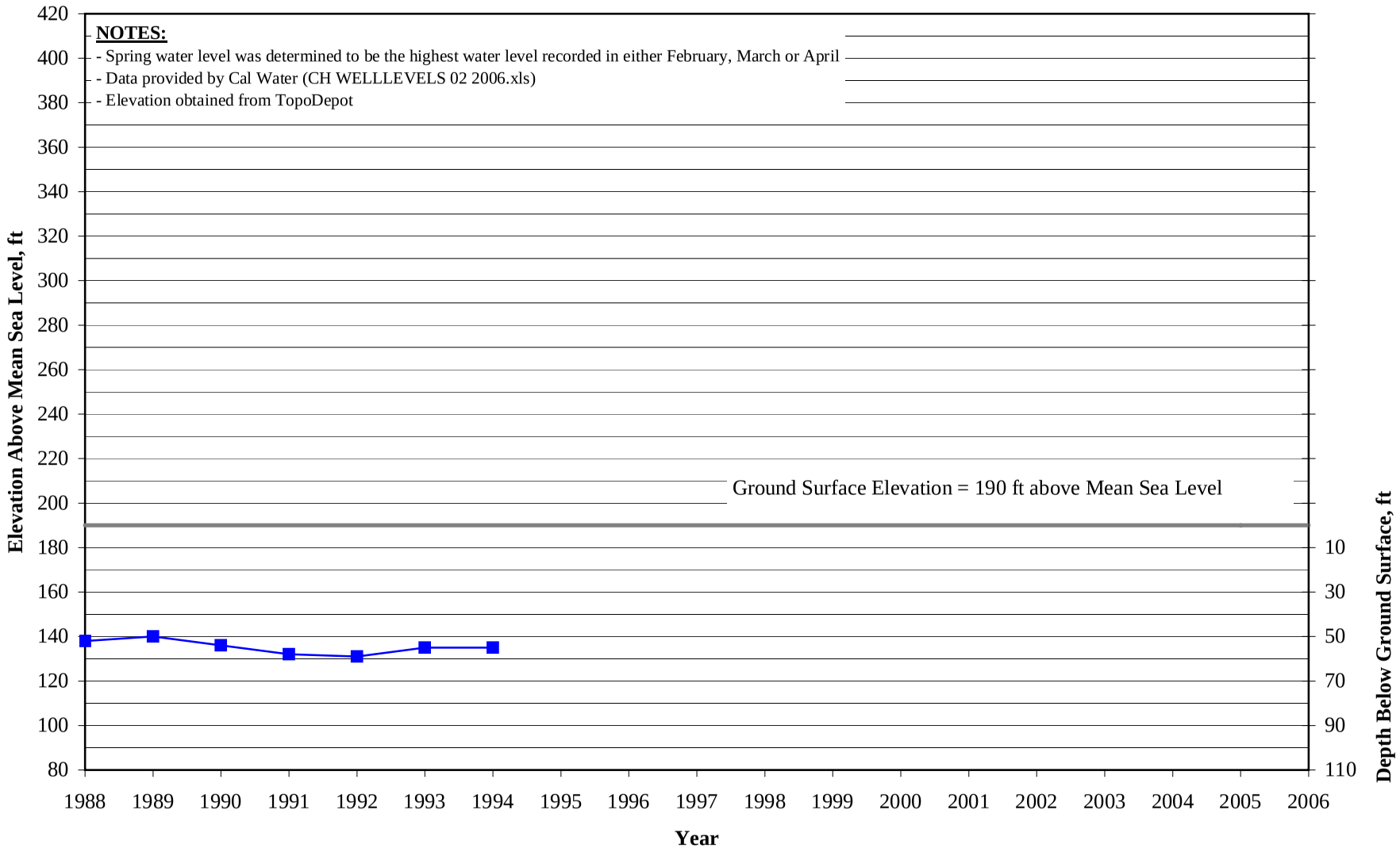



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 003 - Spring Groundwater Level Hydrograph

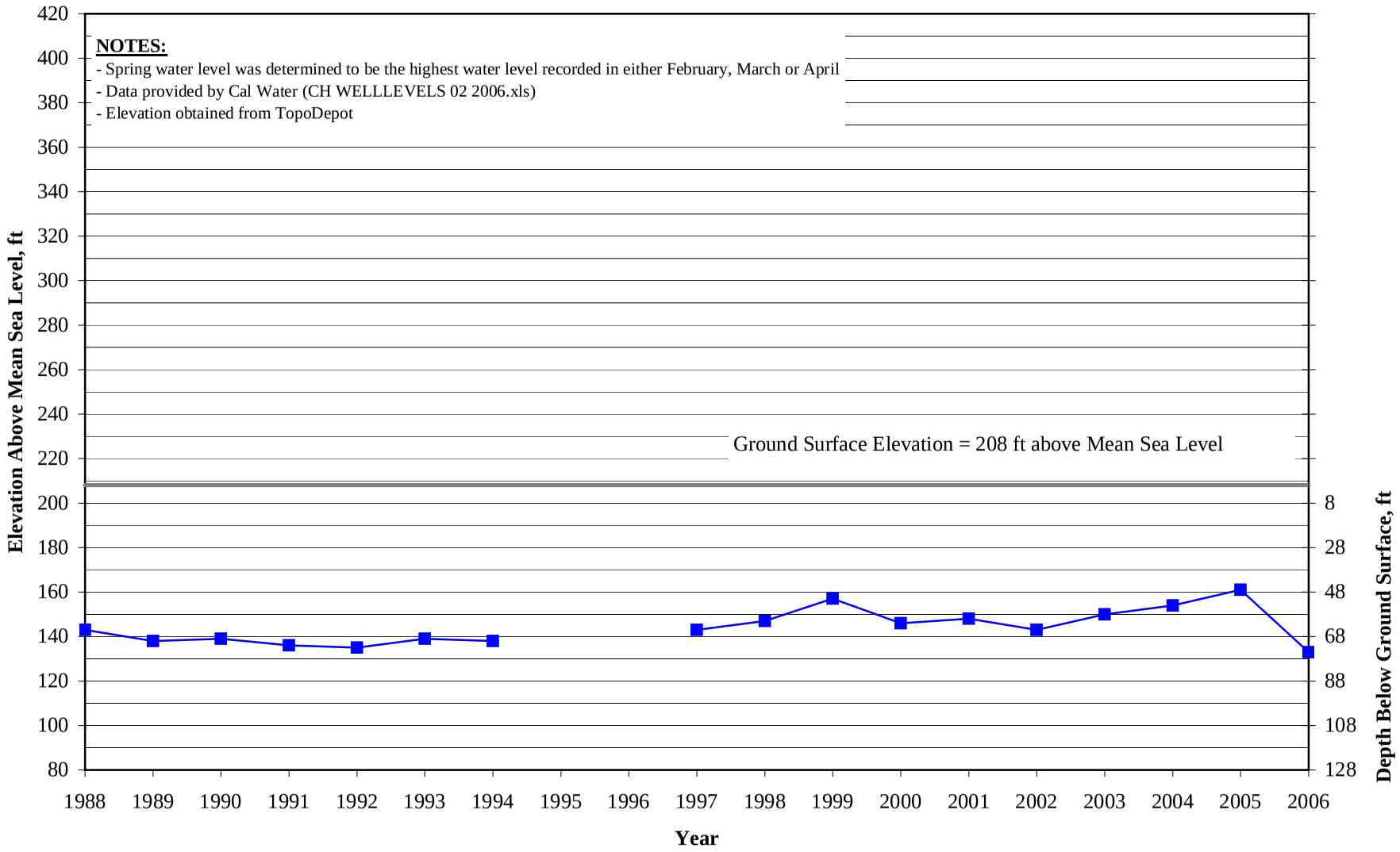



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 007 - Spring Groundwater Level Hydrograph

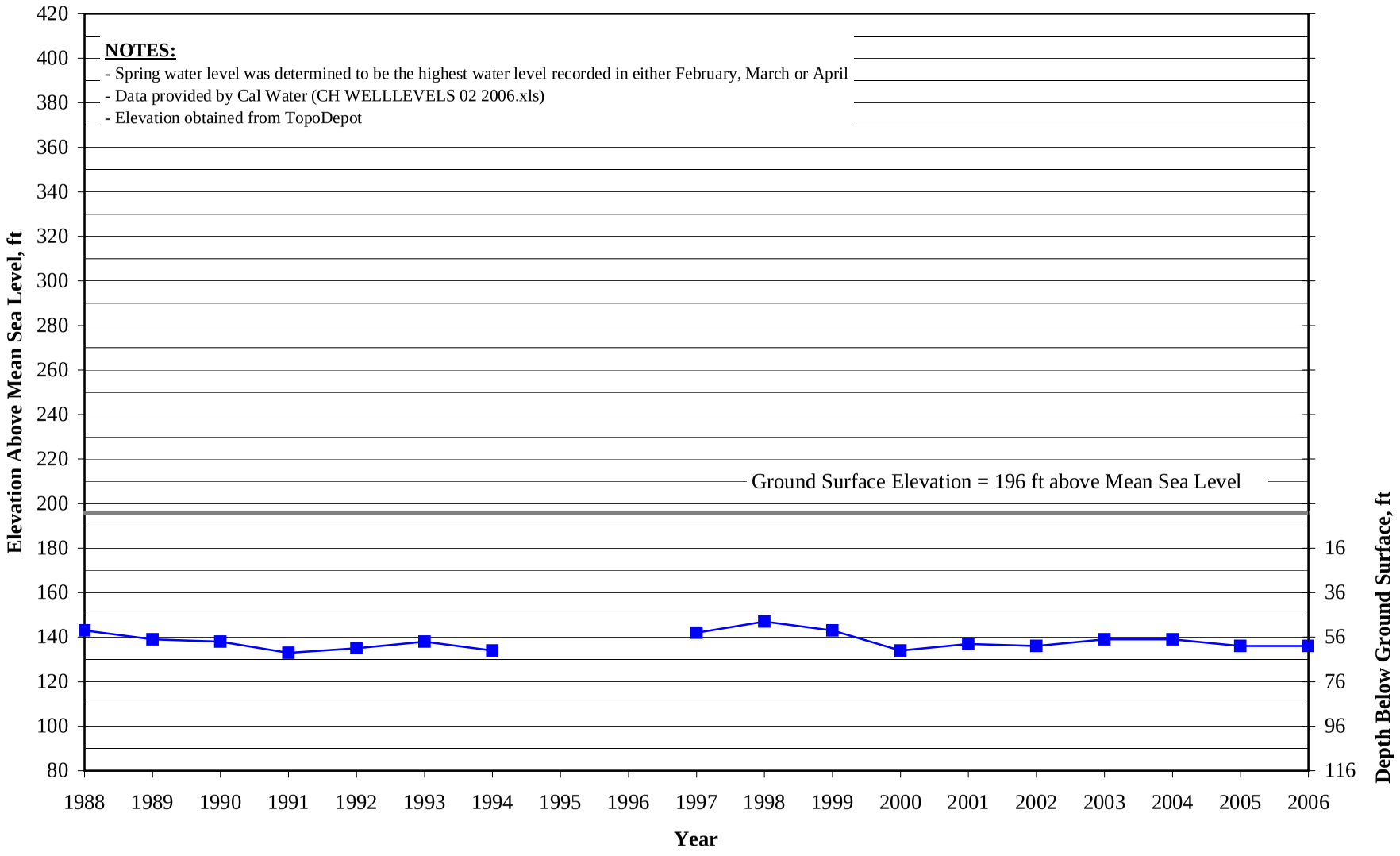



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 008 - Spring Groundwater Level Hydrograph

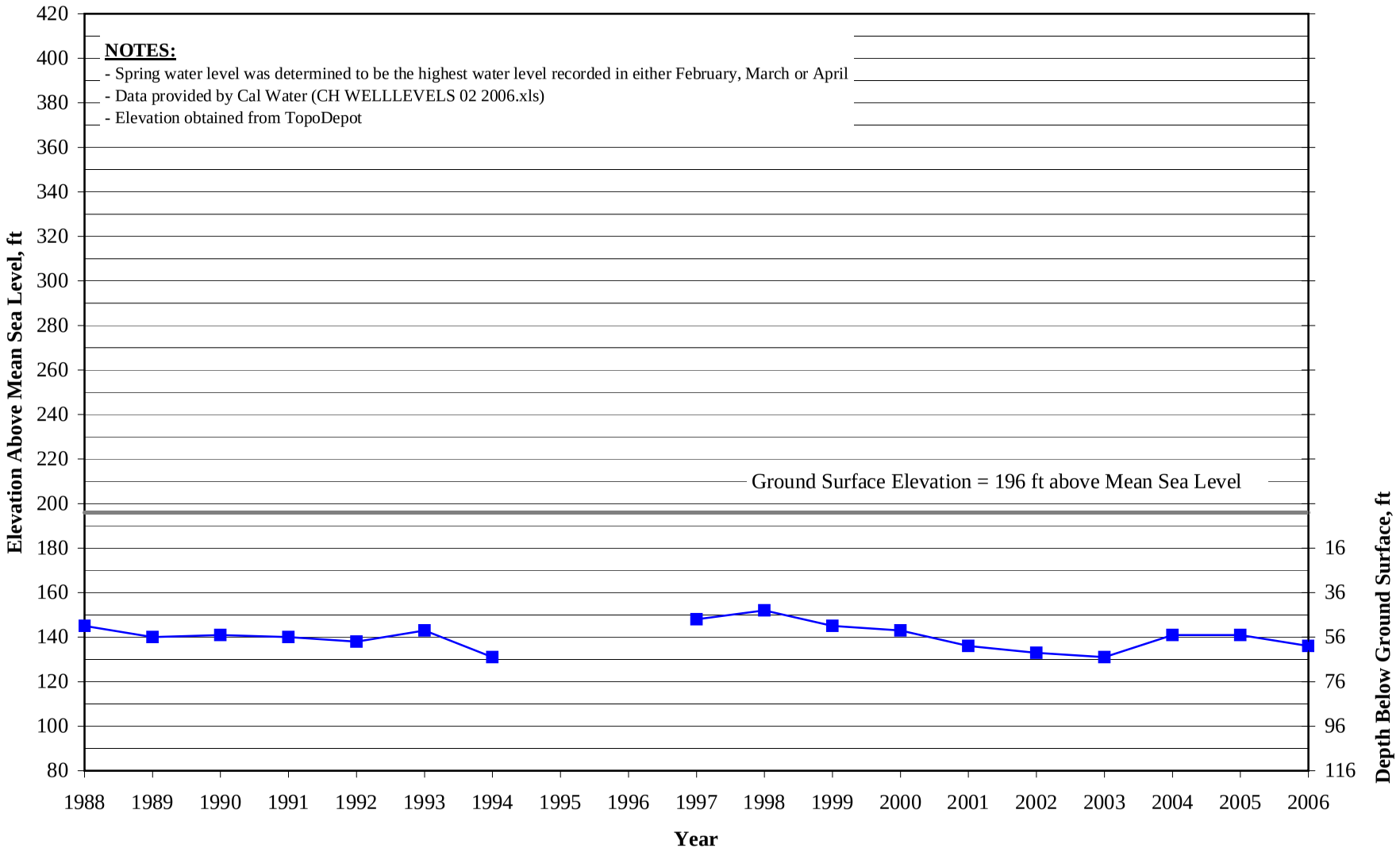



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 011 - Spring Groundwater Level Hydrograph

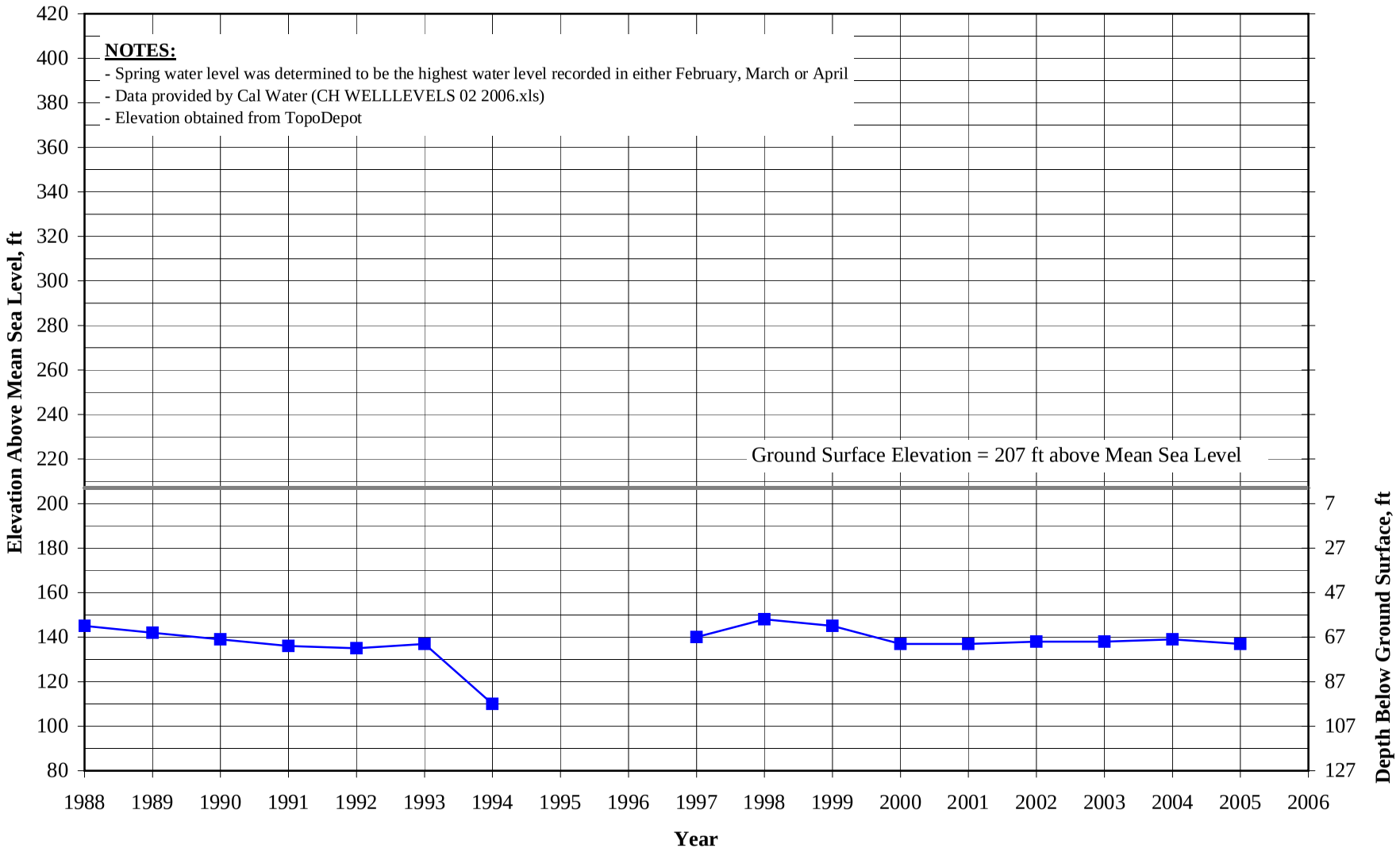



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 012 - Spring Groundwater Level Hydrograph

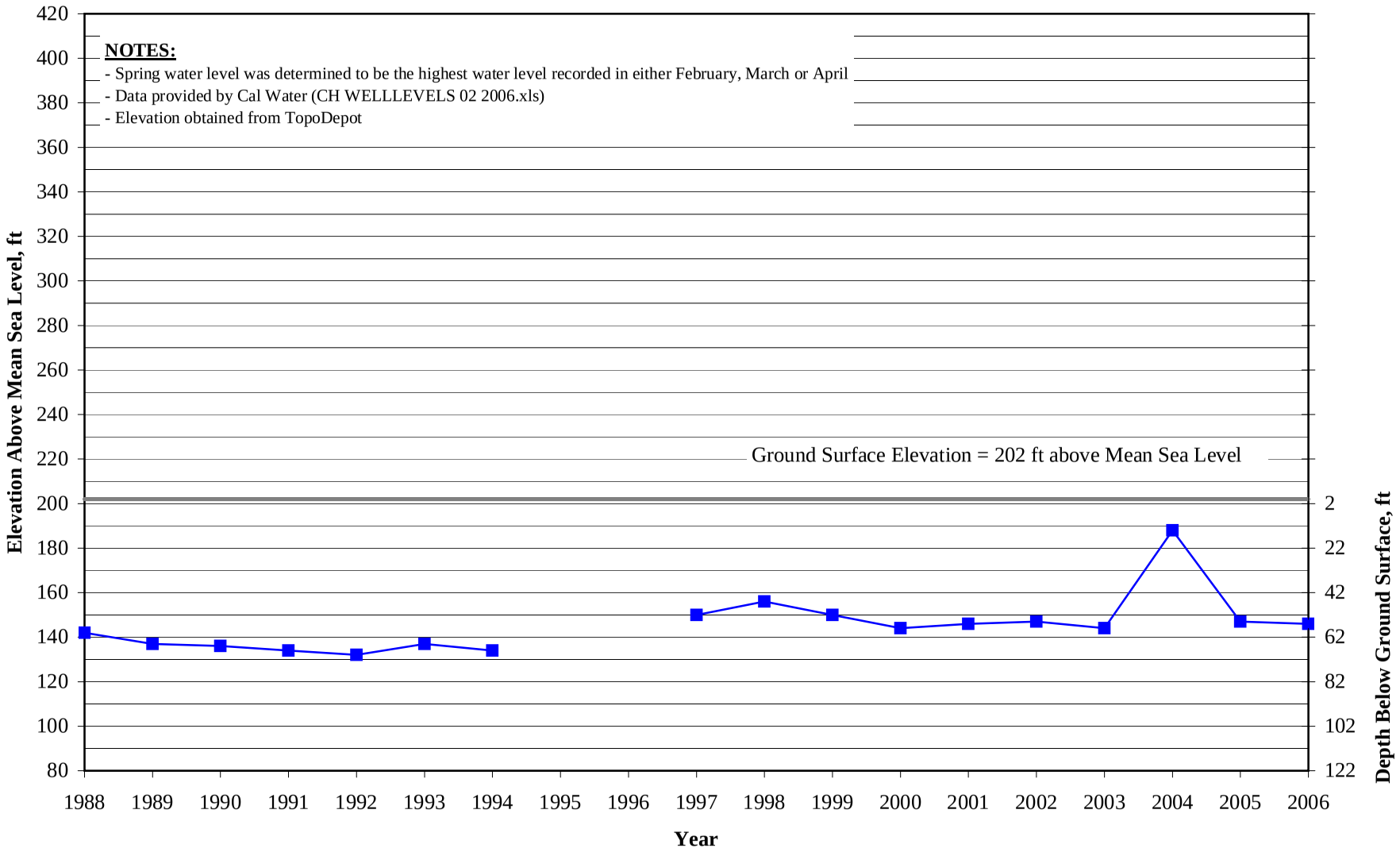



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 014 - Spring Groundwater Level Hydrograph

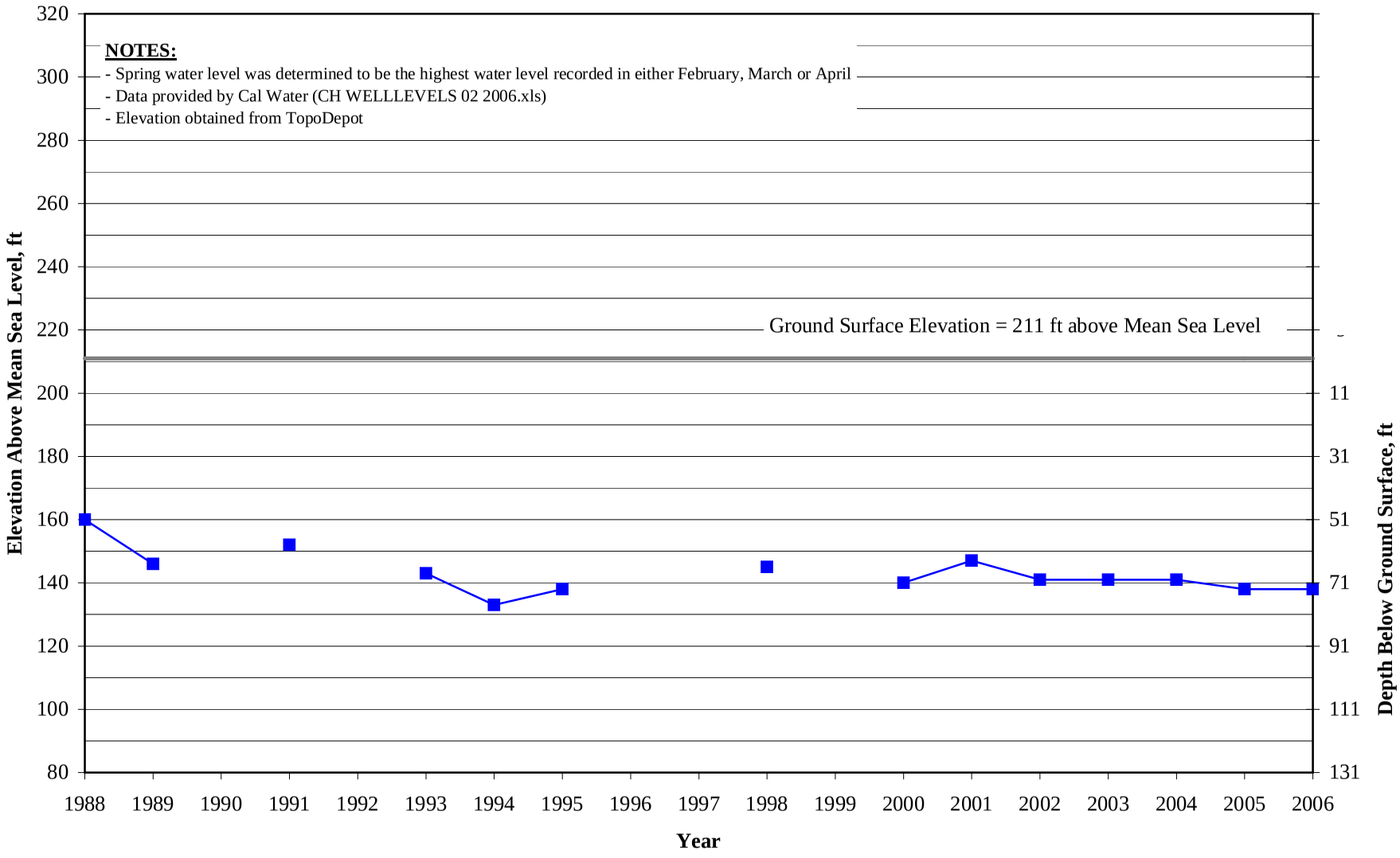



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 016 - Spring Groundwater Level Hydrograph

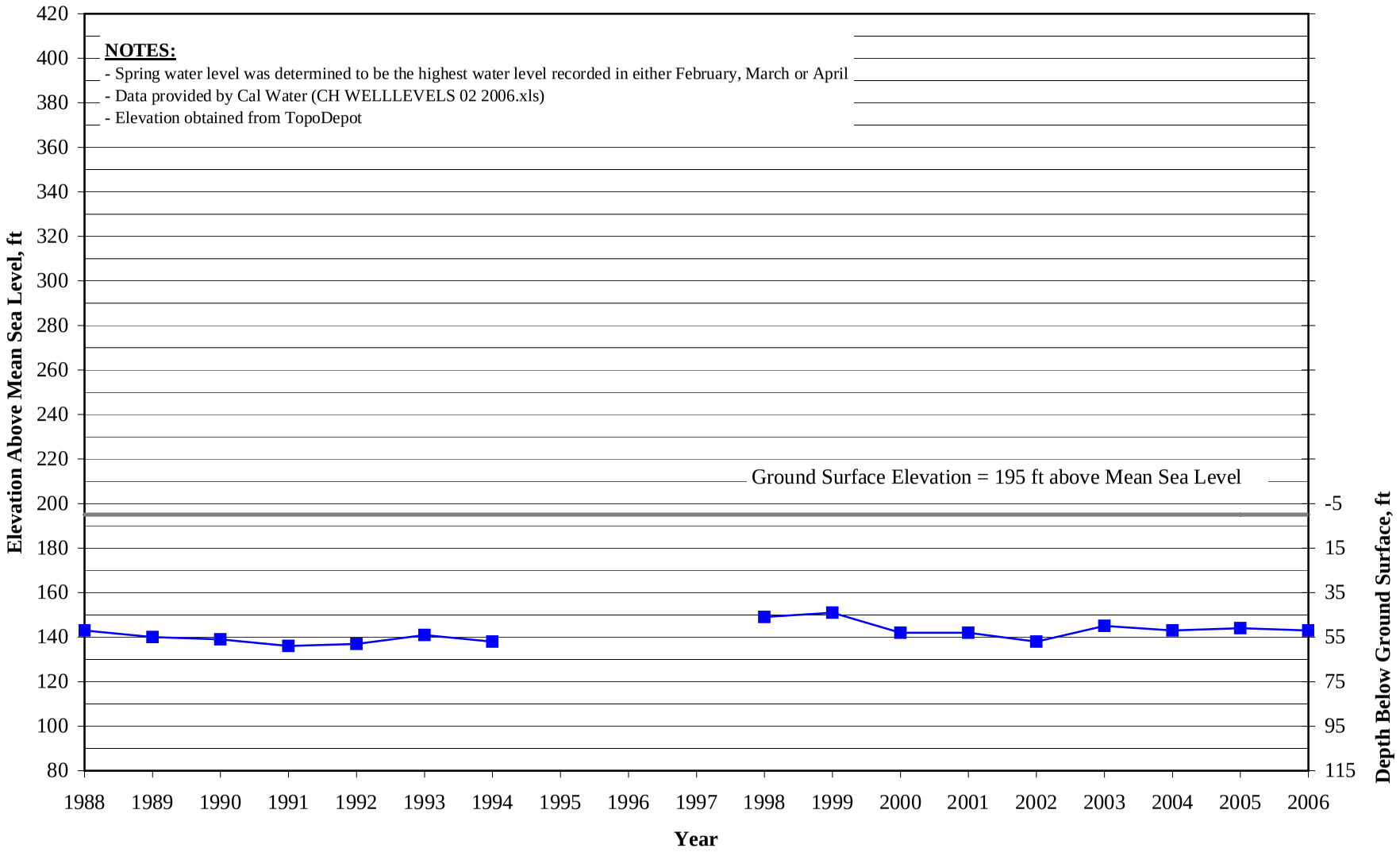



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 017 - Spring Groundwater Level Hydrograph

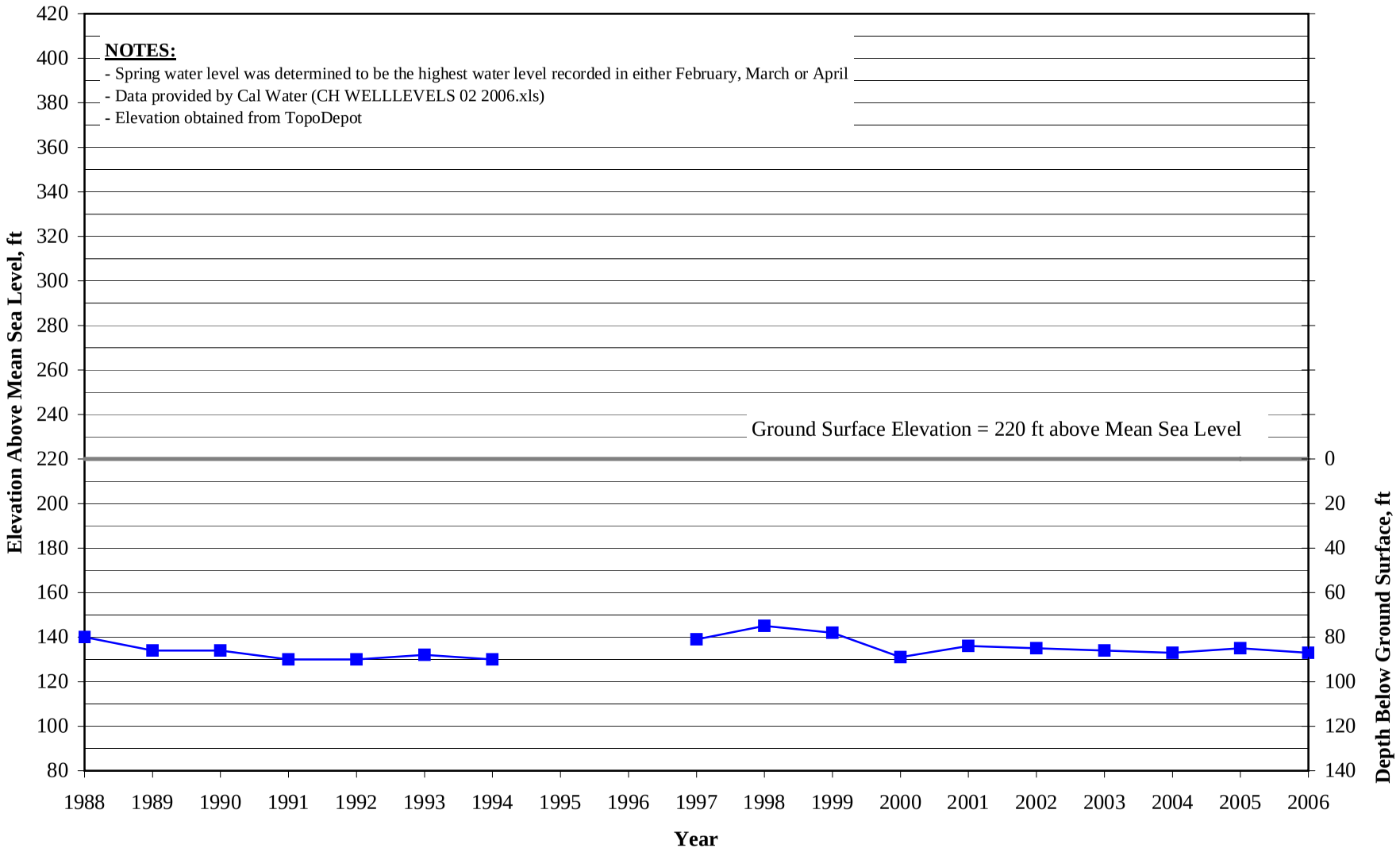



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 018 - Spring Groundwater Level Hydrograph

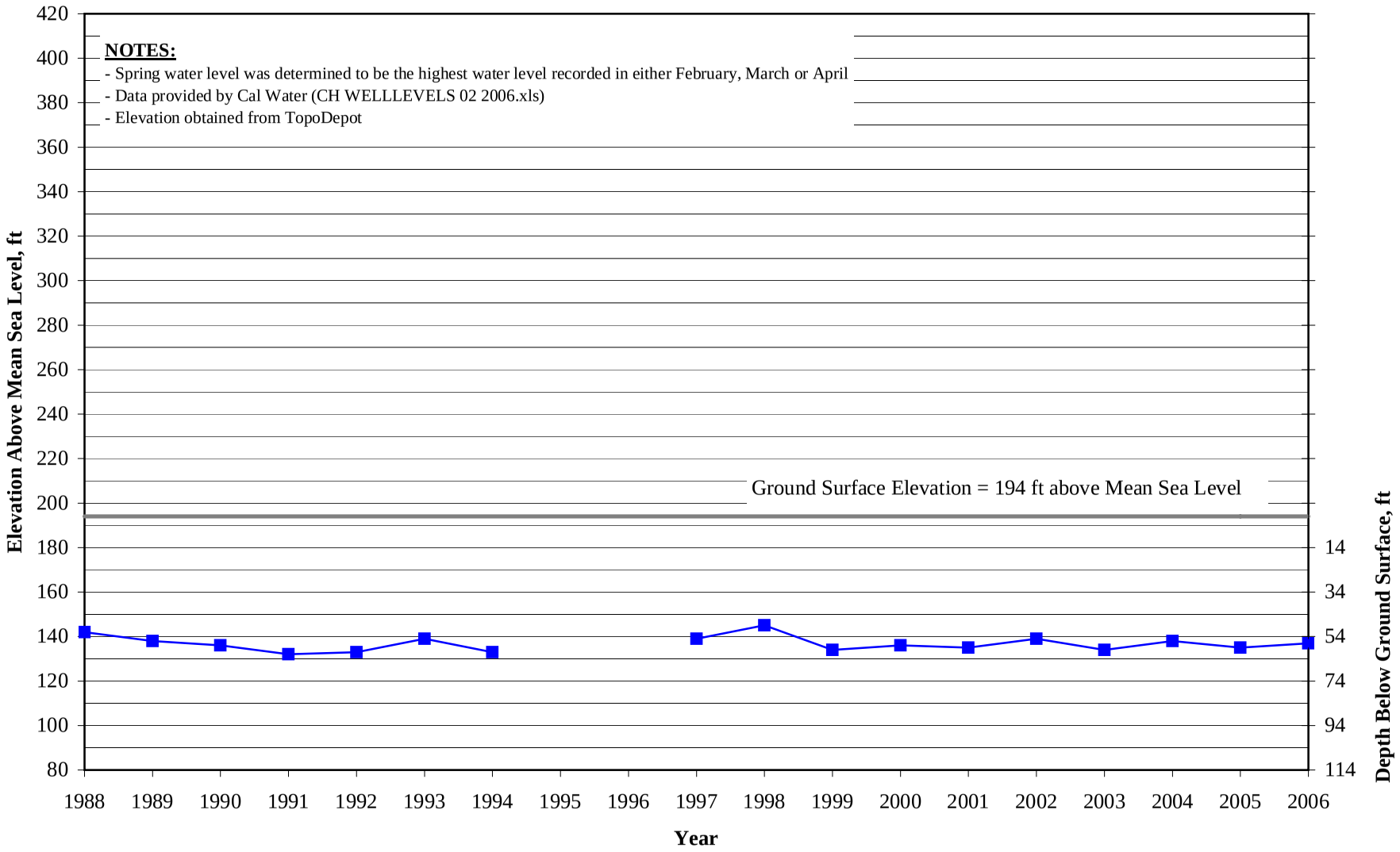



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 019 - Spring Groundwater Level Hydrograph

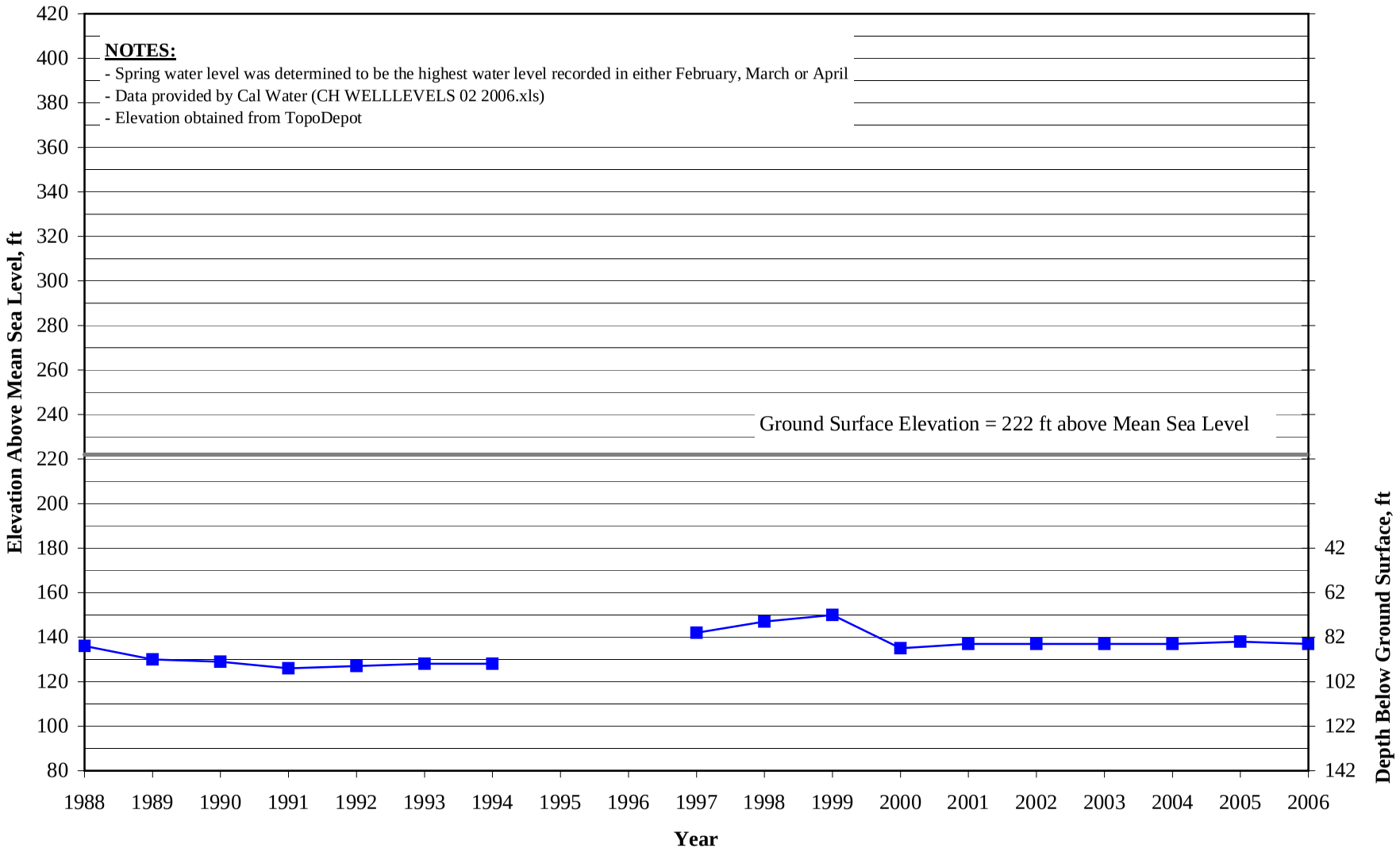



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 020 - Spring Groundwater Level Hydrograph

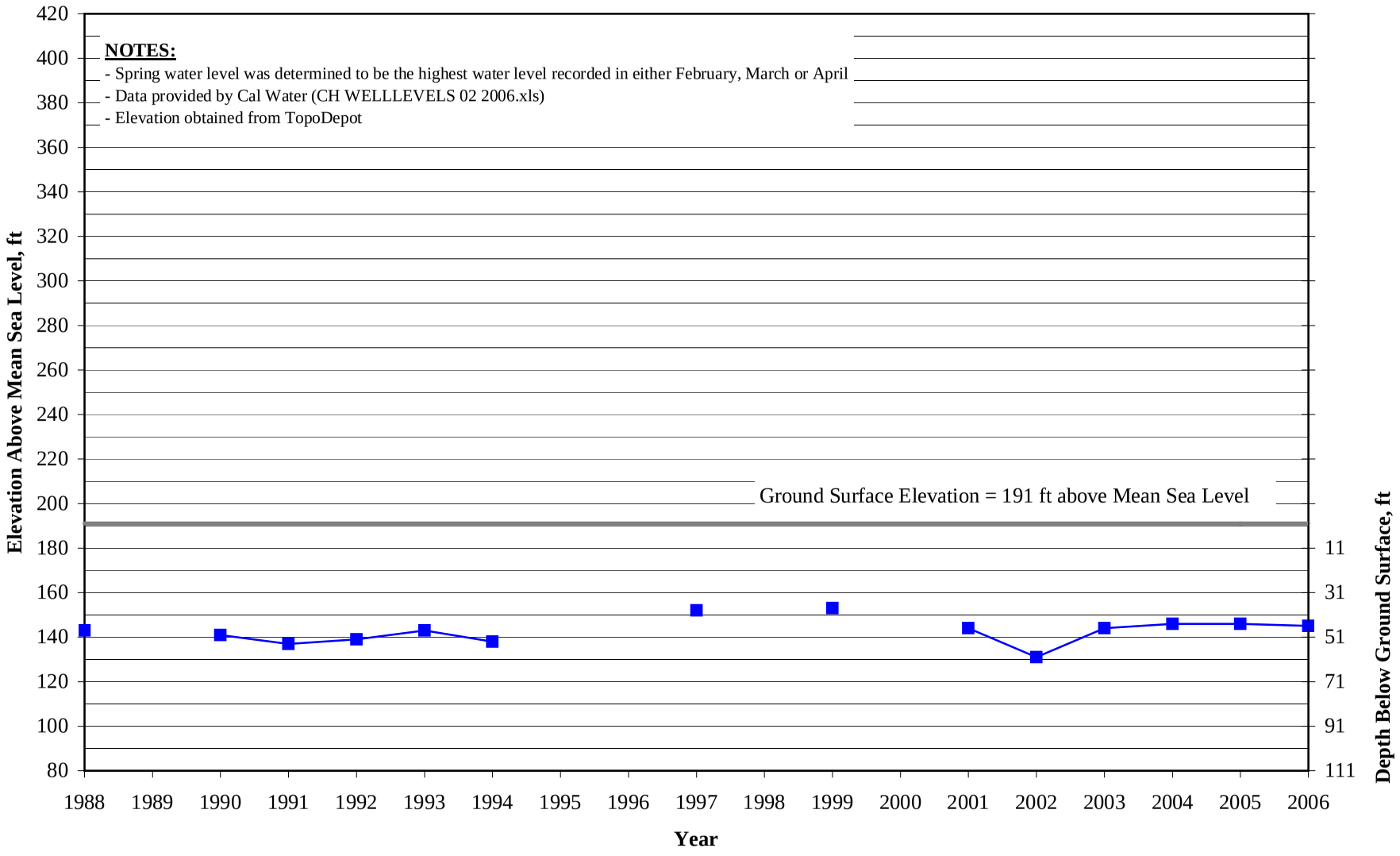



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 021 - Spring Groundwater Level Hydrograph

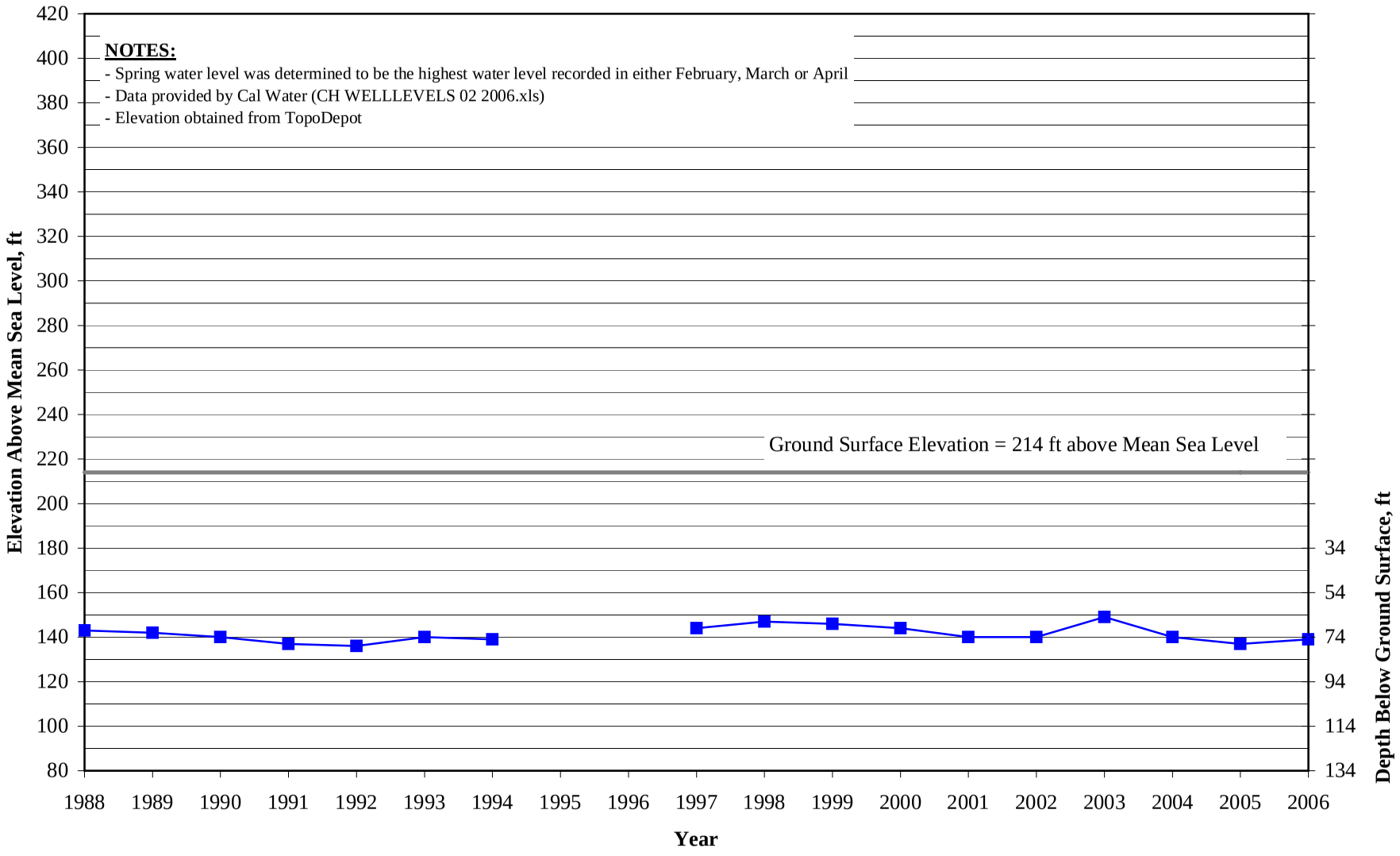



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 022 - Spring Groundwater Level Hydrograph

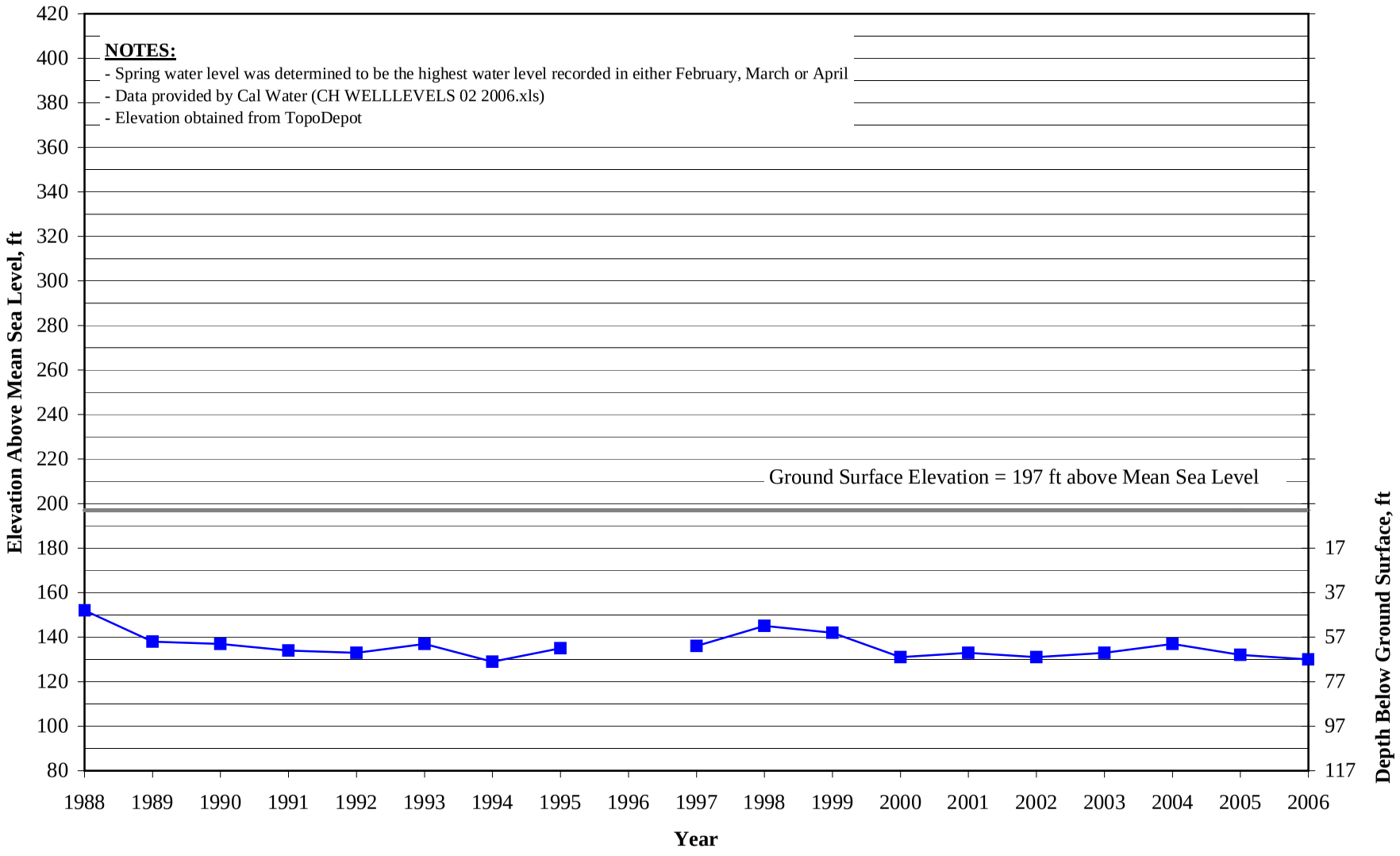



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 023 - Spring Groundwater Level Hydrograph

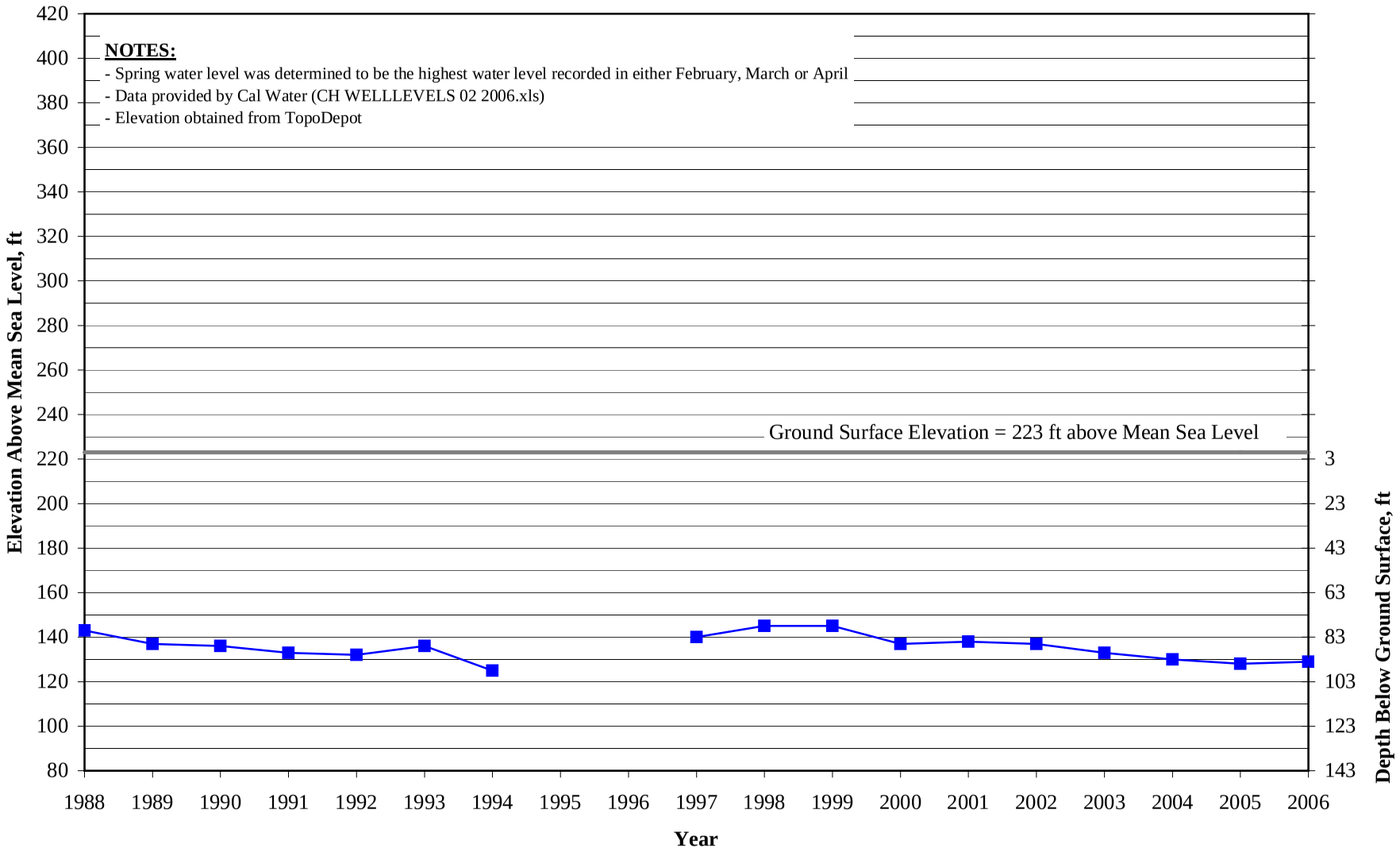



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 024 - Spring Groundwater Level Hydrograph

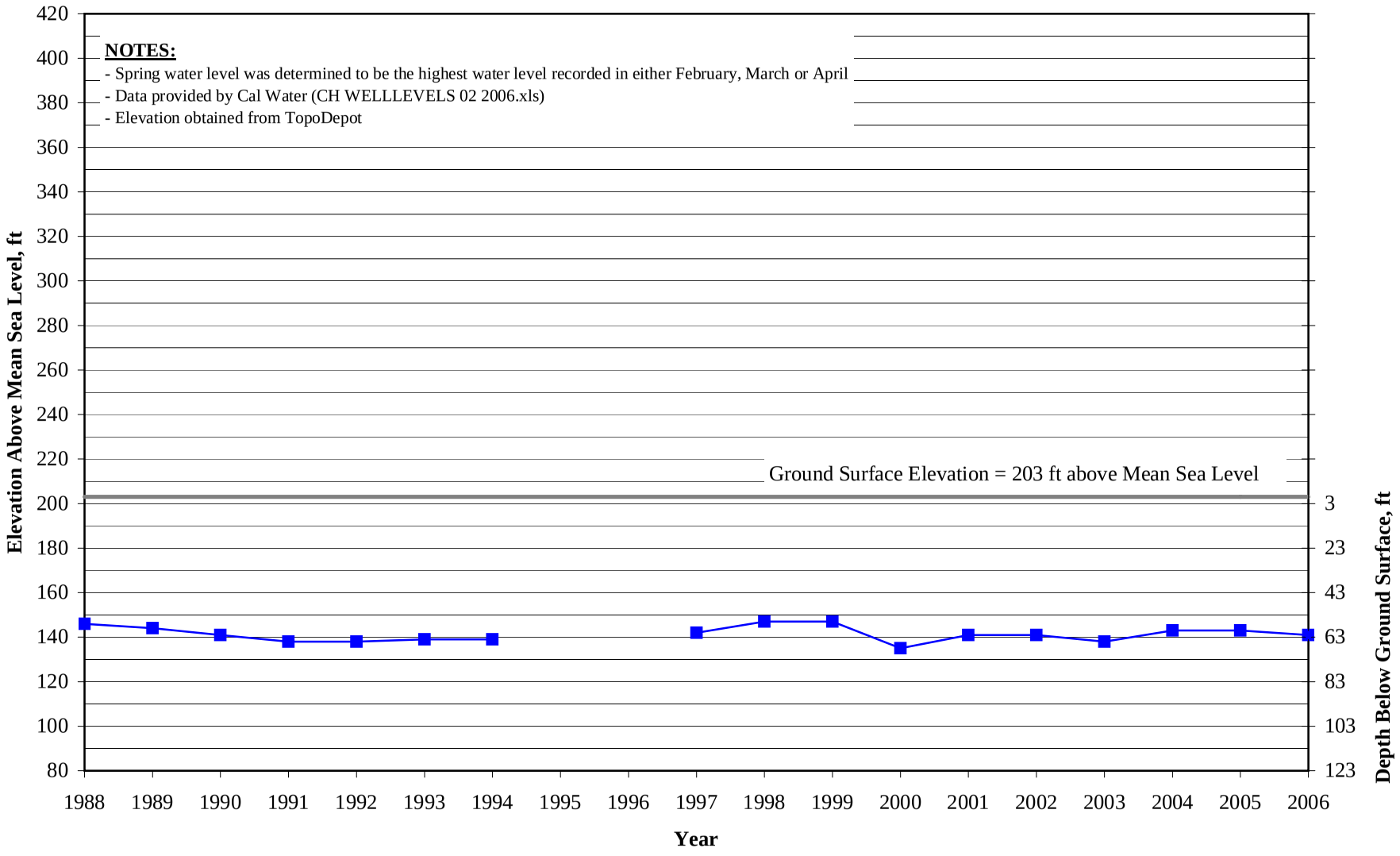



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 025 - Spring Groundwater Level Hydrograph

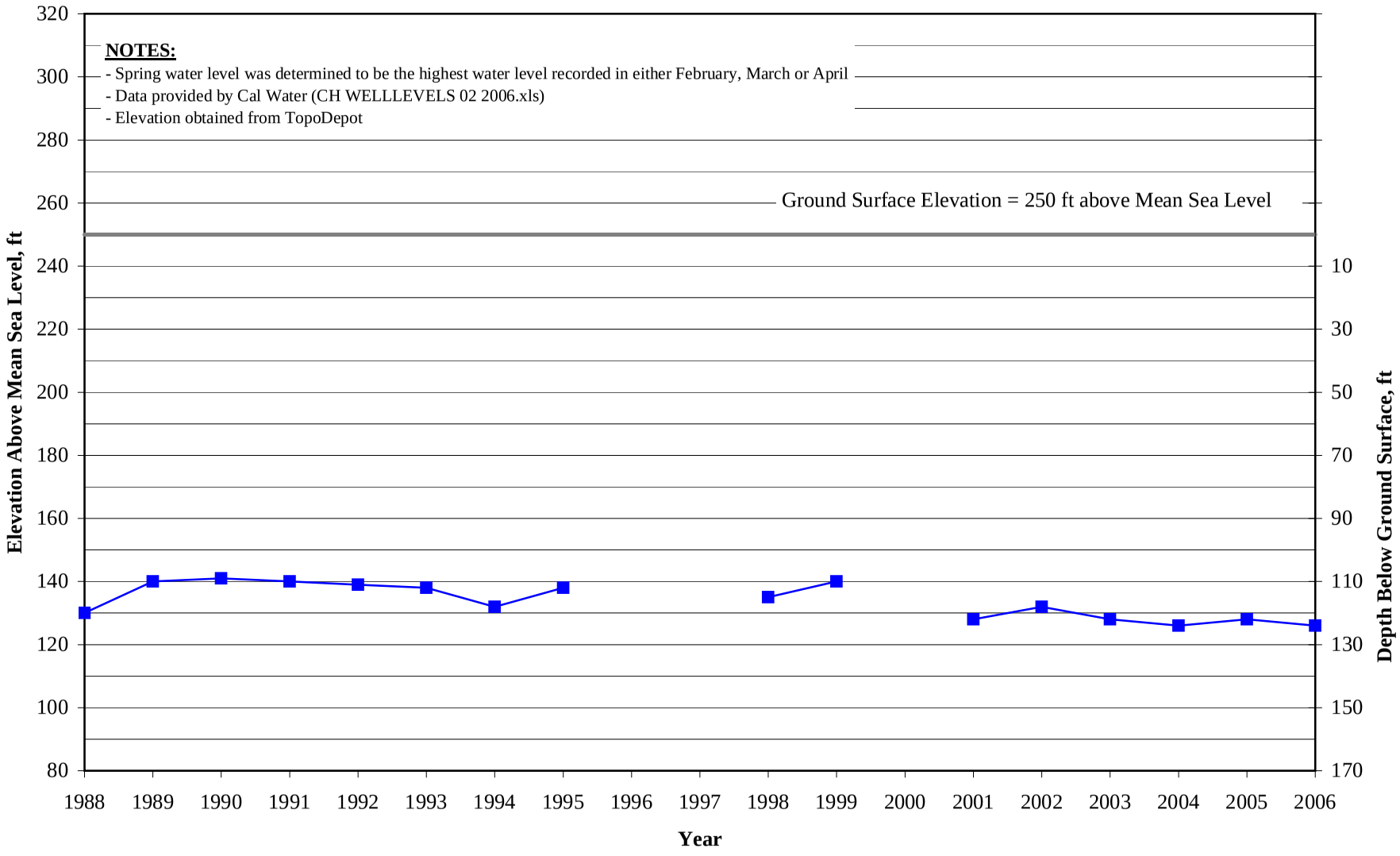



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 026 - Spring Groundwater Level Hydrograph

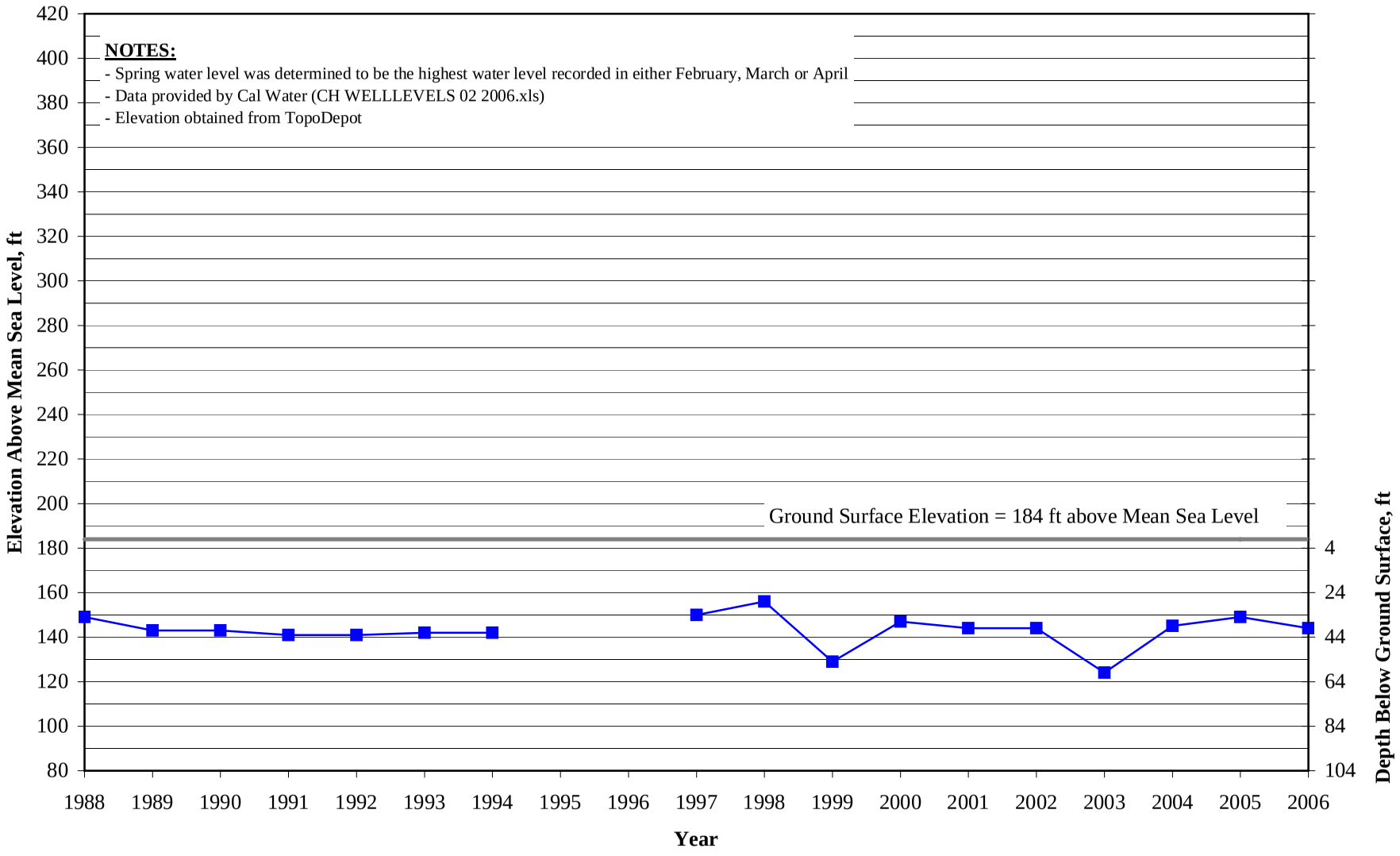



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 027 - Spring Groundwater Level Hydrograph

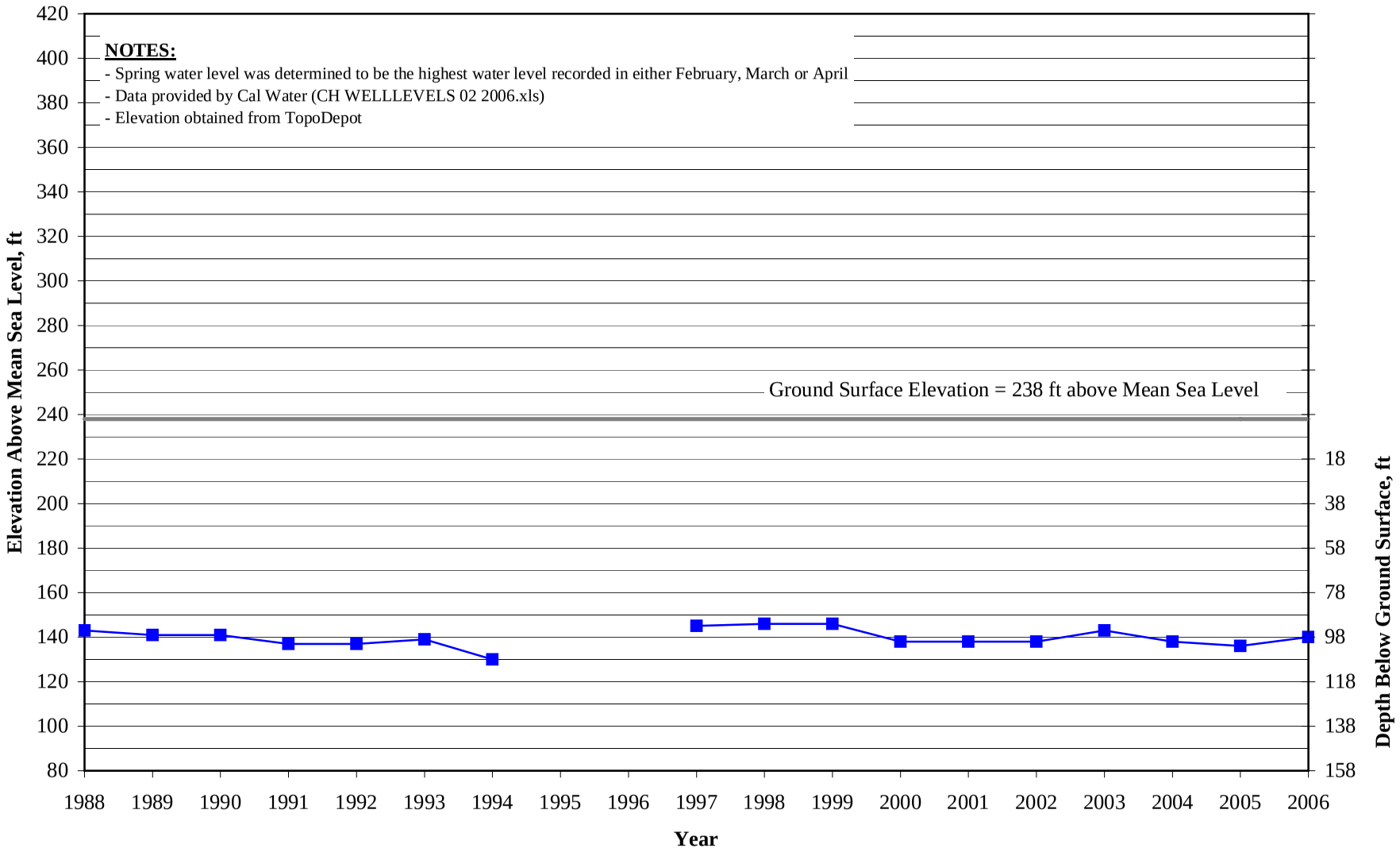



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 028 - Spring Groundwater Level Hydrograph

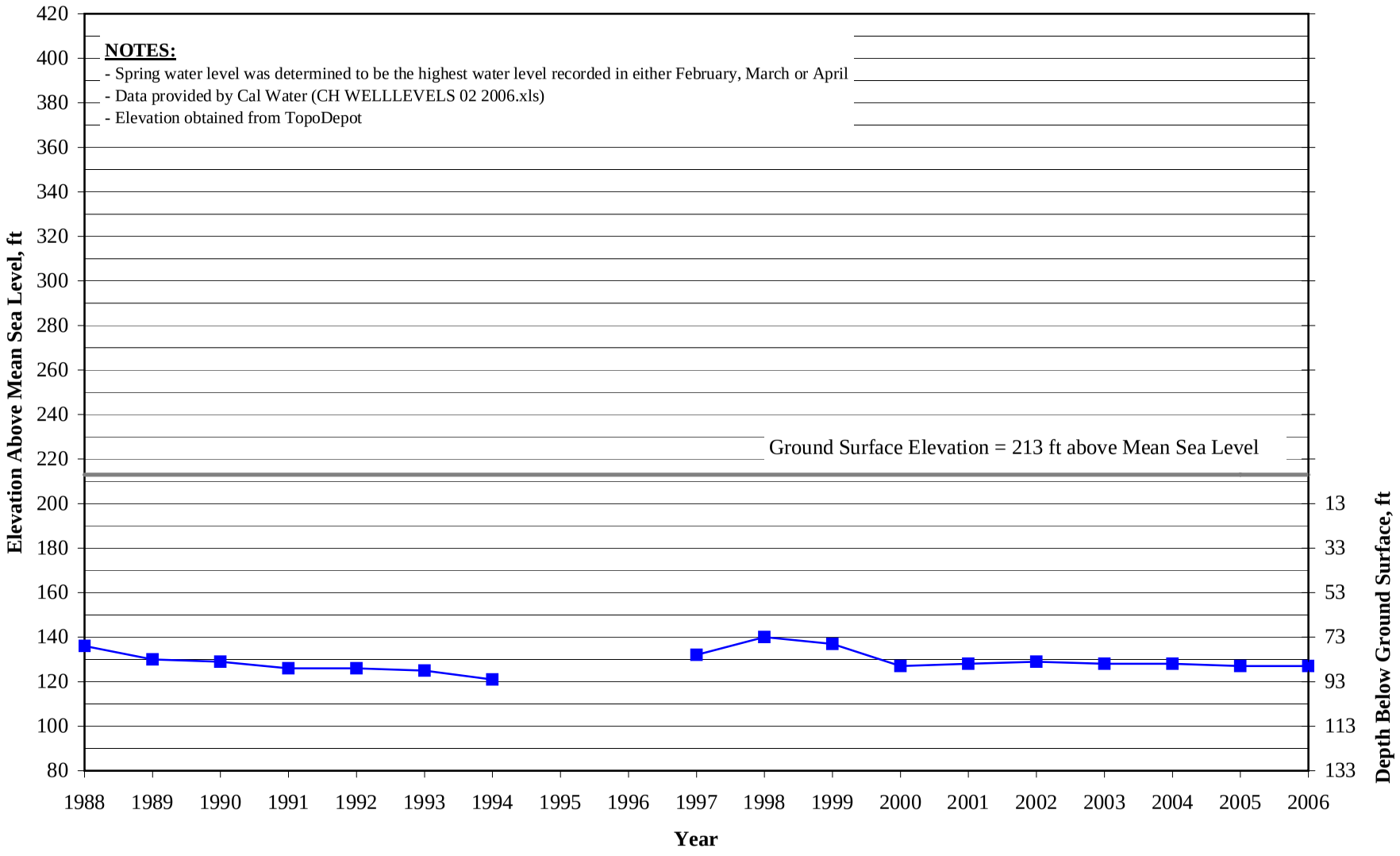



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 029 - Spring Groundwater Level Hydrograph

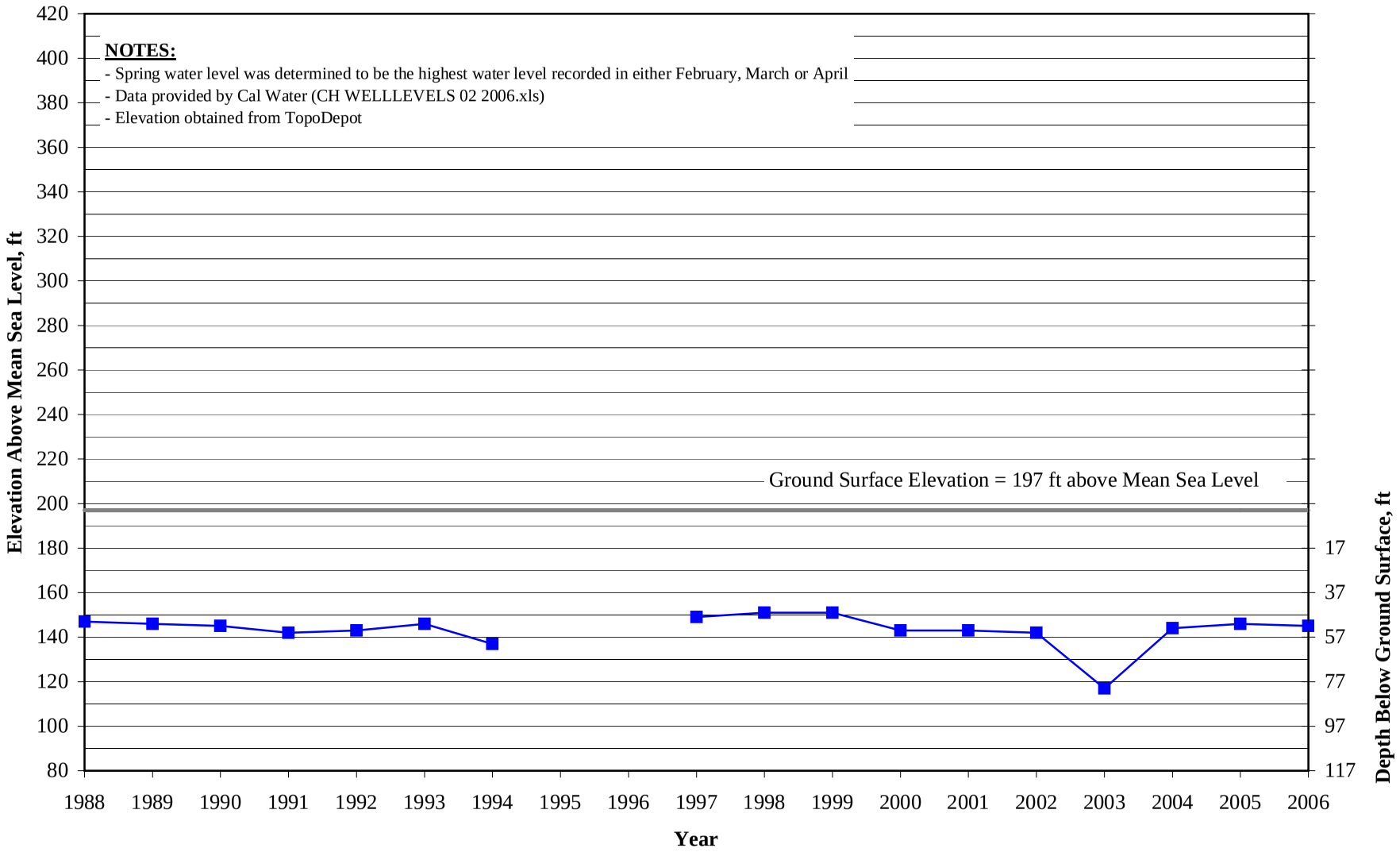



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 030 - Spring Groundwater Level Hydrograph

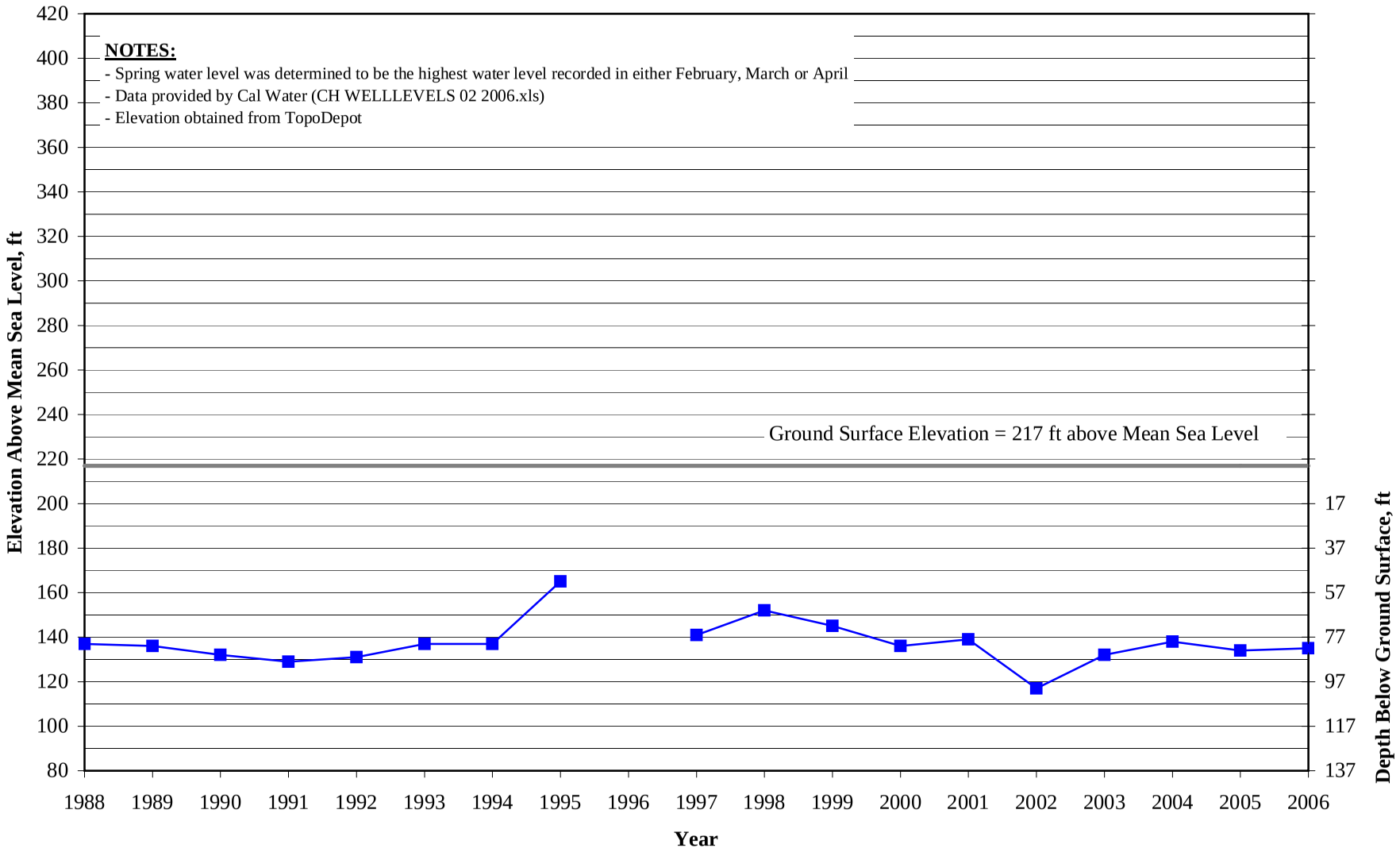



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 031 - Spring Groundwater Level Hydrograph

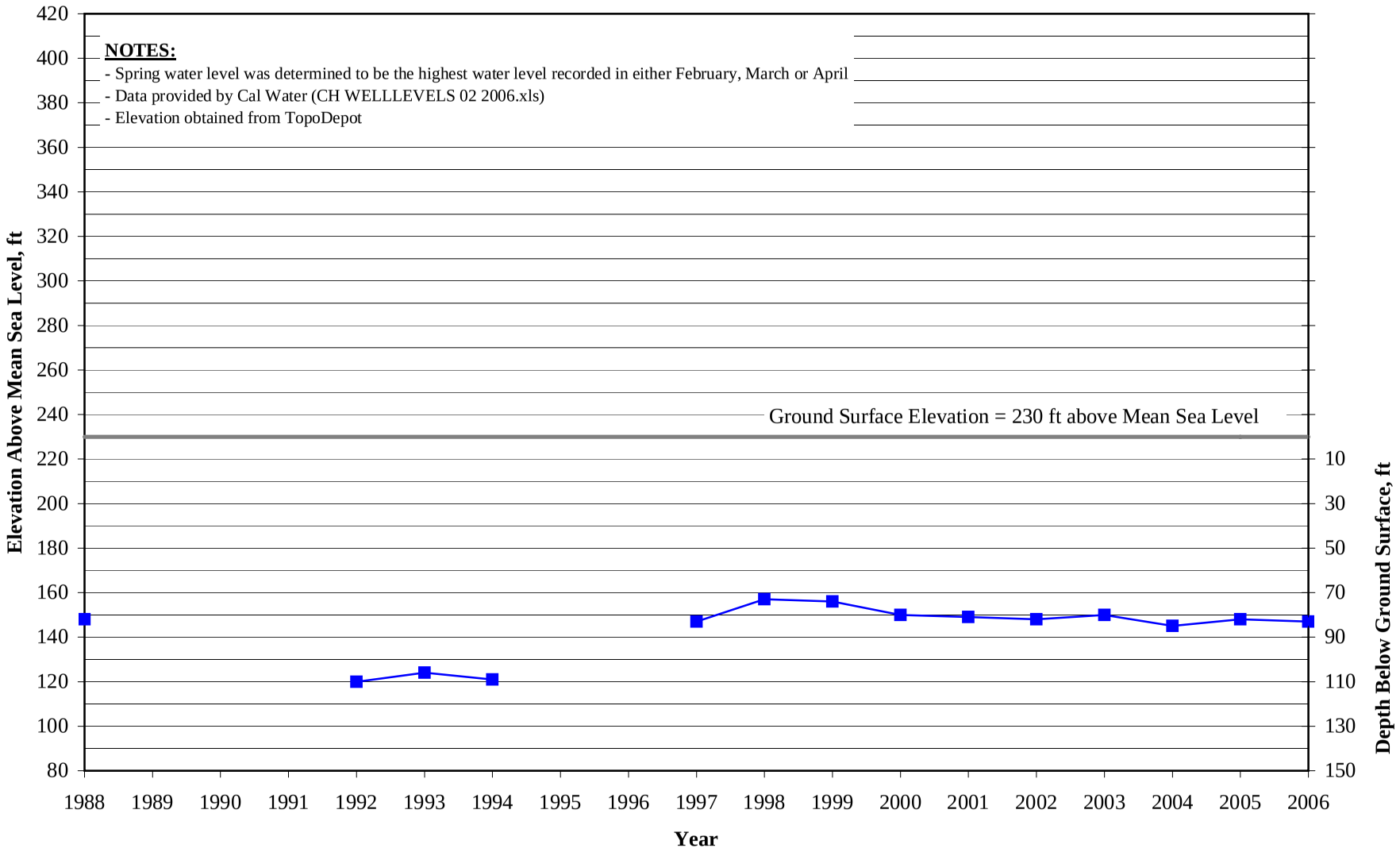



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 032 - Spring Groundwater Level Hydrograph

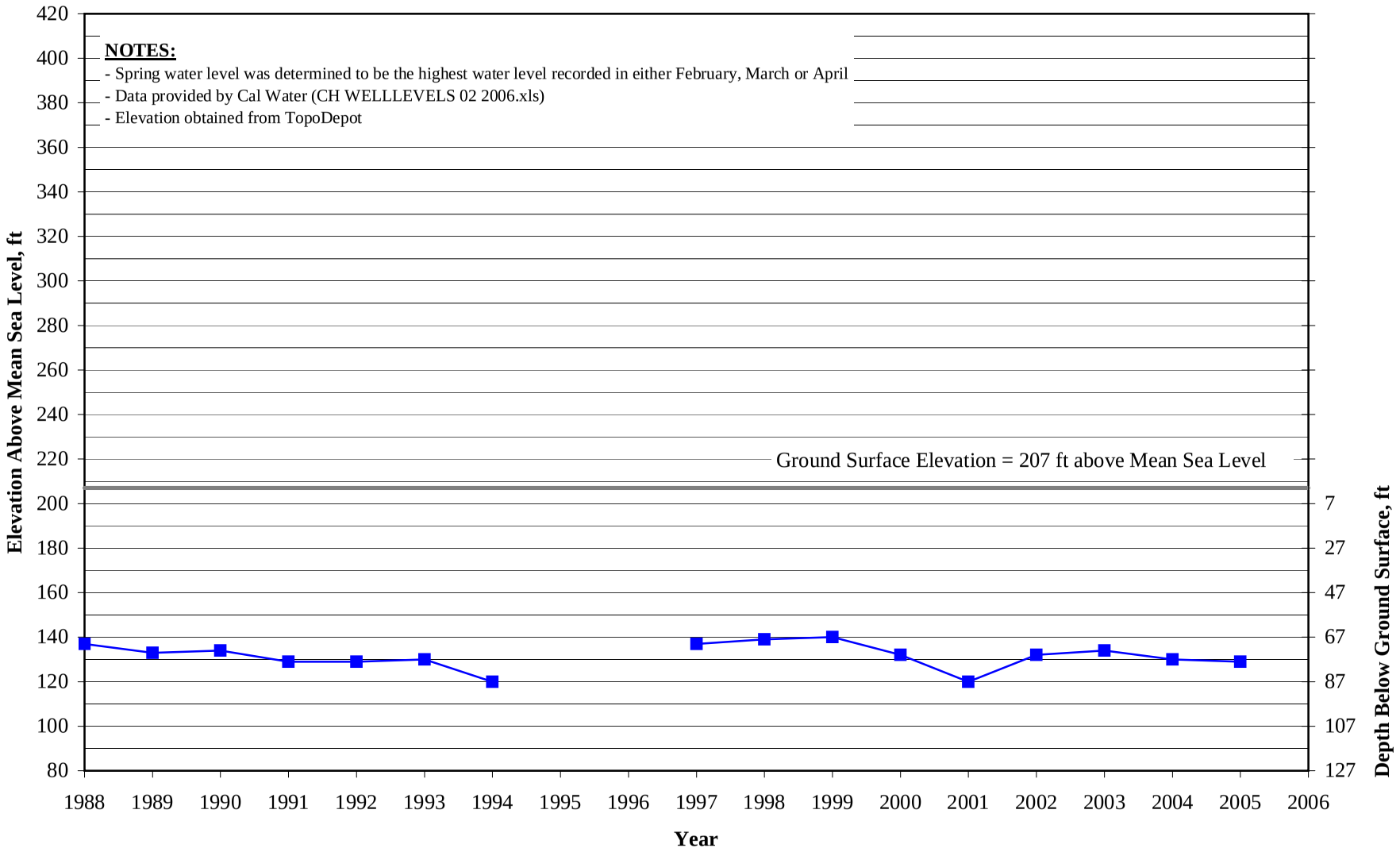



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 035 - Spring Groundwater Level Hydrograph

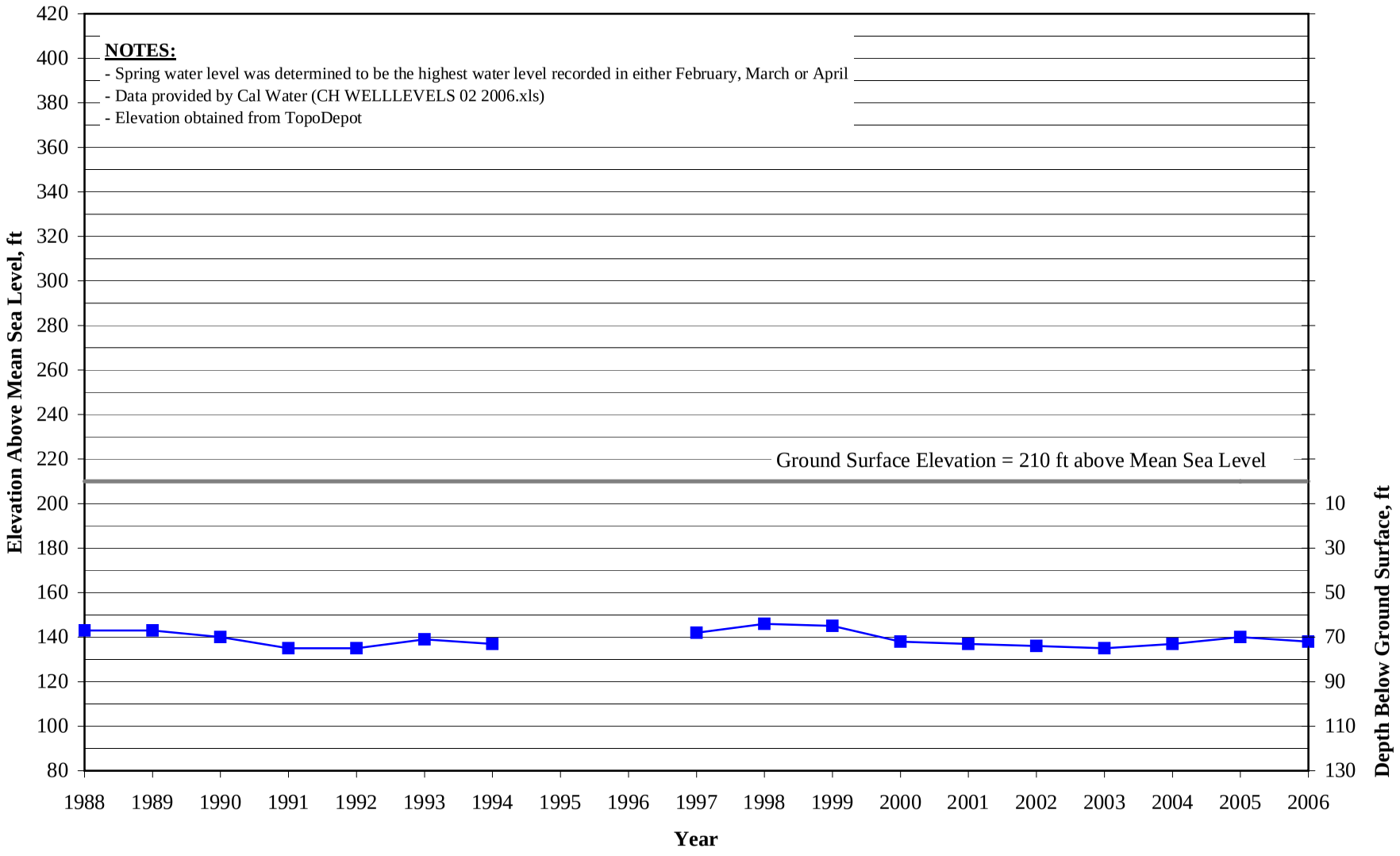



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 037 - Spring Groundwater Level Hydrograph

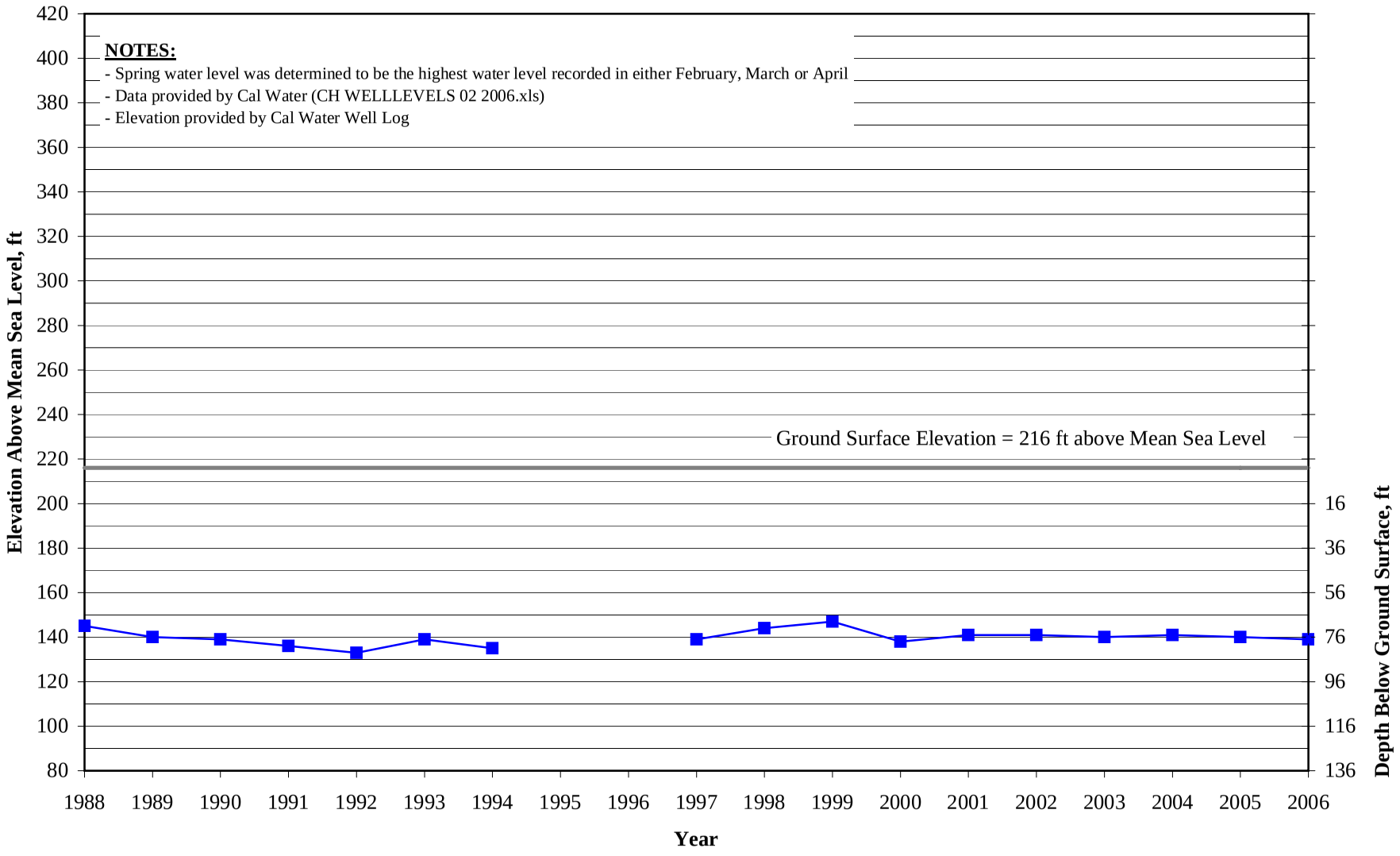



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 038 - Spring Groundwater Level Hydrograph

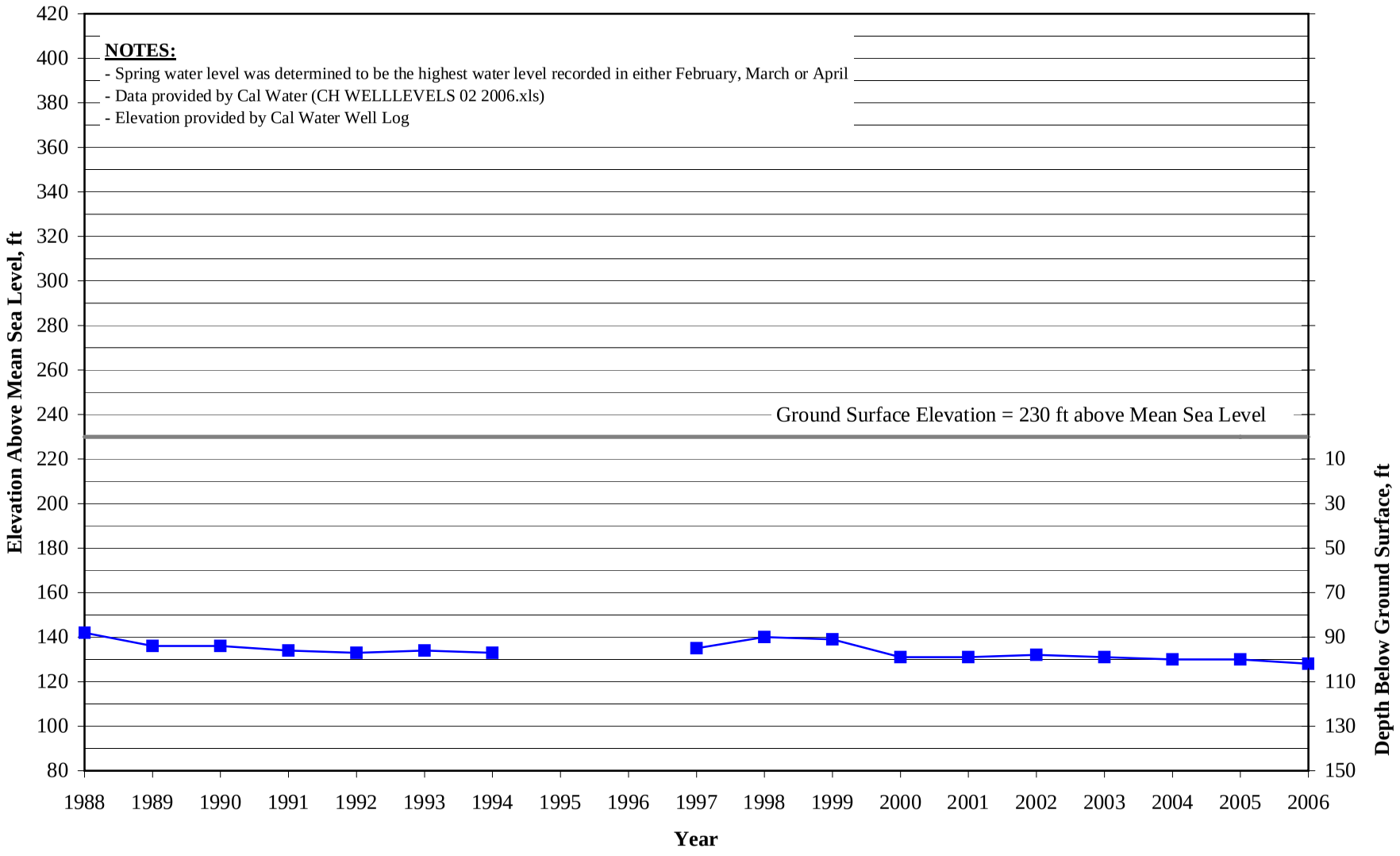



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 039 - Spring Groundwater Level Hydrograph

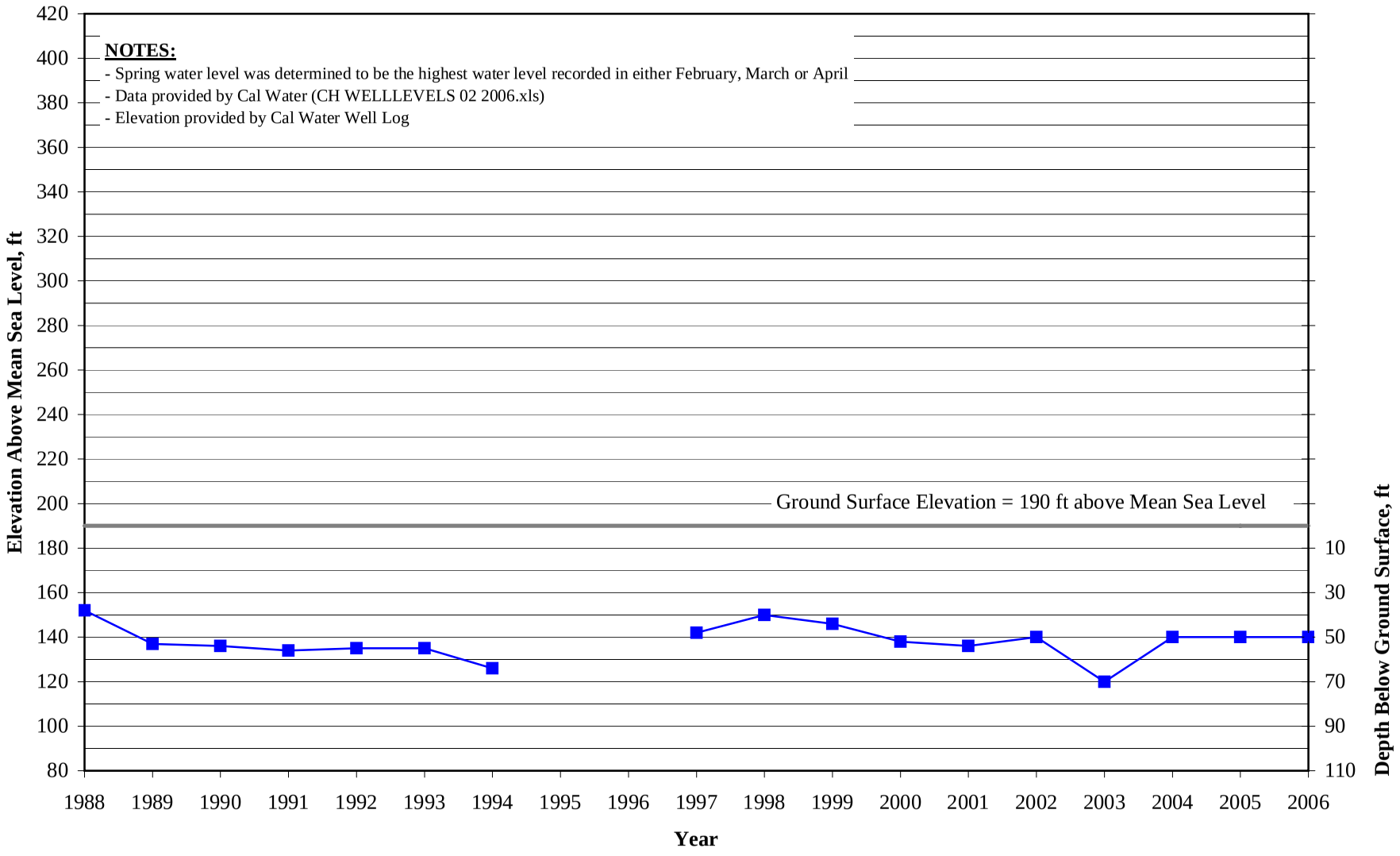



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 040 - Spring Groundwater Level Hydrograph

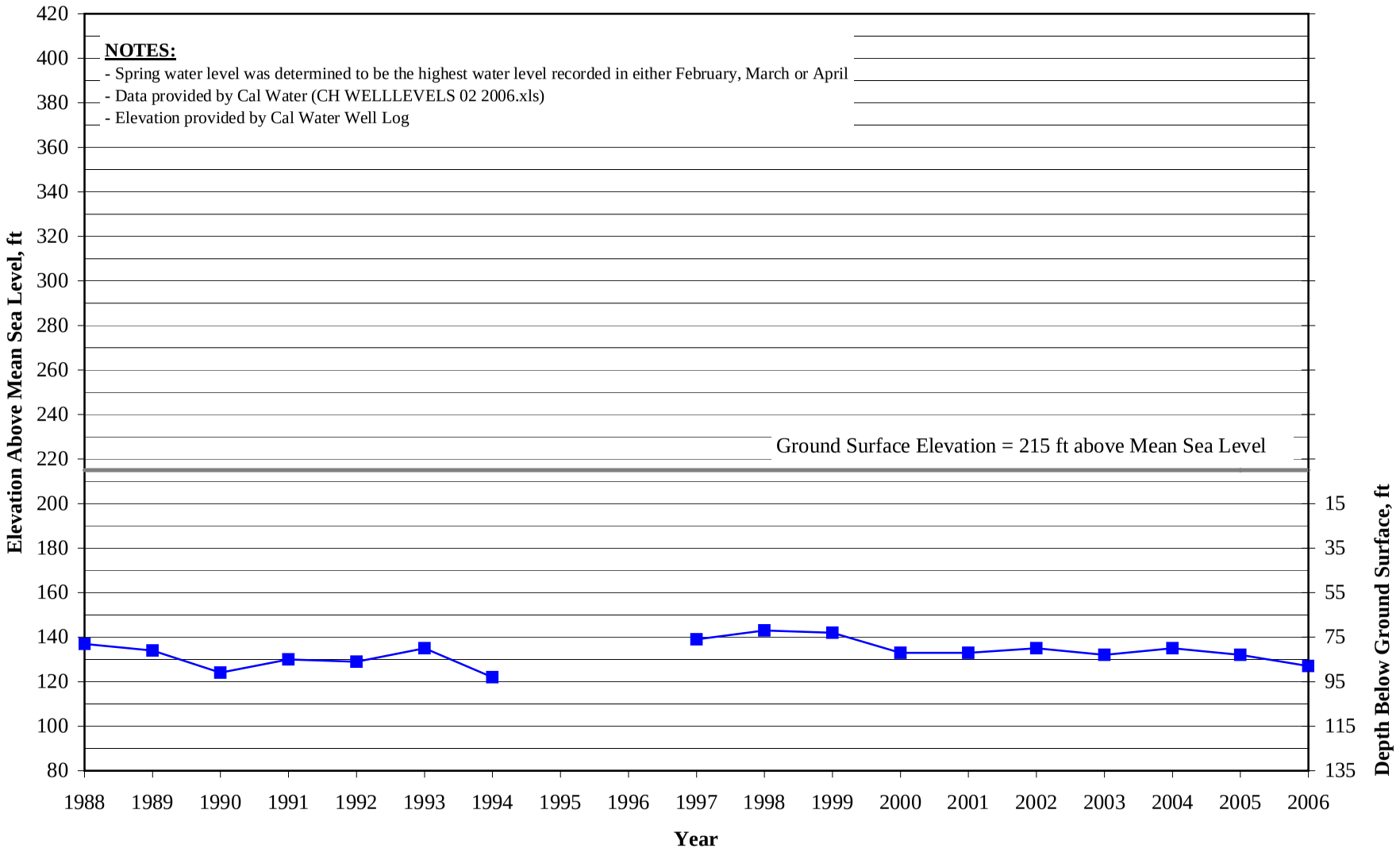



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 041 - Spring Groundwater Level Hydrograph

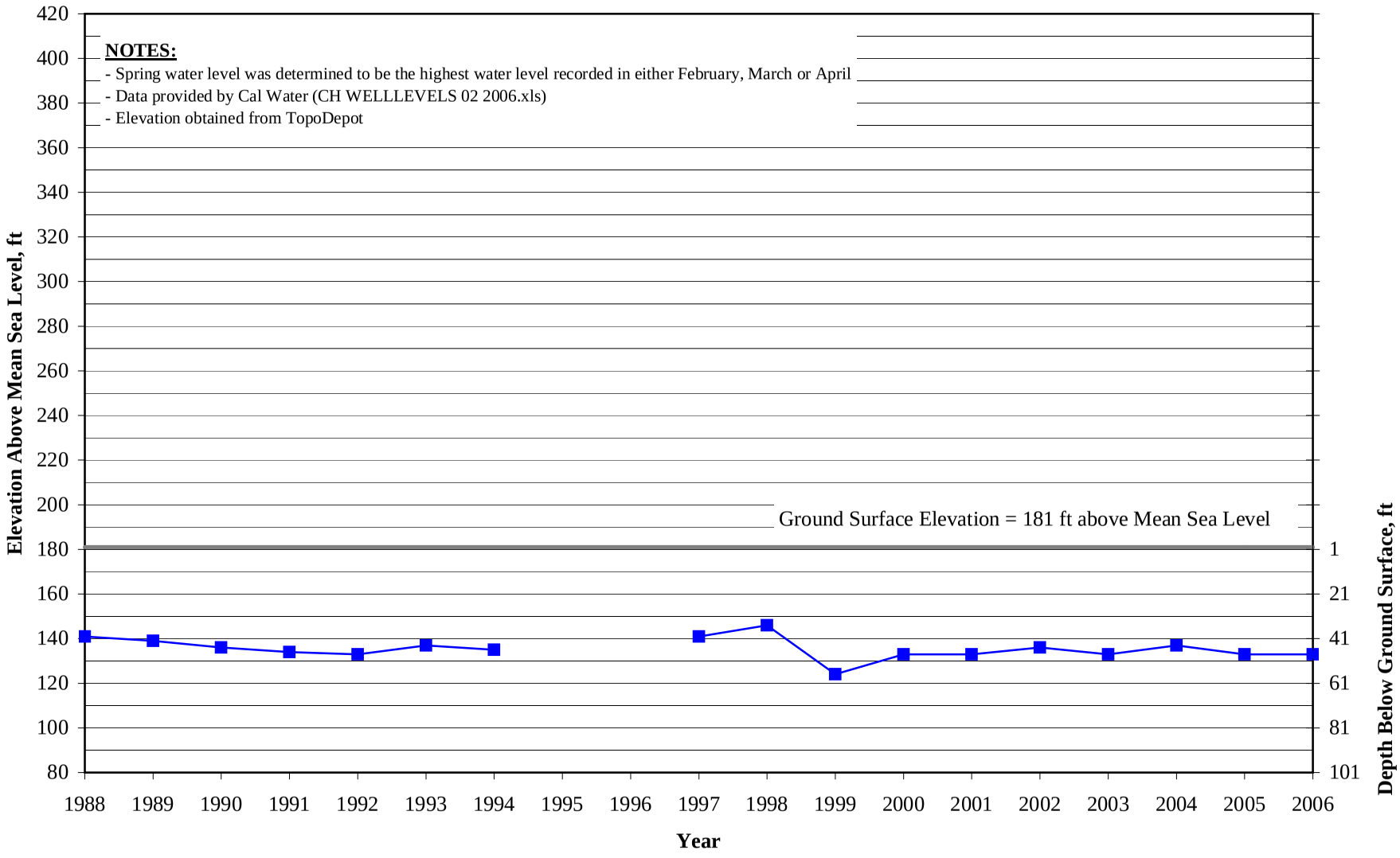



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 042 - Spring Groundwater Level Hydrograph

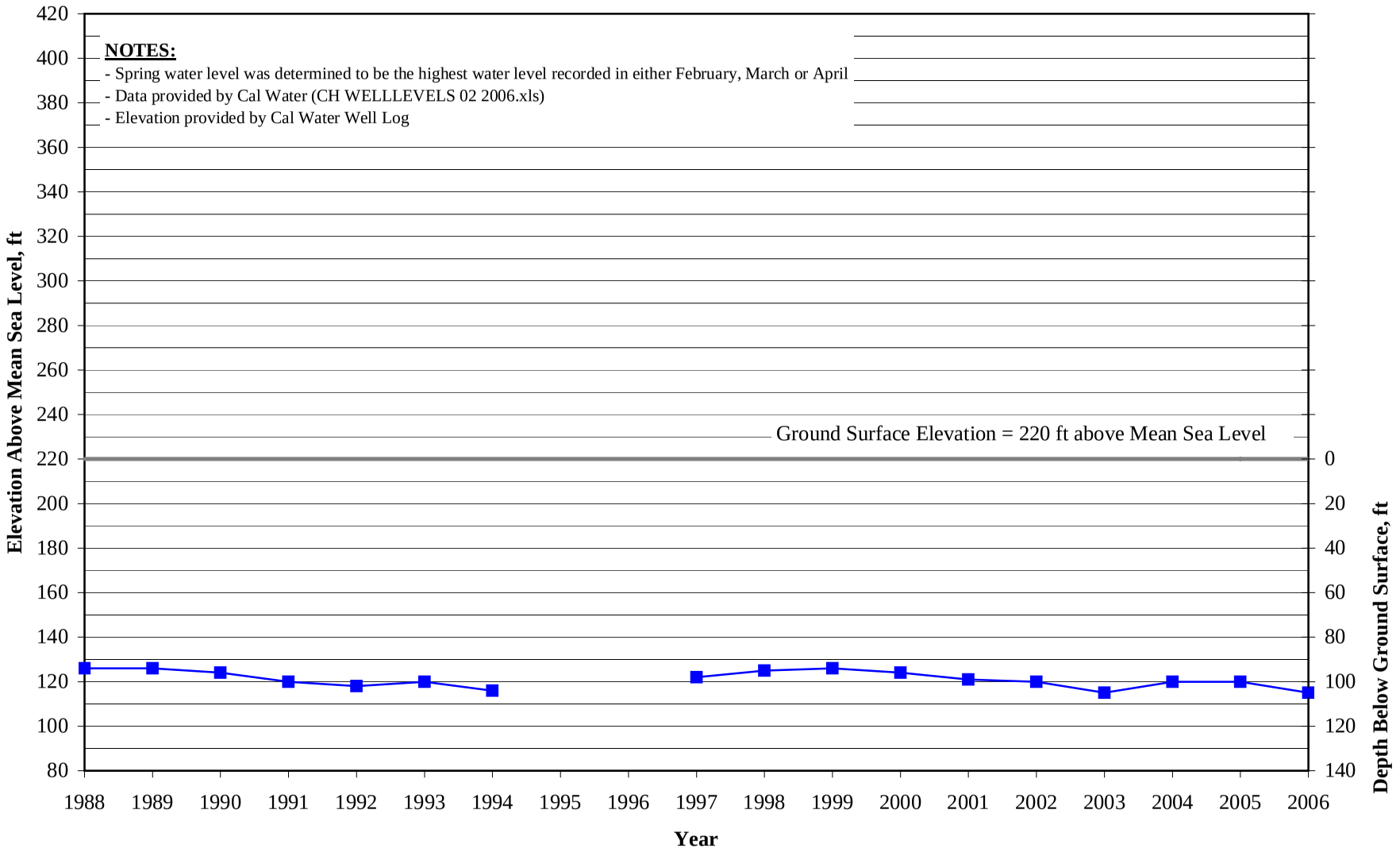



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 044 - Spring Groundwater Level Hydrograph

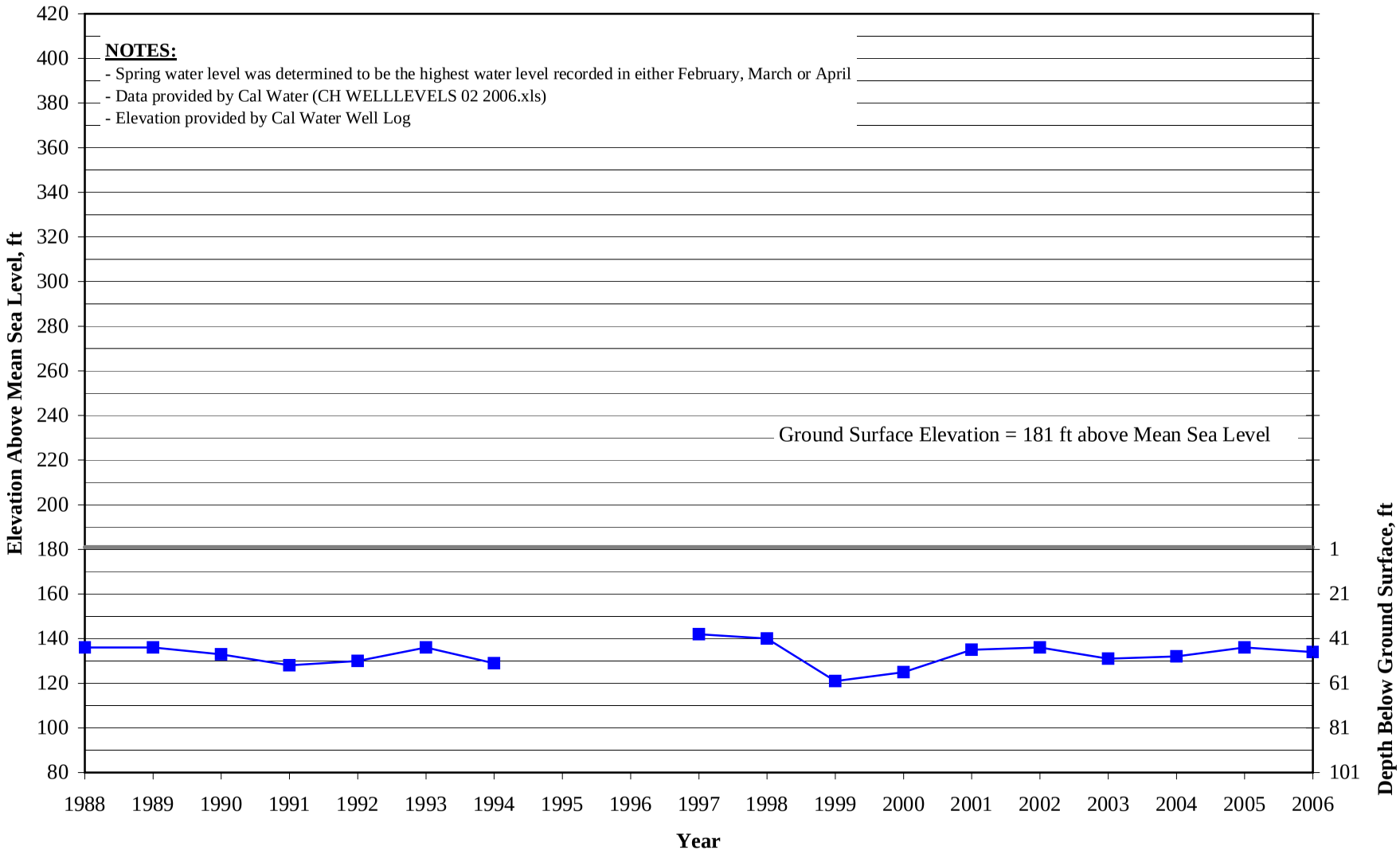



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 046 - Spring Groundwater Level Hydrograph

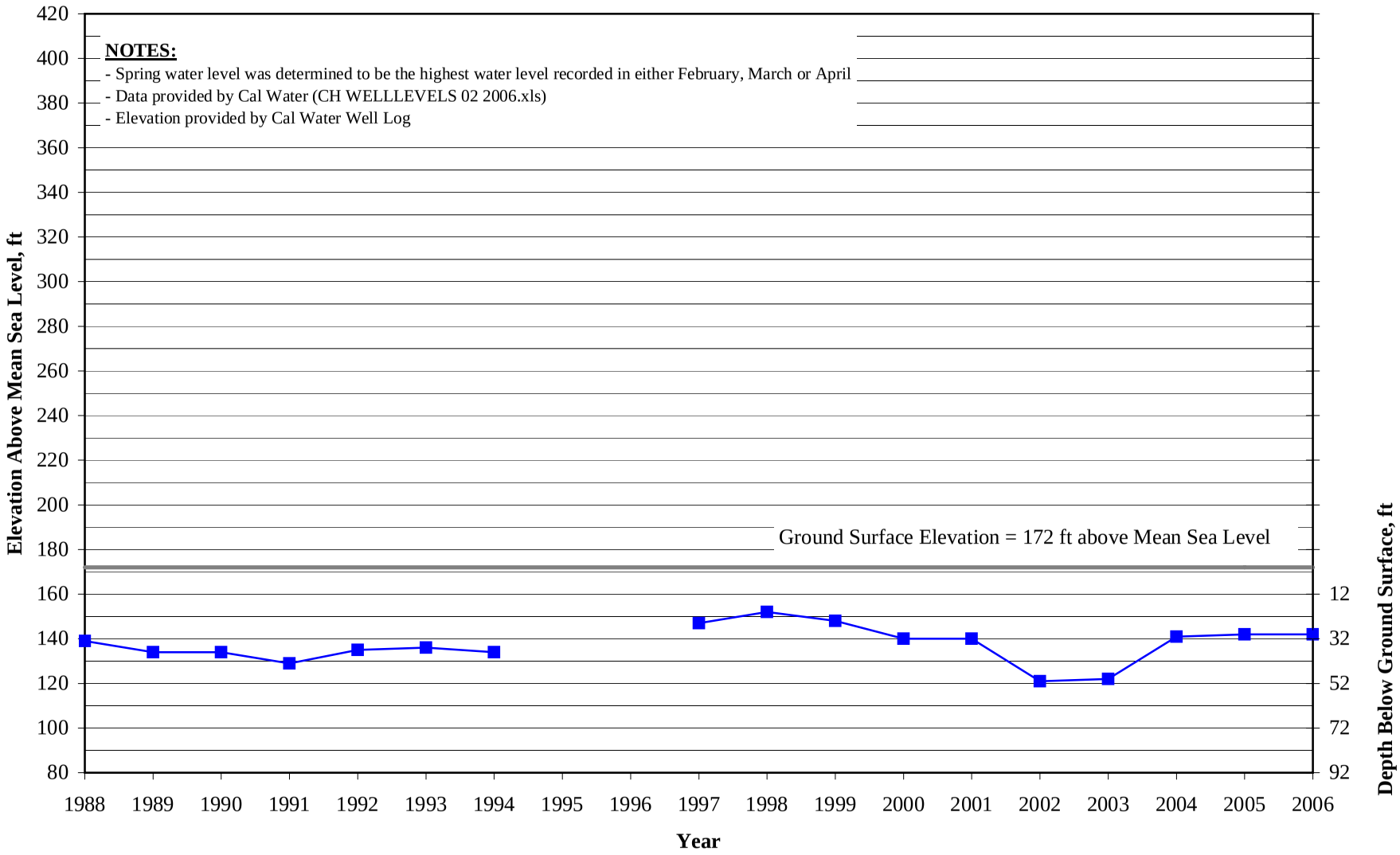



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 047 - Spring Groundwater Level Hydrograph

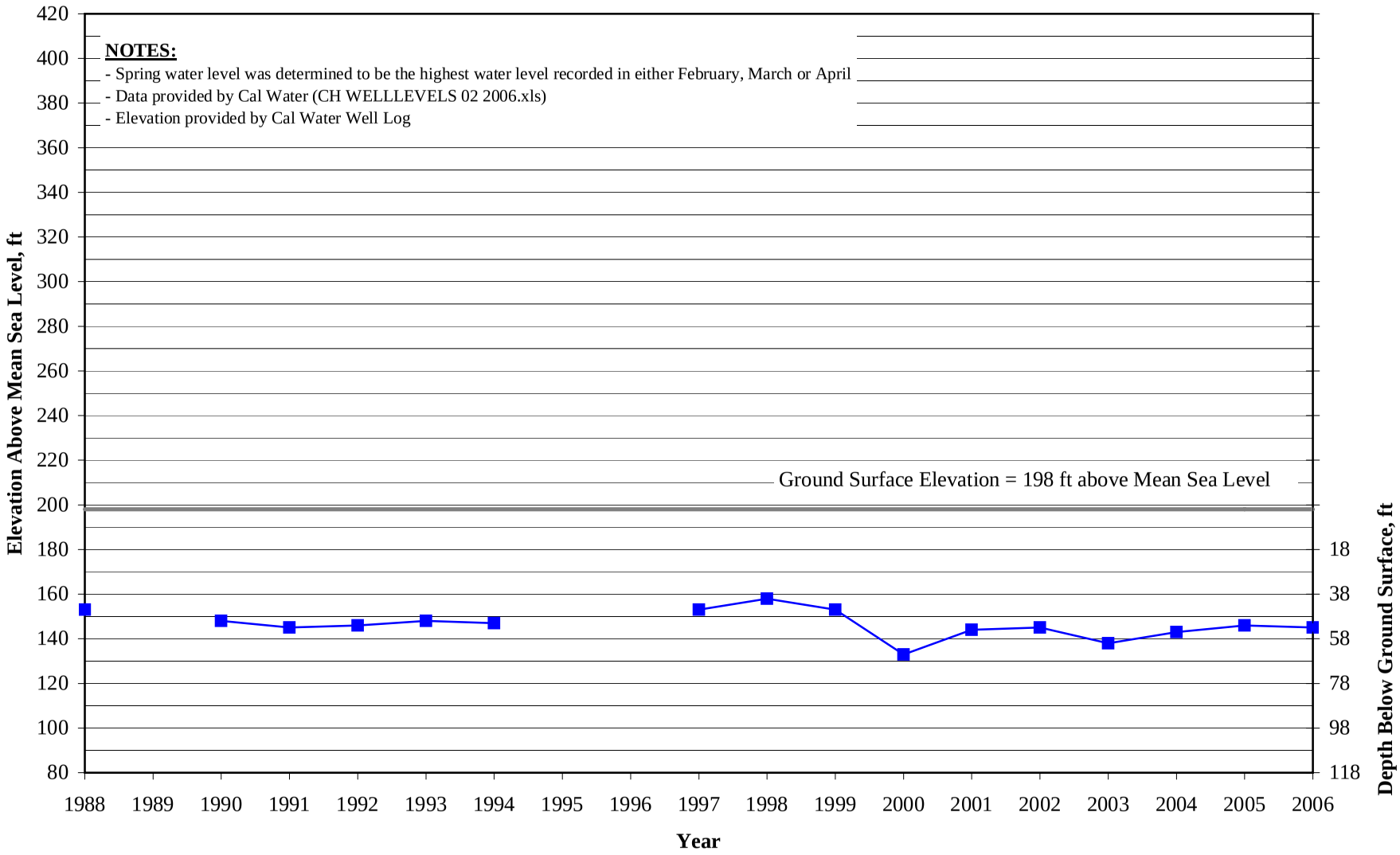



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 048 - Spring Groundwater Level Hydrograph

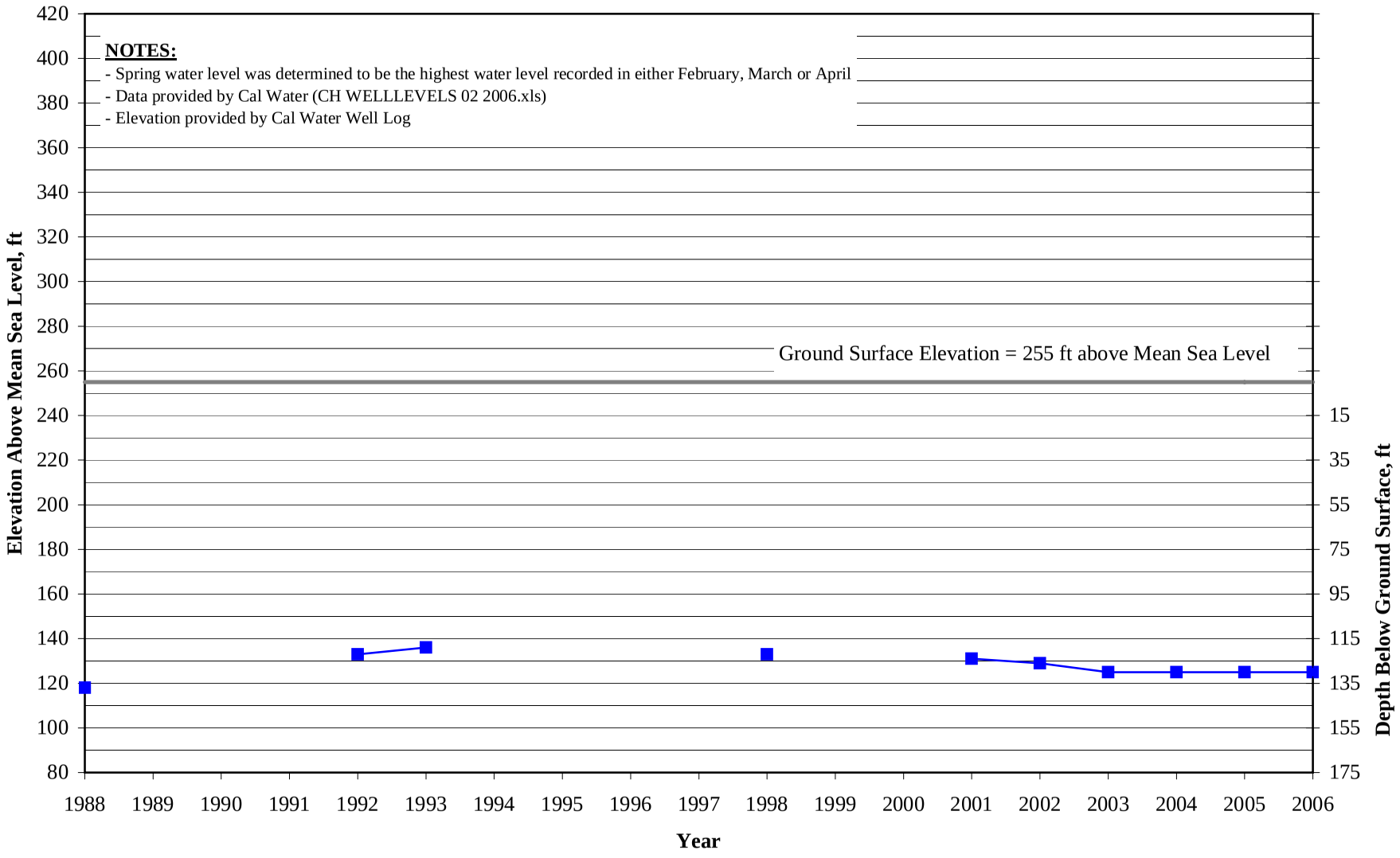



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 049 - Spring Groundwater Level Hydrograph

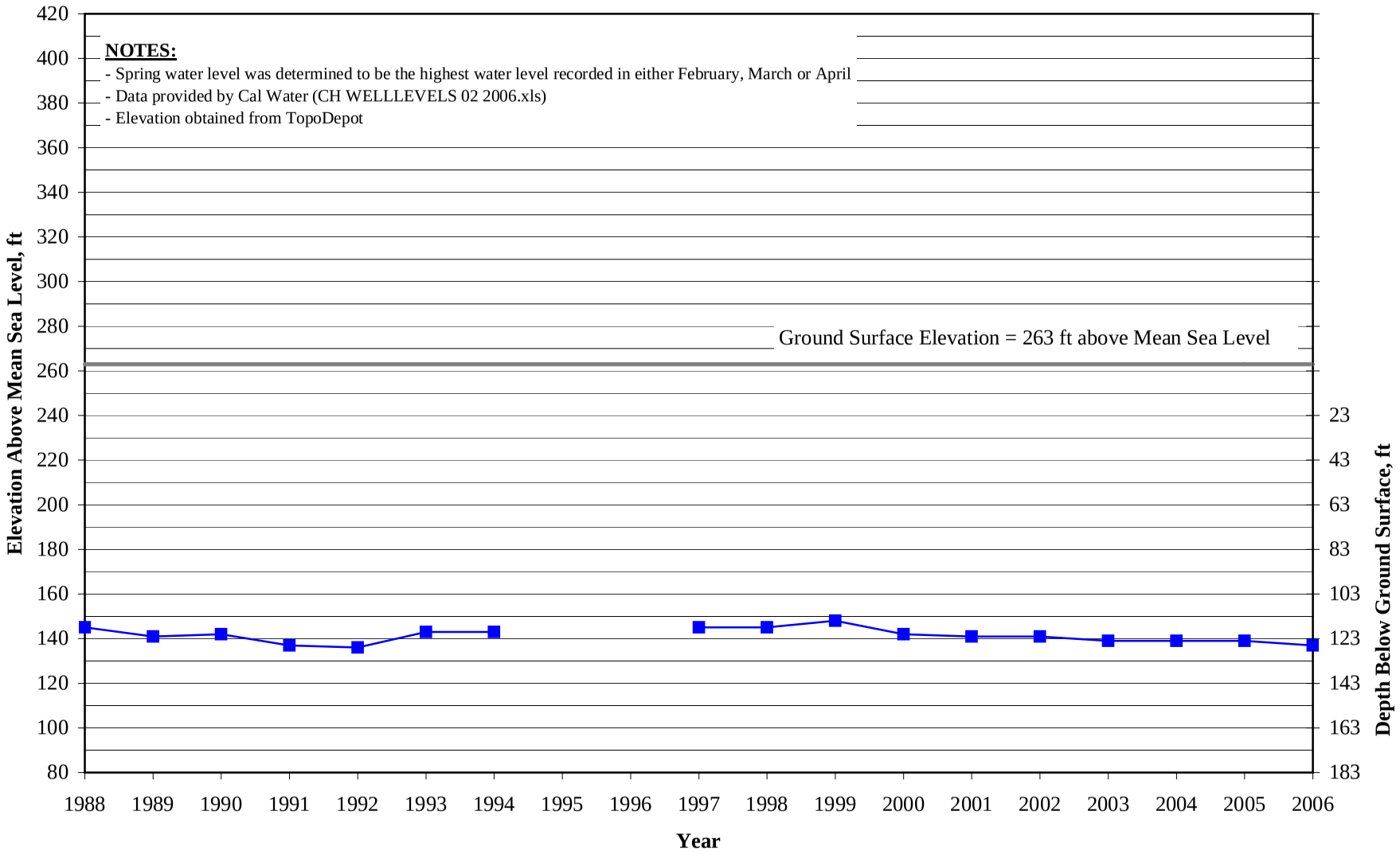



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 050 - Spring Groundwater Level Hydrograph

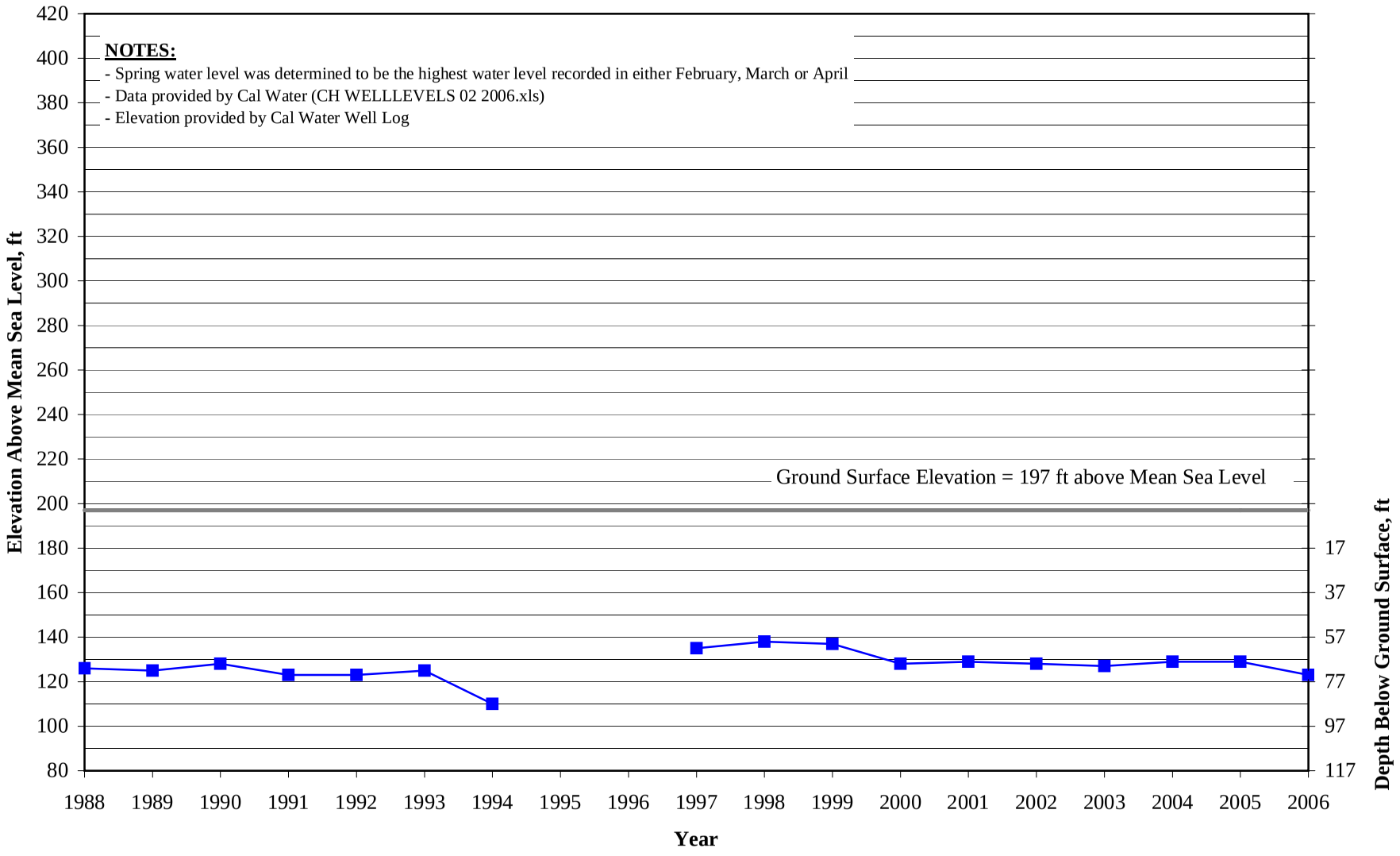



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 051 - Spring Groundwater Level Hydrograph

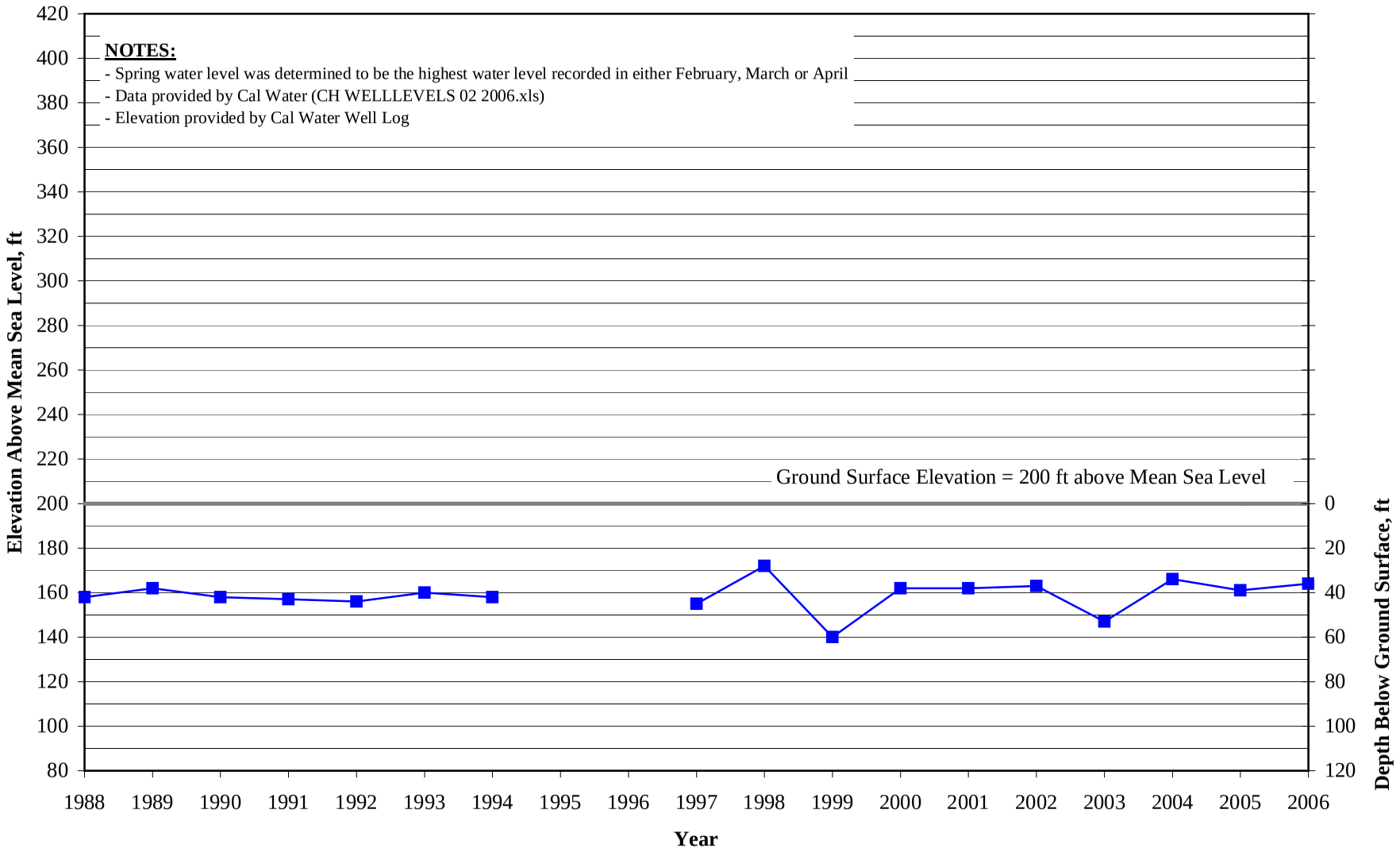



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 052 - Spring Groundwater Level Hydrograph

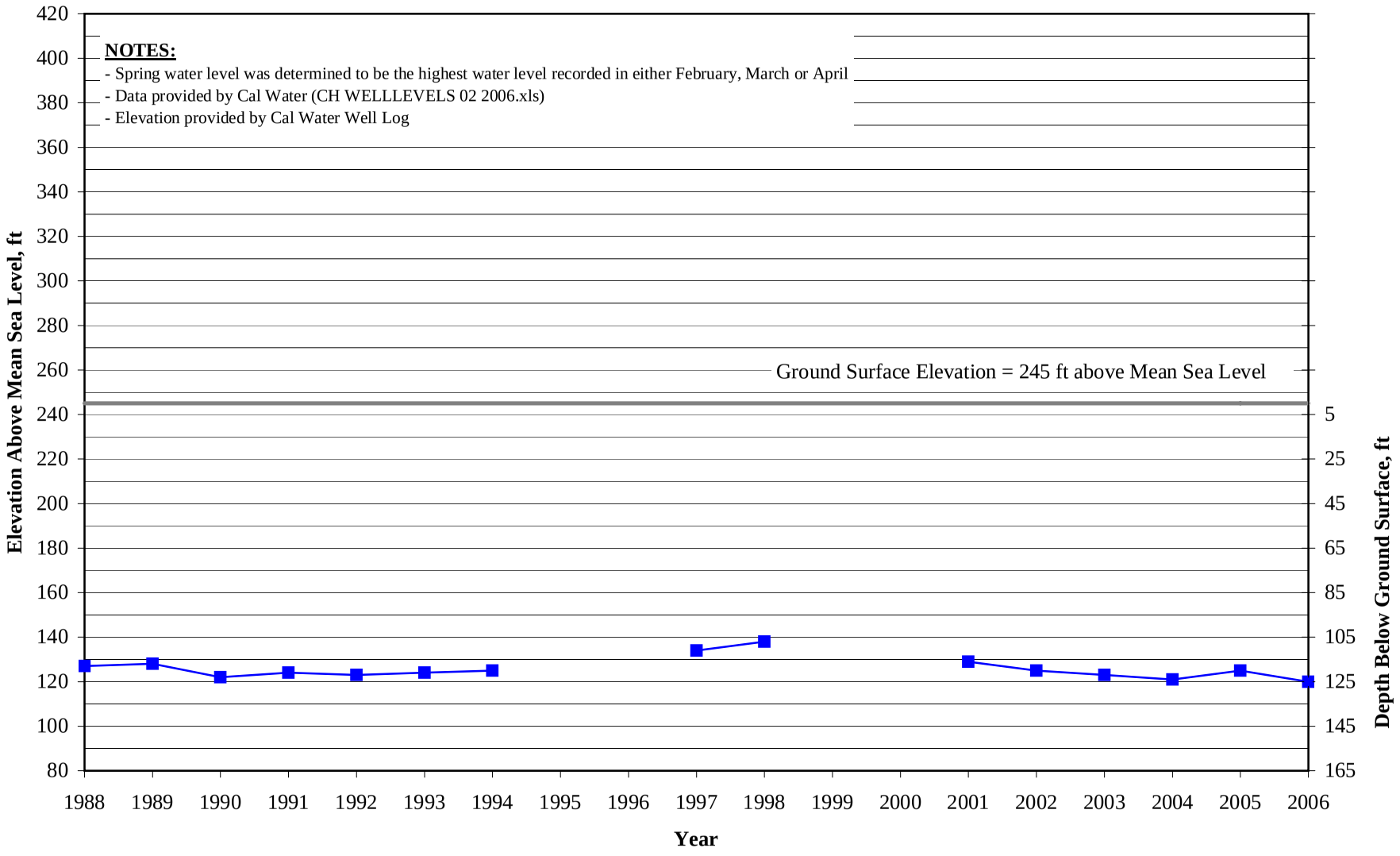



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 053 - Spring Groundwater Level Hydrograph

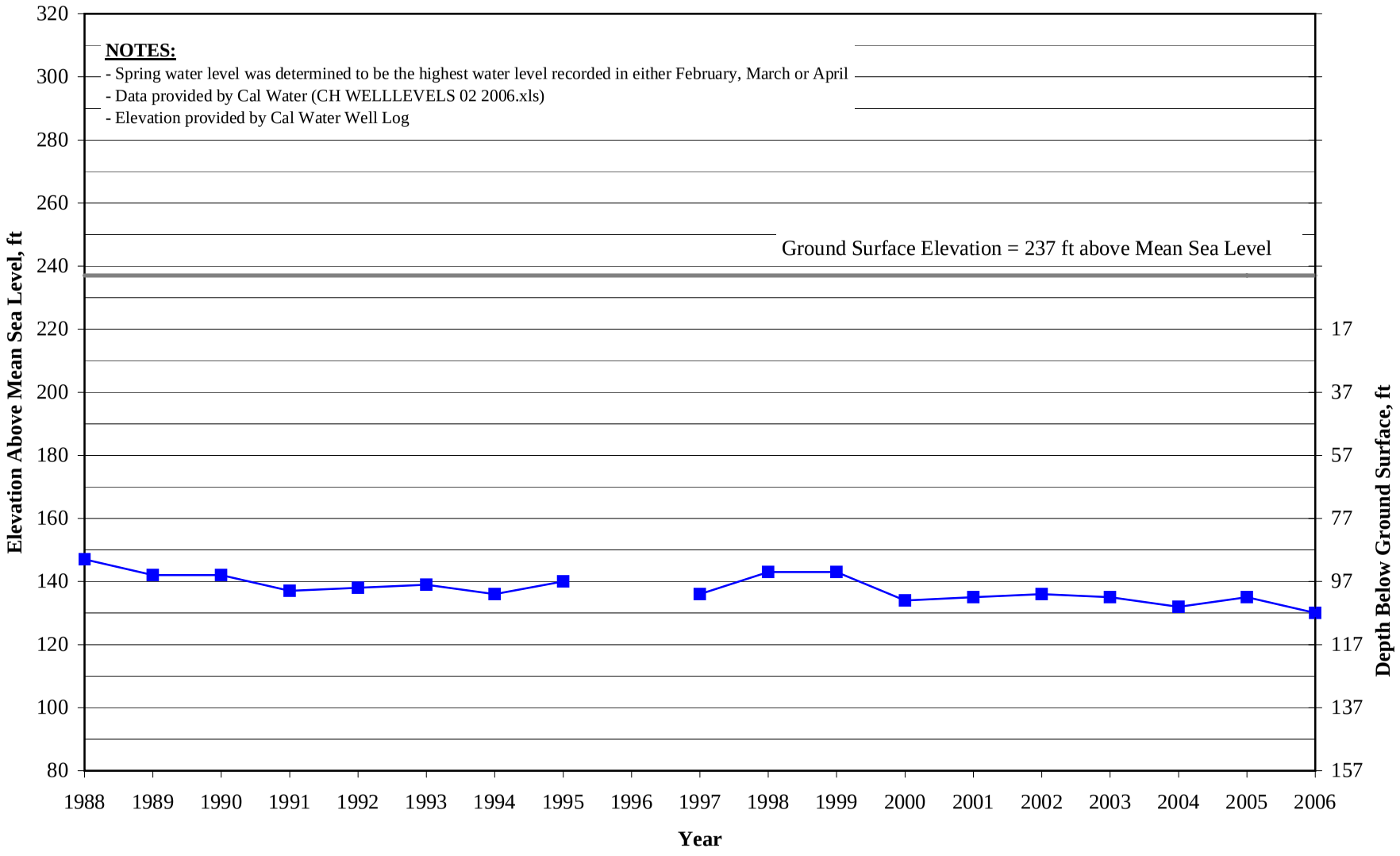



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 054 - Spring Groundwater Level Hydrograph

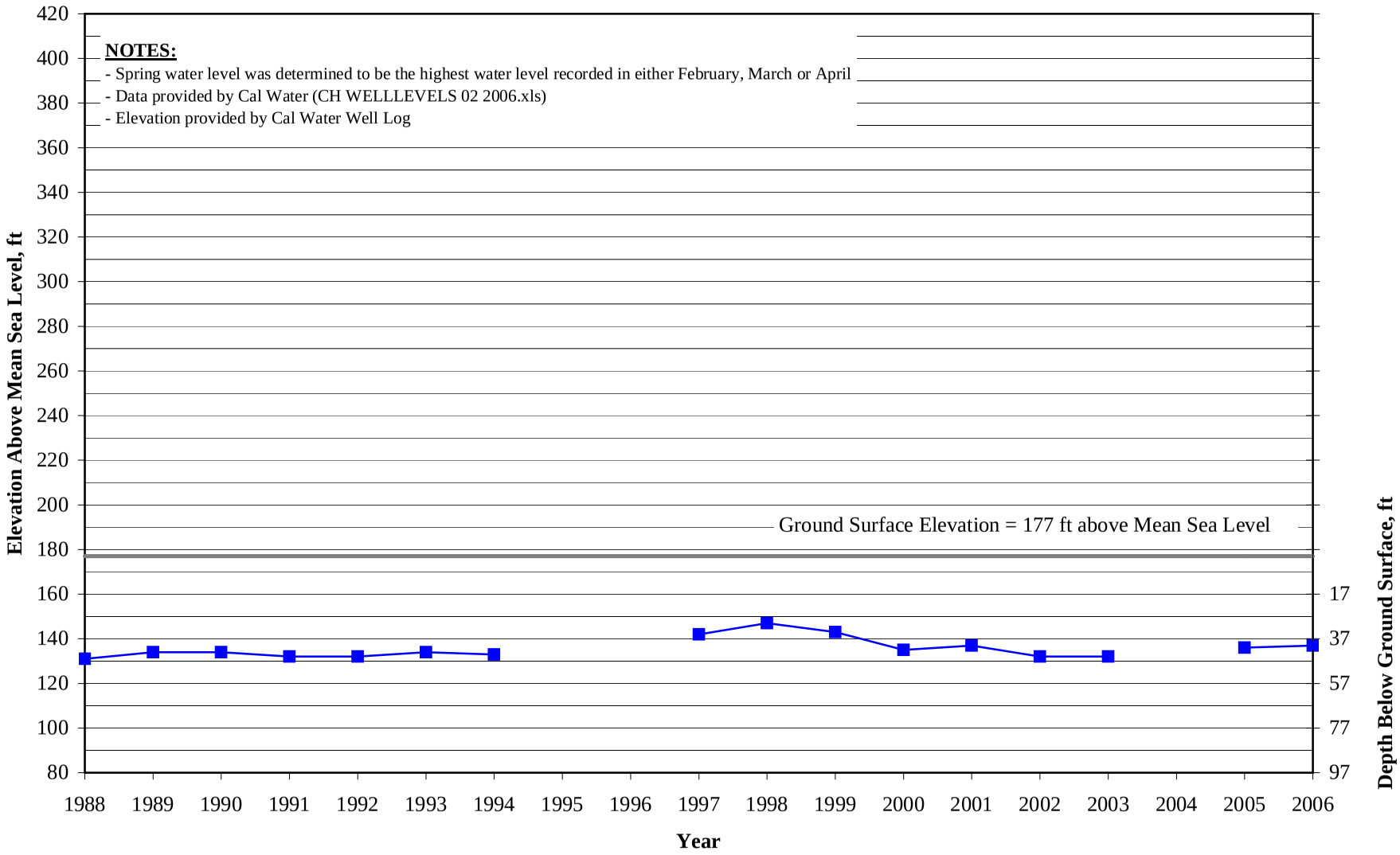



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 055 - Spring Groundwater Level Hydrograph

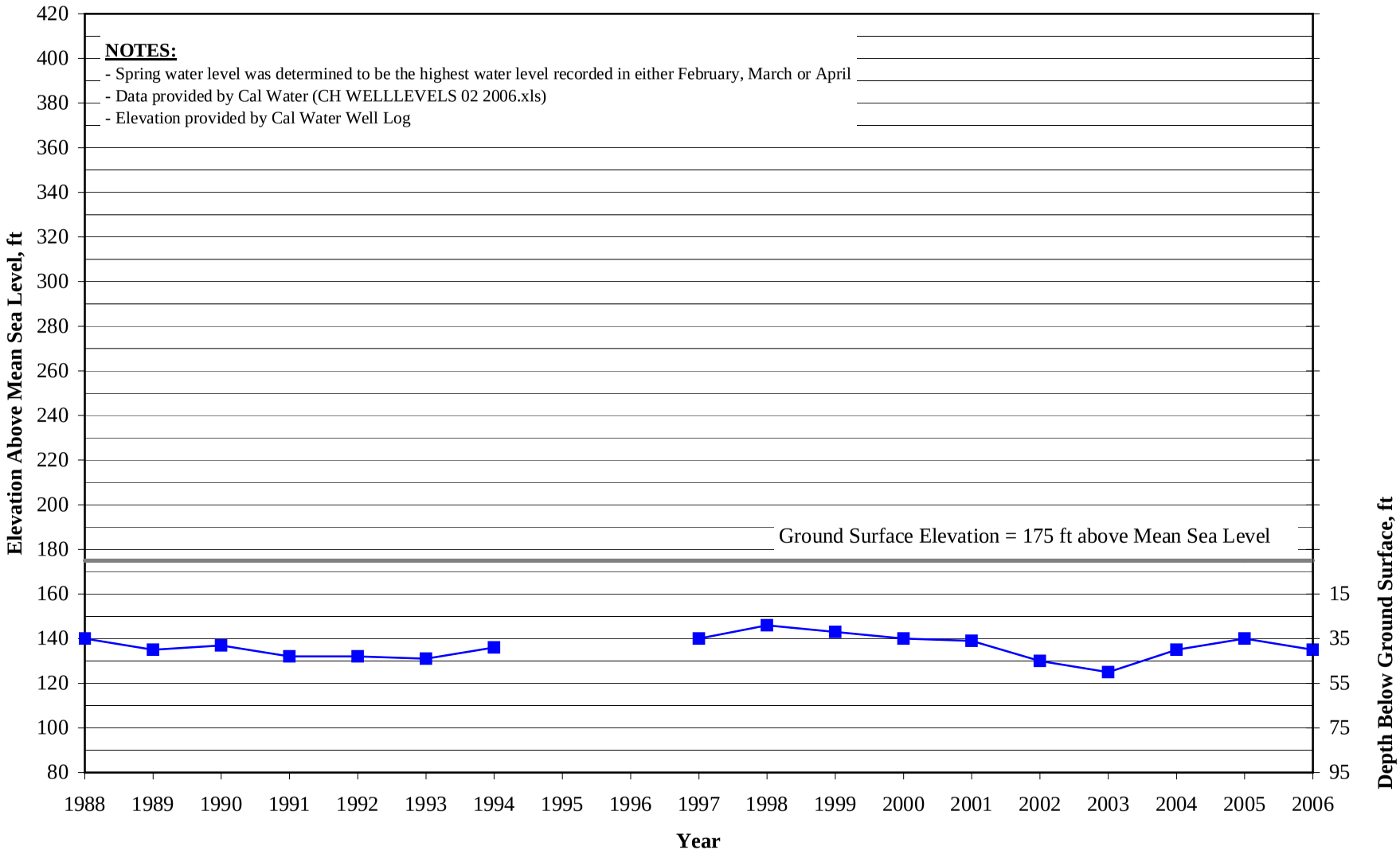



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 056 - Spring Groundwater Level Hydrograph

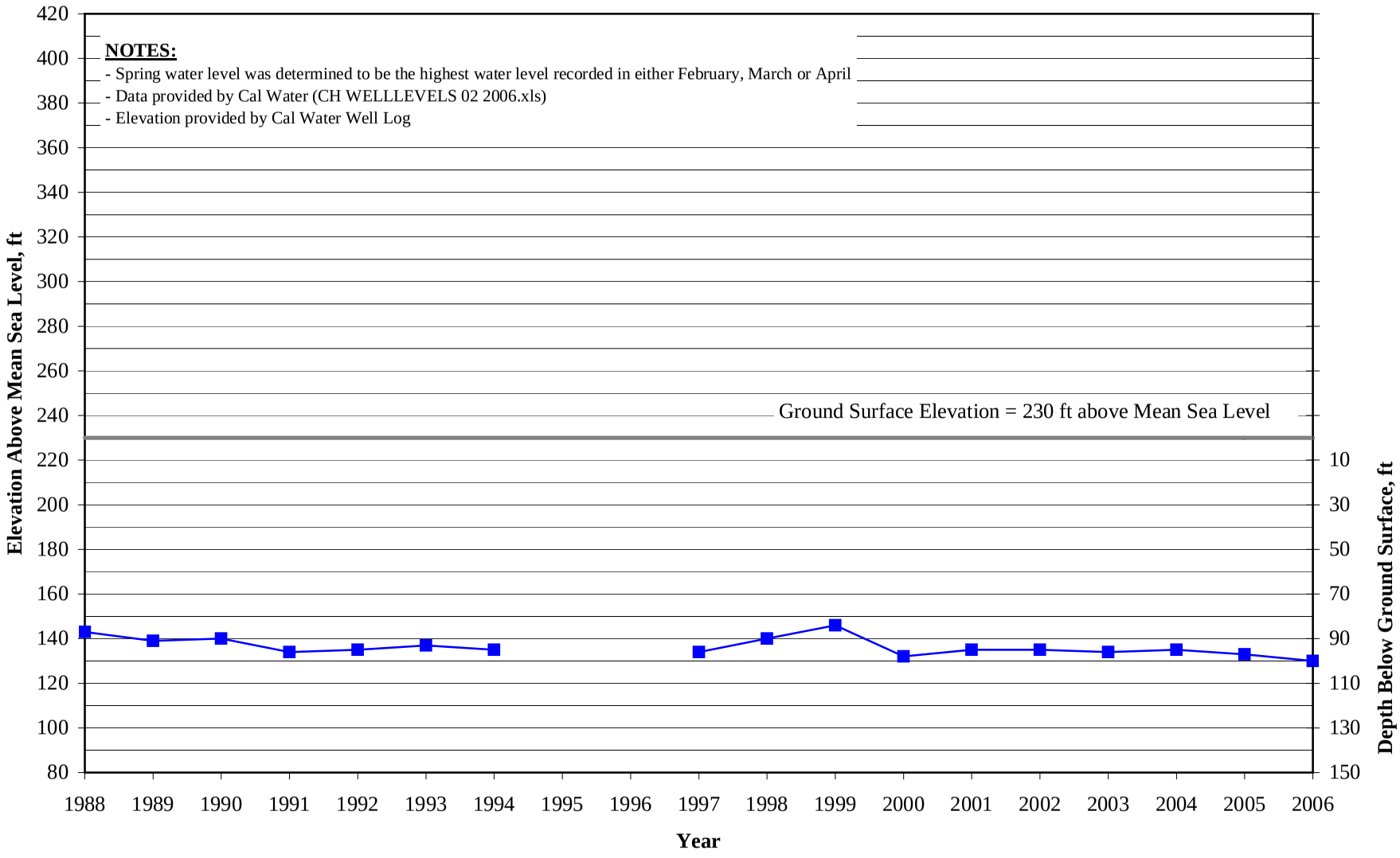



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 057 - Spring Groundwater Level Hydrograph

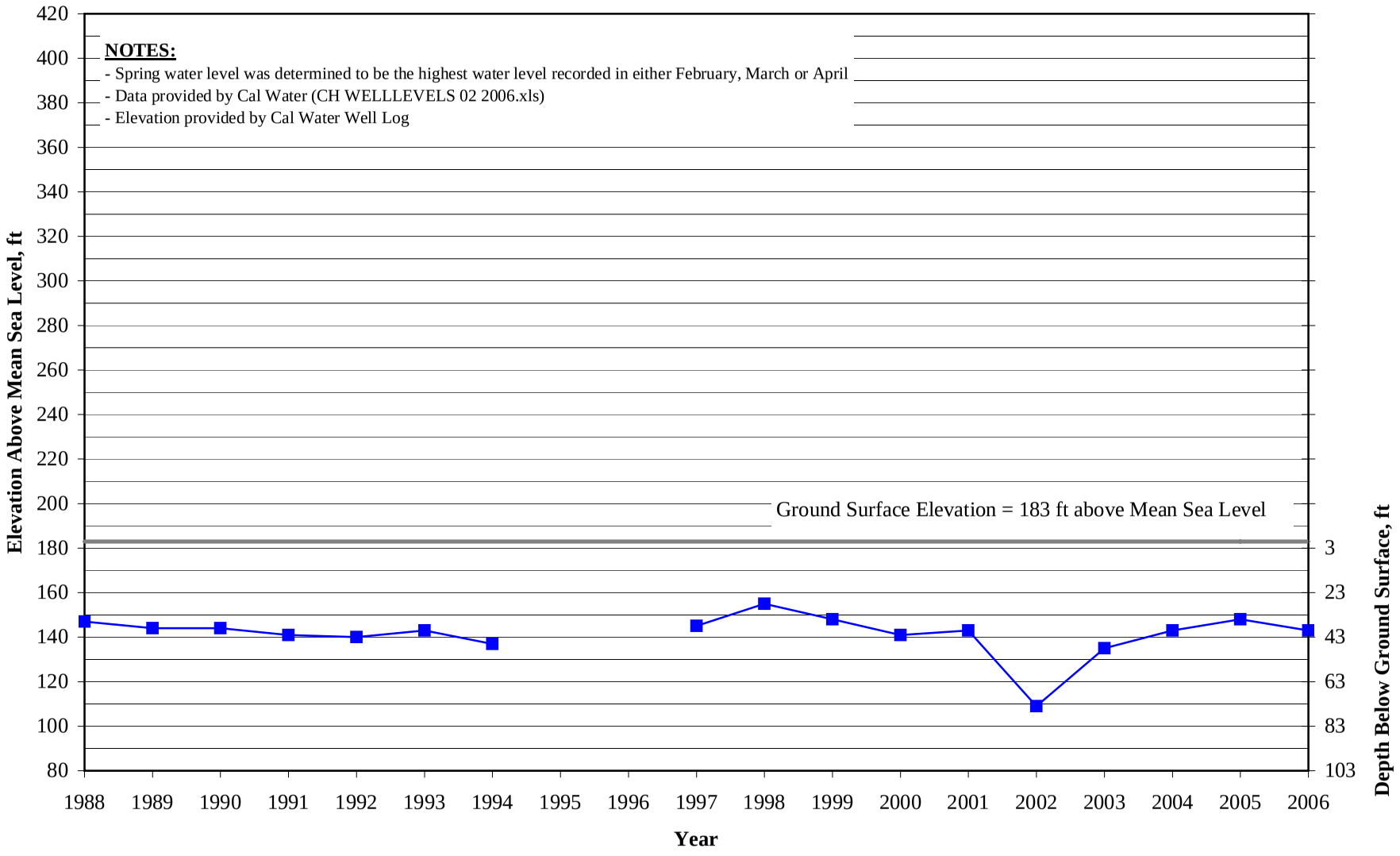



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 058 - Spring Groundwater Level Hydrograph

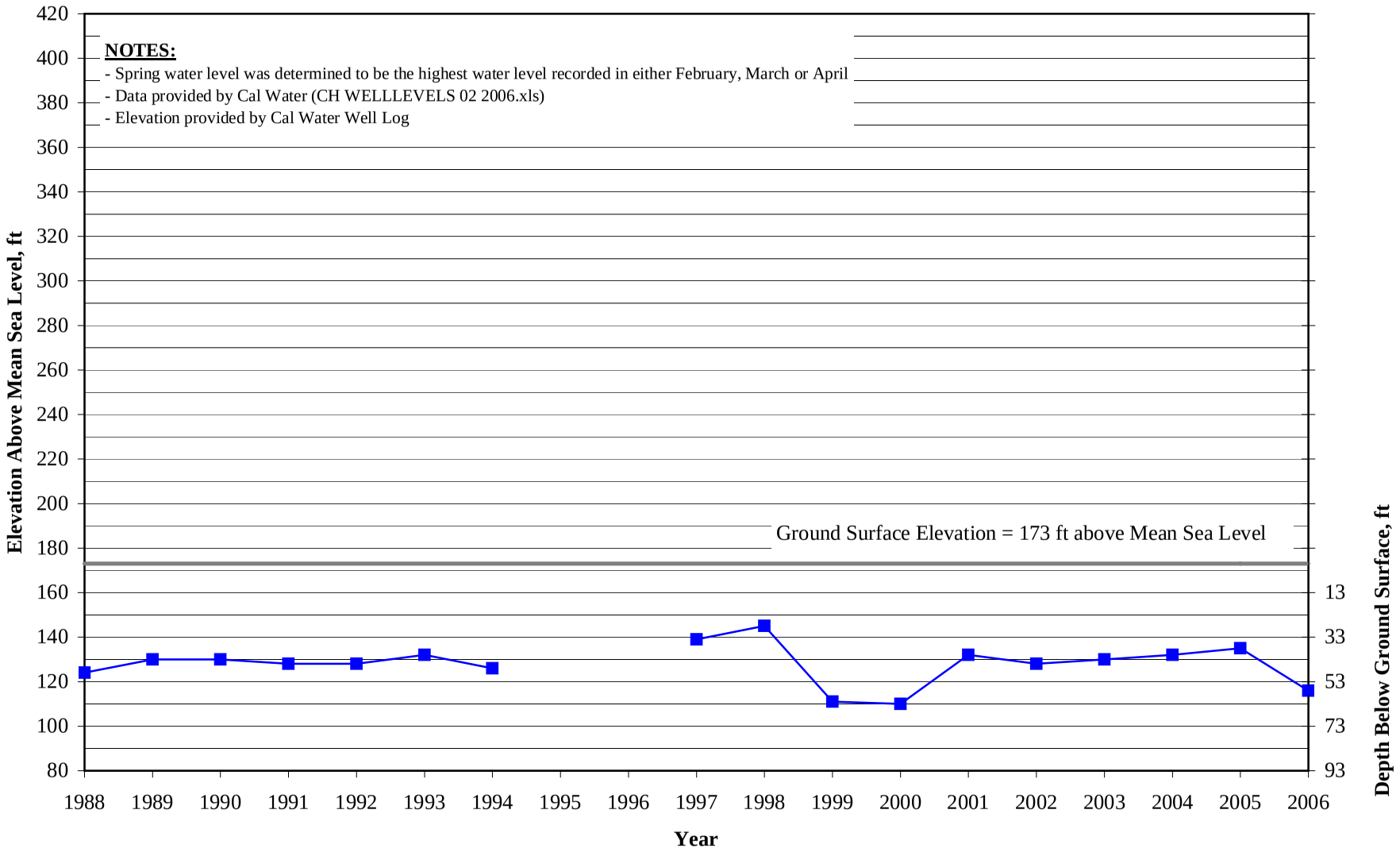



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 059 - Spring Groundwater Level Hydrograph

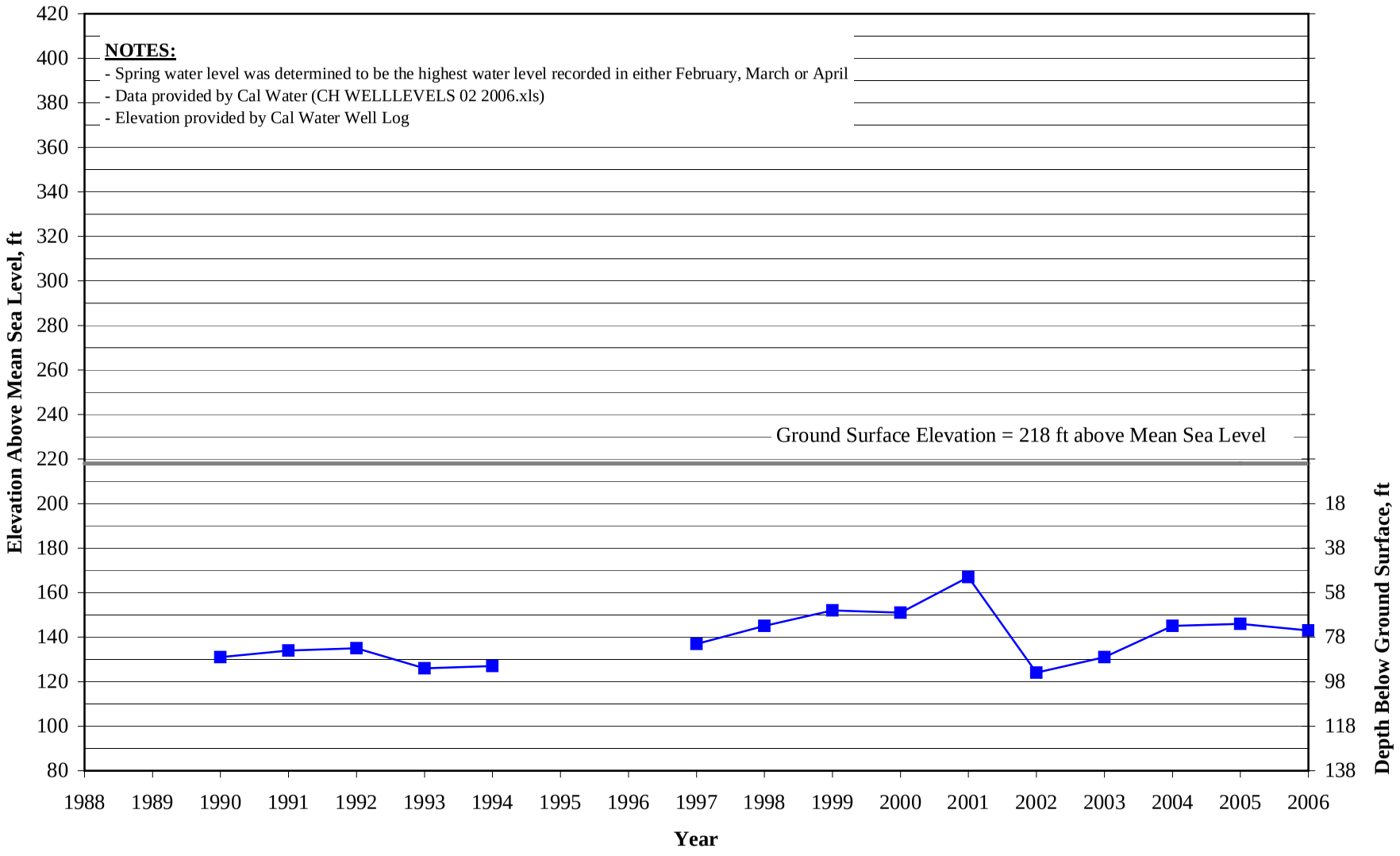



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 061 - Spring Groundwater Level Hydrograph

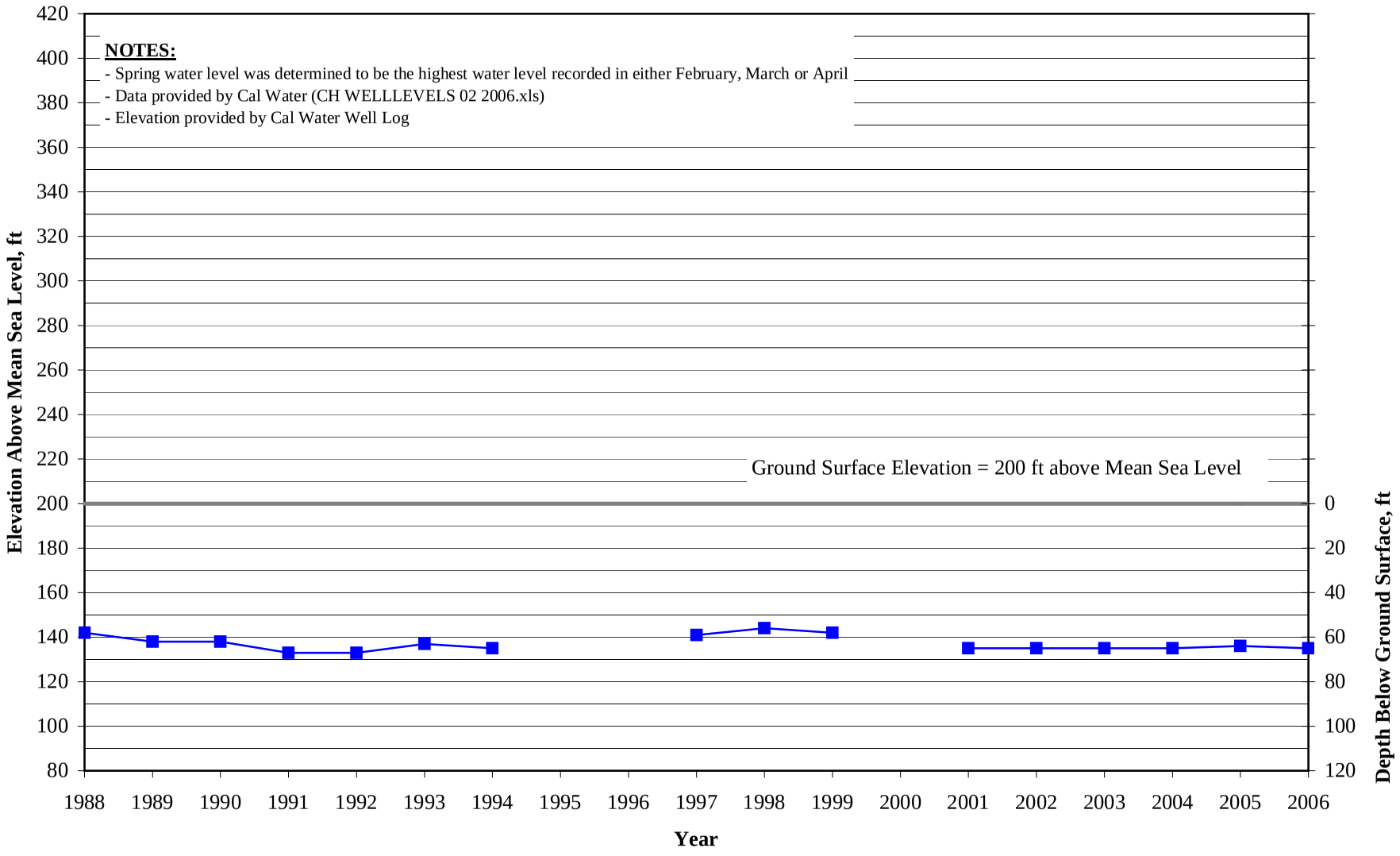



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 062 - Spring Groundwater Level Hydrograph

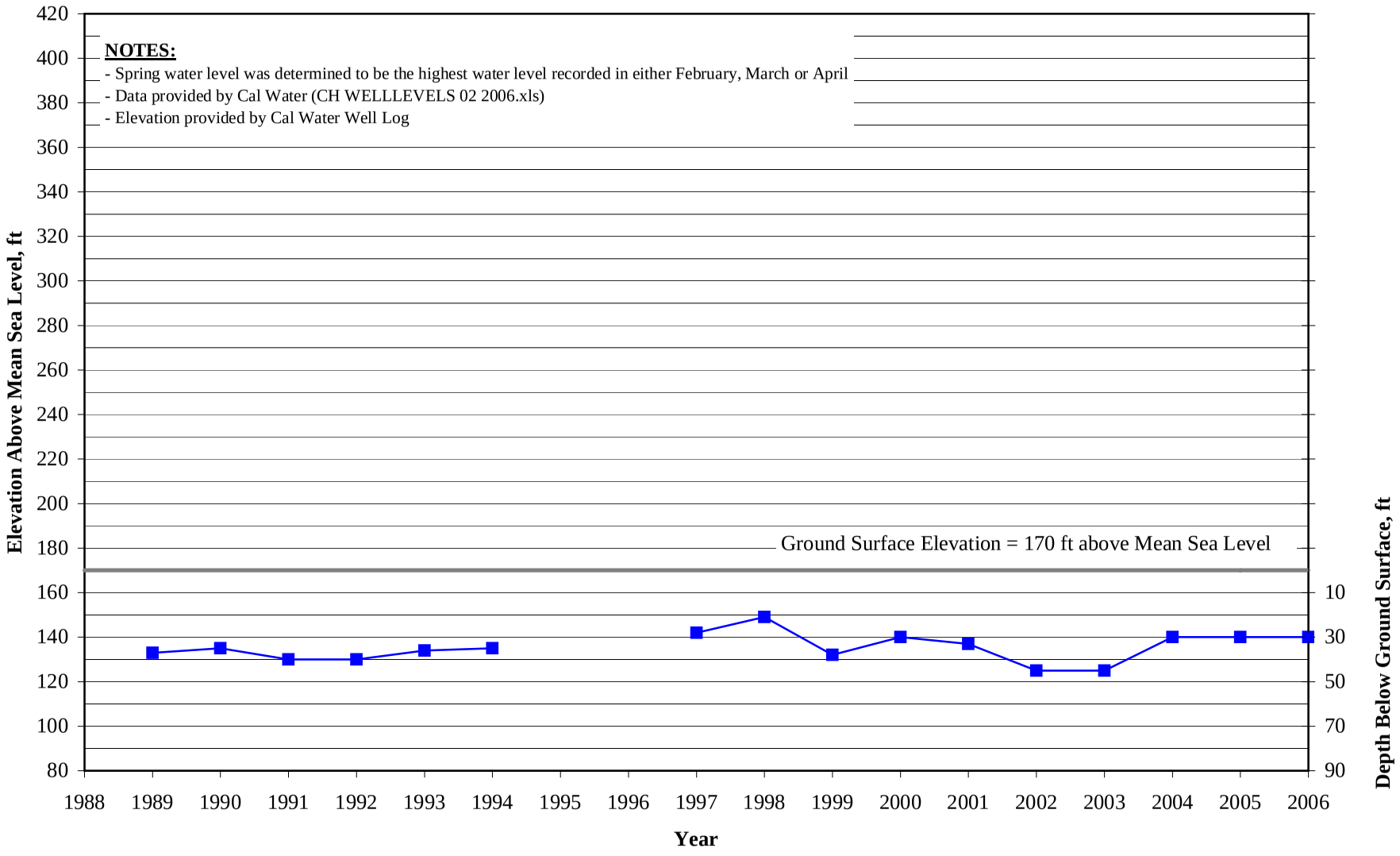



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 063 - Spring Groundwater Level Hydrograph

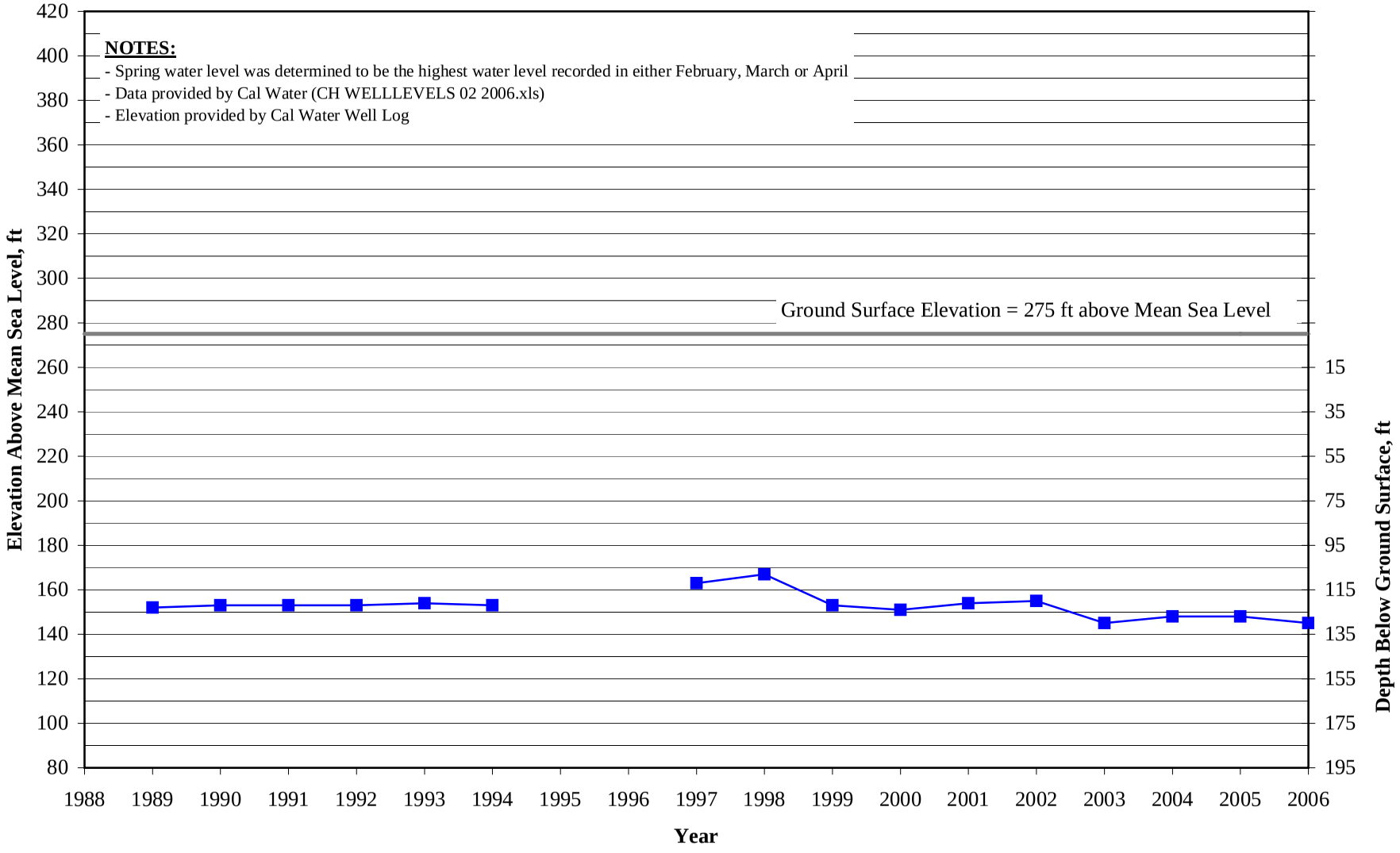



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 064 - Spring Groundwater Level Hydrograph

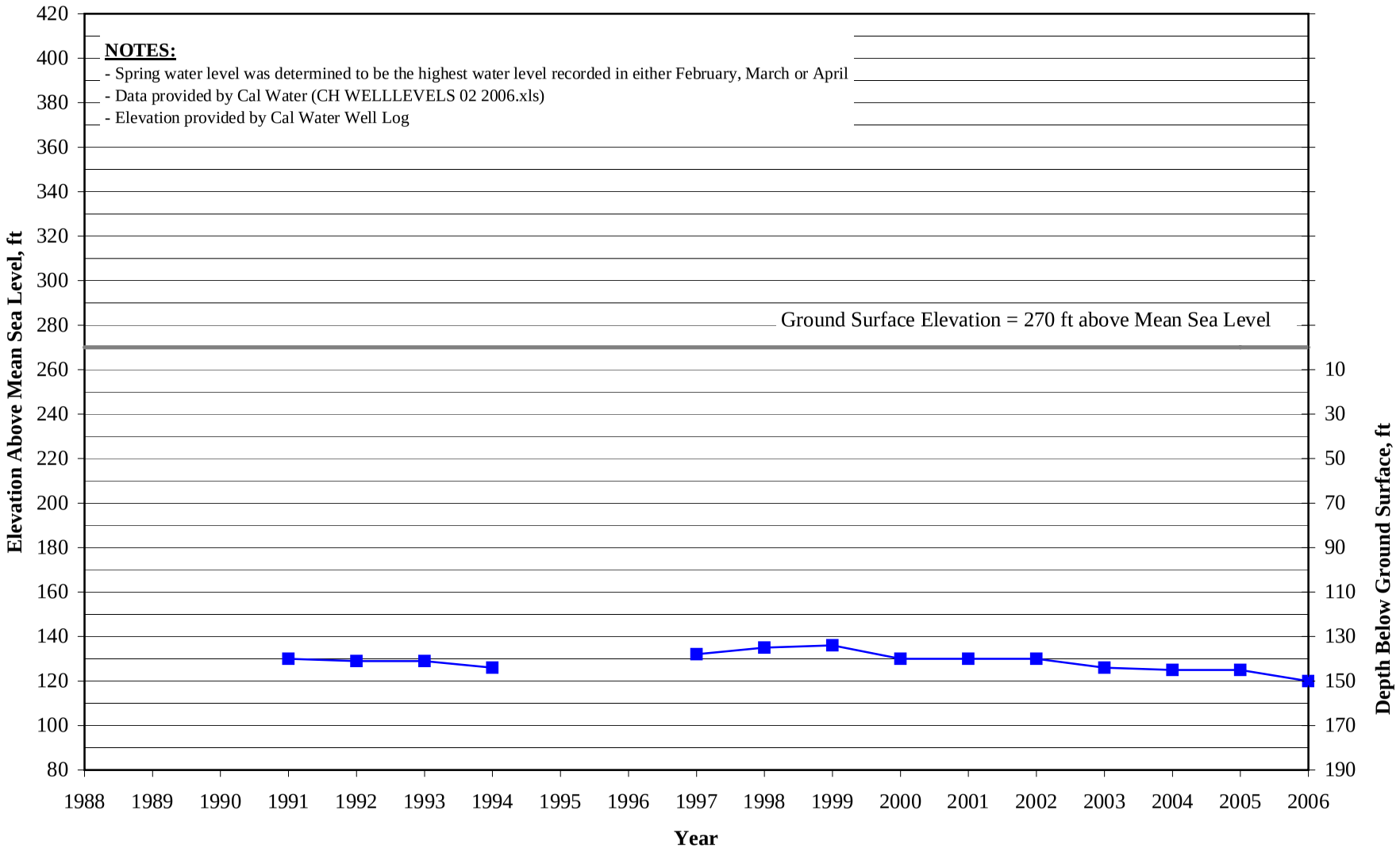



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 065 - Spring Groundwater Level Hydrograph

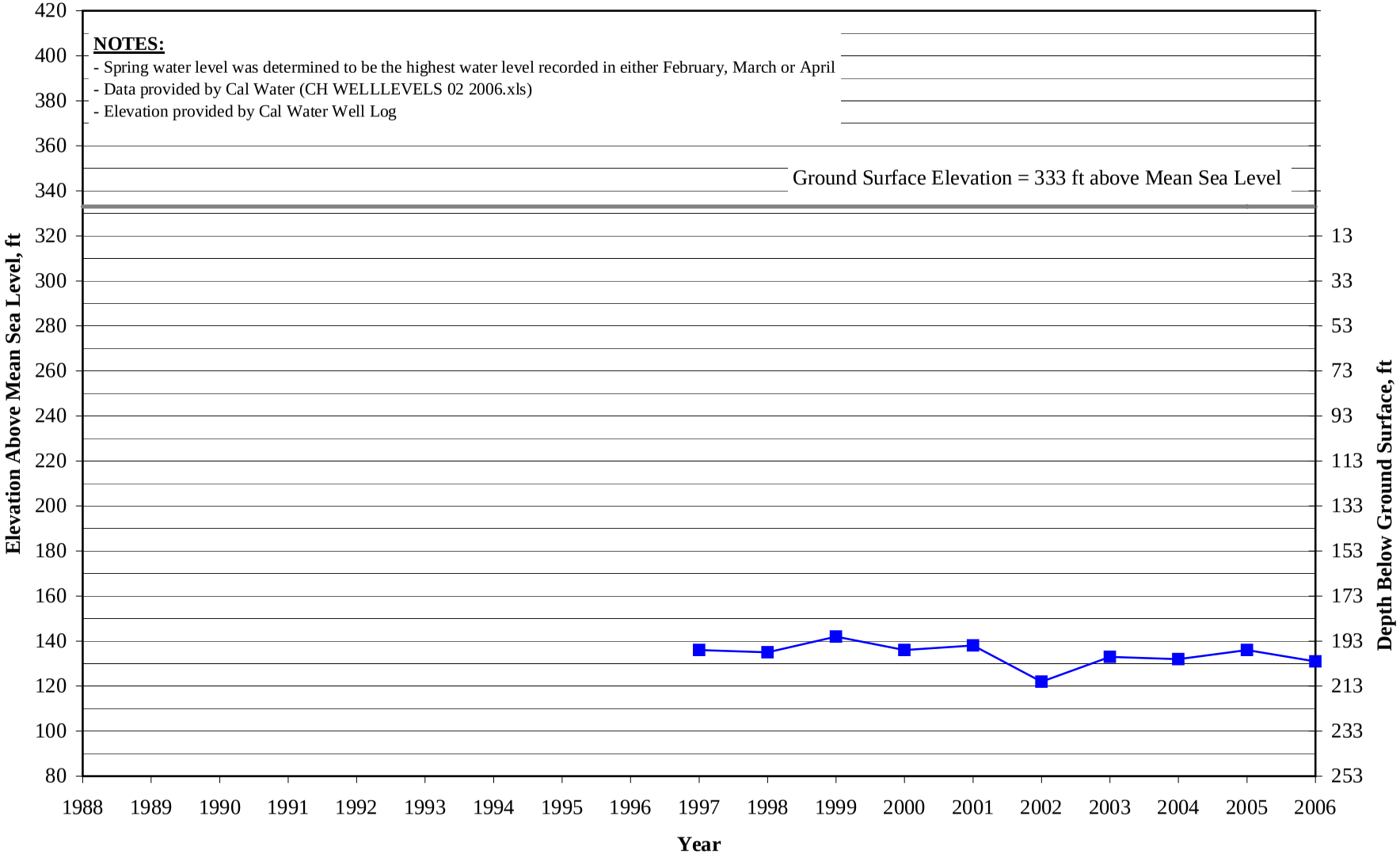



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW1
Last Revised: 11/17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 067 - Spring Groundwater Level Hydrograph

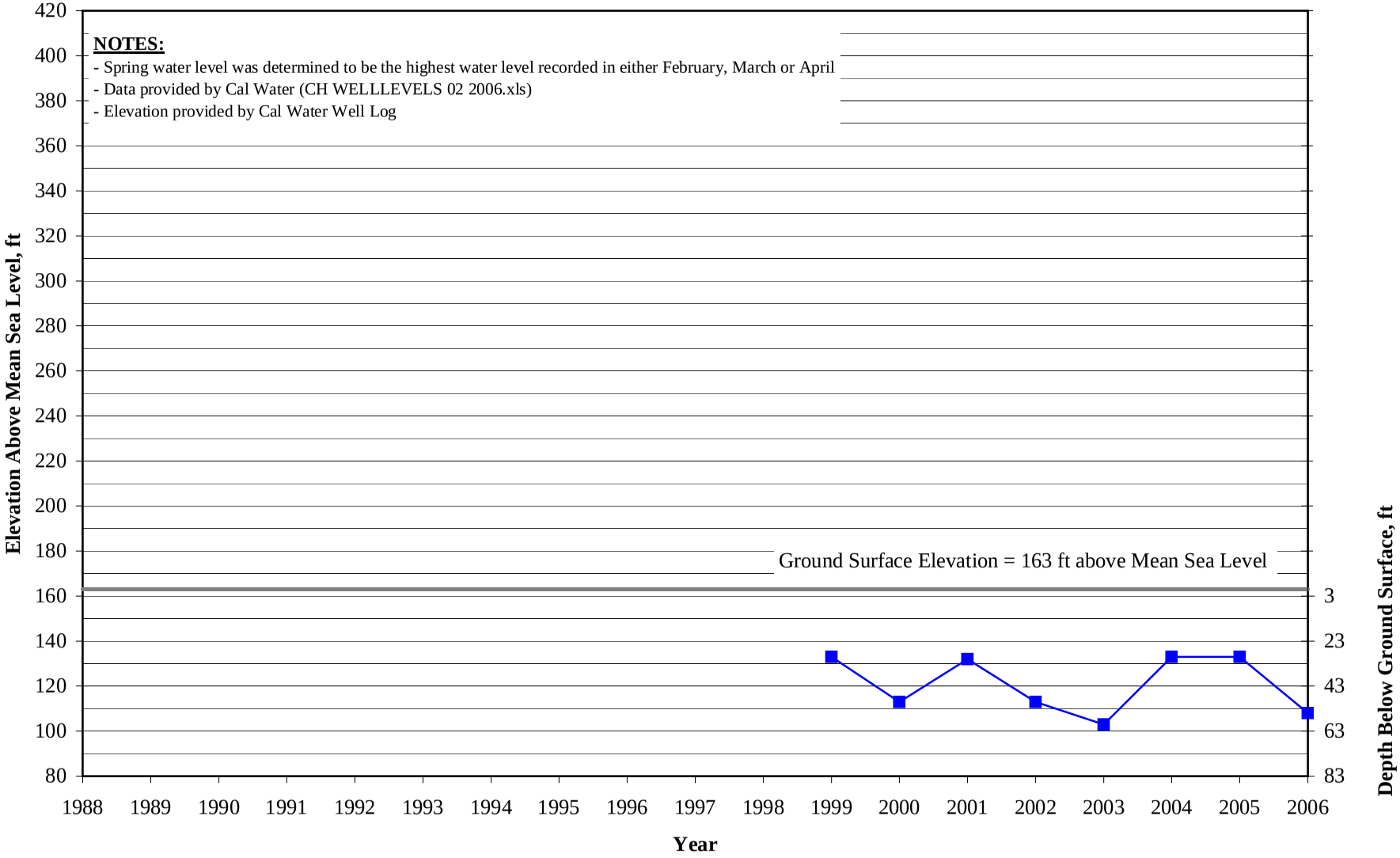



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW2
Last Revised: 11-17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 068 - Spring Groundwater Level Hydrograph

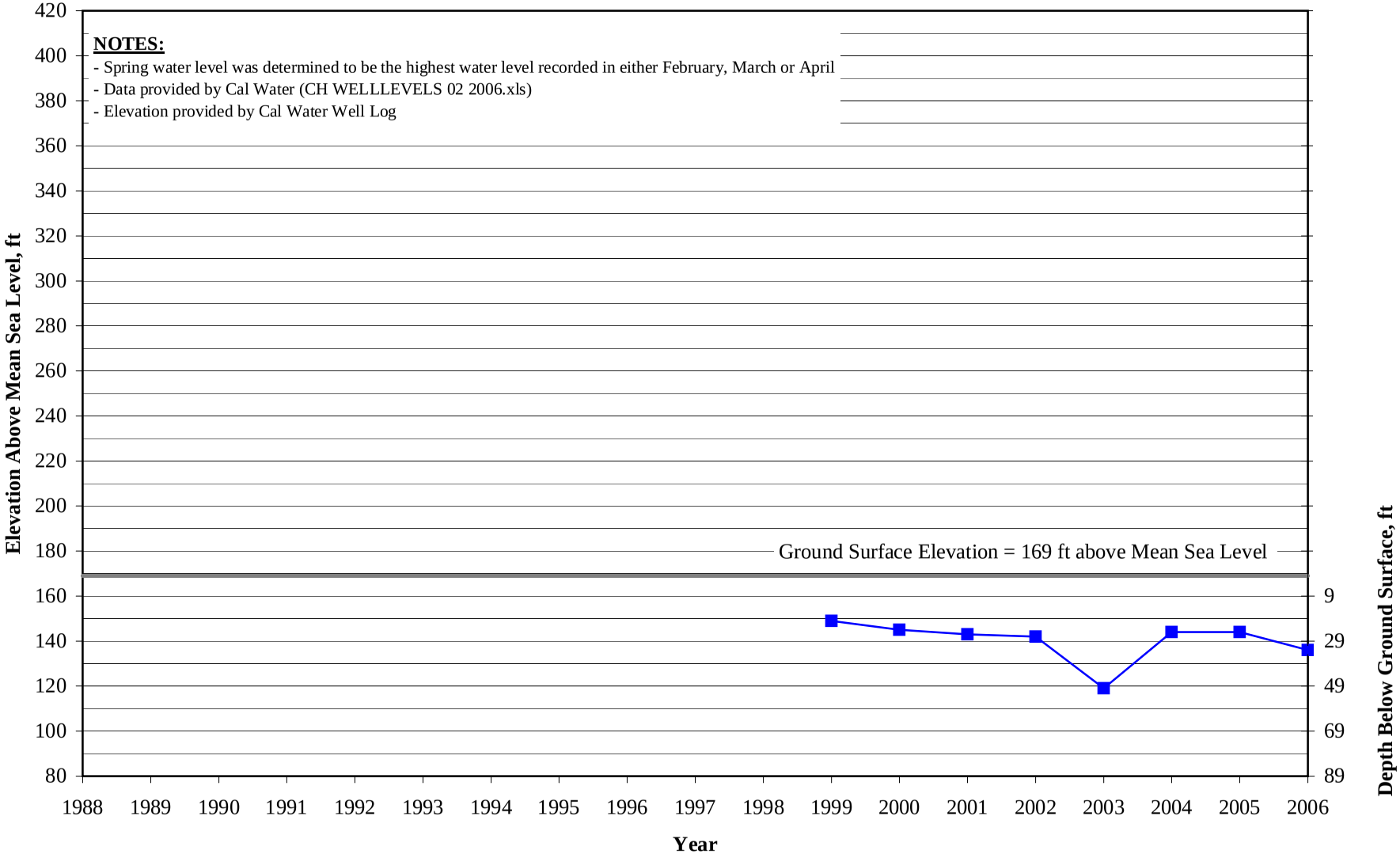



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW2
Last Revised: 11-17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 069 - Spring Groundwater Level Hydrograph

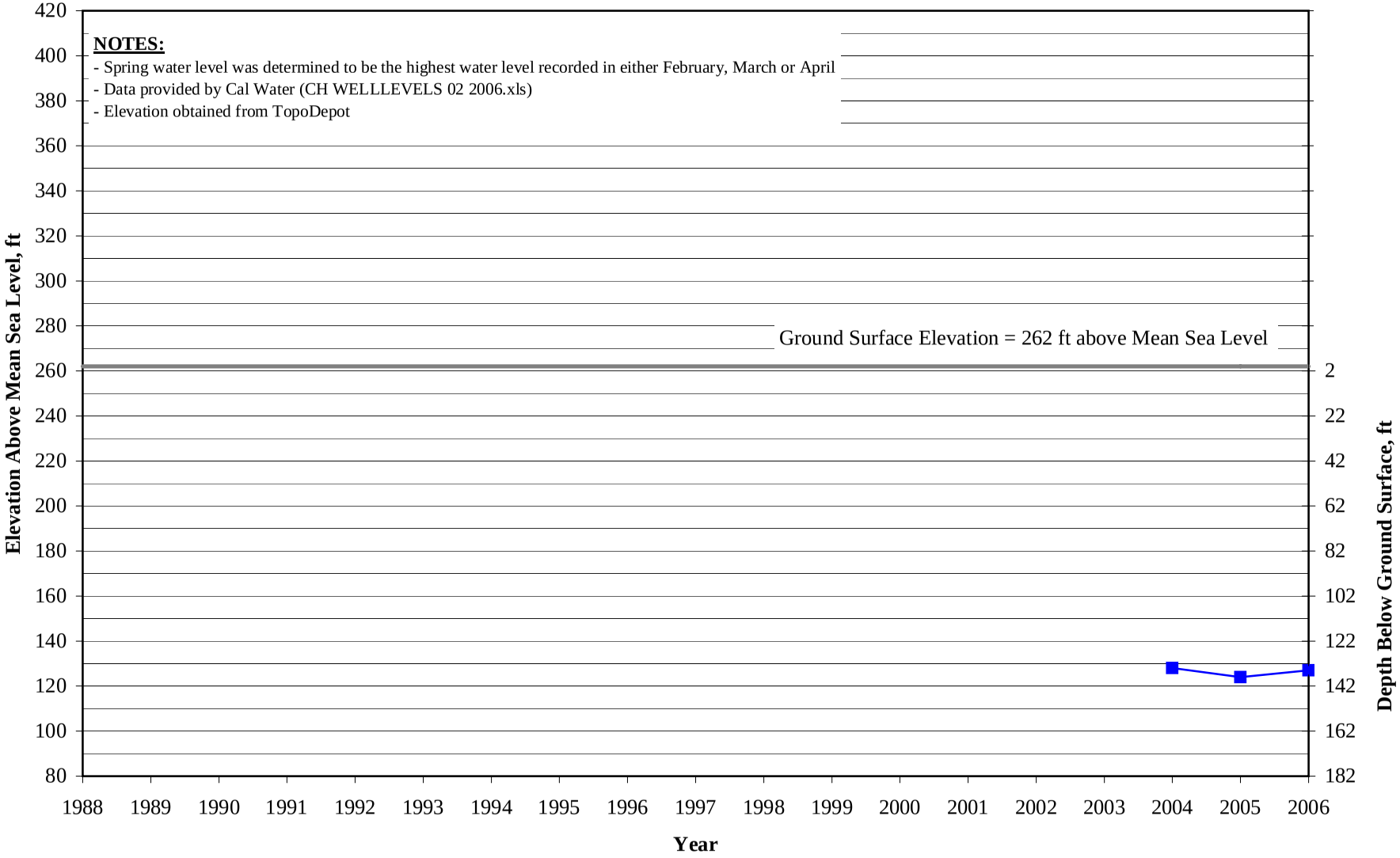



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW2
Last Revised: 11-17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 070 - Spring Groundwater Level Hydrograph

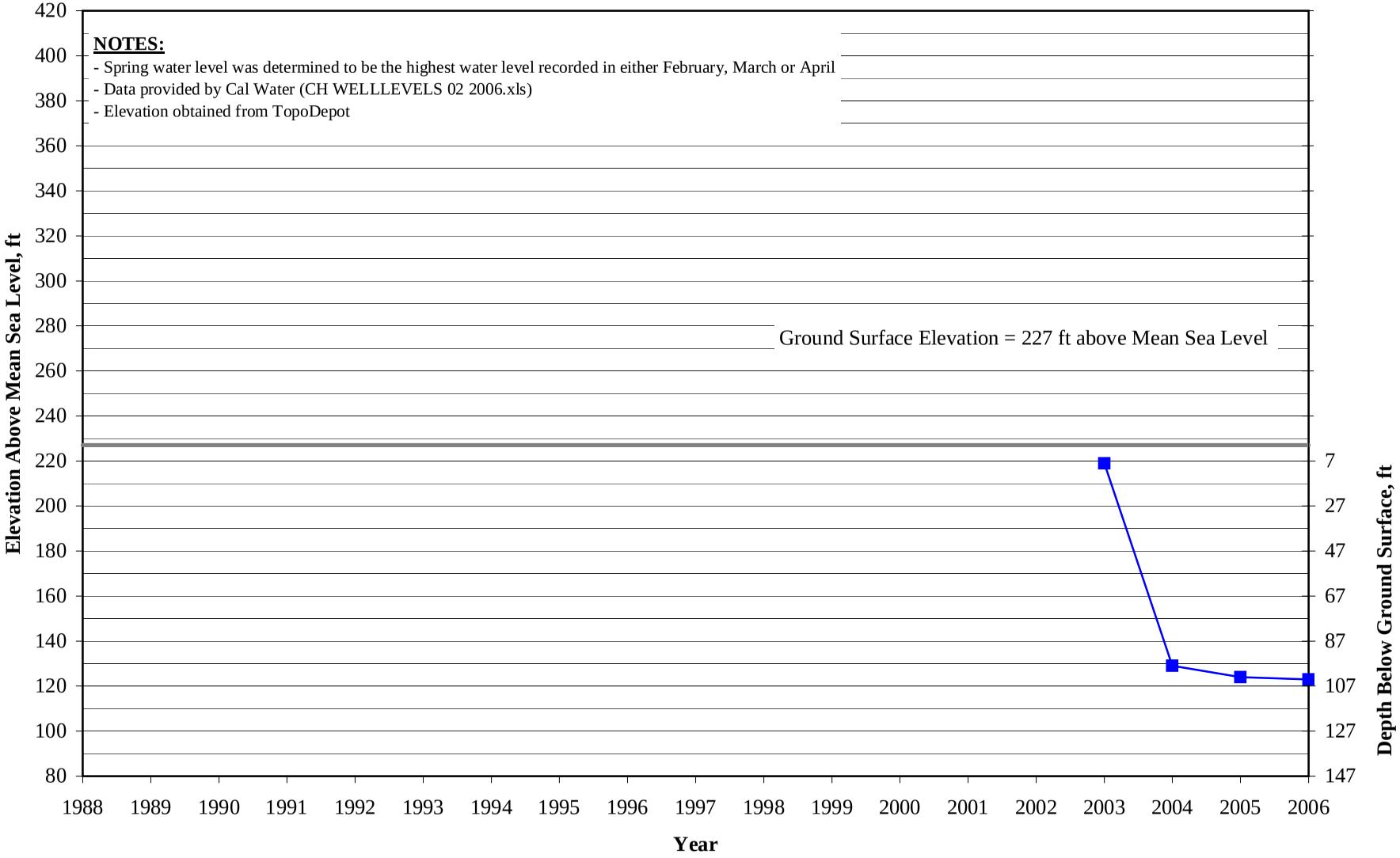



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW2
Last Revised: 11-17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 071 - Spring Groundwater Level Hydrograph

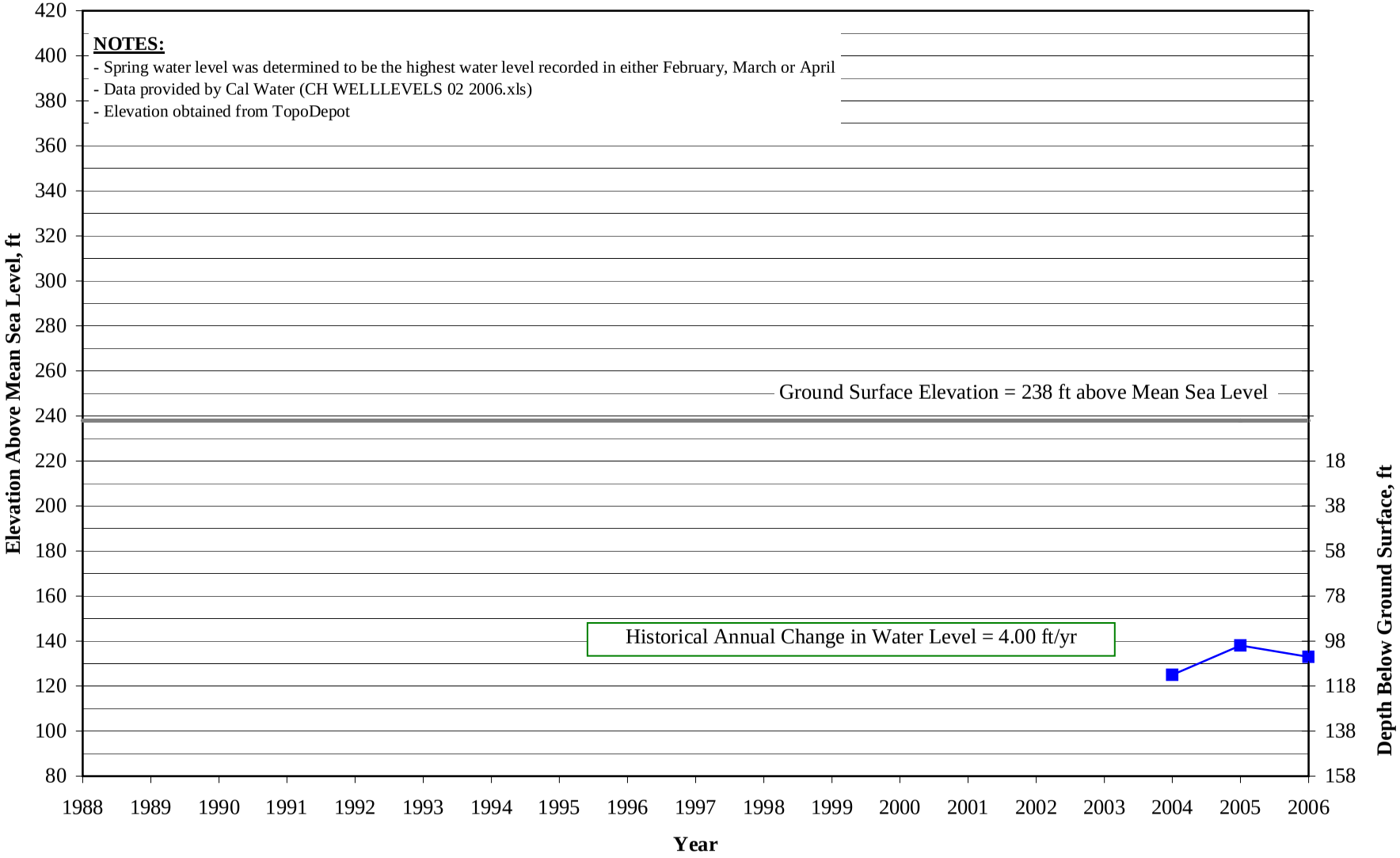



West Yost Associates
436\020603\e\2\gw\CHDepthtoGW2
Last Revised: 11-17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# Station 072 - Spring Groundwater Level Hydrograph




West Yost Associates
436\020603\e\2\gw\CHDepthtoGW2
Last Revised: 11-17/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

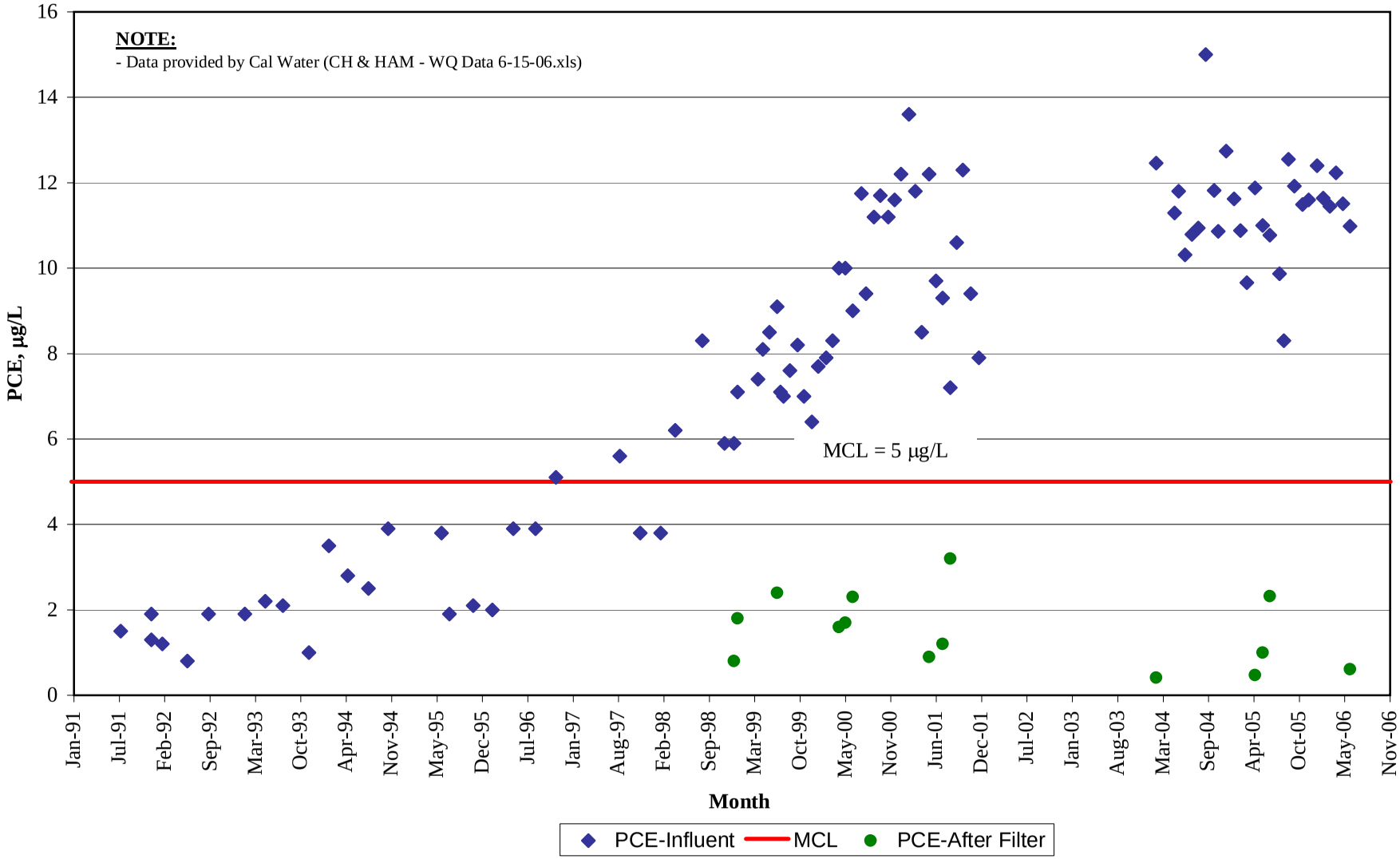
Public Version

Public Version

# APPENDIX I

## Water Quality for Key Cal Water Wells

## Station 021 - Historical PCE Concentrations

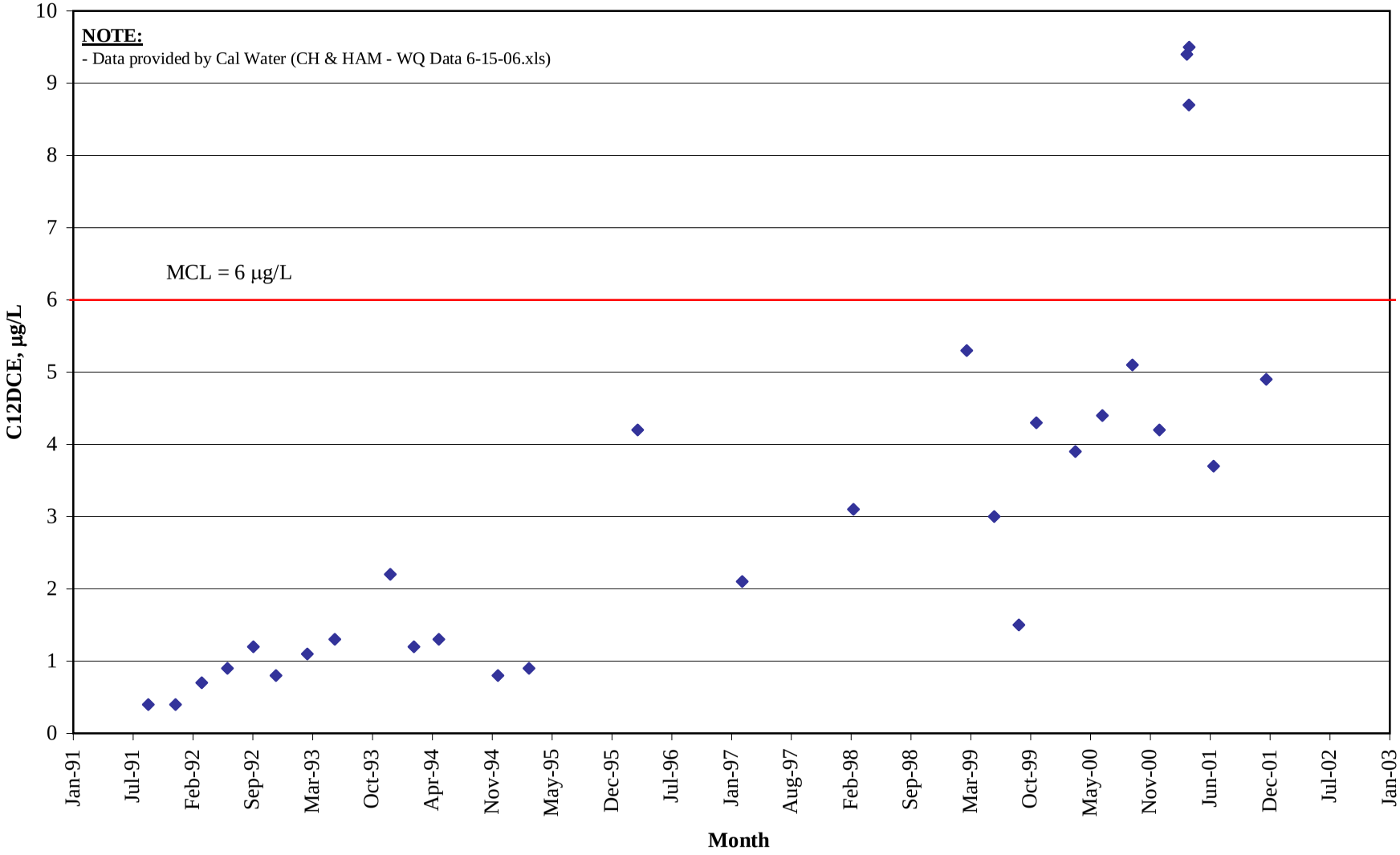



West Yost Associates
436\020603\e\2\wq\CHHAM WQData
Last Revised: 11/03/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

## Station 040 - Historical C12DCE Concentrations

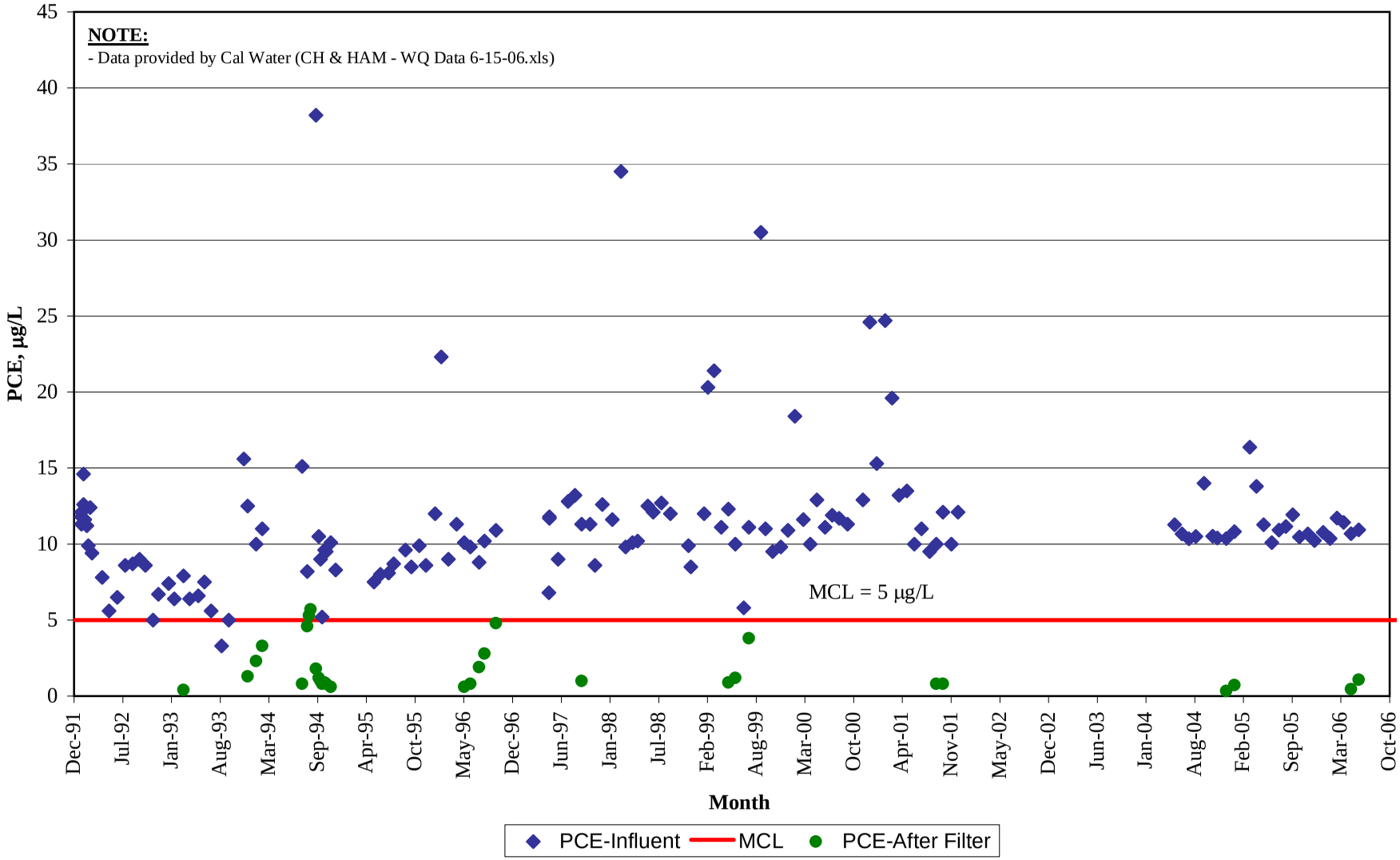



West Yost Associates
436\020603\e\2\wq\CHHAM WQData
Last Revised: 11/03/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

## Station 046 - Historical PCE Concentrations

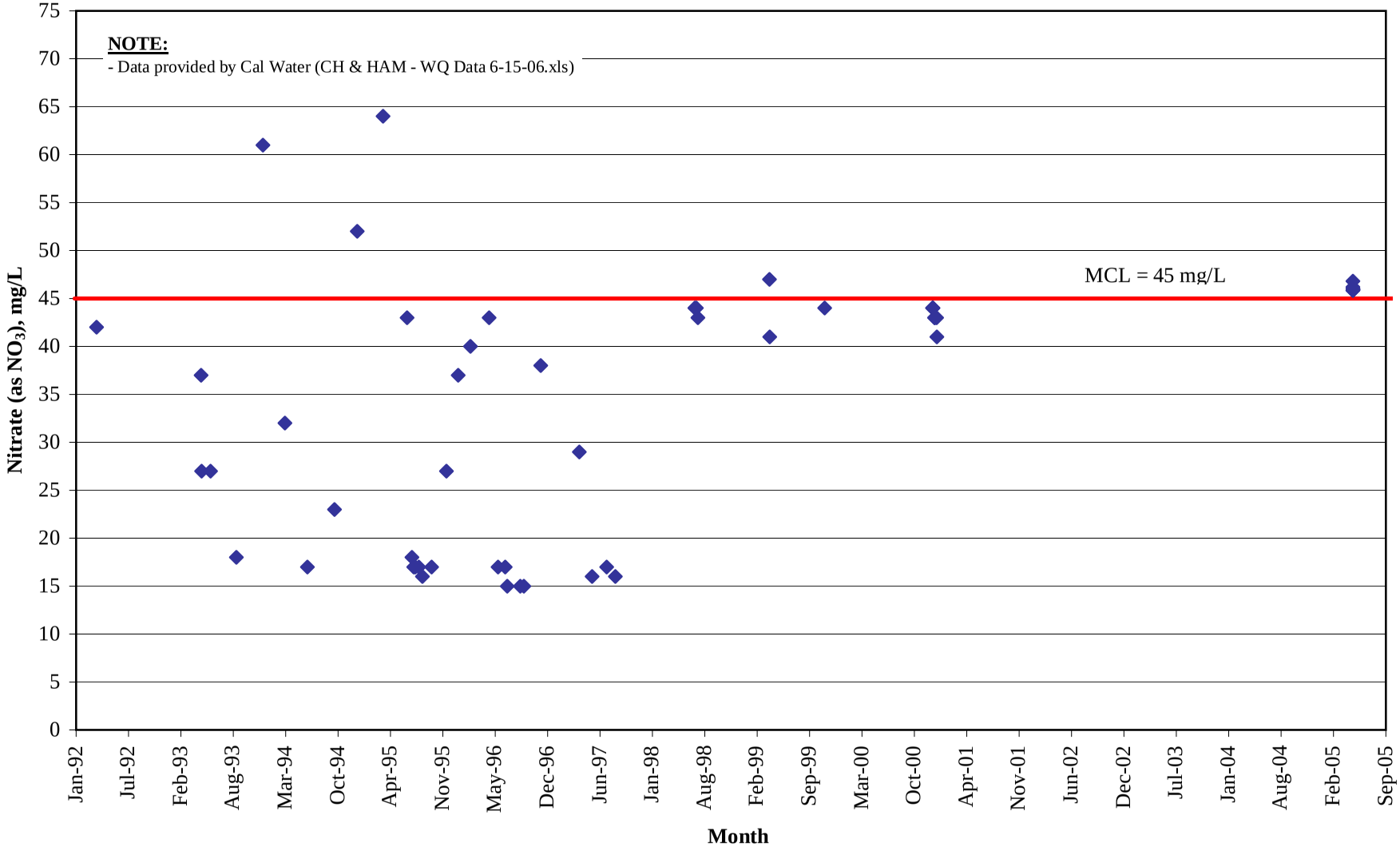



West Yost Associates
436\020603\e\2\wq\CHHAM WQData
Last Revised: 11/03/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

## Station 055 - Historical Nitrate Concentrations

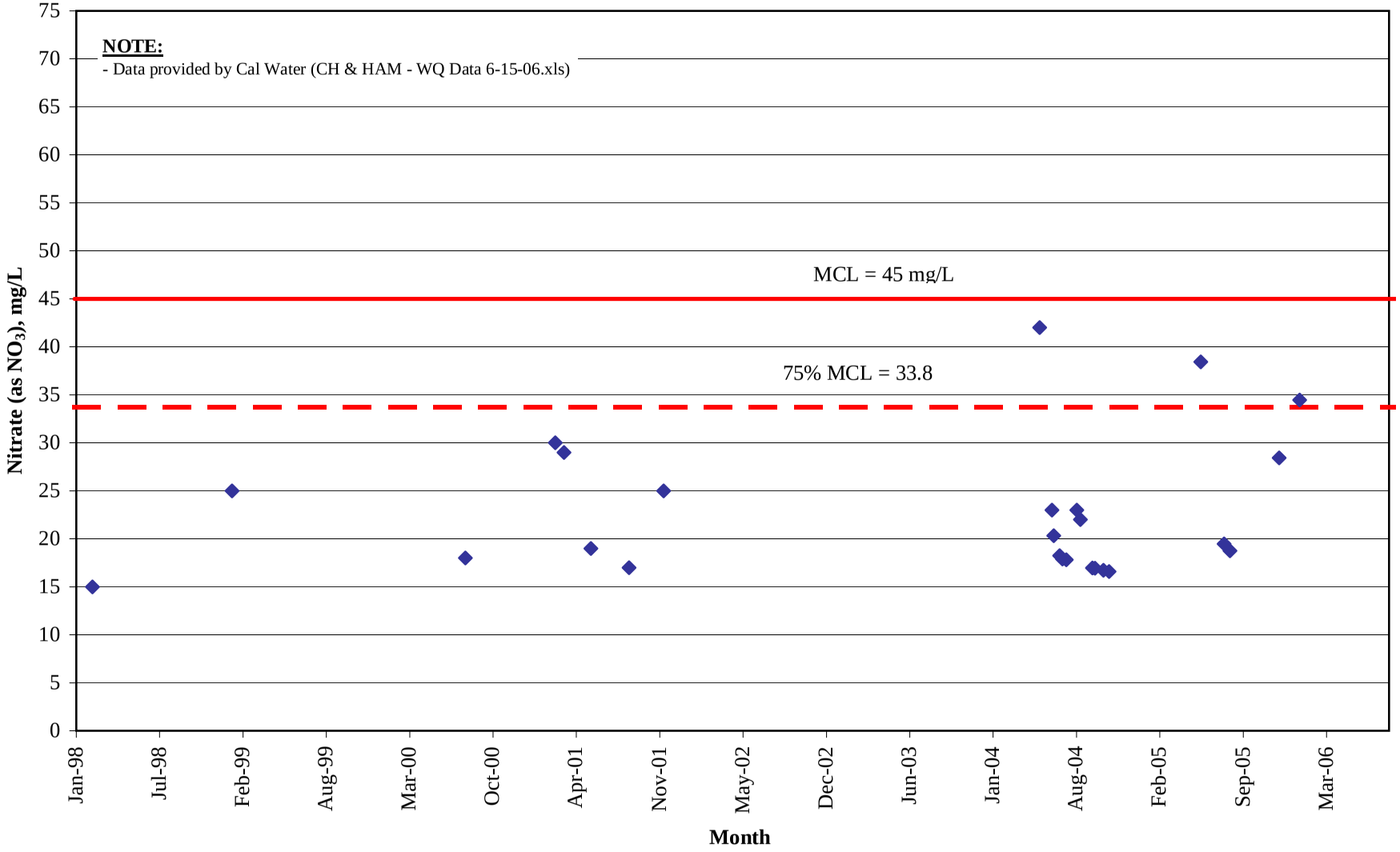



West Yost Associates
436\020603\e\2\wq\CHHAM WQData
Last Revised: 11/03/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

## Station 068 - Historical Nitrate Concentrations




West Yost Associates
436\020603\e\2\wq\CHHAM WQData
Last Revised: 11/03/06

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# APPENDIX J

## SWRCB Sampling Results for Station 16

Public Version

1

DATE: 08/22/06 STATE OF CALIFORNIA PAGE: 1
REPORT: R-040/2-2 DRINKING WATER PROGRAM

DRINKING WATER ANALYSES RESULTS REPORT
ALL SAMPLES FOR ALL CONSTITUENTS - EQ OR GT TRIGGERS
FOR SAMPLE DATE RANGE OF 19940101 THRU 20060822
REPORT OF COUNTY: 04 BUTTE

SYSTEM NO: 0410002 NAME: Cal-Water Service Co.-Chico COUNTY: BUTTE
SOURCE NO: 015 NAME: WELL 16-01 PSCODE: 0410002-015 CLASS: CLGA STATUS: AR

| GROUP IDENTIFICATION / CONSTITUENT IDENTIFICATION | SAMPLE DATE | RESULT * | MCL | DLR | TRIGGER | UNIT |
|---|---|---|---|---|---|---|
| NI NITRATE/NITRITE | | | | | | |
| 71850 NITRATE (AS NO3) | 12/05/1994 | 51.4000 * | 45.0000 | 2.0000 | 23.0000 | MG/L |
| S1 REGULATED VOC | | | | | | |
| 77093 CIS-1,2-DICHLOROETHYLENE | 12/05/1994 | .5800 * | 6.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 01/13/1994 | 1.4000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 02/07/1994 | 1.2000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 03/01/1994 | 1.7000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 04/13/1994 | 1.7000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 05/11/1994 | 1.4000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 06/13/1994 | 1.7000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 07/21/1994 | 1.5000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 08/11/1994 | 2.0000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 09/15/1994 | 1.5000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 10/17/1994 | .9000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 11/15/1994 | 1.3000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 12/05/1994 | 1.2000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 01/18/1995 | 1.1000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 03/15/1995 | .5000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 08/09/1995 | 1.7000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 09/18/1995 | 1.3000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 10/12/1995 | 1.2000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 11/06/1995 | 1.2000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 12/11/1995 | .9000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 01/17/1996 | 1.0000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 02/20/1996 | .7000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 03/18/1996 | .6000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 04/26/1996 | 1.0000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 05/16/1996 | 1.1000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 06/10/1996 | 1.0000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 07/16/1996 | 1.1000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 09/09/1996 | 1.5000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 11/04/1996 | 1.2000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 01/23/1997 | 1.1000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 02/12/1997 | .8000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 03/13/1997 | .8000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 04/08/1997 | .8000 * | 5.0000 | .5000 | .5000 | UG/L |

NOTE1: * = RESULT IS EQUAL TO OR GREATER THAN TRIGGER

Public Version

NOTE2: .000 = RESULT WAS REPORTED AS NON-DETECTED EXCEPT FOR RAD
1



DRINKING WATER ANALYSES RESULTS REPORT
ALL SAMPLES FOR ALL CONSTITUENTS - EQ OR GT TRIGGERS
FOR SAMPLE DATE RANGE OF 19940101 THRU 20060822
REPORT OF COUNTY: 04 BUTTE

SYSTEM NO: 0410002 NAME: Cal-Water Service Co.-Chico COUNTY: BUTTE
SOURCE NO: 015 NAME: WELL 16-01 PSCODE: 0410002-015 CLASS: CLGA STATUS:
AR

| GROUP IDENTIFICATION CONSTITUENT IDENTIFICATION | SAMPLE DATE | RESULT * | MCL | DLR | TRIGGER | UNIT |
|---|---|---|---|---|---|---|
| 34475 TETRACHLOROETHYLENE | 05/06/1997 | .8000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 06/05/1997 | .8000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 07/16/1997 | 1.4000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 08/13/1997 | 1.2000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 09/10/1997 | .9000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 10/14/1997 | .8000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 11/12/1997 | .7000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 12/04/1997 | .8000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 01/14/1998 | .8000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 02/18/1998 | .5000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 03/09/1998 | .6000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 07/01/1998 | .7000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 08/03/1998 | .8000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 11/23/1998 | .6000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 02/03/1999 | .7000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 03/02/1999 | .6000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 05/05/1999 | .7000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 07/07/1999 | .6000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 08/04/1999 | .6000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 10/05/1999 | .8000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 11/04/1999 | .7000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 12/13/1999 | .6200 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 02/08/2000 | .8000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 04/05/2000 | .8100 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 07/05/2000 | .6000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 08/02/2000 | .8000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 09/06/2000 | 1.0000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 10/04/2000 | .5000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 02/07/2001 | .9000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 06/12/2001 | 1.1000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 06/12/2001 | 1.1000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 07/06/2001 | .7400 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 07/06/2001 | .7400 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 08/08/2001 | .5800 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 08/08/2001 | .5800 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 10/04/2001 | 3.7000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 12/03/2001 | 4.2000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 06/26/2002 | 3.2000 * | 5.0000 | .5000 | .5000 | UG/L |

NOTE1: * = RESULT IS EQUAL TO OR GREATER THAN TRIGGER
NOTE2: .000 = RESULT WAS REPORTED AS NON-DETECTED EXCEPT FOR RAD

Public Version

1



DRINKING WATER ANALYSES RESULTS REPORT
ALL SAMPLES FOR ALL CONSTITUENTS - EQ OR GT TRIGGERS
FOR SAMPLE DATE RANGE OF 19940101 THRU 20060822
REPORT OF COUNTY: 04 BUTTE

SYSTEM NO: 0410002 NAME: Cal-Water Service Co.-Chico COUNTY: BUTTE
SOURCE NO: 015 NAME: WELL 16-01 PSCODE: 0410002-015 CLASS: CLGA STATUS: AR

| GROUP IDENTIFICATION / CONSTITUENT IDENTIFICATION | SAMPLE DATE | RESULT * | MCL | DLR | TRIGGER | UNIT |
|---|---|---|---|---|---|---|
| 34475 TETRACHLOROETHYLENE | 08/07/2002 | 2.6000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 09/10/2002 | 1.3000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 11/05/2002 | .6000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 02/03/2003 | 2.9000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 03/04/2003 | 1.9000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 04/22/2003 | 2.5000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 05/06/2003 | .6000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 08/04/2003 | .5000 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 06/08/2004 | .5400 * | 5.0000 | .5000 | .5000 | UG/L |
| 34475 TETRACHLOROETHYLENE | 09/07/2004 | .6000 * | 5.0000 | .5000 | .5000 | UG/L |
| TH TRIHALOMETHANES | | | | | | |
| 82080 TOTAL TRIHALOMETHANES | 02/07/1994 | .5000 * | 100.0000 | .5000 | .5000 | UG/L |
| 82080 TOTAL TRIHALOMETHANES | 08/11/1994 | 2.9000 * | 100.0000 | .5000 | .5000 | UG/L |
| 82080 TOTAL TRIHALOMETHANES | 09/15/1994 | .6000 * | 100.0000 | .5000 | .5000 | UG/L |
| 82080 TOTAL TRIHALOMETHANES | 10/17/1994 | 1.1000 * | 100.0000 | .5000 | .5000 | UG/L |
| 82080 TOTAL TRIHALOMETHANES | 12/05/1994 | 9.6000 * | 100.0000 | .5000 | .5000 | UG/L |
| 82080 TOTAL TRIHALOMETHANES | 03/15/1995 | 2.0000 * | 100.0000 | .5000 | .5000 | UG/L |
| 82080 TOTAL TRIHALOMETHANES | 10/12/1995 | .7000 * | 100.0000 | .5000 | .5000 | UG/L |
| 82080 TOTAL TRIHALOMETHANES | 01/17/1996 | 2.2000 * | 100.0000 | .5000 | .5000 | UG/L |
| 82080 TOTAL TRIHALOMETHANES | 04/26/1996 | .8000 * | 100.0000 | .5000 | .5000 | UG/L |
| 82080 TOTAL TRIHALOMETHANES | 05/16/1996 | 1.5000 * | 100.0000 | .5000 | .5000 | UG/L |
| 82080 TOTAL TRIHALOMETHANES | 06/10/1996 | 2.5000 * | 100.0000 | .5000 | .5000 | UG/L |
| 82080 TOTAL TRIHALOMETHANES | 07/16/1996 | .6000 * | 100.0000 | .5000 | .5000 | UG/L |
| UA STATE UCMR | | | | | | |
| 32101 BROMODICHLORMETHANE (THM) | 06/10/1996 | .7000 * | 100.0000 | .5000 | .5000 | UG/L |
| 32104 BROMOFORM (THM) | 02/07/1994 | .5000 * | 100.0000 | .5000 | .5000 | UG/L |
| 32104 BROMOFORM (THM) | 08/11/1994 | 1.7000 * | 100.0000 | .5000 | .5000 | UG/L |
| 32104 BROMOFORM (THM) | 10/17/1994 | .6000 * | 100.0000 | .5000 | .5000 | UG/L |
| 32104 BROMOFORM (THM) | 03/15/1995 | 1.1000 * | 100.0000 | .5000 | .5000 | UG/L |
| 32104 BROMOFORM (THM) | 01/17/1996 | 1.5000 * | 100.0000 | .5000 | .5000 | UG/L |
| 32104 BROMOFORM (THM) | 04/26/1996 | .8000 * | 100.0000 | .5000 | .5000 | UG/L |
| 32104 BROMOFORM (THM) | 05/16/1996 | .8000 * | 100.0000 | .5000 | .5000 | UG/L |
| 32104 BROMOFORM (THM) | 06/10/1996 | .6000 * | 100.0000 | .5000 | .5000 | UG/L |
| 32104 BROMOFORM (THM) | 07/16/1996 | .6000 * | 100.0000 | .5000 | .5000 | UG/L |
| 32105 DIBROMOCHLOROMETHANE (THM) | 08/11/1994 | 1.2000 * | 100.0000 | .5000 | .5000 | UG/L |
| 32105 DIBROMOCHLOROMETHANE (THM) | 09/15/1994 | .6000 * | 100.0000 | .5000 | .5000 | UG/L |

NOTE1: * = RESULT IS EQUAL TO OR GREATER THAN TRIGGER
NOTE2: .000 = RESULT WAS REPORTED AS NON-DETECTED EXCEPT FOR RAD

Public Version

# APPENDIX K

## Detailed Cost Estimate for Groundwater Supply

**Table K-1a. Summary of Total Customer Expenditure for Maintaining Existing Groundwater Production Capacity**

| Year | Total Annual Customer Expenditure by Capital Improvement Phase[a] | | | | | Total Annual Customer Expenditure | Existing Groundwater Production | Unit Cost |
|---|---|---|---|---|---|---|---|---|
| | 2006 to 2010 | 2011 to 2015 | 2016 to 2020 | 2021 to 2025 | 2026 to 230 | | | |
| 2006 | $4,825,650 | $0 | $0 | $0 | $0 | $4,825,650 | 30,000 | $160.86 |
| 2007 | $4,722,300 | $0 | $0 | $0 | $0 | $4,722,300 | 30,000 | $157.41 |
| 2008 | $4,618,950 | $0 | $0 | $0 | $0 | $4,618,950 | 30,000 | $153.97 |
| 2009 | $4,515,600 | $0 | $0 | $0 | $0 | $4,515,600 | 30,000 | $150.52 |
| 2010 | $4,412,250 | $0 | $0 | $0 | $0 | $4,412,250 | 30,000 | $147.08 |
| 2011 | $4,308,900 | $992,000 | $0 | $0 | $0 | $5,300,900 | 30,000 | $176.70 |
| 2012 | $4,205,550 | $971,200 | $0 | $0 | $0 | $5,176,750 | 30,000 | $172.56 |
| 2013 | $4,102,200 | $950,400 | $0 | $0 | $0 | $5,052,600 | 30,000 | $168.42 |
| 2014 | $3,998,850 | $929,600 | $0 | $0 | $0 | $4,928,450 | 30,000 | $164.28 |
| 2015 | $3,895,500 | $908,800 | $0 | $0 | $0 | $4,804,300 | 30,000 | $160.14 |
| 2016 | $3,792,150 | $888,000 | $1,023,000 | $0 | $0 | $5,703,150 | 30,000 | $190.11 |
| 2017 | $3,688,800 | $867,200 | $1,001,550 | $0 | $0 | $5,557,550 | 30,000 | $185.25 |
| 2018 | $3,585,450 | $846,400 | $980,100 | $0 | $0 | $5,411,950 | 30,000 | $180.40 |
| 2019 | $3,482,100 | $825,600 | $958,650 | $0 | $0 | $5,266,350 | 30,000 | $175.55 |
| 2020 | $3,378,750 | $804,800 | $937,200 | $0 | $0 | $5,120,750 | 30,000 | $170.69 |
| 2021 | $3,275,400 | $784,000 | $915,750 | $914,500 | $0 | $5,889,650 | 30,000 | $196.32 |
| 2022 | $3,172,050 | $763,200 | $894,300 | $895,325 | $0 | $5,724,875 | 30,000 | $190.83 |
| 2023 | $3,068,700 | $742,400 | $872,850 | $876,150 | $0 | $5,560,100 | 30,000 | $185.34 |
| 2024 | $2,965,350 | $721,600 | $851,400 | $856,975 | $0 | $5,395,325 | 30,000 | $179.84 |
| 2025 | $2,862,000 | $700,800 | $829,950 | $837,800 | $0 | $5,230,550 | 30,000 | $174.35 |
| 2026 | $2,758,650 | $680,000 | $808,500 | $818,625 | $449,500 | $5,515,275 | 30,000 | $183.84 |
| 2027 | $2,655,300 | $659,200 | $787,050 | $799,450 | $440,075 | $5,341,075 | 30,000 | $178.04 |
| 2028 | $2,551,950 | $638,400 | $765,600 | $780,275 | $430,650 | $5,166,875 | 30,000 | $172.23 |
| 2029 | $2,448,600 | $617,600 | $744,150 | $761,100 | $421,225 | $4,992,675 | 30,000 | $166.42 |
| 2030 | $2,345,250 | $596,800 | $722,700 | $741,925 | $411,800 | $4,818,475 | 30,000 | $160.62 |

[a] Data obtained from Table 4-F-1b.

Public Version

**Table K-1b. Annualized Groundwater Supply Costs: Existing Capacity Needs**

**2006 to 2010**

Capital Cost $31,800,000 per Project
Depreciation Period 40 Years
Quantity 1
Revenue Requirement Rate 13.0%

| Year | Depreciation Year | Rate Base Value | Revenue Requirement | Depreciation Cost | Total Annual Customer Expenditure |
|---|---|---|---|---|---|
| 2005 | 1 | $31,800,000 | $4,134,000 | $795,000 | $4,929,000 |
| 2006 | 2 | $31,005,000 | $4,030,650 | $795,000 | $4,825,650 |
| 2007 | 3 | $30,210,000 | $3,927,300 | $795,000 | $4,722,300 |
| 2008 | 4 | $29,415,000 | $3,823,950 | $795,000 | $4,618,950 |
| 2009 | 5 | $28,620,000 | $3,720,600 | $795,000 | $4,515,600 |
| 2010 | 6 | $27,825,000 | $3,617,250 | $795,000 | $4,412,250 |
| 2011 | 7 | $27,030,000 | $3,513,900 | $795,000 | $4,308,900 |
| 2012 | 8 | $26,235,000 | $3,410,550 | $795,000 | $4,205,550 |
| 2013 | 9 | $25,440,000 | $3,307,200 | $795,000 | $4,102,200 |
| 2014 | 10 | $24,645,000 | $3,203,850 | $795,000 | $3,998,850 |
| 2015 | 11 | $23,850,000 | $3,100,500 | $795,000 | $3,895,500 |
| 2016 | 12 | $23,055,000 | $2,997,150 | $795,000 | $3,792,150 |
| 2017 | 13 | $22,260,000 | $2,893,800 | $795,000 | $3,688,800 |
| 2018 | 14 | $21,465,000 | $2,790,450 | $795,000 | $3,585,450 |
| 2019 | 15 | $20,670,000 | $2,687,100 | $795,000 | $3,482,100 |
| 2020 | 16 | $19,875,000 | $2,583,750 | $795,000 | $3,378,750 |
| 2021 | 17 | $19,080,000 | $2,480,400 | $795,000 | $3,275,400 |
| 2022 | 18 | $18,285,000 | $2,377,050 | $795,000 | $3,172,050 |
| 2023 | 19 | $17,490,000 | $2,273,700 | $795,000 | $3,068,700 |
| 2024 | 20 | $16,695,000 | $2,170,350 | $795,000 | $2,965,350 |
| 2025 | 21 | $15,900,000 | $2,067,000 | $795,000 | $2,862,000 |
| 2026 | 22 | $15,105,000 | $1,963,650 | $795,000 | $2,758,650 |
| 2027 | 23 | $14,310,000 | $1,860,300 | $795,000 | $2,655,300 |
| 2028 | 24 | $13,515,000 | $1,756,950 | $795,000 | $2,551,950 |
| 2029 | 25 | $12,720,000 | $1,653,600 | $795,000 | $2,448,600 |
| 2030 | 26 | $11,925,000 | $1,550,250 | $795,000 | $2,345,250 |
| | 27 | $11,130,000 | $1,446,900 | $795,000 | $2,241,900 |
| | 28 | $10,335,000 | $1,343,550 | $795,000 | $2,138,550 |
| | 29 | $9,540,000 | $1,240,200 | $795,000 | $2,035,200 |
| | 30 | $8,745,000 | $1,136,850 | $795,000 | $1,931,850 |
| | 31 | $7,950,000 | $1,033,500 | $795,000 | $1,828,500 |
| | 32 | $7,155,000 | $930,150 | $795,000 | $1,725,150 |
| | 33 | $6,360,000 | $826,800 | $795,000 | $1,621,800 |
| | 34 | $5,565,000 | $723,450 | $795,000 | $1,518,450 |
| | 35 | $4,770,000 | $620,100 | $795,000 | $1,415,100 |
| | 36 | $3,975,000 | $516,750 | $795,000 | $1,311,750 |
| | 37 | $3,180,000 | $413,400 | $795,000 | $1,208,400 |
| | 38 | $2,385,000 | $310,050 | $795,000 | $1,105,050 |
| | 39 | $1,590,000 | $206,700 | $795,000 | $1,001,700 |
| | 40 | $795,000 | $103,350 | $795,000 | $898,350 |
| | Total Expenditure | | $84,747,000 | $31,800,000 | $116,547,000 |
| | Average Annual Expenditure | | | | $2,913,675 |

**2011 to 2015**

Capital Cost $6,400,000 per Project
Depreciation Period 40 Years
Quantity 1
Revenue Requirement Rate 13.0%

| Depreciation Year | Rate Base Value | Revenue Requirement | Depreciation Cost | Total Annual Customer Expenditure |
|---|---|---|---|---|
| 1 | $6,400,000 | $832,000 | $160,000 | $992,000 |
| 2 | $6,240,000 | $811,200 | $160,000 | $971,200 |
| 3 | $6,080,000 | $790,400 | $160,000 | $950,400 |
| 4 | $5,920,000 | $769,600 | $160,000 | $929,600 |
| 5 | $5,760,000 | $748,800 | $160,000 | $908,800 |
| 6 | $5,600,000 | $728,000 | $160,000 | $888,000 |
| 7 | $5,440,000 | $707,200 | $160,000 | $867,200 |
| 8 | $5,280,000 | $686,400 | $160,000 | $846,400 |
| 9 | $5,120,000 | $665,600 | $160,000 | $825,600 |
| 10 | $4,960,000 | $644,800 | $160,000 | $804,800 |
| 11 | $4,800,000 | $624,000 | $160,000 | $784,000 |
| 12 | $4,640,000 | $603,200 | $160,000 | $763,200 |
| 13 | $4,480,000 | $582,400 | $160,000 | $742,400 |
| 14 | $4,320,000 | $561,600 | $160,000 | $721,600 |
| 15 | $4,160,000 | $540,800 | $160,000 | $700,800 |
| 16 | $4,000,000 | $520,000 | $160,000 | $680,000 |
| 17 | $3,840,000 | $499,200 | $160,000 | $659,200 |
| 18 | $3,680,000 | $478,400 | $160,000 | $638,400 |
| 19 | $3,520,000 | $457,600 | $160,000 | $617,600 |
| 20 | $3,360,000 | $436,800 | $160,000 | $596,800 |
| 21 | $3,200,000 | $416,000 | $160,000 | $576,000 |
| 22 | $3,040,000 | $395,200 | $160,000 | $555,200 |
| 23 | $2,880,000 | $374,400 | $160,000 | $534,400 |
| 24 | $2,720,000 | $353,600 | $160,000 | $513,600 |
| 25 | $2,560,000 | $332,800 | $160,000 | $492,800 |
| 26 | $2,400,000 | $312,000 | $160,000 | $472,000 |
| 27 | $2,240,000 | $291,200 | $160,000 | $451,200 |
| 28 | $2,080,000 | $270,400 | $160,000 | $430,400 |
| 29 | $1,920,000 | $249,600 | $160,000 | $409,600 |
| 30 | $1,760,000 | $228,800 | $160,000 | $388,800 |
| 31 | $1,600,000 | $208,000 | $160,000 | $368,000 |
| 32 | $1,440,000 | $187,200 | $160,000 | $347,200 |
| 33 | $1,280,000 | $166,400 | $160,000 | $326,400 |
| 34 | $1,120,000 | $145,600 | $160,000 | $305,600 |
| 35 | $960,000 | $124,800 | $160,000 | $284,800 |
| 36 | $800,000 | $104,000 | $160,000 | $264,000 |
| 37 | $640,000 | $83,200 | $160,000 | $243,200 |
| 38 | $480,000 | $62,400 | $160,000 | $222,400 |
| 39 | $320,000 | $41,600 | $160,000 | $201,600 |
| 40 | $160,000 | $20,800 | $160,000 | $180,800 |
| Total Expenditure | | $17,056,000 | $6,400,000 | $23,456,000 |
| Average Annual Expenditure | | | | $586,400 |

**2016 to 2020**

Capital Cost $6,600,000 per Project
Depreciation Period 40 Years
Quantity 1
Revenue Requirement Rate 13.0%

| Depreciation Year | Rate Base Value | Revenue Requirement | Depreciation Cost | Total Annual Customer Expenditure |
|---|---|---|---|---|
| 1 | $6,600,000 | $858,000 | $165,000 | $1,023,000 |
| 2 | $6,435,000 | $836,550 | $165,000 | $1,001,550 |
| 3 | $6,270,000 | $815,100 | $165,000 | $980,100 |
| 4 | $6,105,000 | $793,650 | $165,000 | $958,650 |
| 5 | $5,940,000 | $772,200 | $165,000 | $937,200 |
| 6 | $5,775,000 | $750,750 | $165,000 | $915,750 |
| 7 | $5,610,000 | $729,300 | $165,000 | $894,300 |
| 8 | $5,445,000 | $707,850 | $165,000 | $872,850 |
| 9 | $5,280,000 | $686,400 | $165,000 | $851,400 |
| 10 | $5,115,000 | $664,950 | $165,000 | $829,950 |
| 11 | $4,950,000 | $643,500 | $165,000 | $808,500 |
| 12 | $4,785,000 | $622,050 | $165,000 | $787,050 |
| 13 | $4,620,000 | $600,600 | $165,000 | $765,600 |
| 14 | $4,455,000 | $579,150 | $165,000 | $744,150 |
| 15 | $4,290,000 | $557,700 | $165,000 | $722,700 |
| 16 | $4,125,000 | $536,250 | $165,000 | $701,250 |
| 17 | $3,960,000 | $514,800 | $165,000 | $679,800 |
| 18 | $3,795,000 | $493,350 | $165,000 | $658,350 |
| 19 | $3,630,000 | $471,900 | $165,000 | $636,900 |
| 20 | $3,465,000 | $450,450 | $165,000 | $615,450 |
| 21 | $3,300,000 | $429,000 | $165,000 | $594,000 |
| 22 | $3,135,000 | $407,550 | $165,000 | $572,550 |
| 23 | $2,970,000 | $386,100 | $165,000 | $551,100 |
| 24 | $2,805,000 | $364,650 | $165,000 | $529,650 |
| 25 | $2,640,000 | $343,200 | $165,000 | $508,200 |
| 26 | $2,475,000 | $321,750 | $165,000 | $486,750 |
| 27 | $2,310,000 | $300,300 | $165,000 | $465,300 |
| 28 | $2,145,000 | $278,850 | $165,000 | $443,850 |
| 29 | $1,980,000 | $257,400 | $165,000 | $422,400 |
| 30 | $1,815,000 | $235,950 | $165,000 | $400,950 |
| 31 | $1,650,000 | $214,500 | $165,000 | $379,500 |
| 32 | $1,485,000 | $193,050 | $165,000 | $358,050 |
| 33 | $1,320,000 | $171,600 | $165,000 | $336,600 |
| 34 | $1,155,000 | $150,150 | $165,000 | $315,150 |
| 35 | $990,000 | $128,700 | $165,000 | $293,700 |
| 36 | $825,000 | $107,250 | $165,000 | $272,250 |
| 37 | $660,000 | $85,800 | $165,000 | $250,800 |
| 38 | $495,000 | $64,350 | $165,000 | $229,350 |
| 39 | $330,000 | $42,900 | $165,000 | $207,900 |
| 40 | $165,000 | $21,450 | $165,000 | $186,450 |
| Total Expenditure | | $17,589,000 | $6,600,000 | $24,189,000 |
| Average Annual Expenditure | | | | $604,725 |

**2021 to 2025**

Capital Cost $5,900,000 per Project
Depreciation Period 40 Years
Quantity 1
Revenue Requirement Rate 13.0%

| Depreciation Year | Rate Base Value | Revenue Requirement | Depreciation Cost | Total Annual Customer Expenditure |
|---|---|---|---|---|
| 1 | $5,900,000 | $767,000 | $147,500 | $914,500 |
| 2 | $5,752,500 | $747,825 | $147,500 | $895,325 |
| 3 | $5,605,000 | $728,650 | $147,500 | $876,150 |
| 4 | $5,457,500 | $709,475 | $147,500 | $856,975 |
| 5 | $5,310,000 | $690,300 | $147,500 | $837,800 |
| 6 | $5,162,500 | $671,125 | $147,500 | $818,625 |
| 7 | $5,015,000 | $651,950 | $147,500 | $799,450 |
| 8 | $4,867,500 | $632,775 | $147,500 | $780,275 |
| 9 | $4,720,000 | $613,600 | $147,500 | $761,100 |
| 10 | $4,572,500 | $594,425 | $147,500 | $741,925 |
| 11 | $4,425,000 | $575,250 | $147,500 | $722,750 |
| 12 | $4,277,500 | $556,075 | $147,500 | $703,575 |
| 13 | $4,130,000 | $536,900 | $147,500 | $684,400 |
| 14 | $3,982,500 | $517,725 | $147,500 | $665,225 |
| 15 | $3,835,000 | $498,550 | $147,500 | $646,050 |
| 16 | $3,687,500 | $479,375 | $147,500 | $626,875 |
| 17 | $3,540,000 | $460,200 | $147,500 | $607,700 |
| 18 | $3,392,500 | $441,025 | $147,500 | $588,525 |
| 19 | $3,245,000 | $421,850 | $147,500 | $569,350 |
| 20 | $3,097,500 | $402,675 | $147,500 | $550,175 |
| 21 | $2,950,000 | $383,500 | $147,500 | $531,000 |
| 22 | $2,802,500 | $364,325 | $147,500 | $511,825 |
| 23 | $2,655,000 | $345,150 | $147,500 | $492,650 |
| 24 | $2,507,500 | $325,975 | $147,500 | $473,475 |
| 25 | $2,360,000 | $306,800 | $147,500 | $454,300 |
| 26 | $2,212,500 | $287,625 | $147,500 | $435,125 |
| 27 | $2,065,000 | $268,450 | $147,500 | $415,950 |
| 28 | $1,917,500 | $249,275 | $147,500 | $396,775 |
| 29 | $1,770,000 | $230,100 | $147,500 | $377,600 |
| 30 | $1,622,500 | $210,925 | $147,500 | $358,425 |
| 31 | $1,475,000 | $191,750 | $147,500 | $339,250 |
| 32 | $1,327,500 | $172,575 | $147,500 | $320,075 |
| 33 | $1,180,000 | $153,400 | $147,500 | $300,900 |
| 34 | $1,032,500 | $134,225 | $147,500 | $281,725 |
| 35 | $885,000 | $115,050 | $147,500 | $262,550 |
| 36 | $737,500 | $95,875 | $147,500 | $243,375 |
| 37 | $590,000 | $76,700 | $147,500 | $224,200 |
| 38 | $442,500 | $57,525 | $147,500 | $205,025 |
| 39 | $295,000 | $38,350 | $147,500 | $185,850 |
| 40 | $147,500 | $19,175 | $147,500 | $166,675 |
| Total Expenditure | | $15,723,500 | $5,900,000 | $21,623,500 |
| Average Annual Expenditure | | | | $540,588 |

**2026 to 2030**

Capital Cost $2,900,000 per Project
Depreciation Period 40 Years
Quantity 1
Revenue Requirement Rate 13.0%

| Depreciation Year | Rate Base Value | Revenue Requirement | Depreciation Cost | Total Annual Customer Expenditure |
|---|---|---|---|---|
| 1 | $2,900,000 | $377,000 | $72,500 | $449,500 |
| 2 | $2,827,500 | $367,575 | $72,500 | $440,075 |
| 3 | $2,755,000 | $358,150 | $72,500 | $430,650 |
| 4 | $2,682,500 | $348,725 | $72,500 | $421,225 |
| 5 | $2,610,000 | $339,300 | $72,500 | $411,800 |
| 6 | $2,537,500 | $329,875 | $72,500 | $402,375 |
| 7 | $2,465,000 | $320,450 | $72,500 | $392,950 |
| 8 | $2,392,500 | $311,025 | $72,500 | $383,525 |
| 9 | $2,320,000 | $301,600 | $72,500 | $374,100 |
| 10 | $2,247,500 | $292,175 | $72,500 | $364,675 |
| 11 | $2,175,000 | $282,750 | $72,500 | $355,250 |
| 12 | $2,102,500 | $273,325 | $72,500 | $345,825 |
| 13 | $2,030,000 | $263,900 | $72,500 | $336,400 |
| 14 | $1,957,500 | $254,475 | $72,500 | $326,975 |
| 15 | $1,885,000 | $245,050 | $72,500 | $317,550 |
| 16 | $1,812,500 | $235,625 | $72,500 | $308,125 |
| 17 | $1,740,000 | $226,200 | $72,500 | $298,700 |
| 18 | $1,667,500 | $216,775 | $72,500 | $289,275 |
| 19 | $1,595,000 | $207,350 | $72,500 | $279,850 |
| 20 | $1,522,500 | $197,925 | $72,500 | $270,425 |
| 21 | $1,450,000 | $188,500 | $72,500 | $261,000 |
| 22 | $1,377,500 | $179,075 | $72,500 | $251,575 |
| 23 | $1,305,000 | $169,650 | $72,500 | $242,150 |
| 24 | $1,232,500 | $160,225 | $72,500 | $232,725 |
| 25 | $1,160,000 | $150,800 | $72,500 | $223,300 |
| 26 | $1,087,500 | $141,375 | $72,500 | $213,875 |
| 27 | $1,015,000 | $131,950 | $72,500 | $204,450 |
| 28 | $942,500 | $122,525 | $72,500 | $195,025 |
| 29 | $870,000 | $113,100 | $72,500 | $185,600 |
| 30 | $797,500 | $103,675 | $72,500 | $176,175 |
| 31 | $725,000 | $94,250 | $72,500 | $166,750 |
| 32 | $652,500 | $84,825 | $72,500 | $157,325 |
| 33 | $580,000 | $75,400 | $72,500 | $147,900 |
| 34 | $507,500 | $65,975 | $72,500 | $138,475 |
| 35 | $435,000 | $56,550 | $72,500 | $129,050 |
| 36 | $362,500 | $47,125 | $72,500 | $119,625 |
| 37 | $290,000 | $37,700 | $72,500 | $110,200 |
| 38 | $217,500 | $28,275 | $72,500 | $100,775 |
| 39 | $145,000 | $18,850 | $72,500 | $91,350 |
| 40 | $72,500 | $9,425 | $72,500 | $81,925 |
| Total Expenditure | | $7,728,500 | $2,900,000 | $10,628,500 |
| Average Annual Expenditure | | | | $265,713 |


Public Version

**Table K-2a. Summary of Total Customer Expenditure for Future Groundwater Production Capacity**

| Year | Total Annual Customer Expenditure by Capital Improvement Phase[a] | | | | | Total Annual Customer Expenditure | Existing Groundwater Production | Unit Cost |
|---|---|---|---|---|---|---|---|---|
| | 2006 to 2010 | 2011 to 2015 | 2016 to 2020 | 2021 to 2025 | 2026 to 230 | | | |
| 2006 | $0 | $0 | $0 | $0 | $0 | $0 | 1,100 | $0.00 |
| 2007 | $0 | $0 | $0 | $0 | $0 | $0 | 1,600 | $0.00 |
| 2008 | $0 | $0 | $0 | $0 | $0 | $0 | 2,200 | $0.00 |
| 2009 | $0 | $0 | $0 | $0 | $0 | $0 | 2,800 | $0.00 |
| 2010 | $0 | $0 | $0 | $0 | $0 | $0 | 3,500 | $0.00 |
| 2011 | $0 | $0 | $0 | $0 | $0 | $0 | 4,200 | $0.00 |
| 2012 | $0 | $0 | $0 | $0 | $0 | $0 | 4,900 | $0.00 |
| 2013 | $0 | $0 | $0 | $0 | $0 | $0 | 5,700 | $0.00 |
| 2014 | $0 | $0 | $0 | $0 | $0 | $0 | 6,400 | $0.00 |
| 2015 | $0 | $0 | $0 | $0 | $0 | $0 | 7,900 | $0.00 |
| 2016 | $0 | $0 | $8,680,000 | $0 | $0 | $8,680,000 | 9,500 | $913.68 |
| 2017 | $0 | $0 | $8,498,000 | $0 | $0 | $8,498,000 | 11,100 | $765.59 |
| 2018 | $0 | $0 | $8,316,000 | $0 | $0 | $8,316,000 | 12,600 | $660.00 |
| 2019 | $0 | $0 | $8,134,000 | $0 | $0 | $8,134,000 | 14,200 | $572.82 |
| 2020 | $0 | $0 | $7,952,000 | $0 | $0 | $7,952,000 | 15,800 | $503.29 |
| 2021 | $0 | $0 | $7,770,000 | $6,510,000 | $0 | $14,280,000 | 16,700 | $855.09 |
| 2022 | $0 | $0 | $7,588,000 | $6,373,500 | $0 | $13,961,500 | 17,500 | $797.80 |
| 2023 | $0 | $0 | $7,406,000 | $6,237,000 | $0 | $13,643,000 | 18,400 | $741.47 |
| 2024 | $0 | $0 | $7,224,000 | $6,100,500 | $0 | $13,324,500 | 19,300 | $690.39 |
| 2025 | $0 | $0 | $7,042,000 | $5,964,000 | $0 | $13,006,000 | 20,100 | $647.06 |
| 2026 | $0 | $0 | $6,860,000 | $5,827,500 | $5,425,000 | $18,112,500 | 21,000 | $862.50 |
| 2027 | $0 | $0 | $6,678,000 | $5,691,000 | $5,311,250 | $17,680,250 | 21,800 | $811.02 |
| 2028 | $0 | $0 | $6,496,000 | $5,554,500 | $5,197,500 | $17,248,000 | 22,700 | $759.82 |
| 2029 | $0 | $0 | $6,314,000 | $5,418,000 | $5,083,750 | $16,815,750 | 23,400 | $718.62 |
| 2030 | $0 | $0 | $6,132,000 | $5,281,500 | $4,970,000 | $16,383,500 | 24,300 | $674.22 |

[a] Data obtained from Table 4-F-2b.

Public Version

**Table K-2b. Annualized Groundwater Supply Costs: Future Capacity Needs**

**2006 to 2010**

Capital Cost $0 per Project
Depreciation Period 40 Years
Quantity 0
Revenue Requirement Rate 13.0%

| Depreciation Year | Rate Base Value | Revenue Requirement | Depreciation Cost | Total Annual Customer Expenditure |
|---|---|---|---|---|
| 1 | $0 | $0 | $0 | $0 |
| 2 | $0 | $0 | $0 | $0 |
| 3 | $0 | $0 | $0 | $0 |
| 4 | $0 | $0 | $0 | $0 |
| 5 | $0 | $0 | $0 | $0 |
| 6 | $0 | $0 | $0 | $0 |
| 7 | $0 | $0 | $0 | $0 |
| 8 | $0 | $0 | $0 | $0 |
| 9 | $0 | $0 | $0 | $0 |
| 10 | $0 | $0 | $0 | $0 |
| 11 | $0 | $0 | $0 | $0 |
| 12 | $0 | $0 | $0 | $0 |
| 13 | $0 | $0 | $0 | $0 |
| 14 | $0 | $0 | $0 | $0 |
| 15 | $0 | $0 | $0 | $0 |
| 16 | $0 | $0 | $0 | $0 |
| 17 | $0 | $0 | $0 | $0 |
| 18 | $0 | $0 | $0 | $0 |
| 19 | $0 | $0 | $0 | $0 |
| 20 | $0 | $0 | $0 | $0 |
| 21 | $0 | $0 | $0 | $0 |
| 22 | $0 | $0 | $0 | $0 |
| 23 | $0 | $0 | $0 | $0 |
| 24 | $0 | $0 | $0 | $0 |
| 25 | $0 | $0 | $0 | $0 |
| 26 | $0 | $0 | $0 | $0 |
| 27 | $0 | $0 | $0 | $0 |
| 28 | $0 | $0 | $0 | $0 |
| 29 | $0 | $0 | $0 | $0 |
| 30 | $0 | $0 | $0 | $0 |
| 31 | $0 | $0 | $0 | $0 |
| 32 | $0 | $0 | $0 | $0 |
| 33 | $0 | $0 | $0 | $0 |
| 34 | $0 | $0 | $0 | $0 |
| 35 | $0 | $0 | $0 | $0 |
| 36 | $0 | $0 | $0 | $0 |
| 37 | $0 | $0 | $0 | $0 |
| 38 | $0 | $0 | $0 | $0 |
| 39 | $0 | $0 | $0 | $0 |
| 40 | $0 | $0 | $0 | $0 |
| Total Expenditure | | $0 | $0 | $0 |
| Average Annual Expenditure | | | | $0 |

**2011 to 2015**

Capital Cost $5,600,000 per Project
Depreciation Period 40 Years
Quantity 0
Revenue Requirement Rate 13.0%

| Depreciation Year | Rate Base Value | Revenue Requirement | Depreciation Cost | Total Annual Customer Expenditure |
|---|---|---|---|---|
| 1 | $0 | $0 | $0 | $0 |
| 2 | $0 | $0 | $0 | $0 |
| 3 | $0 | $0 | $0 | $0 |
| 4 | $0 | $0 | $0 | $0 |
| 5 | $0 | $0 | $0 | $0 |
| 6 | $0 | $0 | $0 | $0 |
| 7 | $0 | $0 | $0 | $0 |
| 8 | $0 | $0 | $0 | $0 |
| 9 | $0 | $0 | $0 | $0 |
| 10 | $0 | $0 | $0 | $0 |
| 11 | $0 | $0 | $0 | $0 |
| 12 | $0 | $0 | $0 | $0 |
| 13 | $0 | $0 | $0 | $0 |
| 14 | $0 | $0 | $0 | $0 |
| 15 | $0 | $0 | $0 | $0 |
| 16 | $0 | $0 | $0 | $0 |
| 17 | $0 | $0 | $0 | $0 |
| 18 | $0 | $0 | $0 | $0 |
| 19 | $0 | $0 | $0 | $0 |
| 20 | $0 | $0 | $0 | $0 |
| 21 | $0 | $0 | $0 | $0 |
| 22 | $0 | $0 | $0 | $0 |
| 23 | $0 | $0 | $0 | $0 |
| 24 | $0 | $0 | $0 | $0 |
| 25 | $0 | $0 | $0 | $0 |
| 26 | $0 | $0 | $0 | $0 |
| 27 | $0 | $0 | $0 | $0 |
| 28 | $0 | $0 | $0 | $0 |
| 29 | $0 | $0 | $0 | $0 |
| 30 | $0 | $0 | $0 | $0 |
| 31 | $0 | $0 | $0 | $0 |
| 32 | $0 | $0 | $0 | $0 |
| 33 | $0 | $0 | $0 | $0 |
| 34 | $0 | $0 | $0 | $0 |
| 35 | $0 | $0 | $0 | $0 |
| 36 | $0 | $0 | $0 | $0 |
| 37 | $0 | $0 | $0 | $0 |
| 38 | $0 | $0 | $0 | $0 |
| 39 | $0 | $0 | $0 | $0 |
| 40 | $0 | $0 | $0 | $0 |
| Total Expenditure | | $0 | $0 | $0 |
| Average Annual Expenditure | | | | $0 |

**2016 to 2020**

Capital Cost $14,000,000 per Project
Depreciation Period 40 Years
Quantity 4
Revenue Requirement Rate 13.0%

| Depreciation Year | Rate Base Value | Revenue Requirement | Depreciation Cost | Total Annual Customer Expenditure |
|---|---|---|---|---|
| 1 | $56,000,000 | $7,280,000 | $1,400,000 | $8,680,000 |
| 2 | $54,600,000 | $7,098,000 | $1,400,000 | $8,498,000 |
| 3 | $53,200,000 | $6,916,000 | $1,400,000 | $8,316,000 |
| 4 | $51,800,000 | $6,734,000 | $1,400,000 | $8,134,000 |
| 5 | $50,400,000 | $6,552,000 | $1,400,000 | $7,952,000 |
| 6 | $49,000,000 | $6,370,000 | $1,400,000 | $7,770,000 |
| 7 | $47,600,000 | $6,188,000 | $1,400,000 | $7,588,000 |
| 8 | $46,200,000 | $6,006,000 | $1,400,000 | $7,406,000 |
| 9 | $44,800,000 | $5,824,000 | $1,400,000 | $7,224,000 |
| 10 | $43,400,000 | $5,642,000 | $1,400,000 | $7,042,000 |
| 11 | $42,000,000 | $5,460,000 | $1,400,000 | $6,860,000 |
| 12 | $40,600,000 | $5,278,000 | $1,400,000 | $6,678,000 |
| 13 | $39,200,000 | $5,096,000 | $1,400,000 | $6,496,000 |
| 14 | $37,800,000 | $4,914,000 | $1,400,000 | $6,314,000 |
| 15 | $36,400,000 | $4,732,000 | $1,400,000 | $6,132,000 |
| 16 | $35,000,000 | $4,550,000 | $1,400,000 | $5,950,000 |
| 17 | $33,600,000 | $4,368,000 | $1,400,000 | $5,768,000 |
| 18 | $32,200,000 | $4,186,000 | $1,400,000 | $5,586,000 |
| 19 | $30,800,000 | $4,004,000 | $1,400,000 | $5,404,000 |
| 20 | $29,400,000 | $3,822,000 | $1,400,000 | $5,222,000 |
| 21 | $28,000,000 | $3,640,000 | $1,400,000 | $5,040,000 |
| 22 | $26,600,000 | $3,458,000 | $1,400,000 | $4,858,000 |
| 23 | $25,200,000 | $3,276,000 | $1,400,000 | $4,676,000 |
| 24 | $23,800,000 | $3,094,000 | $1,400,000 | $4,494,000 |
| 25 | $22,400,000 | $2,912,000 | $1,400,000 | $4,312,000 |
| 26 | $21,000,000 | $2,730,000 | $1,400,000 | $4,130,000 |
| 27 | $19,600,000 | $2,548,000 | $1,400,000 | $3,948,000 |
| 28 | $18,200,000 | $2,366,000 | $1,400,000 | $3,766,000 |
| 29 | $16,800,000 | $2,184,000 | $1,400,000 | $3,584,000 |
| 30 | $15,400,000 | $2,002,000 | $1,400,000 | $3,402,000 |
| 31 | $14,000,000 | $1,820,000 | $1,400,000 | $3,220,000 |
| 32 | $12,600,000 | $1,638,000 | $1,400,000 | $3,038,000 |
| 33 | $11,200,000 | $1,456,000 | $1,400,000 | $2,856,000 |
| 34 | $9,800,000 | $1,274,000 | $1,400,000 | $2,674,000 |
| 35 | $8,400,000 | $1,092,000 | $1,400,000 | $2,492,000 |
| 36 | $7,000,000 | $910,000 | $1,400,000 | $2,310,000 |
| 37 | $5,600,000 | $728,000 | $1,400,000 | $2,128,000 |
| 38 | $4,200,000 | $546,000 | $1,400,000 | $1,946,000 |
| 39 | $2,800,000 | $364,000 | $1,400,000 | $1,764,000 |
| 40 | $1,400,000 | $182,000 | $1,400,000 | $1,582,000 |
| Total Expenditure | | $149,240,000 | $56,000,000 | $205,240,000 |
| Average Annual Expenditure | | | | $5,131,000 |

**2021 to 2025**

Capital Cost $8,400,000 per Project
Depreciation Period 40 Years
Quantity 5
Revenue Requirement Rate 13.0%

| Depreciation Year | Rate Base Value | Revenue Requirement | Depreciation Cost | Total Annual Customer Expenditure |
|---|---|---|---|---|
| 1 | $42,000,000 | $5,460,000 | $1,050,000 | $6,510,000 |
| 2 | $40,950,000 | $5,323,500 | $1,050,000 | $6,373,500 |
| 3 | $39,900,000 | $5,187,000 | $1,050,000 | $6,237,000 |
| 4 | $38,850,000 | $5,050,500 | $1,050,000 | $6,100,500 |
| 5 | $37,800,000 | $4,914,000 | $1,050,000 | $5,964,000 |
| 6 | $36,750,000 | $4,777,500 | $1,050,000 | $5,827,500 |
| 7 | $35,700,000 | $4,641,000 | $1,050,000 | $5,691,000 |
| 8 | $34,650,000 | $4,504,500 | $1,050,000 | $5,554,500 |
| 9 | $33,600,000 | $4,368,000 | $1,050,000 | $5,418,000 |
| 10 | $32,550,000 | $4,231,500 | $1,050,000 | $5,281,500 |
| 11 | $31,500,000 | $4,095,000 | $1,050,000 | $5,145,000 |
| 12 | $30,450,000 | $3,958,500 | $1,050,000 | $5,008,500 |
| 13 | $29,400,000 | $3,822,000 | $1,050,000 | $4,872,000 |
| 14 | $28,350,000 | $3,685,500 | $1,050,000 | $4,735,500 |
| 15 | $27,300,000 | $3,549,000 | $1,050,000 | $4,599,000 |
| 16 | $26,250,000 | $3,412,500 | $1,050,000 | $4,462,500 |
| 17 | $25,200,000 | $3,276,000 | $1,050,000 | $4,326,000 |
| 18 | $24,150,000 | $3,139,500 | $1,050,000 | $4,189,500 |
| 19 | $23,100,000 | $3,003,000 | $1,050,000 | $4,053,000 |
| 20 | $22,050,000 | $2,866,500 | $1,050,000 | $3,916,500 |
| 21 | $21,000,000 | $2,730,000 | $1,050,000 | $3,780,000 |
| 22 | $19,950,000 | $2,593,500 | $1,050,000 | $3,643,500 |
| 23 | $18,900,000 | $2,457,000 | $1,050,000 | $3,507,000 |
| 24 | $17,850,000 | $2,320,500 | $1,050,000 | $3,370,500 |
| 25 | $16,800,000 | $2,184,000 | $1,050,000 | $3,234,000 |
| 26 | $15,750,000 | $2,047,500 | $1,050,000 | $3,097,500 |
| 27 | $14,700,000 | $1,911,000 | $1,050,000 | $2,961,000 |
| 28 | $13,650,000 | $1,774,500 | $1,050,000 | $2,824,500 |
| 29 | $12,600,000 | $1,638,000 | $1,050,000 | $2,688,000 |
| 30 | $11,550,000 | $1,501,500 | $1,050,000 | $2,551,500 |
| 31 | $10,500,000 | $1,365,000 | $1,050,000 | $2,415,000 |
| 32 | $9,450,000 | $1,228,500 | $1,050,000 | $2,278,500 |
| 33 | $8,400,000 | $1,092,000 | $1,050,000 | $2,142,000 |
| 34 | $7,350,000 | $955,500 | $1,050,000 | $2,005,500 |
| 35 | $6,300,000 | $819,000 | $1,050,000 | $1,869,000 |
| 36 | $5,250,000 | $682,500 | $1,050,000 | $1,732,500 |
| 37 | $4,200,000 | $546,000 | $1,050,000 | $1,596,000 |
| 38 | $3,150,000 | $409,500 | $1,050,000 | $1,459,500 |
| 39 | $2,100,000 | $273,000 | $1,050,000 | $1,323,000 |
| 40 | $1,050,000 | $136,500 | $1,050,000 | $1,186,500 |
| Total Expenditure | | $111,930,000 | $42,000,000 | $153,930,000 |
| Average Annual Expenditure | | | | $3,848,250 |

**2026 to 2030**

Capital Cost $7,000,000 per Project
Depreciation Period 40 Years
Quantity 5
Revenue Requirement Rate 13.0%

| Depreciation Year | Rate Base Value | Revenue Requirement | Depreciation Cost | Total Annual Customer Expenditure |
|---|---|---|---|---|
| 1 | $35,000,000 | $4,550,000 | $875,000 | $5,425,000 |
| 2 | $34,125,000 | $4,436,250 | $875,000 | $5,311,250 |
| 3 | $33,250,000 | $4,322,500 | $875,000 | $5,197,500 |
| 4 | $32,375,000 | $4,208,750 | $875,000 | $5,083,750 |
| 5 | $31,500,000 | $4,095,000 | $875,000 | $4,970,000 |
| 6 | $30,625,000 | $3,981,250 | $875,000 | $4,856,250 |
| 7 | $29,750,000 | $3,867,500 | $875,000 | $4,742,500 |
| 8 | $28,875,000 | $3,753,750 | $875,000 | $4,628,750 |
| 9 | $28,000,000 | $3,640,000 | $875,000 | $4,515,000 |
| 10 | $27,125,000 | $3,526,250 | $875,000 | $4,401,250 |
| 11 | $26,250,000 | $3,412,500 | $875,000 | $4,287,500 |
| 12 | $25,375,000 | $3,298,750 | $875,000 | $4,173,750 |
| 13 | $24,500,000 | $3,185,000 | $875,000 | $4,060,000 |
| 14 | $23,625,000 | $3,071,250 | $875,000 | $3,946,250 |
| 15 | $22,750,000 | $2,957,500 | $875,000 | $3,832,500 |
| 16 | $21,875,000 | $2,843,750 | $875,000 | $3,718,750 |
| 17 | $21,000,000 | $2,730,000 | $875,000 | $3,605,000 |
| 18 | $20,125,000 | $2,616,250 | $875,000 | $3,491,250 |
| 19 | $19,250,000 | $2,502,500 | $875,000 | $3,377,500 |
| 20 | $18,375,000 | $2,388,750 | $875,000 | $3,263,750 |
| 21 | $17,500,000 | $2,275,000 | $875,000 | $3,150,000 |
| 22 | $16,625,000 | $2,161,250 | $875,000 | $3,036,250 |
| 23 | $15,750,000 | $2,047,500 | $875,000 | $2,922,500 |
| 24 | $14,875,000 | $1,933,750 | $875,000 | $2,808,750 |
| 25 | $14,000,000 | $1,820,000 | $875,000 | $2,695,000 |
| 26 | $13,125,000 | $1,706,250 | $875,000 | $2,581,250 |
| 27 | $12,250,000 | $1,592,500 | $875,000 | $2,467,500 |
| 28 | $11,375,000 | $1,478,750 | $875,000 | $2,353,750 |
| 29 | $10,500,000 | $1,365,000 | $875,000 | $2,240,000 |
| 30 | $9,625,000 | $1,251,250 | $875,000 | $2,126,250 |
| 31 | $8,750,000 | $1,137,500 | $875,000 | $2,012,500 |
| 32 | $7,875,000 | $1,023,750 | $875,000 | $1,898,750 |
| 33 | $7,000,000 | $910,000 | $875,000 | $1,785,000 |
| 34 | $6,125,000 | $796,250 | $875,000 | $1,671,250 |
| 35 | $5,250,000 | $682,500 | $875,000 | $1,557,500 |
| 36 | $4,375,000 | $568,750 | $875,000 | $1,443,750 |
| 37 | $3,500,000 | $455,000 | $875,000 | $1,330,000 |
| 38 | $2,625,000 | $341,250 | $875,000 | $1,216,250 |
| 39 | $1,750,000 | $227,500 | $875,000 | $1,102,500 |
| 40 | $875,000 | $113,750 | $875,000 | $988,750 |
| Total Expenditure | | $93,275,000 | $35,000,000 | $128,275,000 |
| Average Annual Expenditure | | | | $3,206,875 |


Public Version

Public Version

# APPENDIX L

## Appendix 6-A. Hydraulic Model Calibration

# APPENDIX 6-A. HYDRAULIC MODEL CALIBRATION

## HYDRANT FLOW TESTS

There were twenty-eight (28) selected hydrant flow testing locations for the Cal Water's Chico and Hamilton City water distribution system (see Figure 6-4). Associated pipeline C-factor evaluations were performed in the field on July 19 and July 20, 2006. The selection of these hydrant tests were based on the location, size and material type of the pipelines. Only twenty-two of these hydrant flow tests were performed due to configuration and time constraints. These tests were used to evaluate pipeline friction factors (C-factors). As part of the model calibration process, these C-factors were adjusted, to represent roughness in the existing pipelines, to more closely represent actual observed field conditions.

Hydrant flow tests were simulated using the updated hydraulic model of the Cal Water's water system, and estimated C-factor values. Results were then compared to the actual field data to verify the C-factors and determine the accuracy of the model. C-factors were then adjusted where necessary to minimize differences between static and residual hydrant pressures observed in the field to pressures simulated with the hydraulic model, (see Tables A-1 through A-28). The goal of the calibration effort was to achieve no greater than a 5 psi differential between the field hydrant test data and the model simulated data.

Cal Water's Chico distribution system consists of approximately 34.5 miles of pipelines, and the Cal Water's Hamilton City distribution system consists of approximately 0.7 miles of pipelines. Distribution pipeline sizes range from 2 inches to 8 inches in diameter, along with larger transmission mains ranging in size from 10 to 14 inches in diameter. The pipelines are primarily constructed of asbestos cement, cast iron, ductile iron, PVC and steel.

The following sections describe each of the specific hydrant testing locations and discuss a comparison of the predicted model pressures compared to pressures observed in the field. A schematic describing the locations of the flowing and observed fire hydrants is also provided for each hydrant flow test.

## SUMMARY OF CALIBRATION RESULTS

Overall, the results from the hydraulic model calibration validated the system pipeline configuration and estimated C-factors. The average pressure differentials between those pressures observed in the field and those predicted by the model were within ± 5 pounds per square inch (psi).

**Hydrant Flow Test No. 1**

Hydrant Flow Test No. 1 was performed Notre Dame Boulevard, south of Jasper Drive. This test was conducted to confirm the C-factor (initially assumed to equal 140) of a 10-inch diameter, AC pipeline. A comparison of the differential pressure readings predicted by the hydraulic model, compared to pressures actually measured in the field, demonstrate that the pressures predicted by the model are within ± 4 psi of the measured field value. The calibrated model results and the field data are shown in Table 6-A-1.

**Table 6-A-1. Hydrant Flow Test No. 1**

| Hydrant[1] | Field Data | | | Modeled Data | | | Comparison of Differential Pressures (psi) (g = c-f) |
|---|---|---|---|---|---|---|---|
| | Static Pressure (psi) (a) | Residual Pressure (psi) (b) | Differential Pressure (c = a-b) | Static Pressure (psi) (d) | Residual Pressure (psi) (e) | Differential Pressure (psi) (f = d-e) | |
| Flowing[2] | 54 | 22 | | 52 | 23 | | |
| 1A[3] | 54 | 32 | 22 | 52 | 25 | 26 | -4 |
| 1B[4] | 55 | 33 | 22 | 52 | 28 | 25 | -3 |
| 1C[5] | 54 | 34 | 20 | 54 | 32 | 22 | -2 |
| 1D[6] | 56 | 38 | 18 | 55 | 35 | 20 | -2 |

(1) Location of fire hydrants can be found on Figure A-1.
(2) The "Flowing Hydrant" is on Notre Dame Boulevard, south of Jasper Drive.
(3) Hydrant 1A is located at Notre Dame Boulevard, south of flowing hydrant.
(4) Hydrant 1B is located at Notre Dame Boulevard, north of New Dawn Circle.
(5) Hydrant 1C is located at Notre Dame Boulevard, south of New Dawn Circle.
(6) Hydrant 1D is located at Notre Dame Boulevard, north of Fremont Street.
NA = Not Applicable

Public Version

**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- ☐ VALVE LOCATION

N

CALIFORNIA WATER SERVICE CO.

**CAL WATER SERVICES CO**
**CHICO-HAMILTON CITY DISTRICT**

**FIGURE A1**

**HYDRANT TEST LOCATIONS**
**JULY 2006**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585

WEST YOST ASSOCIATES
Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/Revised/isFIGA01 Ctest.dwg DATE: 06-28-06 10:22am lsuroso

**Hydrant Flow Test No. 2**

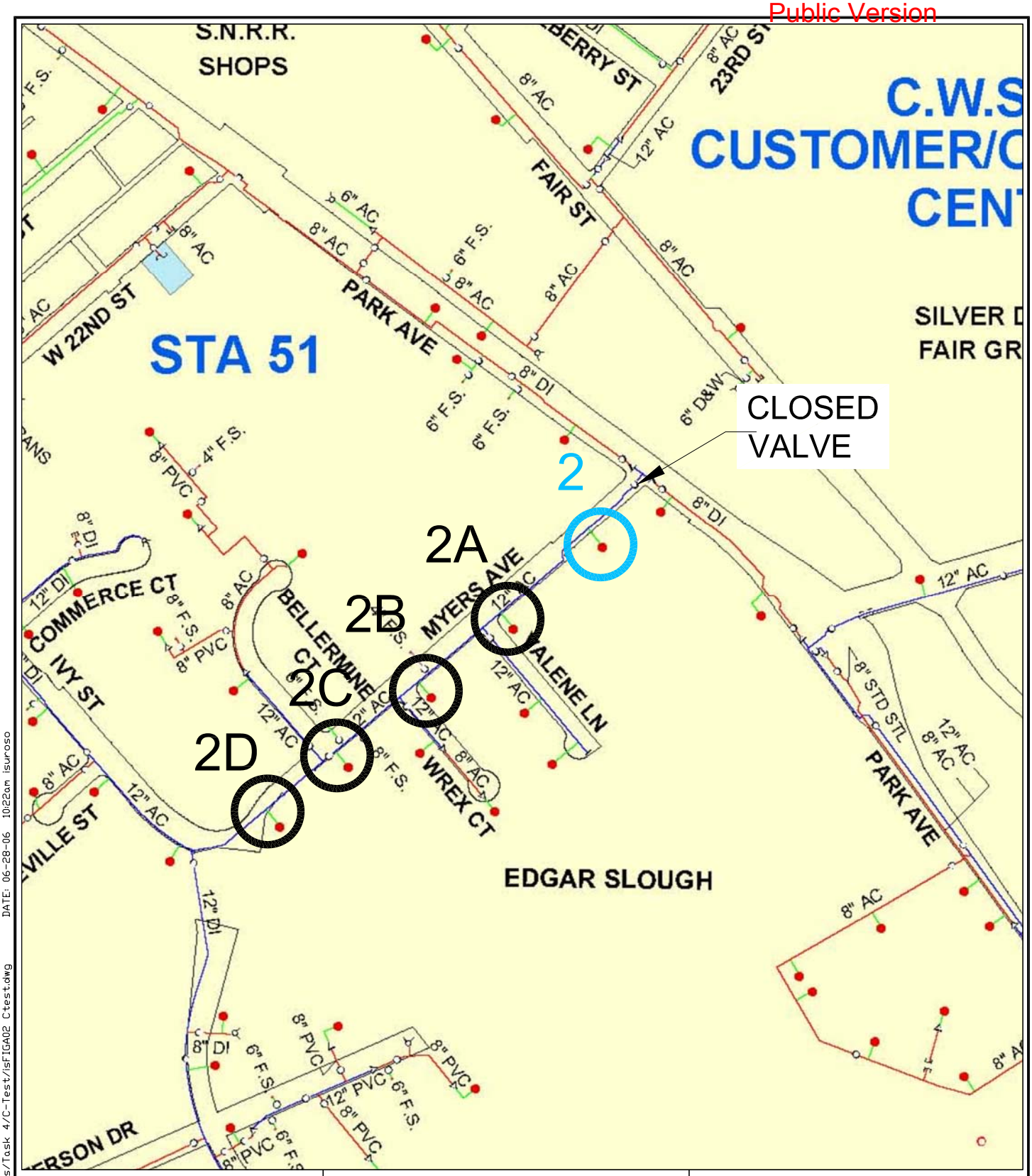
Hydrant Flow Test No. 2 was performed on Myers Avenue, southwest of Park Avenue. This test was conducted to confirm the C-factor (initially assumed to be 140) of a 12-inch diameter, AC pipeline. A comparison of the differential pressure reading predicted by the hydraulic model, compared to pressures actually measured in the field, demonstrate that the model is within ± 3 psi of the measured field value. The calibrated model results and the field data are shown in Table 6-A-2. As indicated by the results in Table 6-A-2, a C-factor of 140 is valid for this size and type of pipeline.

**Table 6-A-2. Hydrant Flow Test No. 2**

| Hydrant[1] | Field Data | | | Modeled Data | | | Comparison of Differential Pressures (psi) (g = c-f) |
|---|---|---|---|---|---|---|---|
| | Static Pressure (psi) (a) | Residual Pressure (psi) (b) | Differential Pressure (c = a-b) | Static Pressure (psi) (d) | Residual Pressure (psi) (e) | Differential Pressure (psi) (f = d-e) | |
| Flowing[2] | 75 | 40 | | 73 | 48 | | |
| 2A[3] | 72 | 52 | 20 | 73 | 50 | 23 | -3 |
| 2B[4] | 80 | 60 | 20 | 74 | 52 | 22 | -2 |
| 2C[5] | 74 | 54 | 20 | 74 | 53 | 21 | -1 |
| 2D[6] | 73 | 56 | 17 | 75 | 55 | 20 | -3 |

(1) Location of fire hydrants can be found on Figure A-2.
(2) The "Flowing Hydrant" is located at Myers Avenue, southwest of Park Avenue.
(3) Hydrant 2A is located at Myers Avenue, northeast of Valene Lane.
(4) Hydrant 2B is located at Myers Avenue, northeast of Wrex Court.
(5) Hydrant 2C is located at Myers Avenue, northwest of Bellermine Court.
(6) Hydrant 2D is located at Myers Avenue, southwest of Bellermine Court.
NA = Not Applicable

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A2**

**HYDRANT TEST LOCATIONS JULY 2006**

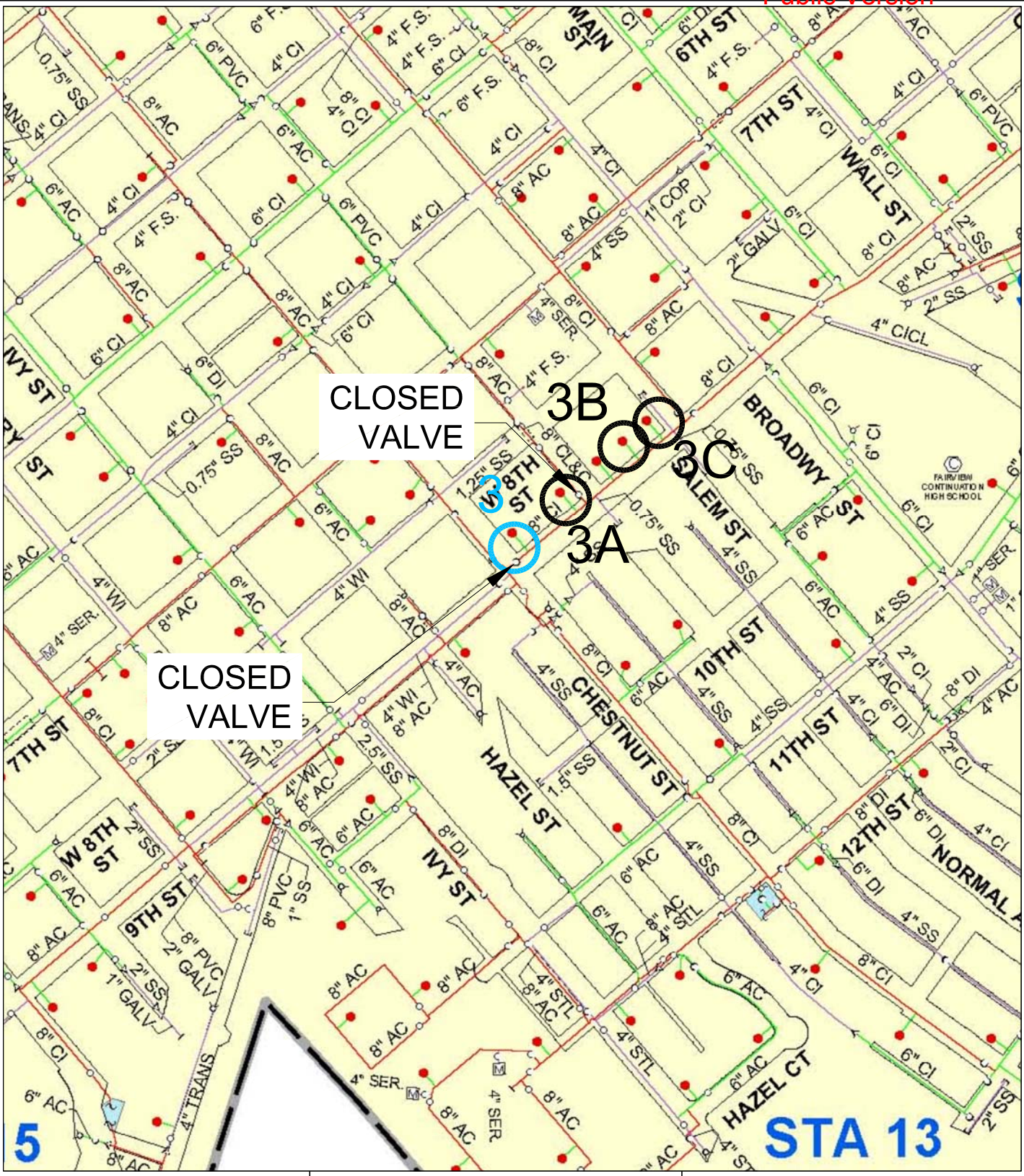
CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585
WEST YOST ASSOCIATES Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA02 Ctest.dwg DATE: 06-28-06 10:22am isuroso

**Hydrant Flow Test No. 3**

Hydrant Flow Test No. 3 was not performed due to location constraint. There were tests performed for this size and type of pipeline (8-inch, cast iron pipeline).

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A3**

**HYDRANT TEST LOCATIONS JULY 2006**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585
WEST YOST ASSOCIATES Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA03 Ctest.dwg DATE: 06-28-06 10:22am isuroso

**Hydrant Flow Test No. 4**

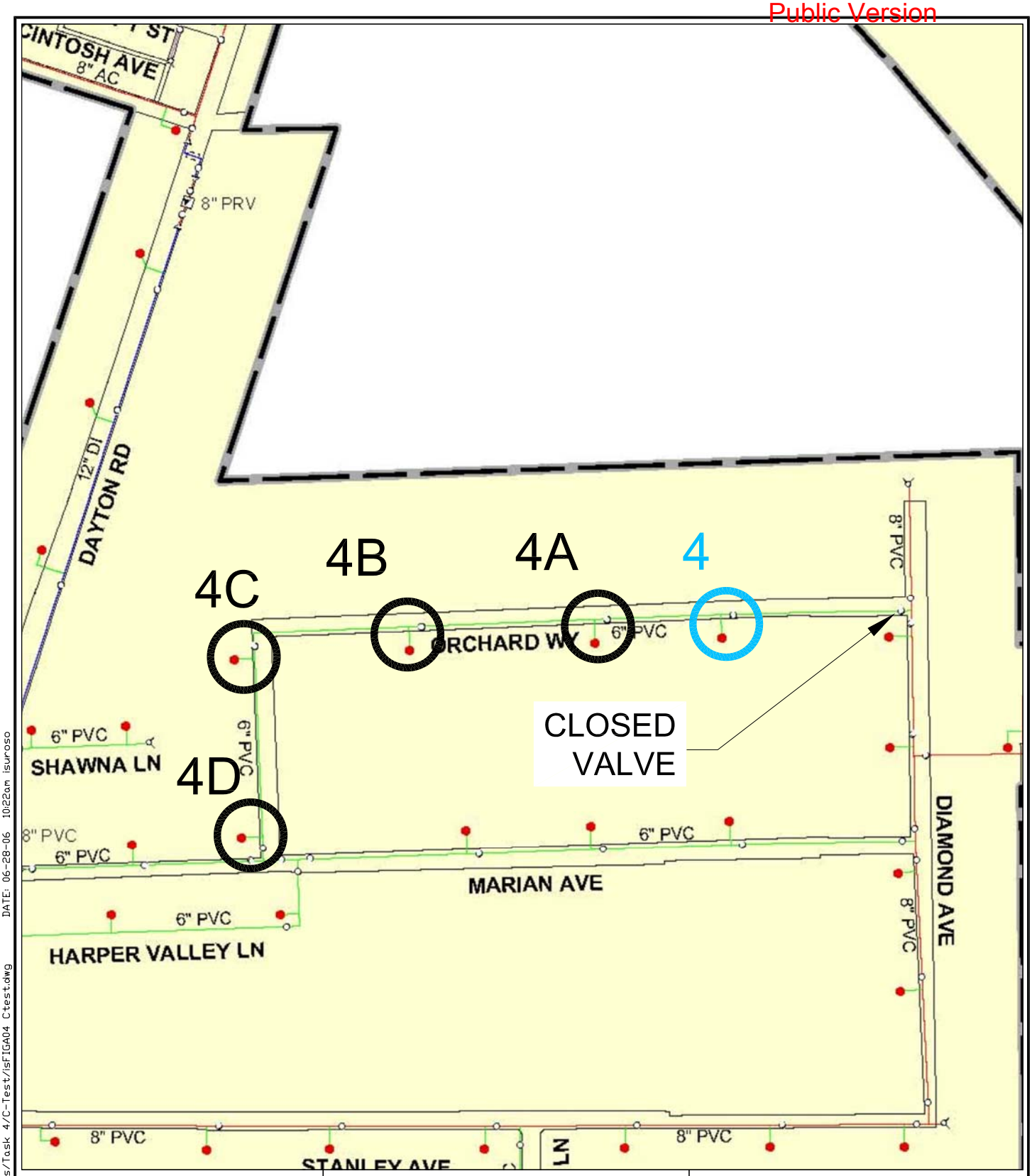
Hydrant Flow Test No. 4 was performed at Orchard Way, west of Diamond Avenue. This test was conducted to confirm the C-factor (initially assumed to equal 140) of a 6-inch diameter, PVC pipeline. A comparison of the differential pressure readings predicted by the hydraulic model, compared to pressures actually measured in the field, indicate that differential pressures are within the ± 3 psi tolerance limit established for calibration. The calibrated model results and the field data are shown in Table 6-A-4, and the results indicate that a C-factor of 140 is valid for the size and type of pipeline.

**Table 6-A-4. Hydrant Flow Test No. 4**

| Hydrant[1] | Field Data | | | Modeled Data | | | Comparison of Differential Pressures (psi) (g = c-f) |
|---|---|---|---|---|---|---|---|
| | Static Pressure (psi) (a) | Residual Pressure (psi) (b) | Differential Pressure (c = a-b) | Static Pressure (psi) (d) | Residual Pressure (psi) (e) | Differential Pressure (psi) (f = d-e) | |
| Flowing[2] | 65 | 8 | | 62 | 1 | | |
| 4A[3] | 64 | 12 | 52 | 63 | 9 | 54 | -2 |
| 4B[4] | 65 | 21 | 44 | 65 | 21 | 43 | 1 |
| 4C[5] | 64 | 31 | 33 | 65 | 33 | 33 | 0 |
| 4D[6] | 66 | 45 | 21 | 66 | 45 | 20 | 1 |

(1) Location of fire hydrants can be found on Figure A-4.
(2) The "Flowing Hydrant" is located at Orchard Way, west of Diamond Avenue.
(3) Hydrant 4A is located at Orchard Way, west of flowing hydrant.
(4) Hydrant 4B is located at Orchard Way, west of Test 4A.
(5) Hydrant 4C is located at Orchard Way, south of west corner of Orchard Way
(6) Hydrant 4D is located at Orchard Way, north of Marian Avenue.
NA = Not Applicable

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A4**

**HYDRANT TEST LOCATIONS JULY 2006**

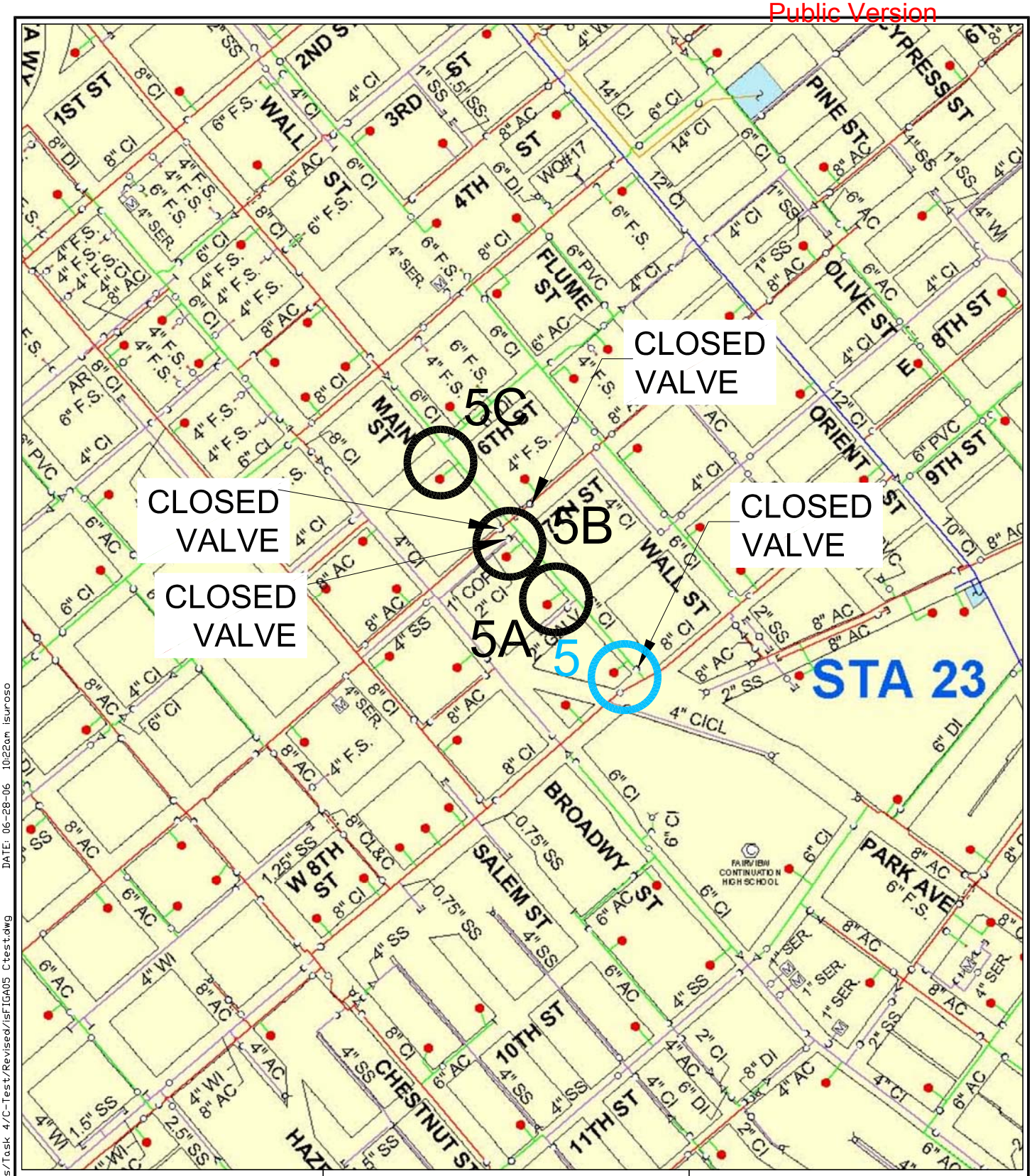
CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585
WEST YOST ASSOCIATES
Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA04 Ctest.dwg DATE: 06-28-06 10:22am isuroso

**Hydrant Flow Test No. 5**

Hydrant Flow Test No. 5 was not performed due to location constraint. There were tests performed for this size and type of pipeline (6-inch, ductile iron pipeline).

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A5**

**HYDRANT TEST LOCATIONS JULY 2006**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585
WEST YOST ASSOCIATES
Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/Revised/isFIGA05 Ctest.dwg DATE: 06-28-06 10:22am isuroso

### Hydrant Flow Test No. 6

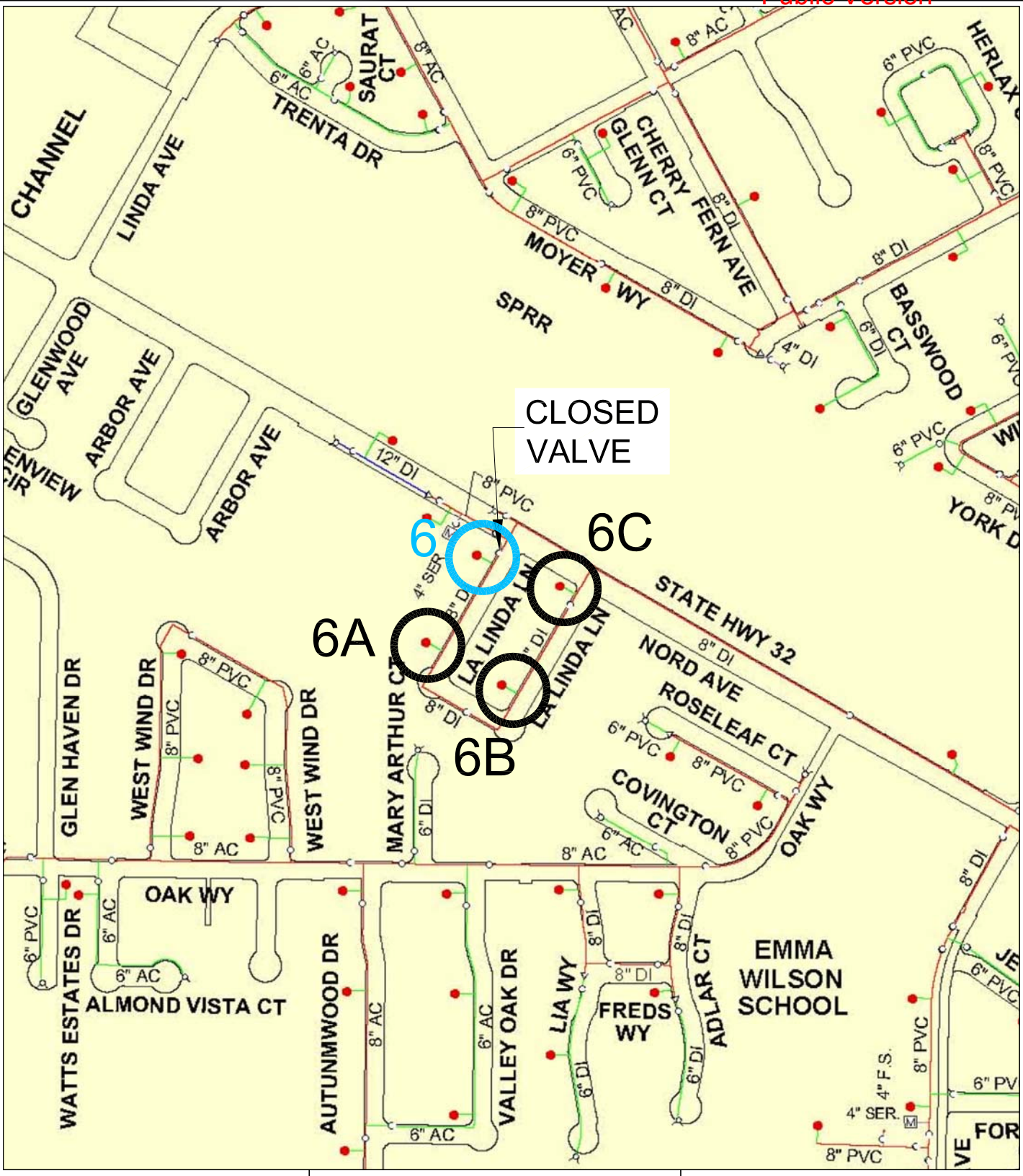
Hydrant Flow Test No. 6 was at La Linda Lane, southwest of Nord Avenue. This test was conducted to confirm the C-factor (initially assumed to equal 130) of an 8-inch diameter, DI pipeline. The preliminary results indicate that possibility of partially opened valve between parcel 1553 and 1547 on La Linda Lane. The Cal Water staff confirmed a partially closed valve on La Linda Lane. The differential pressure reading between the model and the observed field valve are within ± 5 psi. The calibrated model results and the field data are shown in Table 6-A-6.

**Table 6-A-6. Hydrant Flow Test No. 6**

| Hydrant[1] | Field Data | | | Modeled Data | | | Comparison |
|---|---|---|---|---|---|---|---|
| | Static Pressure (psi) (a) | Residual Pressure (psi) (b) | Differential Pressure (c = a-b) | Static Pressure (psi) (d) | Residual Pressure (psi) (e) | Differential Pressure (psi) (f = d-e) | of Differential Pressures (psi) (g = c-f) |
| Flowing[2] | 82 | 13 | | 75 | 10 | | |
| 6A[3] | 80 | 18 | 62 | 76 | 16 | 60 | 2 |
| 6B[4] | 80 | 46 | 34 | 76 | 40 | 36 | -2 |
| 6C[5] | 78 | 49 | 29 | 75 | 43 | 32 | -3 |

(1) Location of fire hydrants can be found on Figure A-6.
(2) The "Flowing Hydrant" is located at La Linda Lane, southwest of Nord Avenue.
(3) Hydrant 6A is located at the northwest end of La Linda Lane, northeast of southwest corner.
(4) Hydrant 6B is located at La Linda, northeast of southeast corner.
(5) Hydrant 6C is located at southwest end of La Linda, south of Nord Avenue.
NA = Not Applicable

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A6**

**HYDRANT TEST LOCATIONS JULY 2006**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585
WEST YOST ASSOCIATES Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA06 Ctest.dwg DATE: 06-28-06 10:22am isuroso

**Hydrant Flow Test No. 7**

Hydrant Flow Test No. 7 was not performed at due to time constraint. There were tests performed for this size and type of pipeline (6-inch, PVC pipeline).

Public Version

**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CALIFORNIA WATER SERVICE CO.

**CAL WATER SERVICES CO**
**CHICO-HAMILTON CITY DISTRICT**

**FIGURE A7**

**HYDRANT TEST LOCATIONS JULY 2006**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585

WEST YOST ASSOCIATES
Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA07 Ctest.dwg DATE: 06-28-06 10:22am isuroso

### Hydrant Flow Test No. 8

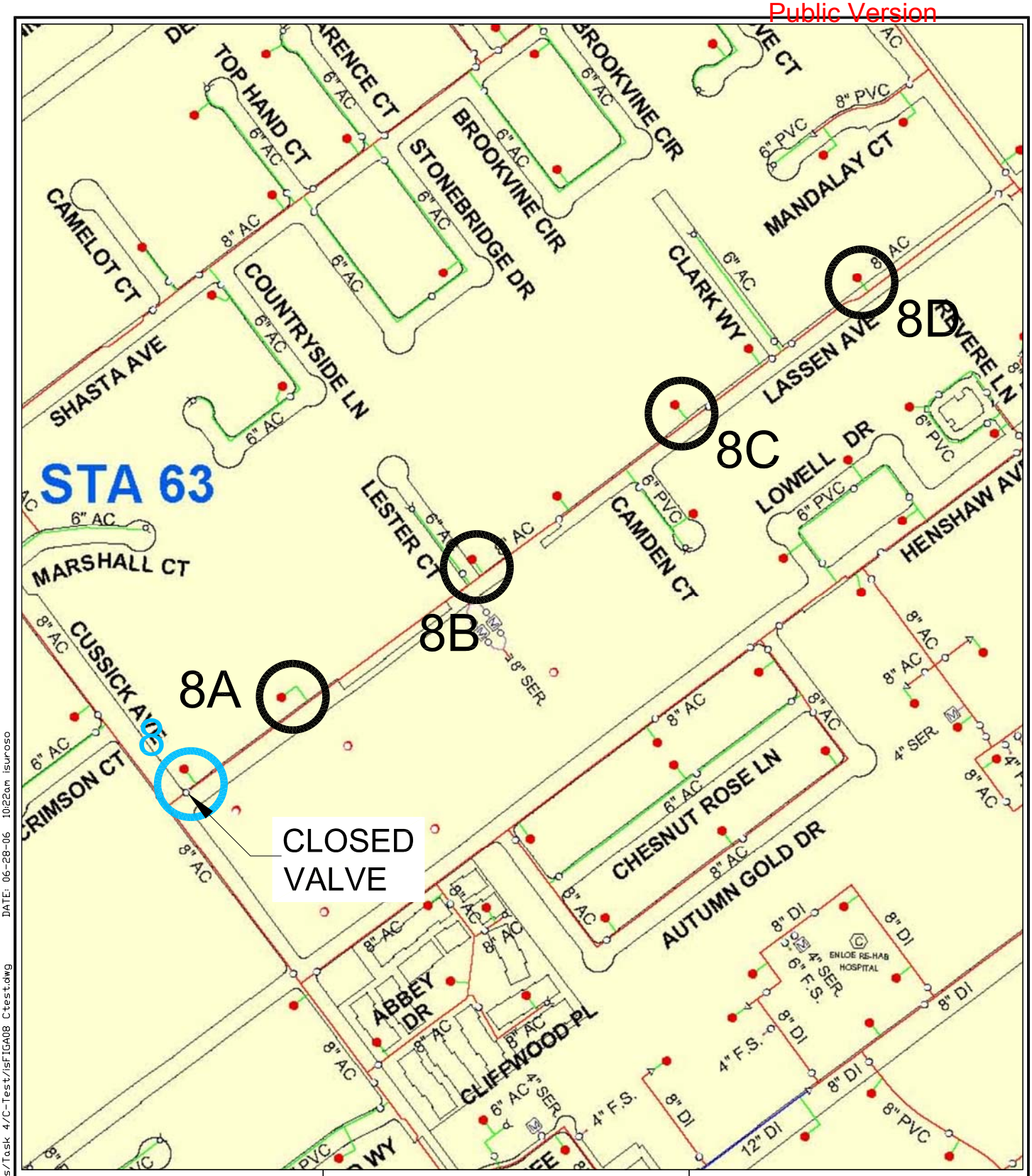
Hydrant Flow Test No. 8 was performed at Lassen Avenue, northeast of Cussick Avenue. This test was conducted to confirm the C-factor (initially assumed to equal 130) of an 8-inch diameter, AC pipeline. A comparison of the differential pressure readings predicted by the hydraulic model, compared to pressures actually measured in the field, demonstrate that the model is within ± 5 psi of the observed field value. The calibrated model results and the field data are shown in Table 6-A-8. The results of this test indicate that the use of a 130 C-factor for this type and size of pipeline is valid.

**Table 6-A-8. Hydrant Flow Test No. 8**

| Hydrant[1] | Field Data | | | Modeled Data | | | Comparison of Differential Pressures (psi) (g = c-f) |
|---|---|---|---|---|---|---|---|
| | Static Pressure (psi) (a) | Residual Pressure (psi) (b) | Differential Pressure (c = a-b) | Static Pressure (psi) (d) | Residual Pressure (psi) (e) | Differential Pressure (psi) (f = d-e) | |
| Flowing[2] | 76 | 16 | | 78 | 18 | | |
| 8A[3] | 74 | 25 | 49 | 78 | 25 | 53 | -4 |
| 8B[4] | 73 | 32 | 41 | 77 | 32 | 45 | -4 |
| 8C[5] | 72 | 44 | 28 | 76 | 44 | 32 | -4 |
| 8D[6] | 70 | 52 | 18 | 76 | 55 | 21 | -3 |

(1) Location of fire hydrants can be found on Figure A-8.
(2) The "Flowing Hydrant" is located at Lassen Avenue, northeast of Cussick Avenue.
(3) Hydrant 8A is located at Lassen Avenue, northeast of flowing hydrant.
(4) Hydrant 8B is located at Lassen Avenue, northeast of Lester Court.
(5) Hydrant 8C is located at Lassen Avenue, northeast of Camden Court.
(6) Hydrant 8D is located at Lassen Avenue, northeast of Clark Way.
NA = Not Applicable

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A8**

**HYDRANT TEST LOCATIONS JULY 2006**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585
WEST YOST ASSOCIATES Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA08 Ctest.dwg DATE: 06-28-06 10:22am isuroso

### Hydrant Flow Test No. 9

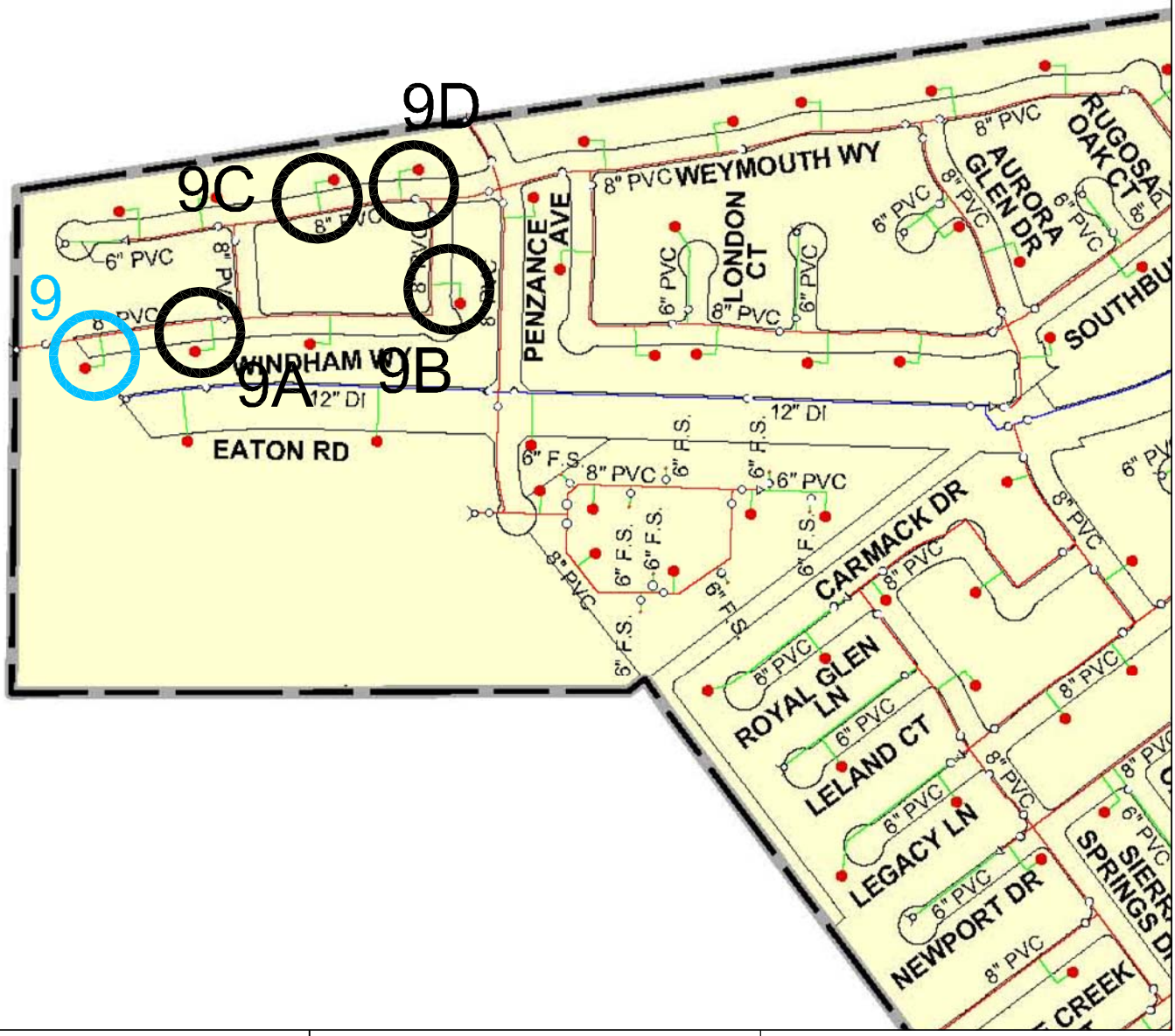
Hydrant Flow Test No. 9 was performed at Windham Way, west of Test 9A. This test was conducted to confirm the C-factor (initially assumed to equal 140) of an 8-inch diameter, PVC. A comparison of the differential pressure readings predicted by the hydraulic model, compared to pressures actually measured in the field, indicate that differential pressures are within the allowable ± 5 psi tolerance limit established for calibration. The calibrated model results and the field data are shown in Table 6-A-9.

**Table 6-A-9. Hydrant Flow Test No. 9**

| Hydrant[1] | Field Data | | | Modeled Data | | | Comparison of Differential Pressures (psi) (g = c-f) |
|---|---|---|---|---|---|---|---|
| | Static Pressure (psi) (a) | Residual Pressure (psi) (b) | Differential Pressure (c = a-b) | Static Pressure (psi) (d) | Residual Pressure (psi) (e) | Differential Pressure (psi) (f = d-e) | |
| Flowing[2] | 74 | 14 | | 101 | 46 | | |
| 9A[3] | 74 | 26 | 48 | 101 | 54 | 47 | 1 |
| 9B[4] | 78 | 35 | 43 | 101 | 61 | 40 | 3 |
| 9C[5] | 77 | 34 | 43 | 101 | 60 | 40 | 3 |
| 9D[6] | 77 | 34 | 43 | 100 | 62 | 38 | 5 |

(1) Location of fire hydrants can be found on Figure A-9.
(2) The "Flowing Hydrant" is located at Windham Way, west of Test 9A.
(3) Hydrant 9A is located at Windham Way, east of flowing hydrant.
(4) Hydrant 9B is located at Windham Way, north of the southeast corner.
(5) Hydrant 9C is located at Weymouth Way, west of Test 9D.
(6) Hydrant 9D is located at Weymouth Way, west of Penzance Avenue.
NA = Not Applicable

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A9**

**HYDRANT TEST LOCATIONS JULY 2006**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585
WEST YOST ASSOCIATES
Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA09 Ctest.dwg DATE: 06-28-06 10:22am isuroso

### Hydrant Flow Test No. 10

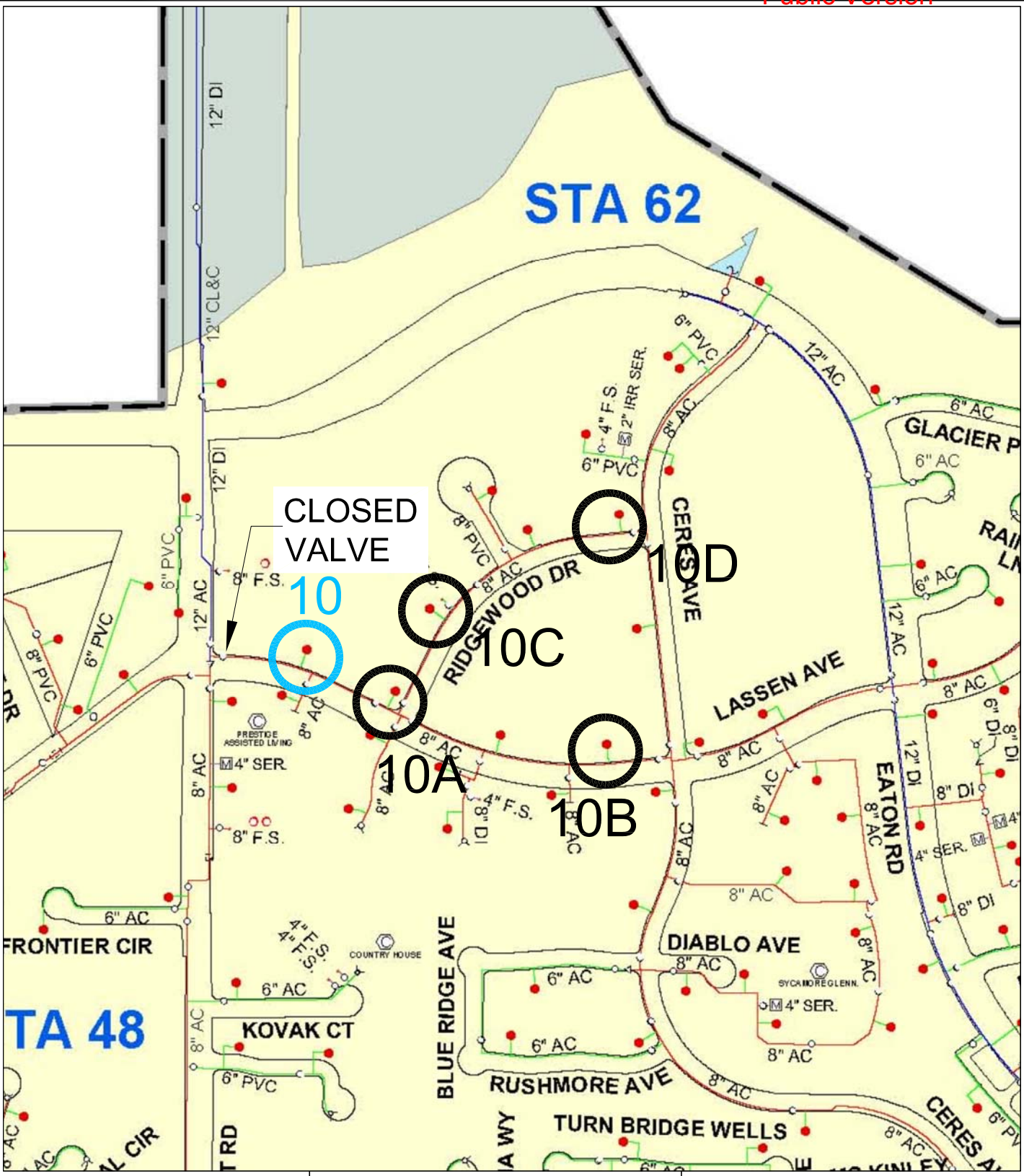
Hydrant Flow Test No. 10 was performed at Lassen Avenue, southeast of Cohasset Road. This test was conducted to confirm the C-factor (initially assumed to equal 130) of an 8-inch diameter, AC pipeline. A comparison of the differential pressure reading predicted by the hydraulic model, compared to pressures actually measured in the field, demonstrate that the model is within the allowable 5 psi tolerance limit established for calibration. The calibrated model results and the field data are shown in Table 6-A-10.

**Table 6-A-10. Hydrant Flow Test No. 10**

| Hydrant[1] | Field Data | | | Modeled Data | | | Comparison |
|---|---|---|---|---|---|---|---|
| | Static Pressure (psi) (a) | Residual Pressure (psi) (b) | Differential Pressure (c = a-b) | Static Pressure (psi) (d) | Residual Pressure (psi) (e) | Differential Pressure (psi) (f = d-e) | of Differential Pressures (psi) (g = c-f) |
| Flowing[2] | 84 | 36 | | 85 | 47 | | |
| 10A[3] | 80 | 52 | 28 | 85 | 54 | 31 | -3 |
| 10B[4] | 80 | 59 | 21 | 84 | 59 | 25 | -4 |
| 10C[5] | 78 | 54 | 24 | 84 | 56 | 29 | -5 |

(1) Location of fire hydrants can be found on Figure A-10.
(2) The "Flowing Hydrant" is located at Lassen Avenue, southeast of Cohasset Road.
(3) Hydrant 10A is located at Lassen Avenue, northwest of Ridgewood Drive.
(4) Hydrant 10B is located at Lassen Avenue, west of Ceres Avenue.
(5) Hydrant 10C is located at Ridgewood Drive, northeast of Lassen Avenue.
(6) Hydrant 10D is located at Ridgewood Drive, west of Ceres Avenue.
NA = Not Applicable

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION
- N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A10**

**HYDRANT TEST LOCATIONS JULY 2006**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585
WEST YOST ASSOCIATES
Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA10 Ctest.dwg DATE: 06-28-06 10:22am isuroso

### Hydrant Flow Test No. 11

Hydrant Flow Test No. 11 was performed at Fortress Street, northwest of Boeing Avenue. This test was conducted to confirm the C-factor (initially assumed to equal 120) of a 10-inch diameter, CI pipeline. A comparison of the differential pressure reading predicted by the hydraulic model, compared to pressures actually measured in the field, demonstrate that the model is within the allowable 5 psi tolerance limit established for calibration. The calibrated model results and the field data are shown in Table 6-A-11.

**Table 6-A-11. Hydrant Flow Test No. 11**

| Hydrant[1] | Field Data | | | Modeled Data | | | Comparison |
|---|---|---|---|---|---|---|---|
| | Static Pressure (psi) (a) | Residual Pressure (psi) (b) | Differential Pressure (c = a-b) | Static Pressure (psi) (d) | Residual Pressure (psi) (e) | Differential Pressure (psi) (f = d-e) | of Differential Pressures (psi) (g = c-f) |
| Flowing[2] | 72 | 28 | | 79 | 35 | | |
| 11A[3] | 70 | 34 | 36 | 77 | 39 | 38 | -2 |
| 11B[4] | 75 | 42 | 33 | 76 | 44 | 31 | 2 |
| 11C[5] | 76 | 44 | 32 | 75 | 47 | 28 | 4 |
| 11D[6] | 76 | 48 | 28 | 77 | 51 | 27 | 1 |

(1) Location of fire hydrants can be found on Figure A-11.
(2) The "Flowing Hydrant" is located at Fortress Street, northwest of Boeing Avenue.
(3) Hydrant 11A is located at Fortress Street, southeast of Fairchild Avenue.
(4) Hydrant 11B is located at Fortress Street, southeast of Convair Avenue.
(5) Hydrant 11C is located at Fortress Street, northwest of Convair Avenue.
(6) Hydrant 11D is located at Fortress Street, southeast of Air Park Boulevard.
NA = Not Applicable

Public Version

CLOSED VALVE

CLOSED VALVE

CLOSED VALVE

CLOSED VALVE

CLOSED VALVE

11D

11C

11B

11A

11

400

STA

LOCKHEED AVE

AIR PARK BLVD

FORTRESS ST

CONVAIR AVE

FAIRCHILD AVE

BOEING AVE

HILLER AVE

LIBERATOR ST

THUNDERBOLT ST

SIKORSKY AVE

**LEGEND:**

- FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A11**

**HYDRANT TEST LOCATIONS JULY 2006**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585

WEST YOST ASSOCIATES
Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/Revised/isFIGA11 C-test.dwg DATE: 06-28-06 10:22am isuroso

**Hydrant Flow Test No. 12**

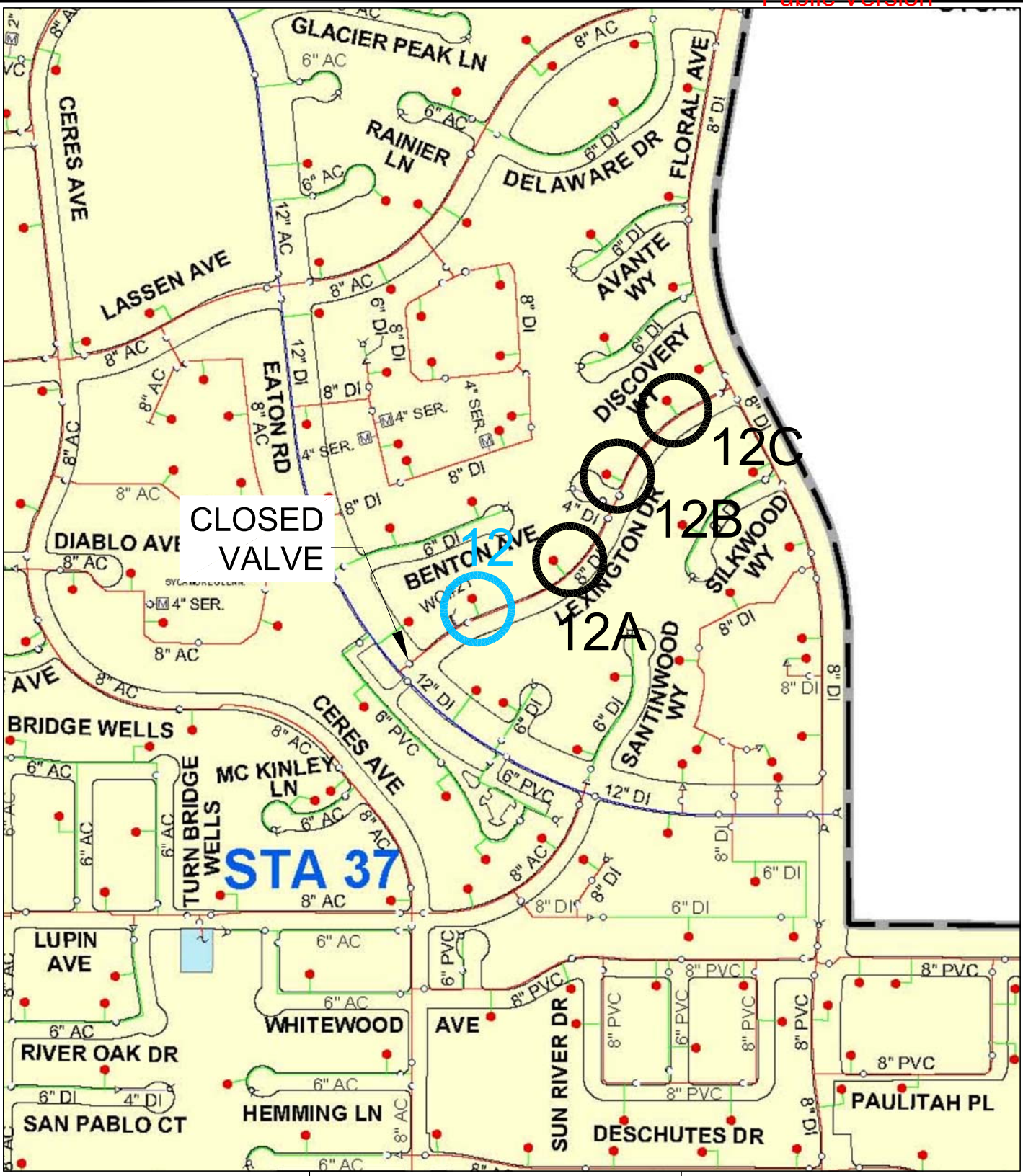
Hydrant Flow Test No. 12 was performed at Lexington Drive, northeast of Eaton Road. This test was conducted to confirm the C-factor (initially assumed to equal 130) of a 8-inch diameter, DI pipeline. A comparison of the differential pressure readings predicted by the hydraulic model, compared to pressures actually measured in the field demonstrates that the model is within ± 3 psi of the measured field value. The calibrated model results and the field data are shown in Table 6-A-12. Test results indicate that a C-factor of 130 is appropriate to use for this size and type of pipeline.

**Table 6-A-12. Hydrant Flow Test No. 12**

| Hydrant[1] | Field Data | | | Modeled Data | | | Comparison of Differential Pressures (psi) (g = c-f) |
|---|---|---|---|---|---|---|---|
| | Static Pressure (psi) (a) | Residual Pressure (psi) (b) | Differential Pressure (c = a-b) | Static Pressure (psi) (d) | Residual Pressure (psi) (e) | Differential Pressure (psi) (f = d-e) | |
| Flowing[2] | 78 | 27 | | 80 | 31 | | |
| 12A[3] | 75 | 36 | 39 | 79 | 38 | 41 | -2 |
| 12B[4] | 71 | 39 | 32 | 78 | 43 | 35 | -3 |
| 12C[5] | 76 | 49 | 28 | 77 | 51 | 26 | 1 |

(1) Location of fire hydrants can be found on Figure A-12.
(2) The "Flowing Hydrant" is located at Lexington Drive, northeast of Eaton Road.
(3) Hydrant 12A is located at Lexington Drive, northeast of flowing hydrant.
(4) Hydrant 12B is located at Lexington Drive, northeast of Test 12A.
(5) Hydrant 12C is located at Lexington Drive, southwest of Floral Avenue.
NA = Not Applicable

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A12**

**HYDRANT TEST LOCATIONS JULY 2006**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585
WEST YOST ASSOCIATES Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA12 Ctest.dwg DATE: 06-28-06 10:22am isuroso

**Hydrant Flow Test No. 13**

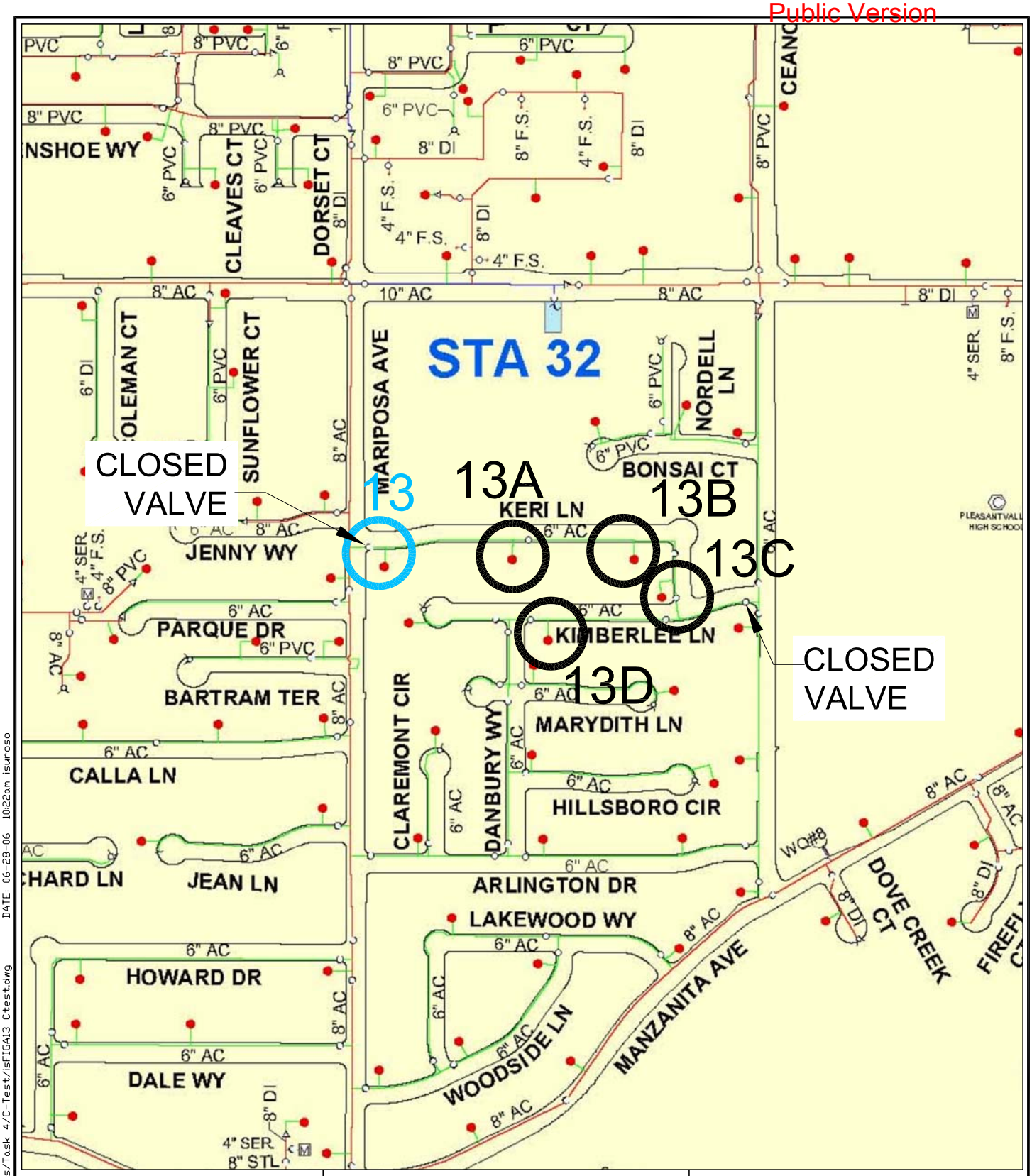
Hydrant Flow Test No. 13 was performed at Keri Lane, east of Mariposa Avenue. This test was conducted to confirm the C-factor (initially assumed to equal 130) of a 6-inch diameter, AC pipeline. A comparison of the differential pressure reading predicted by the hydraulic model, compared to pressures actually measured in the field, demonstrate that the model is within ± 2 psi of the measured field value. The calibrated model results and the field data are shown in Table 6-A-13. These results indicate that a C-factor of 130 is appropriate to use for 6-inch diameter, AC pipeline.

**Table 6-A-13. Hydrant Flow Test No. 13**

| Hydrant[1] | Field Data | | | Modeled Data | | | Comparison of Differential Pressures (psi) (g = c-f) |
|---|---|---|---|---|---|---|---|
| | Static Pressure (psi) (a) | Residual Pressure (psi) (b) | Differential Pressure (c = a-b) | Static Pressure (psi) (d) | Residual Pressure (psi) (e) | Differential Pressure (psi) (f = d-e) | |
| Flowing[2] | 54 | 5 | | 54 | 11 | | |
| 13A[3] | 50 | 10 | 40 | 52 | 14 | 38 | 2 |
| 13B[4] | 49 | 13 | 36 | 51 | 18 | 33 | 3 |
| 13C[5] | 48 | 17 | 31 | 51 | 22 | 29 | 2 |
| 13D[6] | 48 | 28 | 20 | 52 | 30 | 22 | -2 |

(1) Location of fire hydrants can be found on Figure A-13.
(2) The "Flowing Hydrant" is located at Keri Lane, east of Mariposa Avenue.
(3) Hydrant 13A is located at Keri Lane, east of flowing hydrant.
(4) Hydrant 13B is located at Keri Lane, west of northeast corner.
(5) Hydrant 13C is located at Keri Lane, north of Kimberlee Lane.
(6) Hydrant 13D is located at Kimberlee Lane, east of Danbury Way.
NA = Not Applicable

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION
- N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A13**

**HYDRANT TEST LOCATIONS JULY 2006**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585
WEST YOST ASSOCIATES Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA13 Ctest.dwg DATE: 06-28-06 10:22am lsuroso

### Hydrant Flow Test No. 14

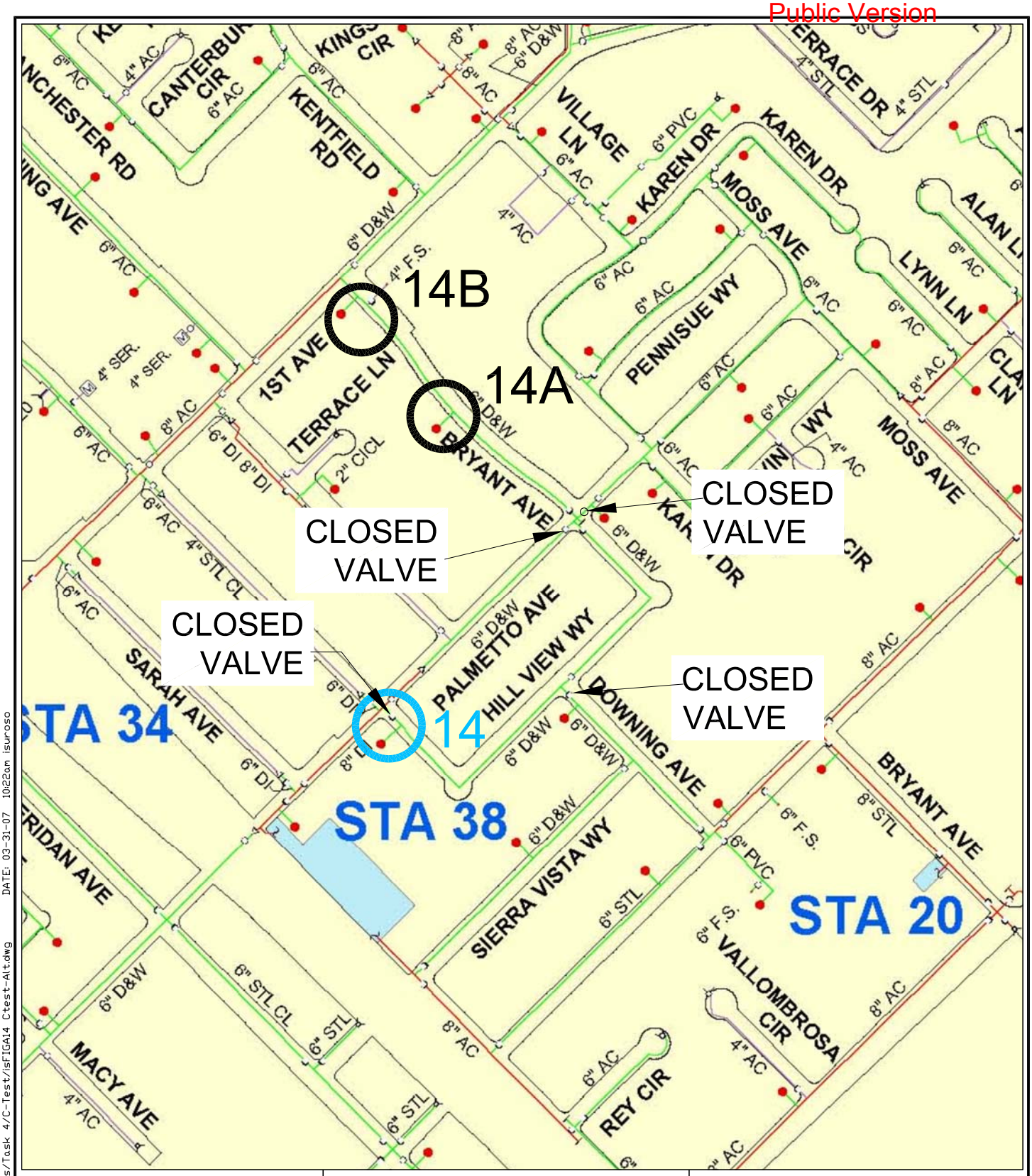
Hydrant Flow Test No. 14 was performed at Bryant Avenue, southeast of 1st Street. This test was conducted to confirm the C-factor (initially assumed to equal 120) of a 6-inch diameter, D&W pipeline. Pressure differences between the hydraulic model and the field reading are within the allowable ± 5 psi. The calibrated model results and the field data are shown in Table 6-A-14.

**Table 6-A-14. Hydrant Flow Test No. 14**

| Hydrant[1] | Field Data | | | Modeled Data | | | Comparison of Differential Pressures (psi) (g = c-f) |
|---|---|---|---|---|---|---|---|
| | Static Pressure (psi) (a) | Residual Pressure (psi) (b) | Differential Pressure (c = a-b) | Static Pressure (psi) (d) | Residual Pressure (psi) (e) | Differential Pressure (psi) (f = d-e) | |
| Flowing[2] | 64 | 3 | | 84 | 21 | | |
| 14A[3] | 64 | 50 | 14 | 83 | 66 | 17 | -3 |
| 14B[4] | 68 | 59 | 9 | 83 | 78 | 5 | 4 |

(1) Location of fire hydrants can be found on Figure A-14.
(2) The "Flowing Hydrant" is located at Hill View Way, southeast of Palmetto Avenue.
(3) Hydrant 14A is located at Bryant Avenue, northwest of Palmetto Avenue.
(4) Hydrant 14B is located at Bryant Avenue, southeast of 1st Avenue.
NA = Not Applicable

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A14**

**HYDRANT TEST LOCATIONS**
**April 2007**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585
WEST YOST ASSOCIATES
Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA14 Ctest-Alt.dwg DATE: 03-31-07 10:22am isuroso

### Hydrant Flow Test No. 15

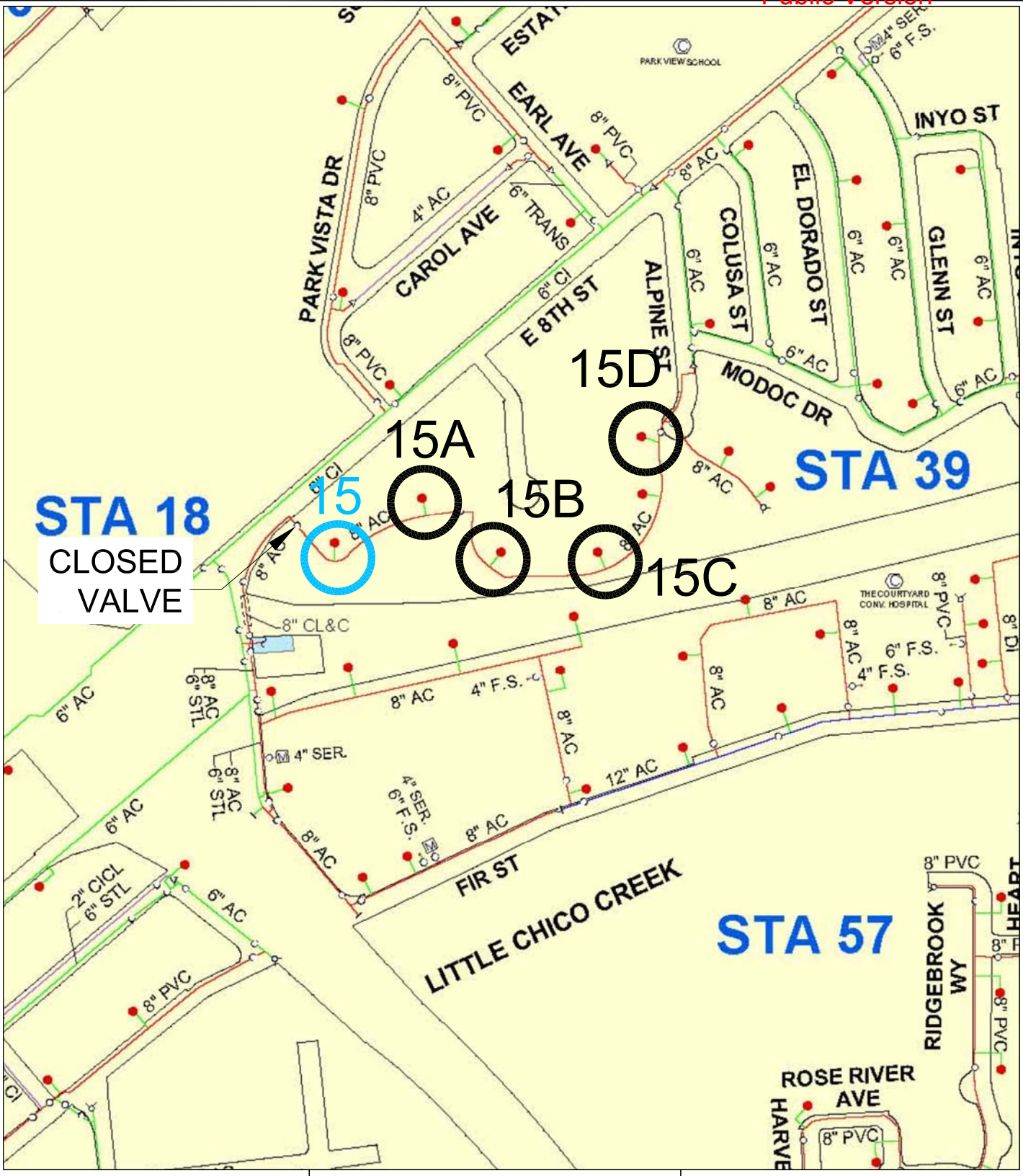
Hydrant Flow Test No. 15 was performed at the intersection of East 8th Street and State Highway 32. This test was conducted to confirm the C-factor (initially assumed to equal 130) of an 8-inch diameter, AC pipeline. A comparison of the differential pressure readings predicted by the hydraulic model, compared to pressures actually measured in the field, indicate that the differential pressures area within the allowable 5 psi tolerance limit established for calibration. The calibrated model results and the field data are shown in Table 6-A-15.

**Table 6-A-15. Hydrant Flow Test No. 15**

| Hydrant[1] | Field Data | | | Modeled Data | | | Comparison of Differential Pressures (psi) (g = c-f) |
|---|---|---|---|---|---|---|---|
| | Static Pressure (psi) (a) | Residual Pressure (psi) (b) | Differential Pressure (c = a-b) | Static Pressure (psi) (d) | Residual Pressure (psi) (e) | Differential Pressure (psi) (f = d-e) | |
| Flowing[2] | 61 | 14 | | 61 | 14 | | |
| 15A[3] | 58 | 18 | 40 | 61 | 18 | 43 | -3 |
| 15B[4] | 59 | 21 | 38 | 61 | 23 | 39 | -1 |
| 15C[5] | 58 | 26 | 32 | 60 | 26 | 34 | -2 |
| 15D[6] | 57 | 29 | 28 | 60 | 32 | 28 | 0 |

(1) Location of fire hydrants can be found on Figure A-15.
(2) The "Flowing Hydrant" is located at the intersection of East 8th Street and State Highway 32.
(3) Hydrant 15A is located northeast of Station 18, east of Test 15.
(4) Hydrant 15B is located southeast of Test 15A.
(5) Hydrant 15C is located east of Test 15B.
(6) Hydrant 15D is located northeast of Test 15C.
NA = Not Applicable

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A15**

**HYDRANT TEST LOCATIONS JULY 2006**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585
WEST YOST ASSOCIATES
Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA15 Ctest.dwg DATE: 06-28-06 10:22am isuroso

**Hydrant Flow Test No. 16**

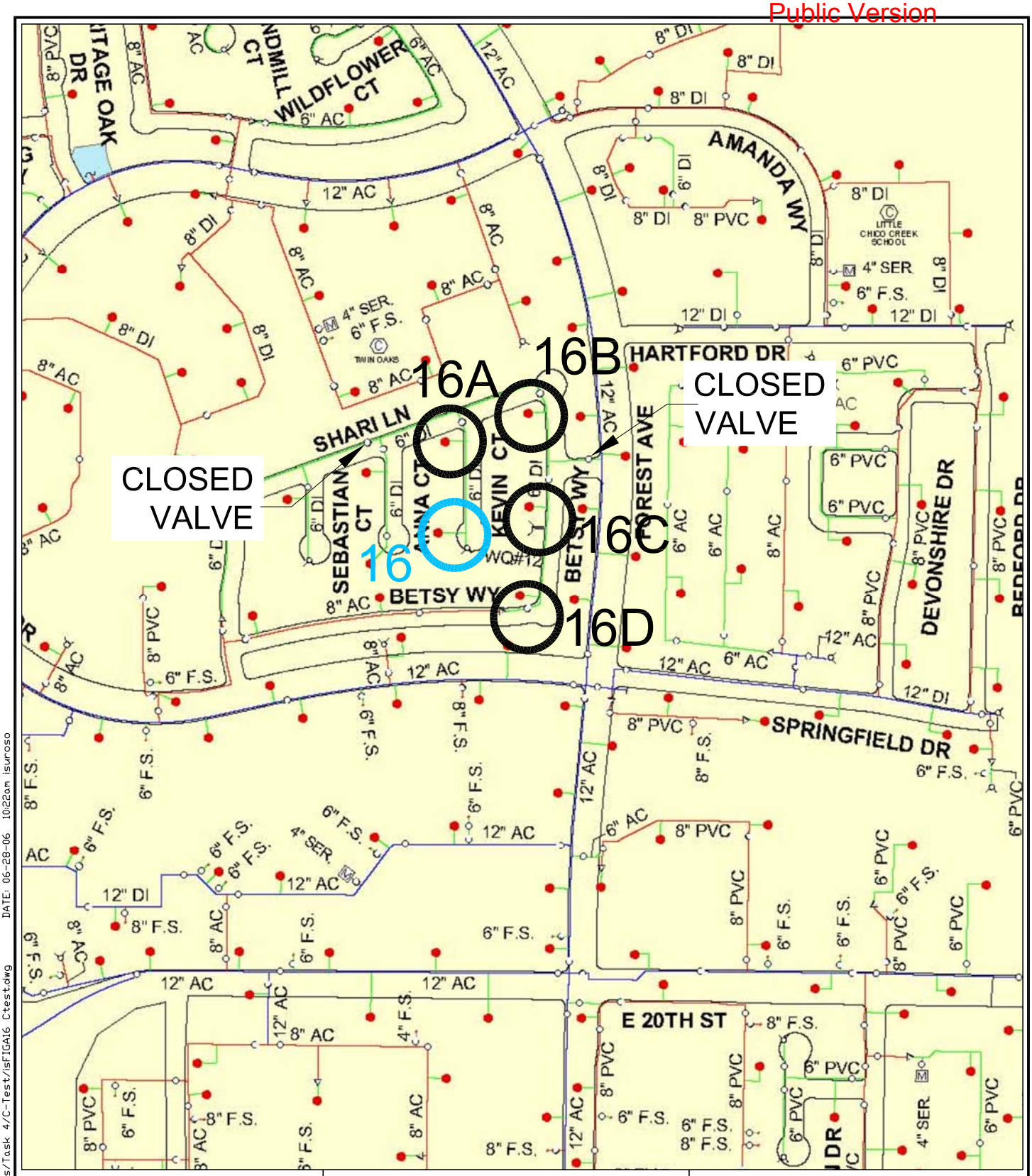
Hydrant Flow Test No. 16 was performed at the end of Kevin Court. This test was conducted to confirm the C-factor (initially assumed to equal 130) of a 6-inch diameter, DI pipeline. The preliminary results indicate that the C-factor is low for this type of pipeline. The C-factor was then increased to 135. A comparison of the differential pressure readings predicted by the hydraulic model, compared to pressures actually measured in the field, demonstrate that the model is within ± 4 psi of the measured field value. Results from this test indicate that the use of a C-factor equal of 135 for this size and type of pipeline is valid. The calibrated model results and the field data are shown in Table 6-A-16.

**Table 6-A-16. Hydrant Flow Test No. 16**

| | Field Data | | | Modeled Data | | | Comparison of Differential Pressures (psi) (g = c-f) |
|---|---|---|---|---|---|---|---|
| Hydrant[1] | Static Pressure (psi) (a) | Residual Pressure (psi) (b) | Differential Pressure (c = a-b) | Static Pressure (psi) (d) | Residual Pressure (psi) (e) | Differential Pressure (psi) (f = d-e) | |
| Flowing[2] | 61 | 8 | | 57 | -6 | | |
| 16A[3] | 60 | 14 | 46 | 57 | 7 | 50 | -4 |
| 16B[4] | 60 | 23 | 37 | 56 | 17 | 39 | -2 |
| 16C[5] | 60 | 32 | 28 | 56 | 26 | 30 | -2 |
| 16D[6] | 59 | 39 | 20 | 57 | 36 | 20 | 0 |

(1) Location of fire hydrants can be found on Figure A-16.
(2) The "Flowing Hydrant" is located at the end of Kevin Court.
(3) Hydrant 16A is located at Kevin Court, south of Shari Lane.
(4) Hydrant 16B is located west of Betsy Way, south of Shari Lane.
(5) Hydrant 16C is located at the middle of Betsy Way.
(6) Hydrant 16D is located at the southeast corner of Betsy Way
NA = Not Applicable

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A16**

**HYDRANT TEST LOCATIONS JULY 2006**

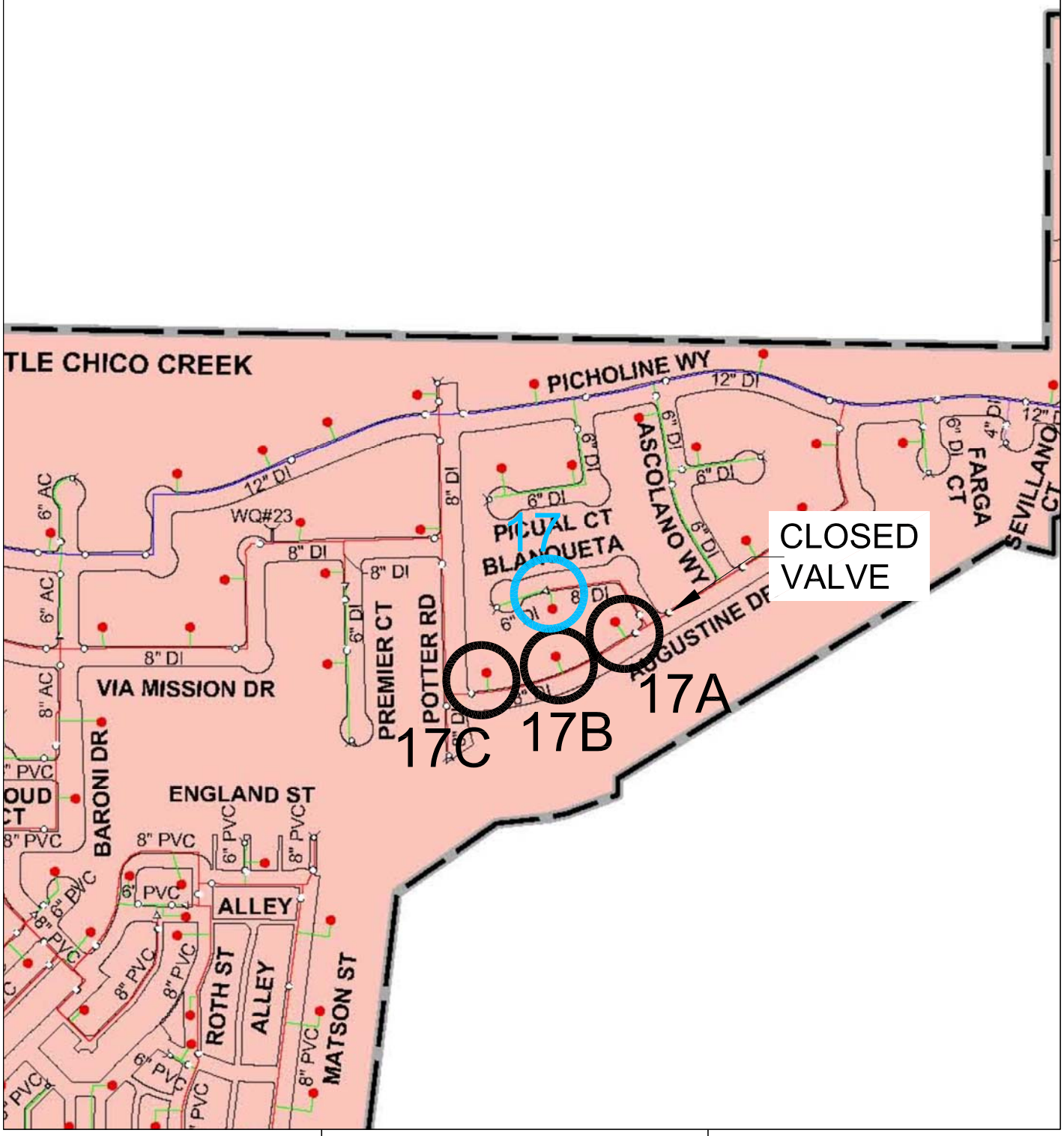
CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585
WEST YOST ASSOCIATES Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA16 Ctest.dwg DATE: 06-28-06 10:22am isuroso

**Hydrant Flow Test No. 17**

Hydrant Flow Test No. 17 was not performed due to time constraint. There were tests performed for this size and type of pipeline (8-inch, ductile iron pipeline).

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A17**

**HYDRANT TEST LOCATIONS JULY 2006**

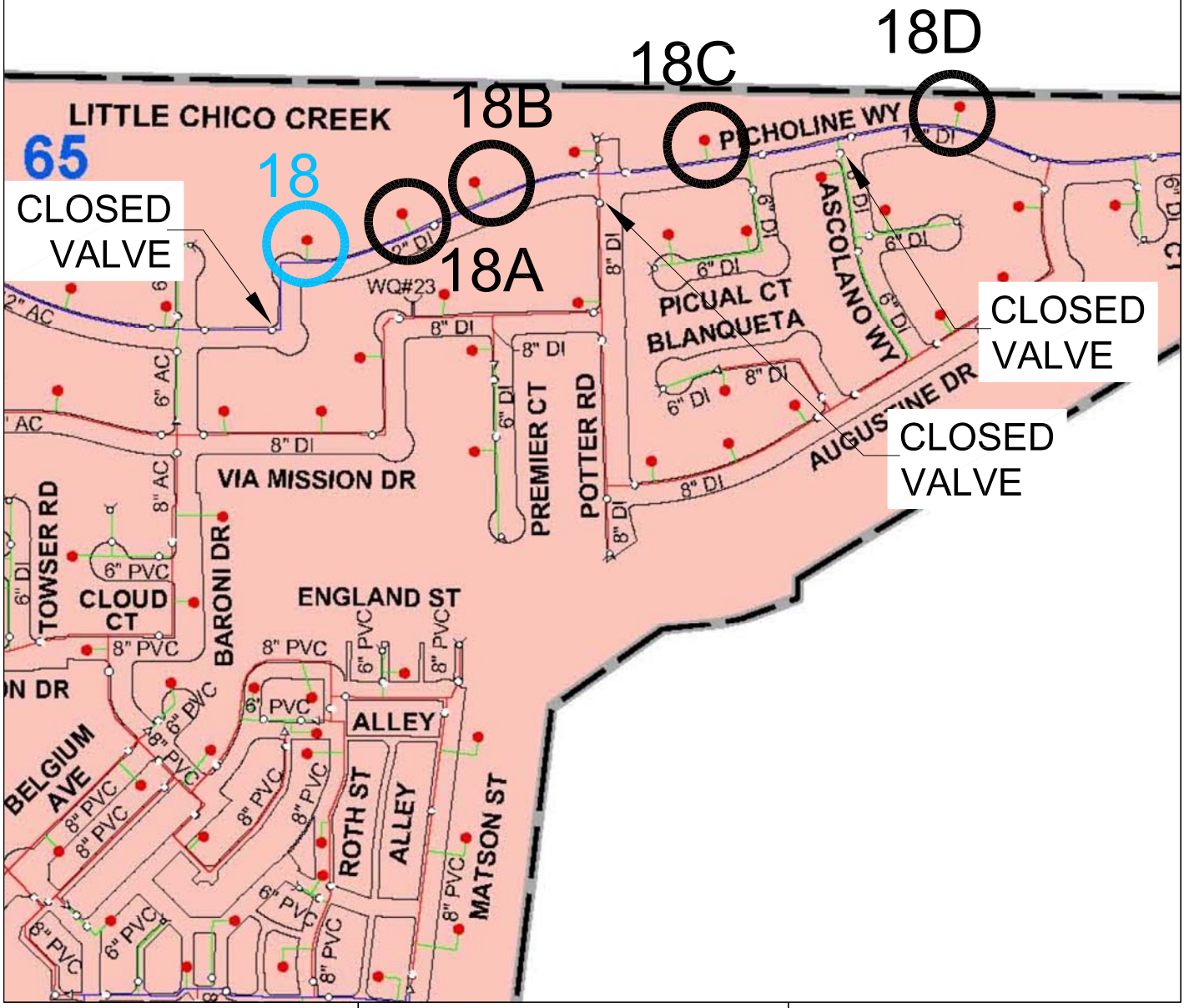
CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585
WEST YOST ASSOCIATES
Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA17 Ctest.dwg DATE: 06-28-06 10:22am isuroso

**Hydrant Flow Test No. 18**

Hydrant Flow Test No. 18 was not performed due to time constraint. There were tests performed for this size and type of pipeline (12-inch, ductile iron pipeline).

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A18**

**HYDRANT TEST LOCATIONS JULY 2006**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585
WEST YOST ASSOCIATES
Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA18 Ctest.dwg DATE: 06-28-06 10:22am isuroso

### Hydrant Flow Test No. 19

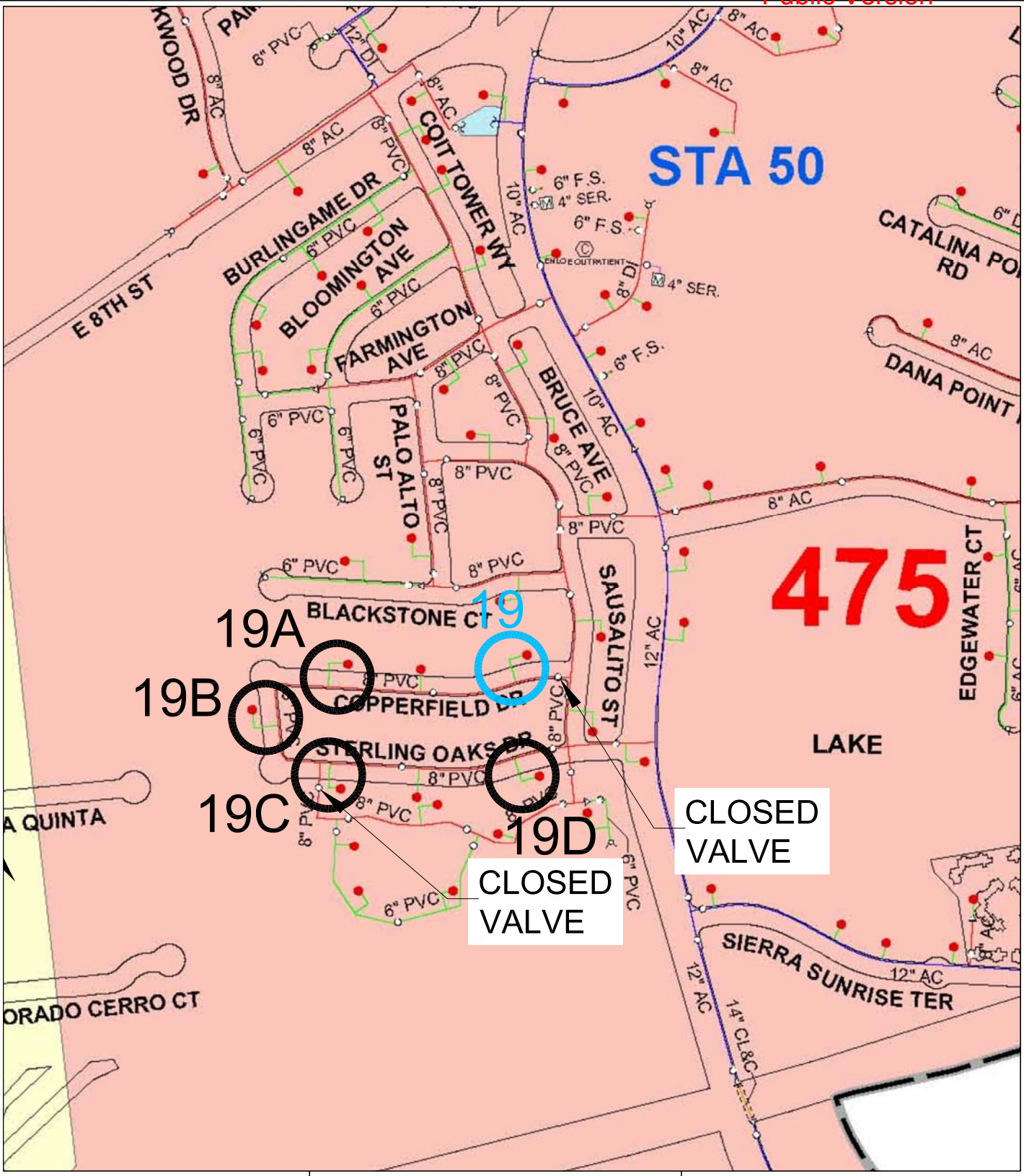
Hydrant Flow Test No. 19 was performed at Copperfield Drive, west of Sausalito Street. This test was conducted to confirm the C-factor (initially assumed to equal 140) of an 8-inch diameter, PVC pipeline. A comparison of the differential pressure readings predicted by the hydraulic model, compared to pressures actually measured in the field, demonstrate that the model is within ± 5 psi of the measured field value. The calibrated model results and the field data are shown in Table 6-A-19. Results from this test indicate that the use of a C-factor equal of 140 for this size and type of pipeline is valid.

**Table 6-A-19. Hydrant Flow Test No. 19**

| Hydrant[1] | Field Data | | | Modeled Data | | | Comparison of Differential Pressures (psi) (g = c-f) |
|---|---|---|---|---|---|---|---|
| | Static Pressure (psi) (a) | Residual Pressure (psi) (b) | Differential Pressure (c = a-b) | Static Pressure (psi) (d) | Residual Pressure (psi) (e) | Differential Pressure (psi) (f = d-e) | |
| Flowing[2] | 121 | 39 | | 118 | 37 | | |
| 19A[3] | 120 | 60 | 60 | 117 | 53 | 64 | -4 |
| 19B[4] | 120 | 67 | 53 | 118 | 62 | 56 | -3 |
| 19C[5] | 120 | 74 | 46 | 118 | 70 | 49 | -3 |
| 19D[6] | 120 | 89 | 31 | 118 | 87 | 31 | 0 |

(1) Location of fire hydrants can be found on Figure A-19.
(2) The "Flowing Hydrant" is located at Copperfield Drive, west of Sausalito Street.
(3) Hydrant 19A is located at Copperfield Drive, west of Sausalito Street.
(4) Hydrant 19B is located at Copperfield Drive, north of Sterling Oaks Drive.
(5) Hydrant 19C is located at Sterling Oaks Drive, east of Copperfield Drive.
(6) Hydrant 19D is located at Sterling Oaks Drive, west of Sausalito Street.
NA = Not Applicable

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- □ VALVE LOCATION

N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A19**

**HYDRANT TEST LOCATIONS JULY 2006**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585
WEST YOST ASSOCIATES
Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA19 Ctest.dwg DATE: 06-28-06 10:22am isuroso

**Hydrant Flow Test No. 20**

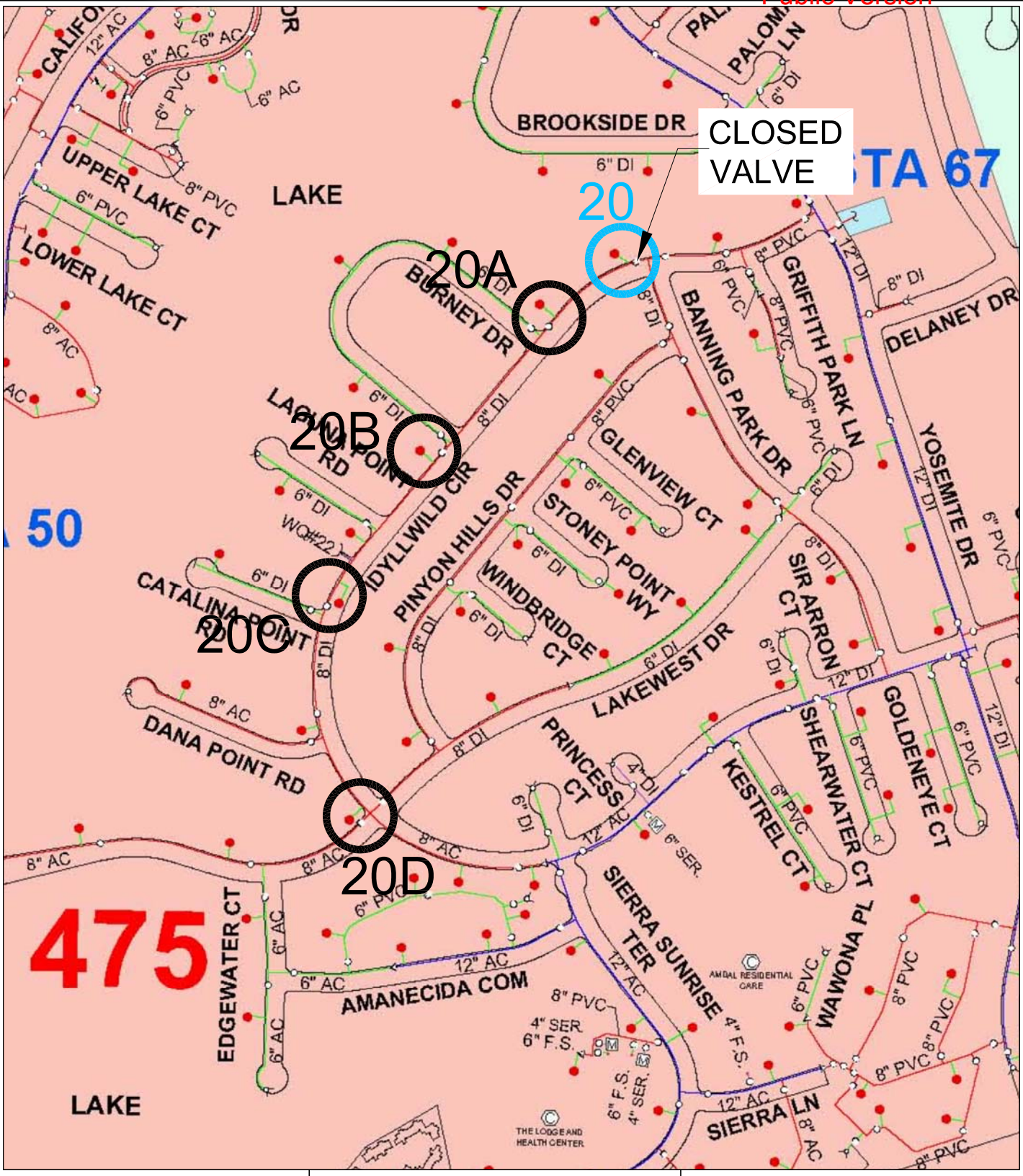
Hydrant Flow Test No. 20 was performed at Idyllwild Circle, southwest of Banning Park Drive. This test was conducted to confirm the C-factor (initially assumed to equal 130) of an 8-inch diameter, DI pipeline. A comparison of the differential pressure readings predicted by the hydraulic model, compared to pressures actually measured in the field, demonstrate that the model is within the allowable ± 5 psi tolerance limit. The calibrated model results and the field data are shown in Table 6-A-20.

**Table 6-A-20. Hydrant Flow Test No. 20**

| Hydrant[1] | Field Data | | | Modeled Data | | | Comparison of Differential Pressures (psi) (g = c-f) |
|---|---|---|---|---|---|---|---|
| | Static Pressure (psi) (a) | Residual Pressure (psi) (b) | Differential Pressure (c = a-b) | Static Pressure (psi) (d) | Residual Pressure (psi) (e) | Differential Pressure (psi) (f = d-e) | |
| Flowing[2] | 70 | 20 | | 69 | 14 | | |
| 20A[3] | 74 | 30 | 44 | 75 | 28 | 47 | -3 |
| 20B[4] | 83 | 48 | 35 | 82 | 43 | 39 | -4 |
| 20C[5] | 90 | 64 | 26 | 90 | 66 | 24 | 2 |
| 20D[6] | 90 | 76 | 14 | 85 | 76 | 9 | 5 |

(1) Location of fire hydrants can64 be found on Figure A-20.
(2) The "Flowing Hydrant" is located at Idyllwild Circle, southwest of Banning Park Drive.
(3) Hydrant 20A is located at Idyllwild Circle, northeast of Burney Drive.
(4) Hydrant 20B is located at Idyllwild Circle, northeast of Laguna Point Road.
(5) Hydrant 20C is located at Idyllwild Drive, north of Catalina Point Road.
(6) Hydrant 20D is located at Idyllwild Circle, northwest of Lakewest Drive.
NA = Not Applicable

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CALIFORNIA WATER SERVICE CO.

**CAL WATER SERVICES CO**
**CHICO-HAMILTON CITY DISTRICT**

**FIGURE A20**

**HYDRANT TEST LOCATIONS**
**JULY 2006**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585

WEST YOST ASSOCIATES
Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA20 Ctest.dwg DATE: 06-28-06 10:22am isuroso

**Hydrant Flow Test No. 21**

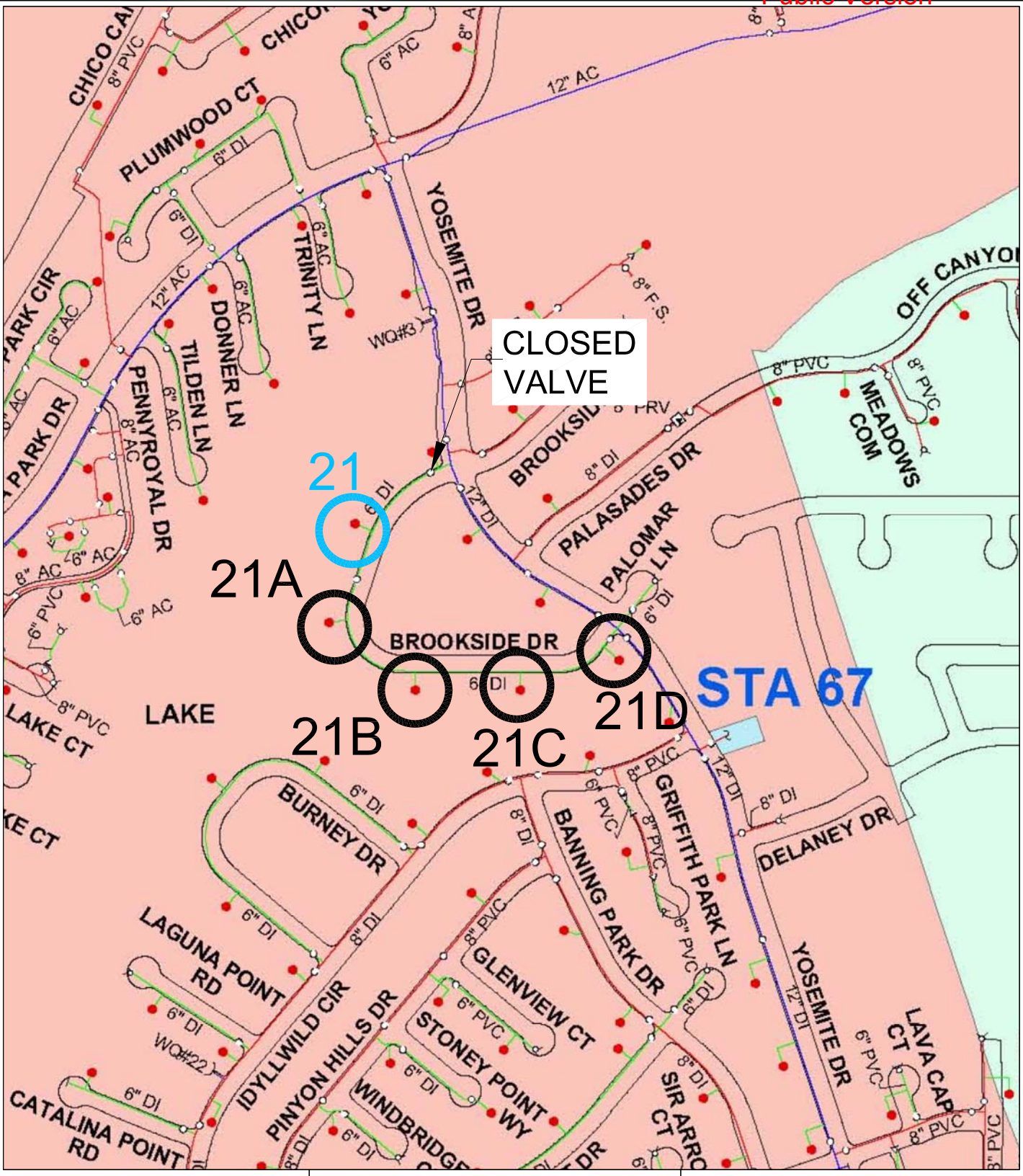
Hydrant Flow Test No. 21 was performed at the north end of Brookside Drive, southwest of Yosemite Drive. This test was conducted to confirm the C-factor (initially assumed to equal 130) of a 6-inch diameter, DI pipeline. The preliminary C-factor assigned to this pipeline is low. The C factor is increased to 135. A comparison of the differential pressure readings predicted by the hydraulic model, compared to pressures actually measured in the field, demonstrate that the model is within the allowable 5 psi tolerance limit. The calibrated model results and the field data are shown in Table 6-A-21.

**Table 6-A-21. Hydrant Flow Test No. 21**

| Hydrant[1] | Field Data | | | Modeled Data | | | Comparison of Differential Pressures (psi) (g = c-f) |
|---|---|---|---|---|---|---|---|
| | Static Pressure (psi) (a) | Residual Pressure (psi) (b) | Differential Pressure (c = a-b) | Static Pressure (psi) (d) | Residual Pressure (psi) (e) | Differential Pressure (psi) (f = d-e) | |
| Flowing[2] | 89 | 14 | | 84 | 14 | | |
| 20A[3] | 89 | 28 | 61 | 87 | 31 | 57 | 4 |
| 20B[4] | 87 | 39 | 48 | 87 | 44 | 43 | 5 |
| 20C[5] | 82 | 50 | 32 | 81 | 54 | 27 | 5 |
| 20D[6] | 75 | 61 | 14 | 76 | 65 | 11 | 3 |

(1) Location of fire hydrants can be found on Figure A-21.
(2) The "Flowing Hydrant" is located at the north end of Brookside Drive, southwest of Yosemite Drive.
(3) Hydrant 20A is located at Brookside Drive, southwest of flowing hydrant.
(4) Hydrant 20B is located east of the southwest corner of Brookside Drive.
(5) Hydrant 20C is located at Brookside Drive, east of Test 21B.
(6) Hydrant 20D is located at Brookside Drive, southwest of Yosemite Drive.
NA = Not Applicable

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A21**

**HYDRANT TEST LOCATIONS JULY 2006**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585
WEST YOST ASSOCIATES Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA21 Ctest.dwg DATE: 06-28-06 10:22am isuroso

**Hydrant Flow Test No. 22**

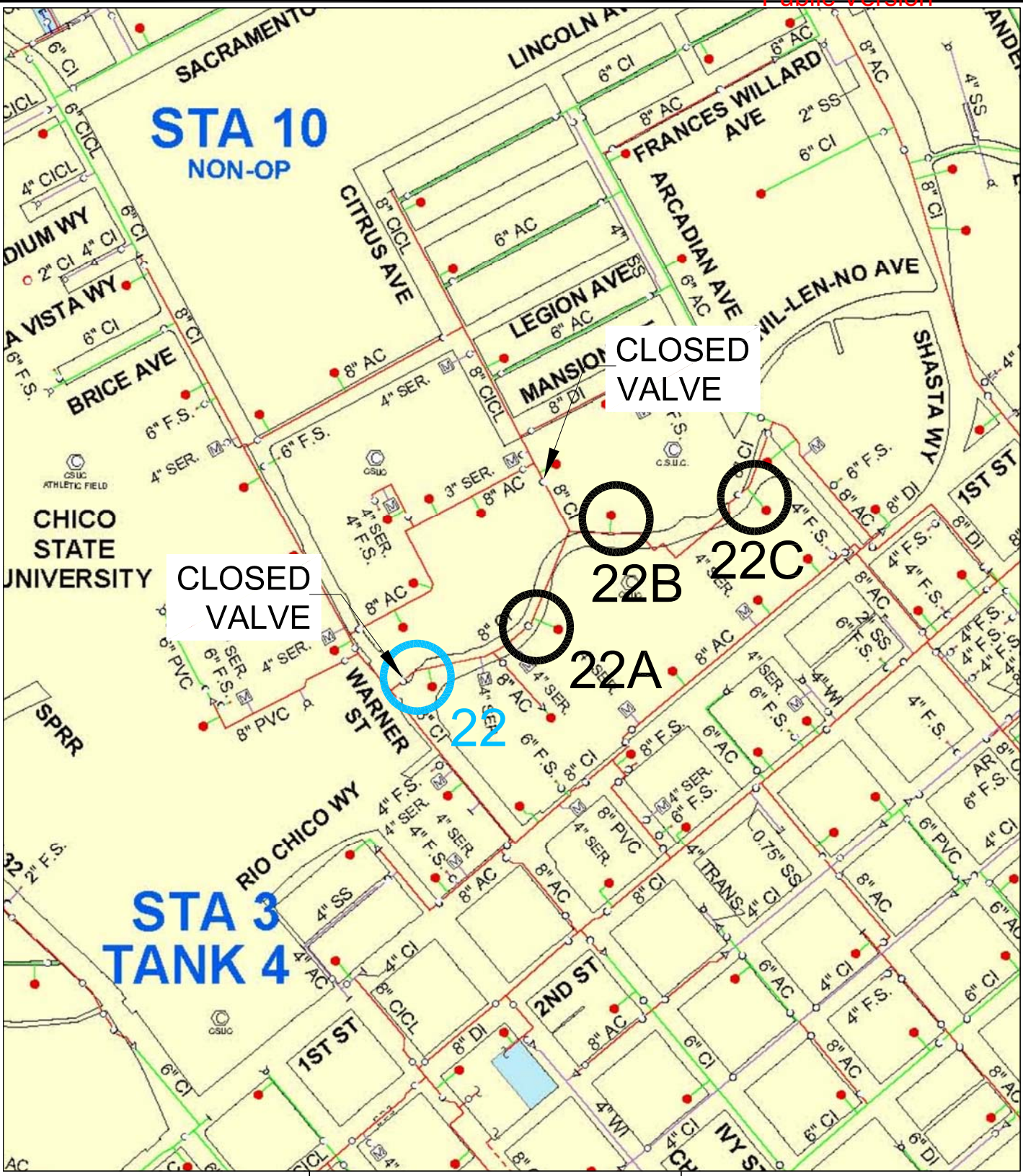
Hydrant Flow Test No. 22 was performed at Warner Street, between 1st Street and Legion Avenue. This test was conducted to confirm the C-factor (initially assumed to equal 110) of an 8-inch diameter, CI pipeline. The preliminary C-factor assigned for this type of pipeline is low. The C-factor is increased to 120. A comparison of the differential pressure readings predicted by the hydraulic model, compared to pressures actually measured in the field, demonstrate that the model is within the allowable 5 psi tolerance limit. The calibrated model results and the field data are shown in Table 6-A-22.

**Table 6-A-22. Hydrant Flow Test No. 22**

| Hydrant[1] | Field Data | | | Modeled Data | | | Comparison of Differential Pressures (psi) (g = c-f) |
|---|---|---|---|---|---|---|---|
| | Static Pressure (psi) (a) | Residual Pressure (psi) (b) | Differential Pressure (c = a-b) | Static Pressure (psi) (d) | Residual Pressure (psi) (e) | Differential Pressure (psi) (f = d-e) | |
| Flowing[2] | 70 | 20 | | 62 | 13 | 49 | |
| 22A[3] | 70 | 30 | 40 | 61 | 19 | 42 | -2 |
| 22B[4] | 76 | 44 | 32 | 60 | 28 | 32 | 0 |
| 22C[5] | 68 | 46 | 22 | 60 | 41 | 19 | 3 |

(1) Location of fire hydrants can be found on Figure A-22.
(2) The "Flowing Hydrant" is located at Warner Street, between 1st Street and Legion Avenue.
(3) Hydrant 22A is located east of flowing hydrant 22.
(4) Hydrant 22B is located east of hydrant 22A.
(5) Hydrant 22C is located east of hydrant 22B.
NA = Not Applicable

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A22**

**HYDRANT TEST LOCATIONS JULY 2006**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585
WEST YOST ASSOCIATES
Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA22 Ctest.dwg DATE: 06-28-06 10:22am isuroso

**Hydrant Flow Test No. 23**

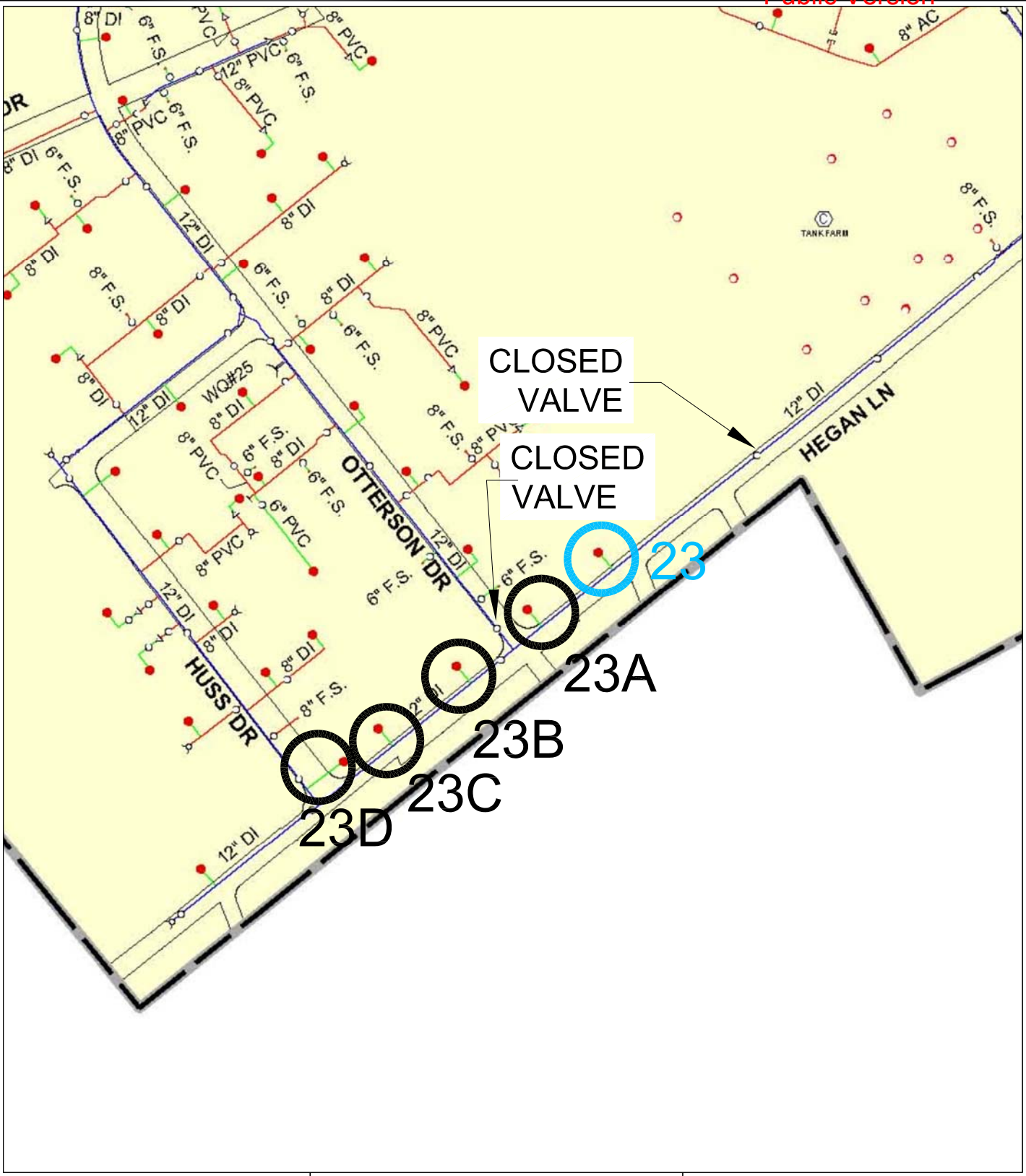
Hydrant Flow Test No. 23 was performed at Hegan Lane, northeast of Test 23A. This test was conducted to confirm the C-factor (initially assumed to equal 140) of a 12-inch diameter, DI pipeline. During the C-factor test, Hydrant 23A was used for HPR which was set to record pressure every 5 minutes. Due to the small interval, pressure record from HPR could not be used in this calibration process; consequently, no comparison of differential pressure was recorded for Hydrant 23A. Pressure differences between the hydraulic model and the field reading are within 5 psi. The calibrated model results and the field data are shown in Table 6-A-23. Results from this test indicate that the use of C-factor equal of 140 for this size and type of pipeline is valid.

**Table 6-A-23. Hydrant Flow Test No. 23**

| Hydrant[1] | Field Data | | | Modeled Data | | | Comparison of Differential Pressures (psi) (g = c-f) |
|---|---|---|---|---|---|---|---|
| | Static Pressure (psi) (a) | Residual Pressure (psi) (b) | Differential Pressure (c = a-b) | Static Pressure (psi) (d) | Residual Pressure (psi) (e) | Differential Pressure (psi) (f = d-e) | |
| Flowing[2] | 72 | 37 | | 63 | 30 | | |
| 23A[3] | NA | NA | NA | 63 | 32 | 31 | NA |
| 23B[4] | 72 | 46 | 26 | 63 | 33 | 30 | -4 |
| 23C[5] | 73 | 49 | 24 | 64 | 35 | 29 | -5 |
| 23D[6] | 73 | 49 | 24 | 64 | 36 | 28 | -4 |

(1) Location of fire hydrants can be found on Figure A-23.
(2) The "Flowing Hydrant" is located at Hegan Lane, northeast of Test 23A.
(3) Hydrant 23A is located at Hegan Lane, northeast of Otterson Drive.
(4) Hydrant 23B is located Hegan Lane, southwest of Otterson Drive.
(5) Hydrant 23C is located Hegan Lane, northwest of Huss Drive.
(6) Hydrant 23D is located Huss Drive, northwest of Hegan Drive.
NA = Not Applicable

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A23**

**HYDRANT TEST LOCATIONS JULY 2006**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585
WEST YOST ASSOCIATES
Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA23 Ctest.dwg DATE: 06-28-06 10:22am isuroso

**Hydrant Flow Test No. 24**

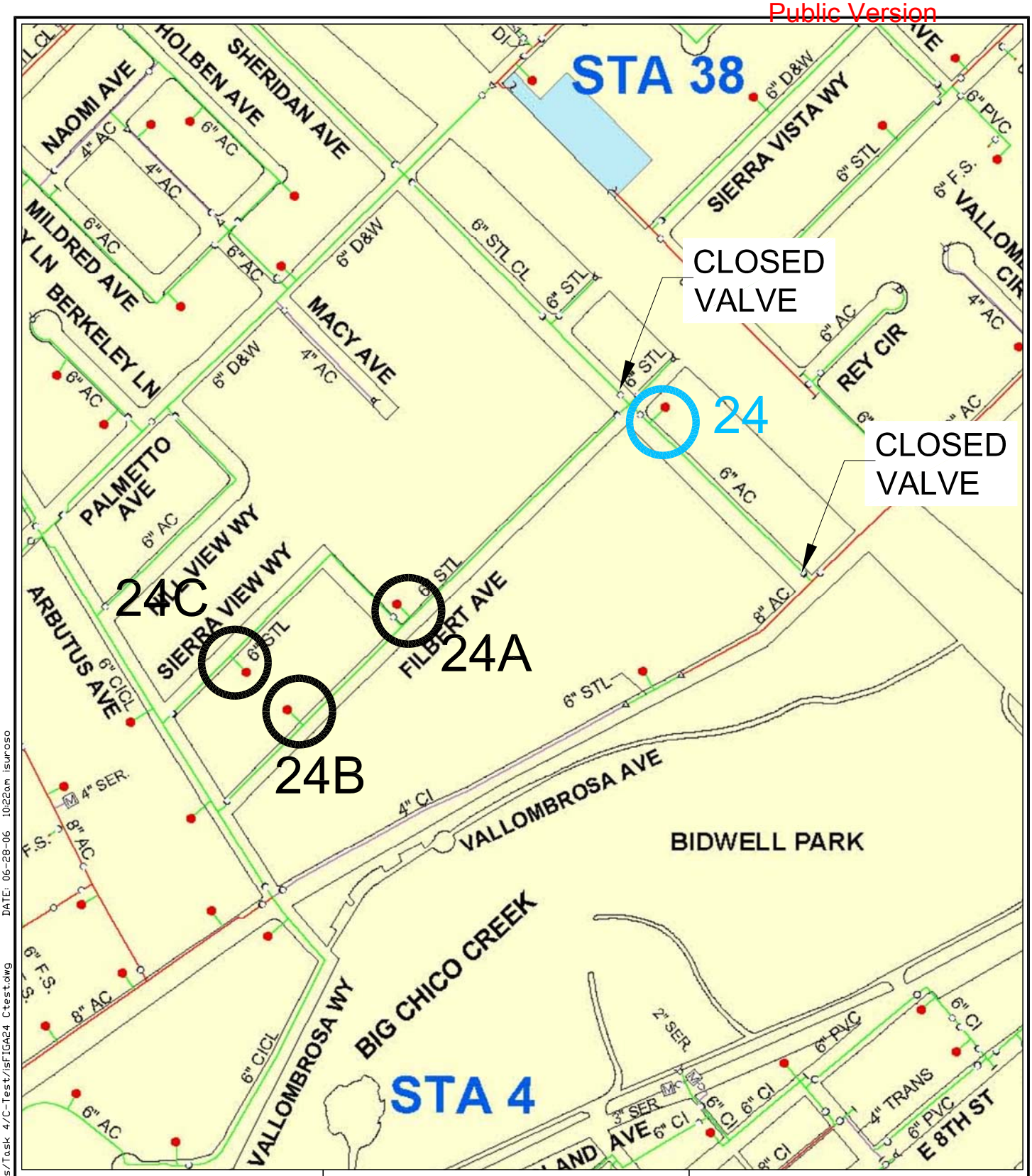
Hydrant Flow Test No. 24 was performed at Sheridan Avenue, southeast of Filbert Avenue. This test was conducted to confirm the C-factor (initially assumed to equal 120) of a 6-inch diameter, steel pipeline. A comparison of the differential pressure readings predicted by the hydraulic model, compared to pressures actually measured in the field, demonstrate that the model is within ± 1 psi of the measured field value. The calibrated model results and the field data are shown in Table 6-A-24. Results from this test indicate that the use of a C-factor equal of 120 for this size and type of pipeline is valid.

**Table 6-A-24. Hydrant Flow Test No. 24**

| Hydrant[1] | Field Data | | | Modeled Data | | | Comparison of Differential Pressures (psi) (g = c-f) |
|---|---|---|---|---|---|---|---|
| | Static Pressure (psi) (a) | Residual Pressure (psi) (b) | Differential Pressure (c = a-b) | Static Pressure (psi) (d) | Residual Pressure (psi) (e) | Differential Pressure (psi) (f = d-e) | |
| Flowing[2] | 62 | 6 | | 50 | 8 | | |
| 24A[3] | 60 | 42 | 18 | 51 | 34 | 18 | 0 |
| 24B[4] | 62 | 49 | 13 | 52 | 38 | 14 | -1 |
| 24C[5] | 60 | 48 | 12 | 53 | 39 | 13 | -1 |

(1) Location of fire hydrants can be found on Figure A-24.
(2) The "Flowing Hydrant" is located at Sheridan Avenue, southeast of Filbert Avenue.
(3) Hydrant 24A is located at Filbert Avenue, northeast of Sierra View Way.
(4) Hydrant 24B is located at Filbert Avenue, northeast of Arbutus Avenue.
(5) Hydrant 24C is located at Sierra View Way, northeast of Arbutus Avenue.
NA = Not Applicable

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A24**

**HYDRANT TEST LOCATIONS JULY 2006**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585
WEST YOST ASSOCIATES
Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA24 Ctest.dwg DATE: 06-28-06 10:22am isuroso

**Hydrant Flow Test No. 25**

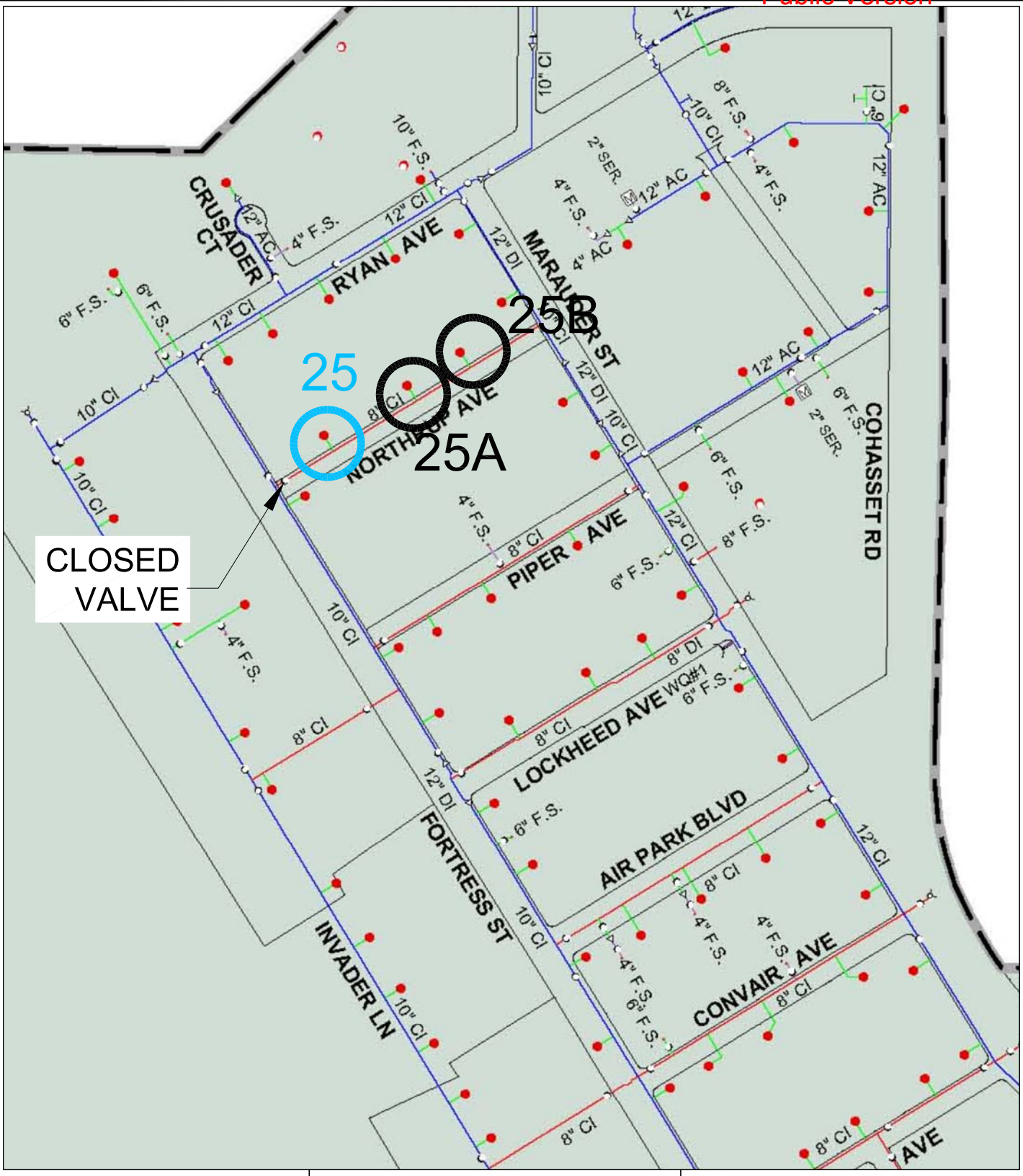
Hydrant Flow Test No. 25 was performed at Northrup Avenue, northeast of Fortress Street. This test was conducted to confirm the C-factor (initially assumed to equal 100) of an 8-inch diameter, CI pipeline. The preliminary C-factor used for this type of pipeline is low. The C-factor was increased to 120. A comparison of the differential pressure readings predicted by the hydraulic model, compared to pressures actually measured in the field, demonstrate that the model is within ± 2 psi of the measured field value. The calibrated model results and the field data are shown in Table 6-A-25. Results from this test indicate that the use of a C-factor equal of 120 for this size and type of pipeline is valid.

**Table 6-A-25. Hydrant Flow Test No. 25**

| Hydrant[1] | Field Data | | | Modeled Data | | | Comparison of Differential Pressures (psi) (g = c-f) |
|---|---|---|---|---|---|---|---|
| | Static Pressure (psi) (a) | Residual Pressure (psi) (b) | Differential Pressure (c = a-b) | Static Pressure (psi) (d) | Residual Pressure (psi) (e) | Differential Pressure (psi) (f = d-e) | |
| Flowing[2] | 70 | 22 | | 66 | 12 | | |
| 25A[3] | 64 | 22 | 42 | 65 | 25 | 40 | 2 |
| 25B[4] | 62 | 32 | 30 | 64 | 33 | 32 | -2 |

(1) Location of fire hydrants can be found on Figure A-25.
(2) The "Flowing Hydrant" is located at Northrup Avenue, northeast of Fortress Street.
(3) Hydrant 25A is located at Northrup Avenue, northeast of flowing hydrant.
(4) Hydrant 25B is located at Northrup Avenue, southwest of Marauder Street.
NA = Not Applicable

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A25**

**HYDRANT TEST LOCATIONS JULY 2006**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585

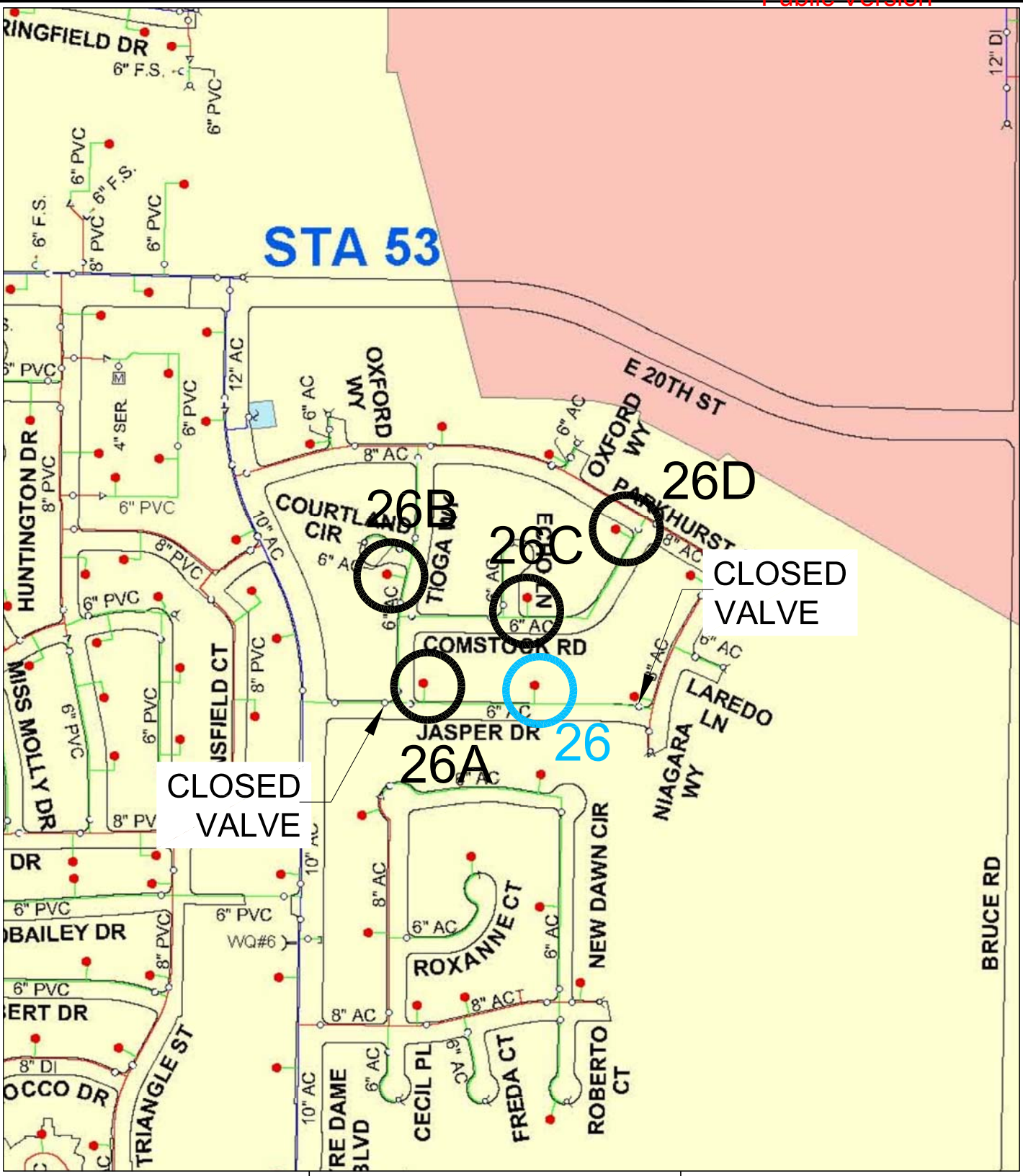
WEST YOST ASSOCIATES
Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/Revised/isFIGA25 Ctest.dwg DATE: 06-28-06 10:22am isuroso

**Hydrant Flow Test No. 26**

Hydrant Flow Test No. 26 was not performed due to time constraint. There were tests performed for this size and type of pipeline (6-inch, AC pipeline).

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A26**

**HYDRANT TEST LOCATIONS JULY 2006**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585
WEST YOST ASSOCIATES Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA26 Ctest.dwg DATE: 06-28-06 10:22am isuroso

**Hydrant Flow Test No. 27**

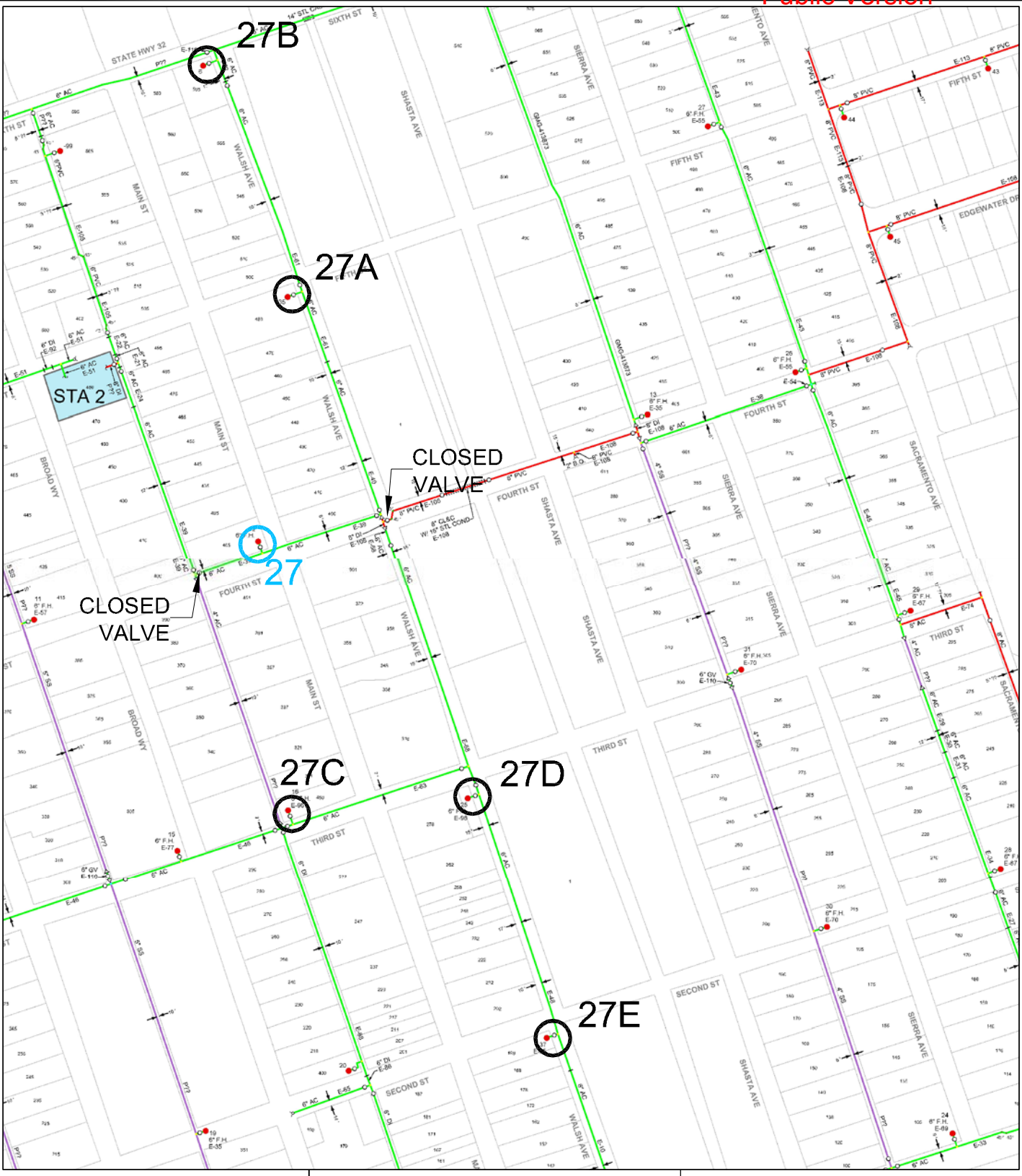
Hydrant Flow Test No. 27 was performed at Fourth Street, southwest of Main Street in Hamilton City. This test was conducted to confirm the C-factor (initially assumed to equal 130) of an 8-inch diameter, AC pipeline. A comparison of the differential pressure readings predicted by the hydraulic model, compared to pressures actually measured in the field, demonstrate that the model is within ± 3 psi of the measured field value. The calibrated model results and the field data are shown in Table 6-A-27. Results from this test indicate that the use of a C-factor equal of 130 for this size and type of pipeline is valid.

**Table 6-A-27. Hydrant Flow Test No. 27**

| Hydrant[1] | Field Data | | | Modeled Data | | | Comparison of Differential Pressures (psi) (g = c-f) |
|---|---|---|---|---|---|---|---|
| | Static Pressure (psi) (a) | Residual Pressure (psi) (b) | Differential Pressure (c = a-b) | Static Pressure (psi) (d) | Residual Pressure (psi) (e) | Differential Pressure (psi) (f = d-e) | |
| Flowing[2] | 65 | 39 | | 65 | 46 | | |
| 27A[3] | 65 | 52 | 13 | 65 | 54 | 11 | 2 |
| 27B[4] | 64 | 54 | 10 | 64 | 55 | 9 | 1 |
| 27C[5] | 63 | 58 | 5 | 65 | 57 | 8 | -3 |
| 27D[6] | NA | NA | NA | 66 | 57 | 8 | NA |
| 27E[7] | 63 | 53 | 10 | 67 | 59 | 7 | 3 |

(1) Location of fire hydrants can be found on Figure A-27.
(2) The "Flowing Hydrant" is located at Fourth Street, southwest of Main Street.
(3) Hydrant 27A is located at Walsh Avenue, southeast of Fifth Street.
(4) Hydrant 27B is located at Walsh Avenue, southeast of Sixth Street.
(5) Hydrant 27C is located at Third Street, southwest of Main Street.
(6) Hydrant 27D is located at Walsh Avenue, southeast of Third Street.
(7) Hydrant 27E is located at Walsh Avenue, southeast of Second Street.
NA = Not Applicable

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CALIFORNIA WATER SERVICE CO.

**CAL WATER SERVICES CO**
**CHICO-HAMILTON CITY DISTRICT**

**FIGURE A27**

**HYDRANT TEST LOCATIONS JULY 2006**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585

WEST YOST ASSOCIATES
Consulting Engineers

CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA27 Ctest.dwg DATE: 06-28-06 10:22am isuroso

### Hydrant Flow Test No. 28

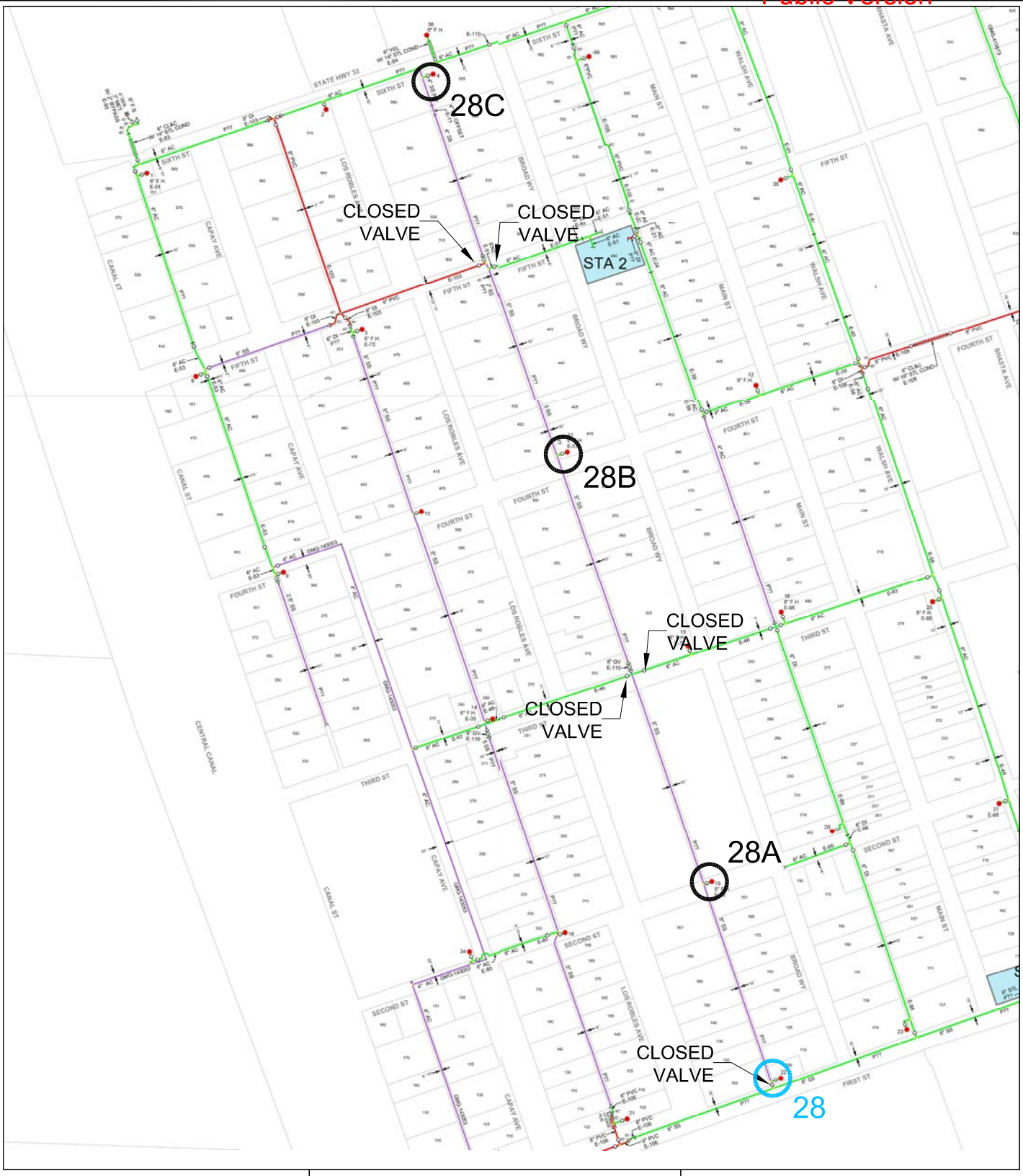
Hydrant Flow Test No. 28 was performed at Los Robles Avenue, southeast of Fifth Street. This test was conducted to confirm the C-factor (initially assumed to equal 120) of a 5-inch diameter, steel pipeline. During the C-factor test, field gauge did not record pressure due to low pressure in the system. Flow from hydrant was manually measured. The preliminary C-factor assigned to this type of pipeline is high. The C-factor is decreased to 30. A comparison of the differential pressure readings predicted by the hydraulic model, compared to pressures actually measured in the field, demonstrate that the model is within the allowable ± 5 psi of tolerance limit. The calibrated model results and the field data are shown in Table 6-A-28.

**Table 6-A-28. Hydrant Flow Test No. 28**

| Hydrant[1] | Field Data | | | Modeled Data | | | Comparison of Differential Pressures (psi) (g = c-f) |
|---|---|---|---|---|---|---|---|
| | Static Pressure (psi) (a) | Residual Pressure (psi) (b) | Differential Pressure (c = a-b) | Static Pressure (psi) (d) | Residual Pressure (psi) (e) | Differential Pressure (psi) (f = d-e) | |
| Flowing[2] | 55 | | | 64 | 12 | | |
| 28A[3] | NA | | | | | | |
| 28B[4] | 54 | 21 | 33 | 63 | 30 | 34 | -1 |
| 28C[5] | 50 | 47 | 3 | 67 | 66 | 1 | 2 |

(1) Location of fire hydrants can be found on Figure A-28.
(2) The "Flowing Hydrant" is located at Los Robles Avenue, southeast of Fifth Street.
(3) Hydrant 28A is located at 2nd Street between Los Robles Avenue and Broadway.
(4) Hydrant 28B is located at 4th Street between Los Robles Avenue and Broadway.
(5) Hydrant 28C is located at the 6th Street between Los Robles Avenue and Broadway.
NA = Not Applicable

Public Version




**LEGEND:**

- ○ FIRE HYDRANT LOCATION
- 1A OBSERVED HYDRANT IDENTIFICATION NUMBER
- VALVE LOCATION

N

CAL WATER SERVICES CO
CHICO-HAMILTON CITY DISTRICT

**FIGURE A28 Retest**

**HYDRANT TEST LOCATIONS**
**April 2007**

CONSULTING ENGINEERS
7041 Koll Center Parkway, Suite 110
Pleasanton, California 94566
(925) 426-2580
FAX (925) 426-2585

WEST YOST ASSOCIATES
Consulting Engineers

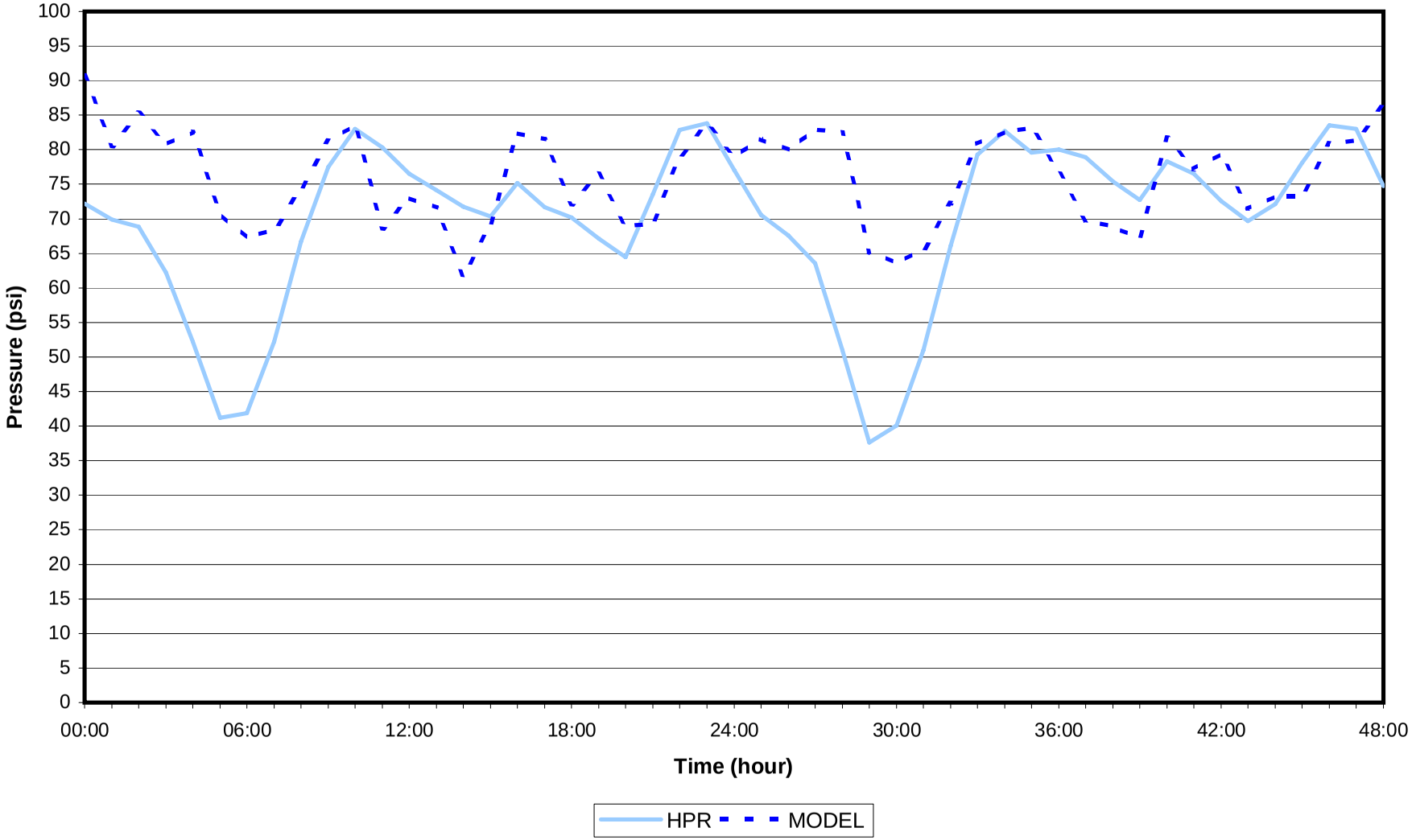
CAD FILE: D:/C/436/02-06-03/CAD/Figures/Task 4/C-Test/isFIGA28 Ctest Retest.dwg DATE: 03-26-07 10:22am isuroso

Public Version

# APPENDIX M

## Verification Results

## HPR B-17: Penzance Avenue
## Pressure Zone 350 - 07/20/06 to 7/21/06

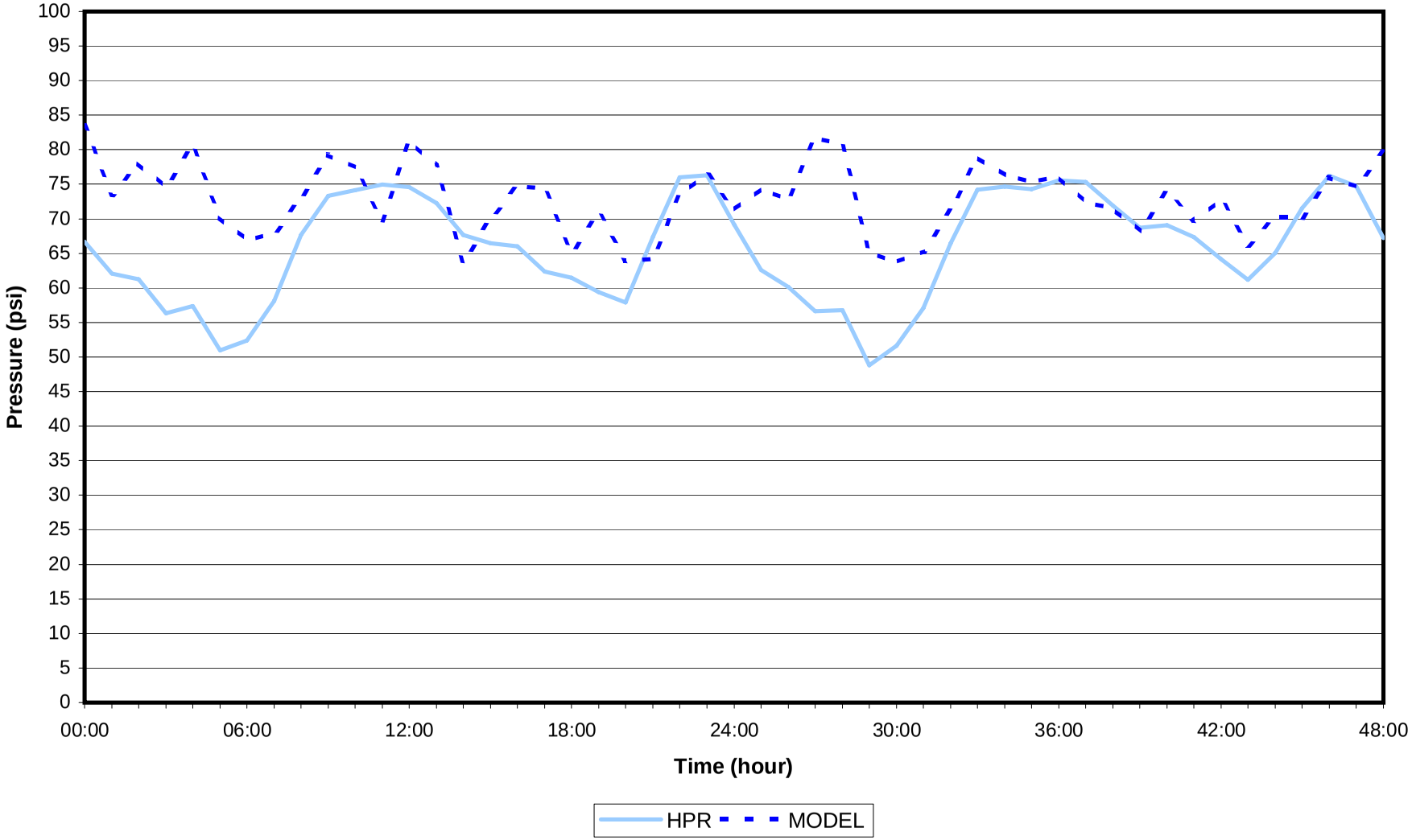



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071806-072506.xls\CH_B-17
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-18: Lawn Drive
## Pressure Zone 350 - 07/20/06 to 7/21/06

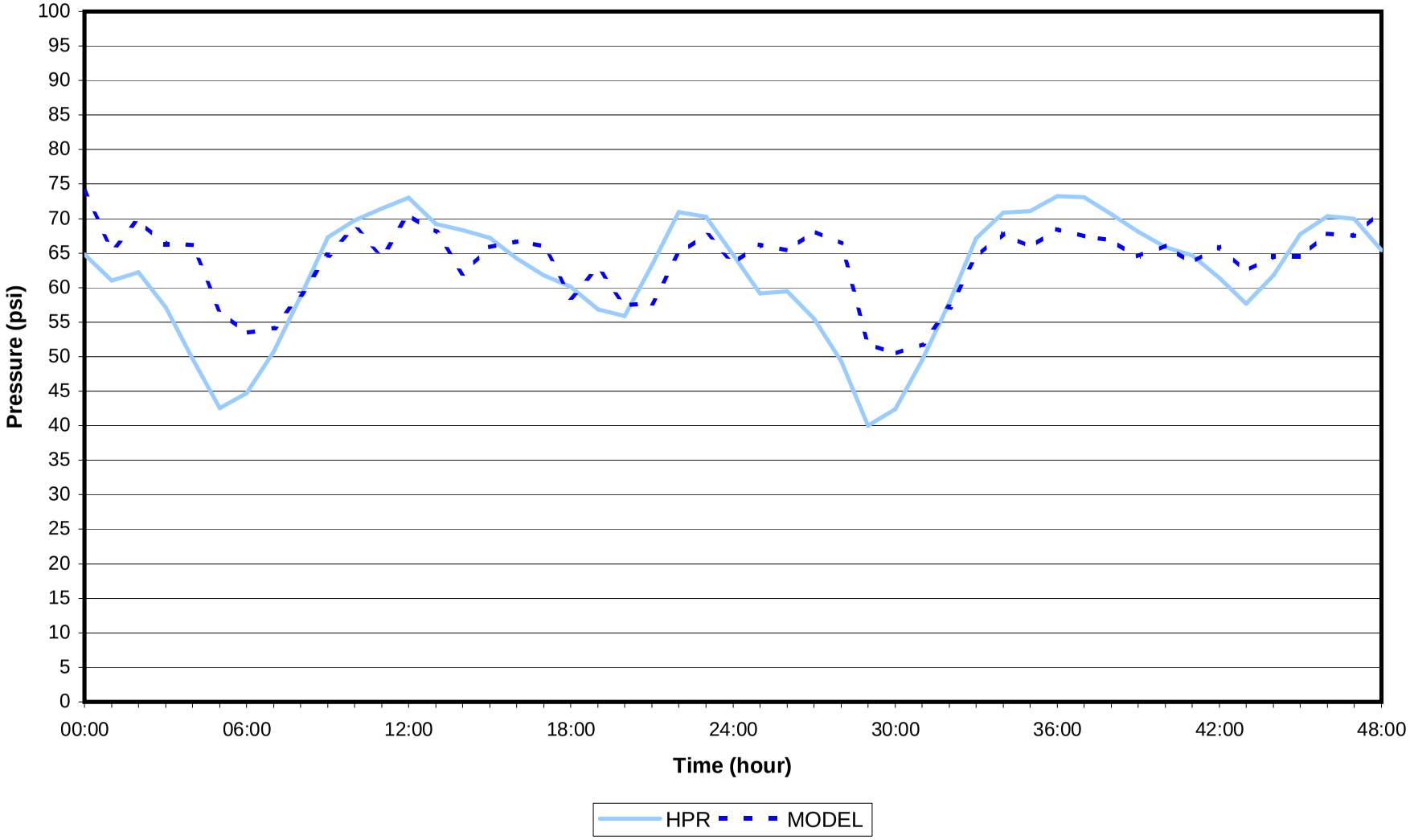



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071806-072506.xls\CH_B-18
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-19: Lexington Drive
## Pressure Zone 350 - 07/20/06 to 7/21/06

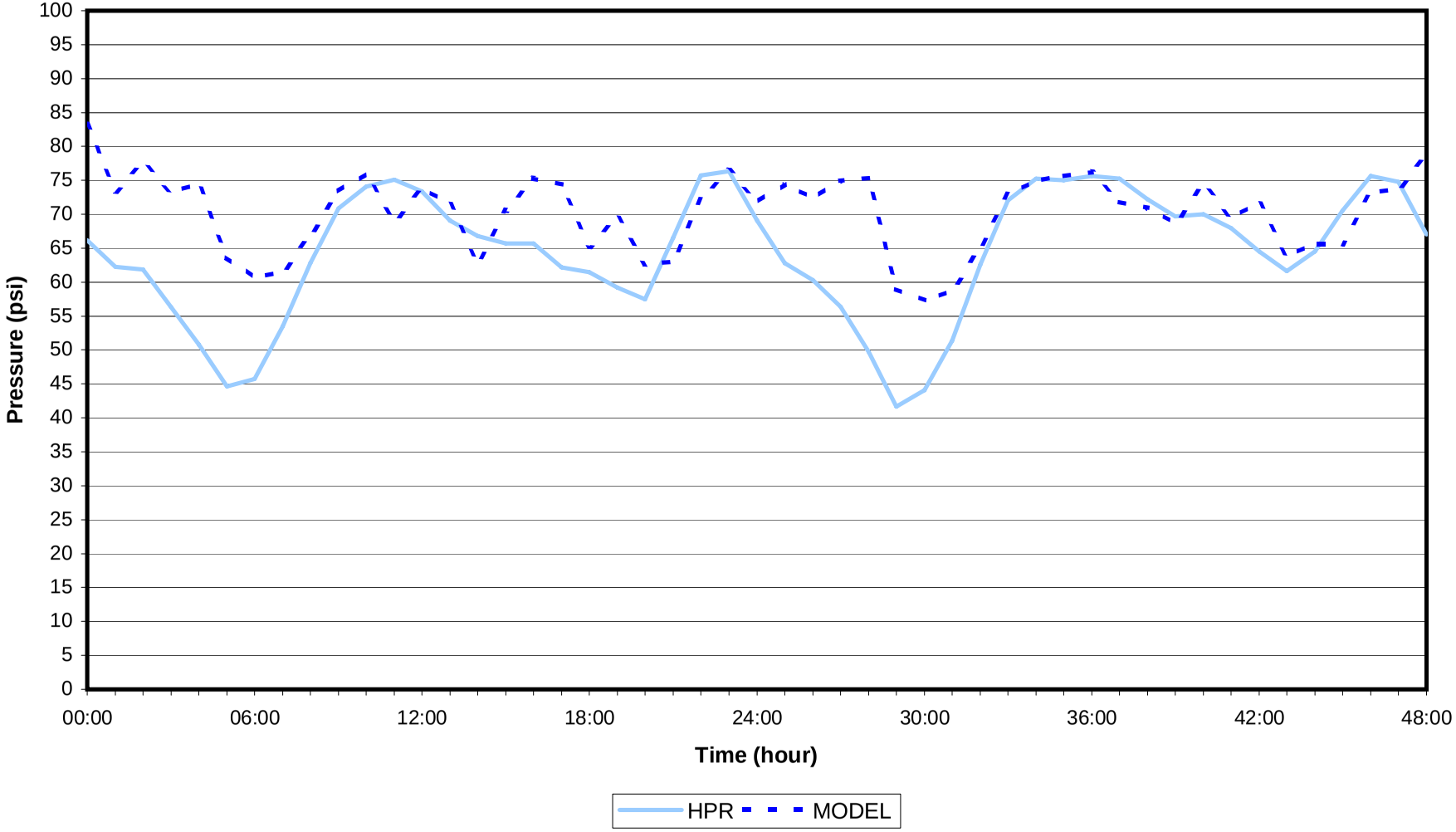



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071806-072506.xls\CH_B-19
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-20: Between Autumn Gold Drive and Mission Ranch Boulevard, northeast of Cussick Avenue
## Pressure Zone 350 - 07/20/06 to 7/21/06

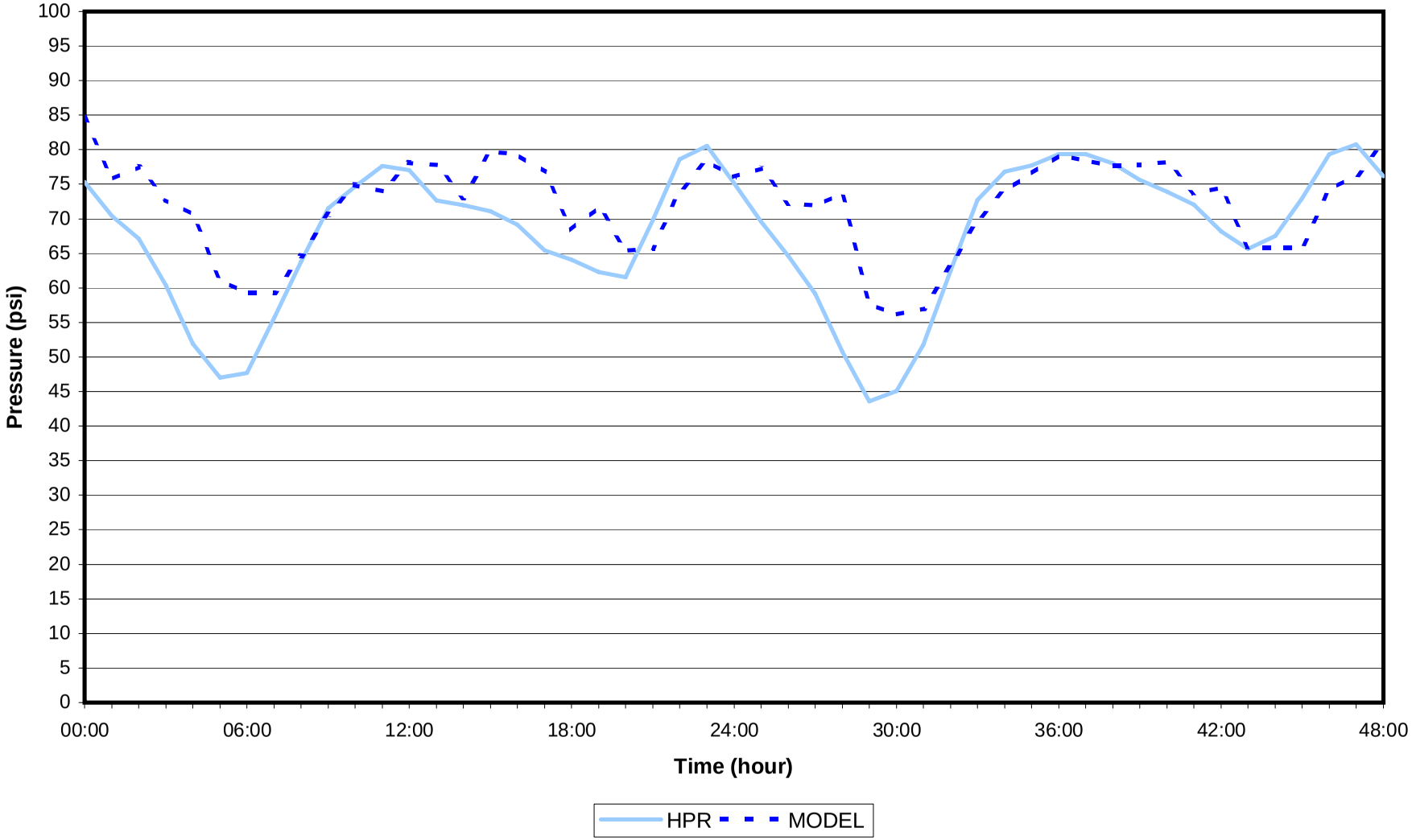



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071806-072506.xls\CH_B-20
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-21: Meadow Road
## Pressure Zone 350 - 07/20/06 to 7/21/06

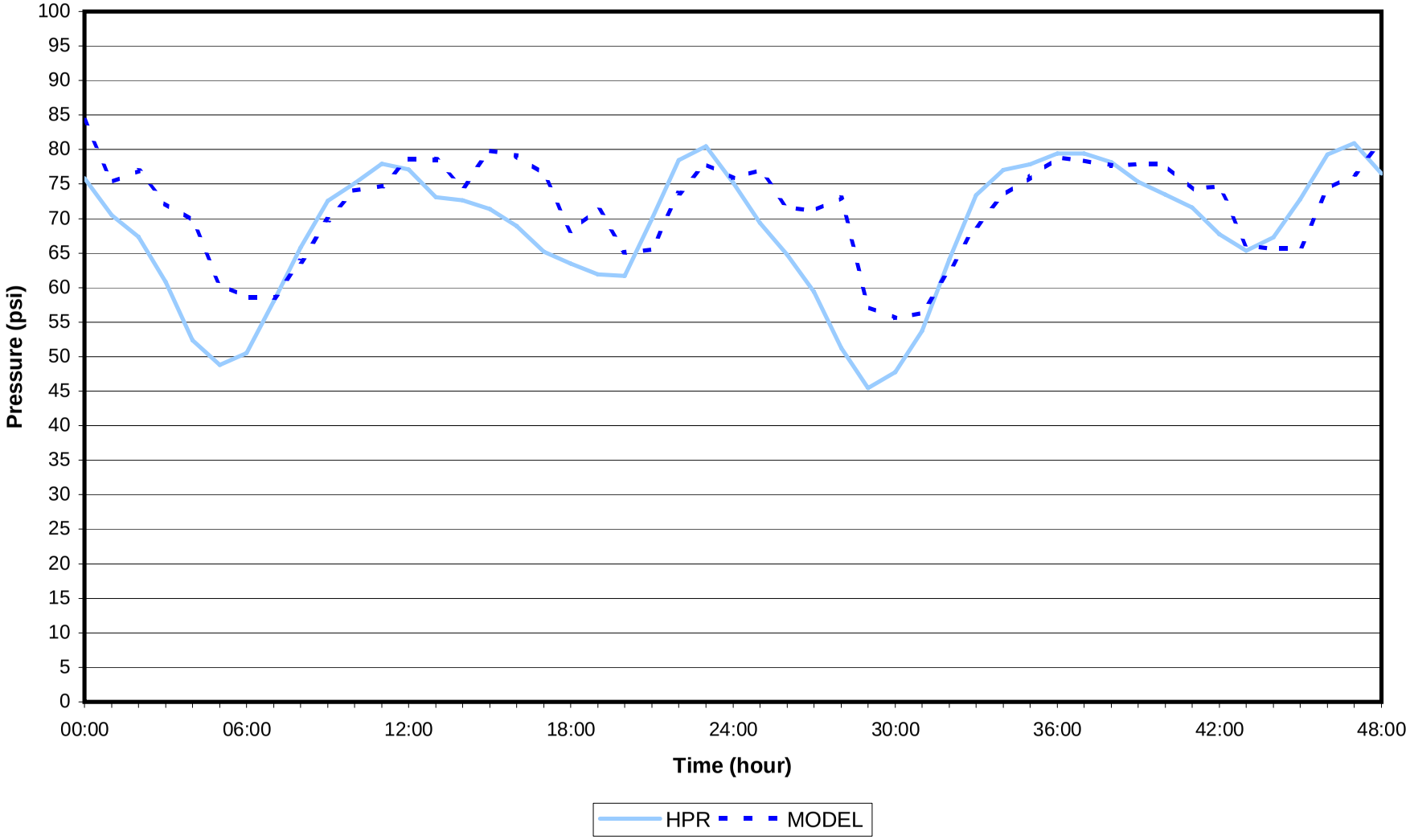



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071806-072506.xls\CH_B-21
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-22: 4th Avenue
## Pressure Zone 350 - 07/20/06 to 7/21/06

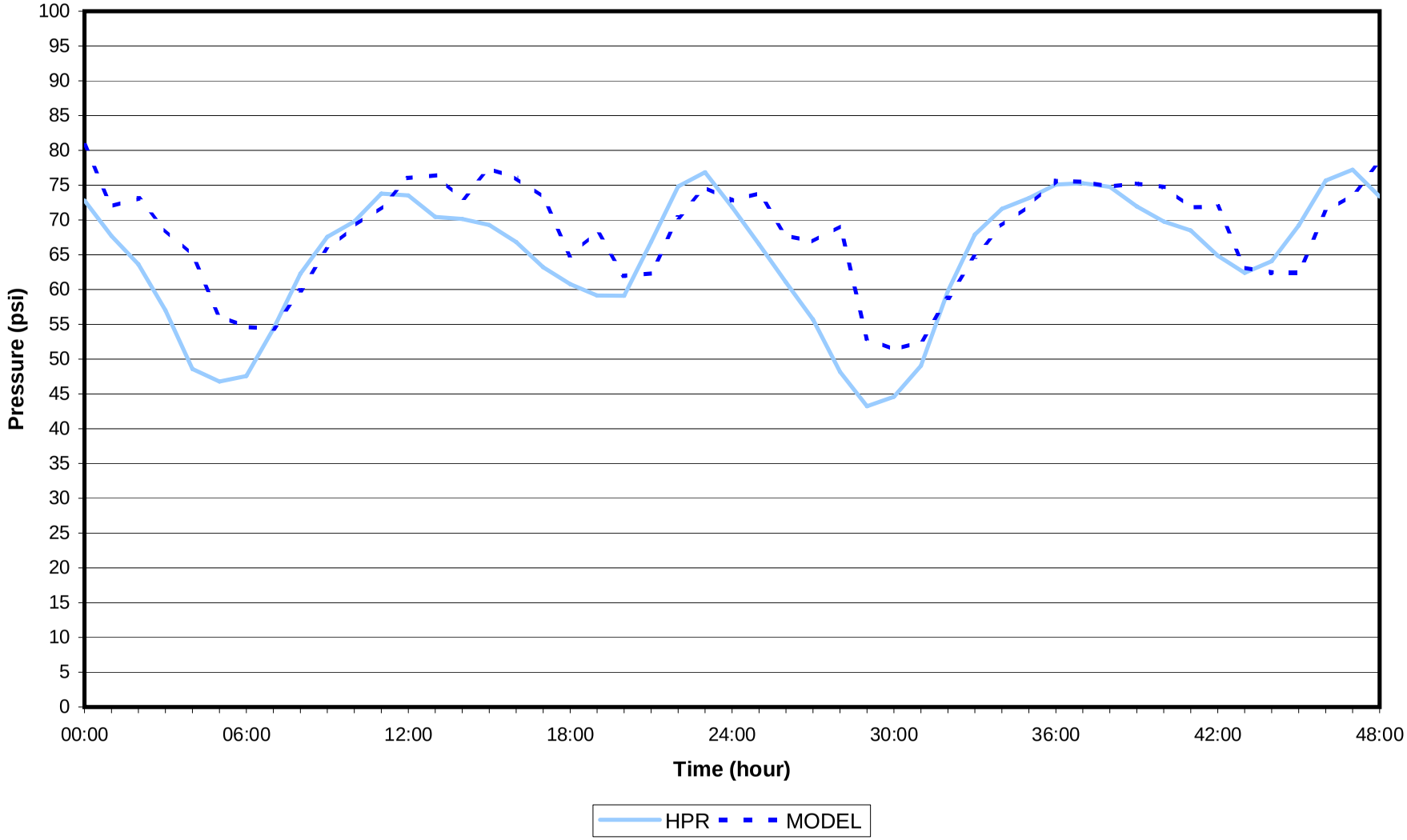



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071806-072506.xls\CH_B-22
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-23: Nord Avenue
## Pressure Zone 350 - 07/20/06 to 7/21/06

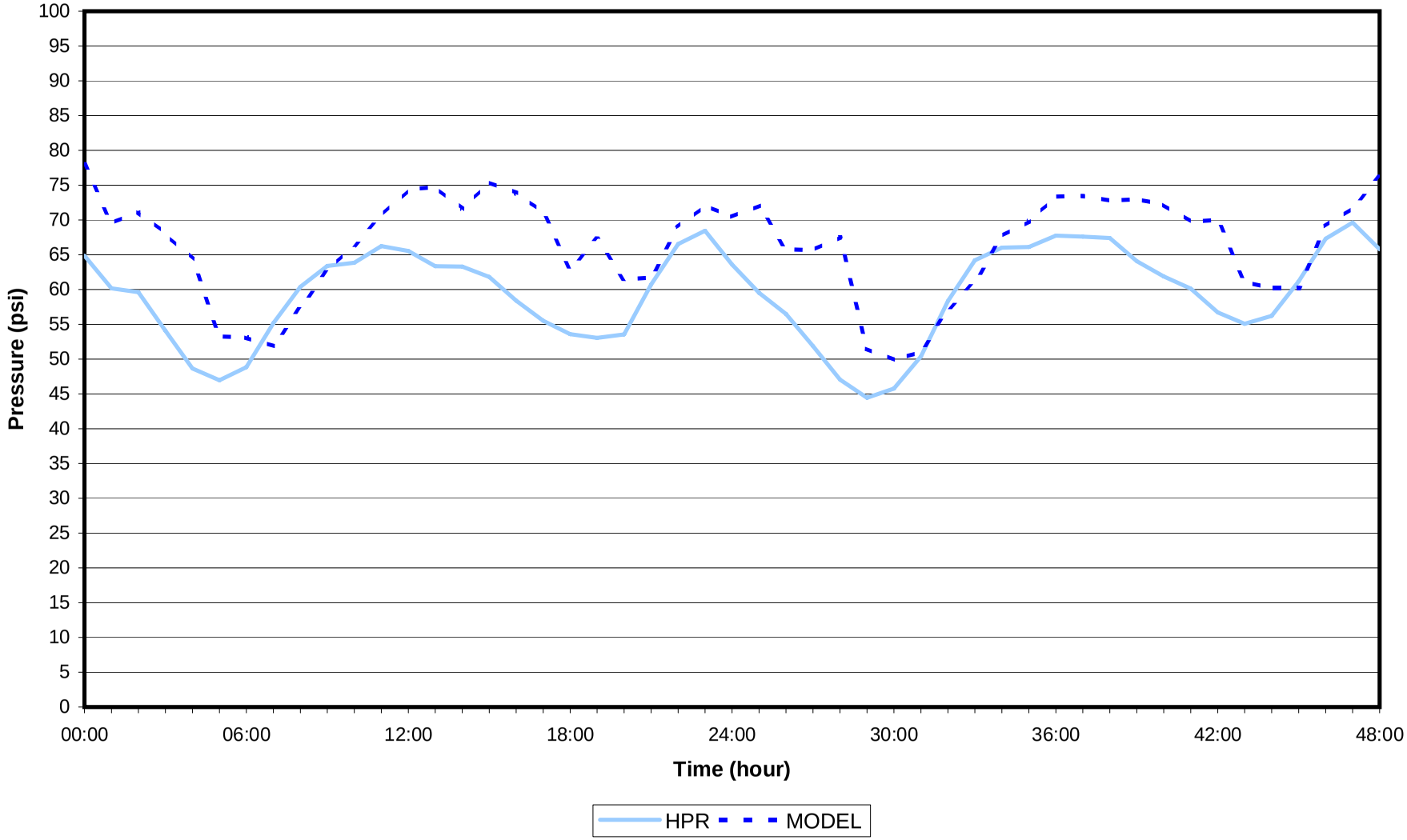



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071806-072506.xls\CH_B-23
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-24: 9th Street
## Pressure Zone 350 - 07/20/06 to 7/21/06

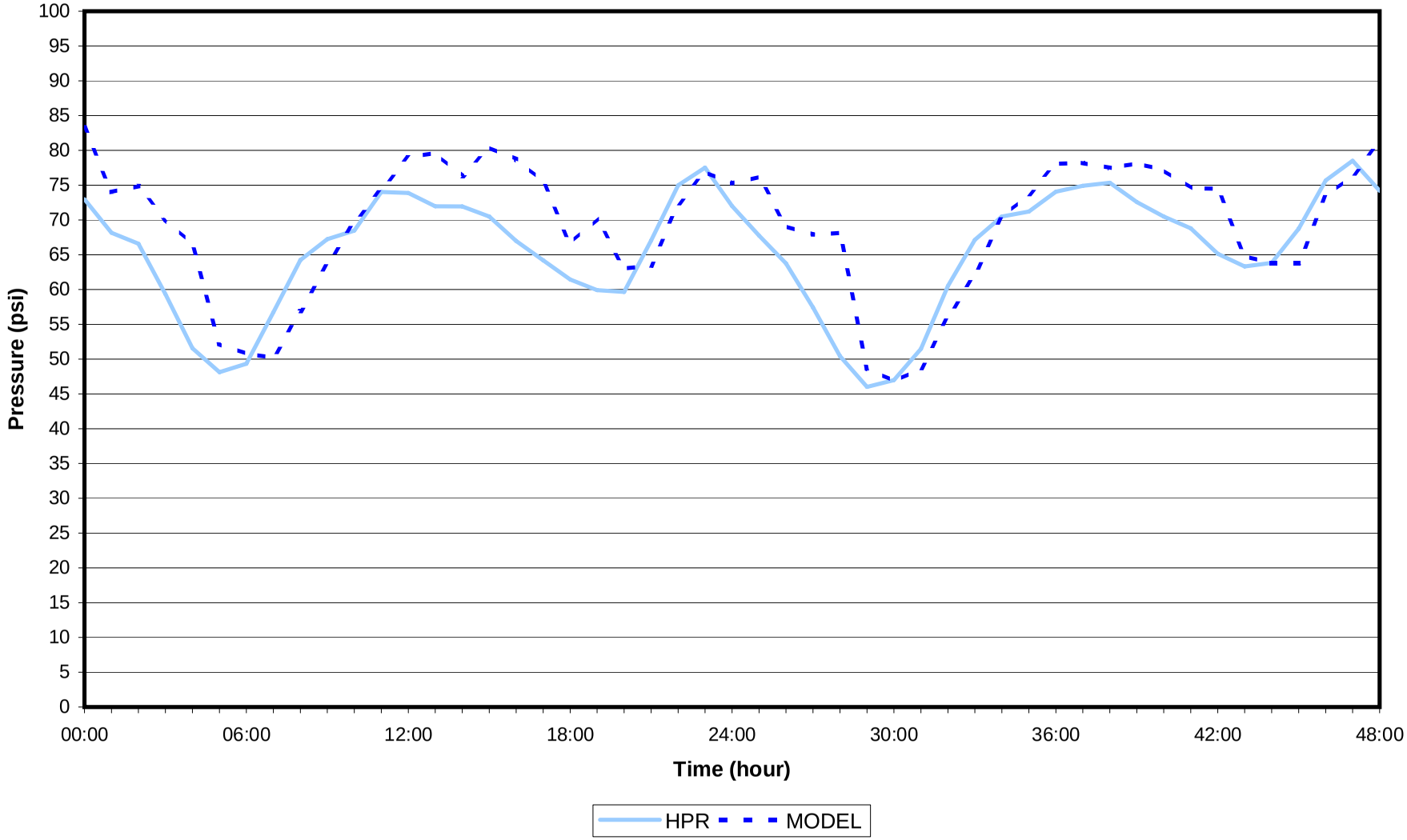



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071806-072506.xls\CH_B-24
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-25: Dayton Road
## Pressure Zone 350 - 07/20/06 to 7/21/06

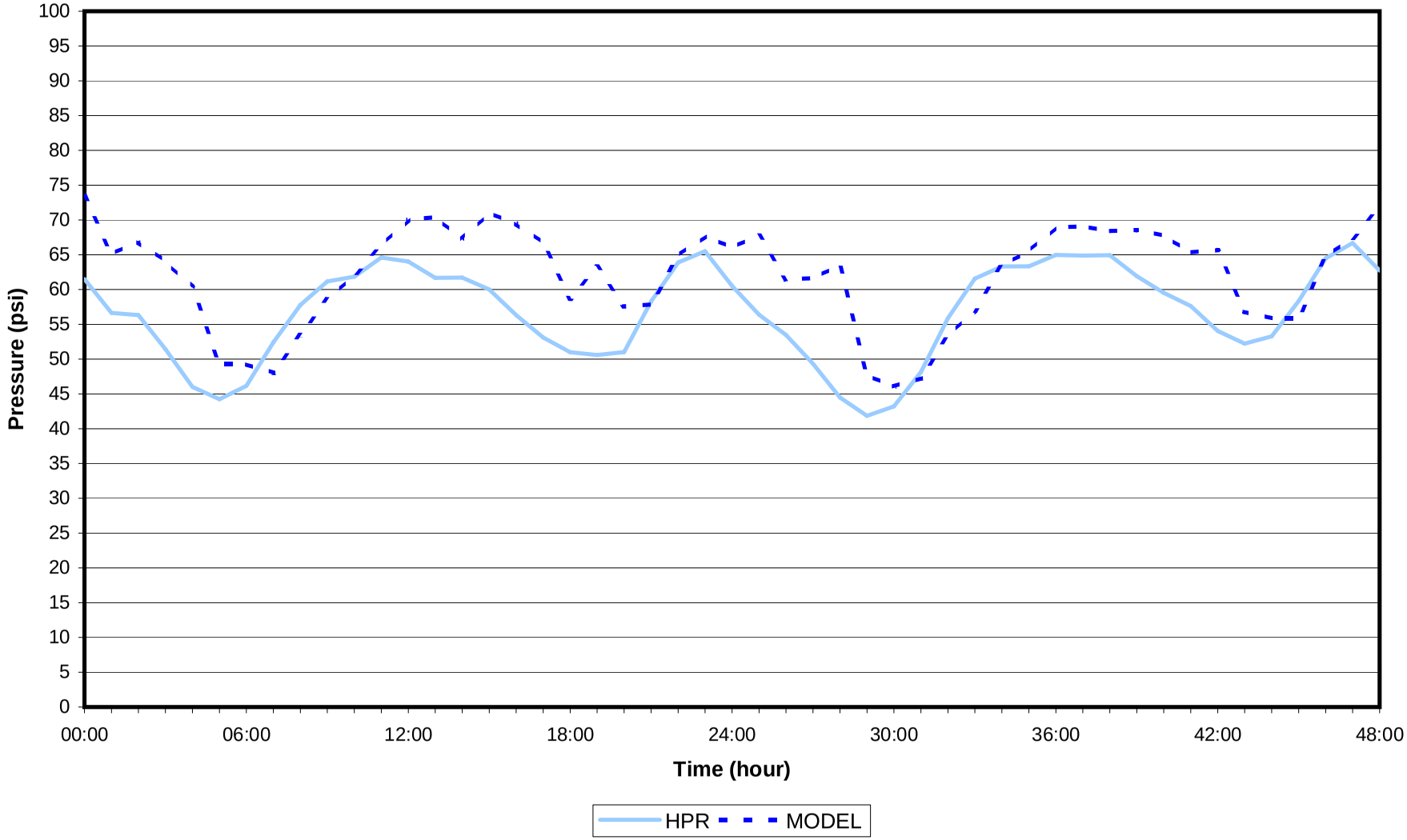



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071806-072506.xls\CH_B-25
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-26: Between 4th street and 5th Street, near northwest end of Poplar Street
## Pressure Zone 350 - 07/20/06 to 7/21/06

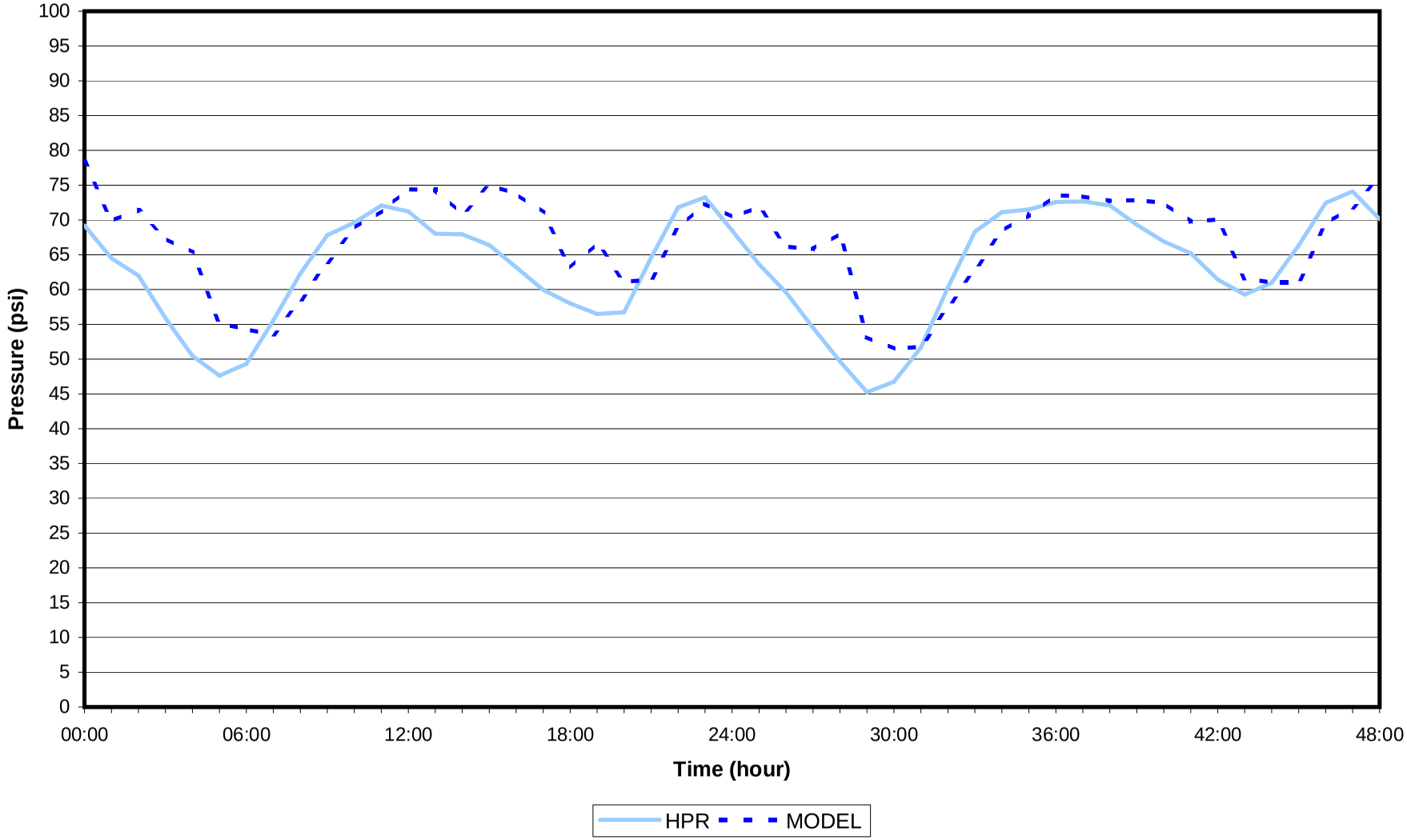



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071806-072506.xls\CH_B-26
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-27: Esplanade
## Pressure Zone 350 - 07/20/06 to 7/21/06

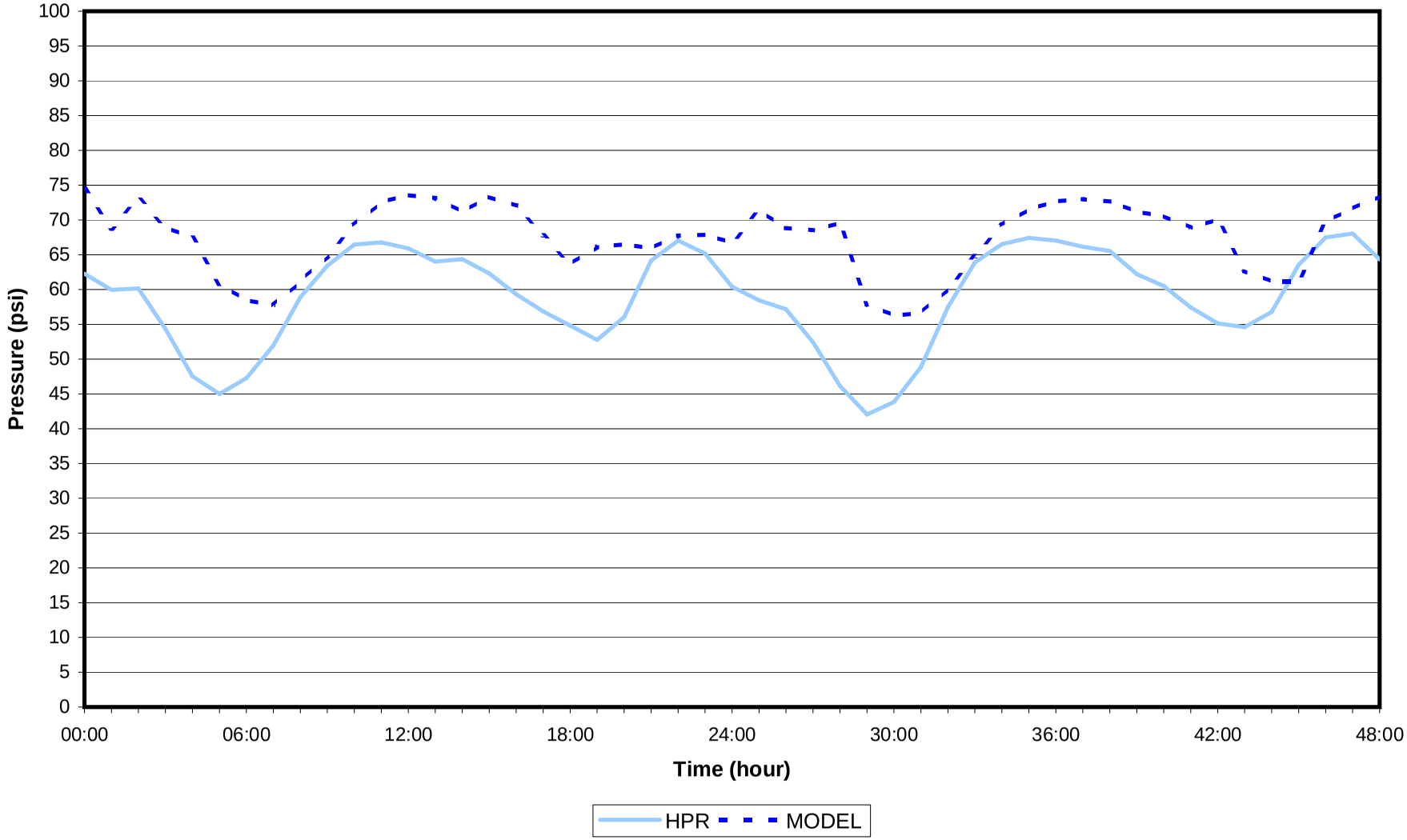



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071806-072506.xls\CH_B-27
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-28: Crister Avenue
## Pressure Zone 350 - 07/20/06 to 7/21/06

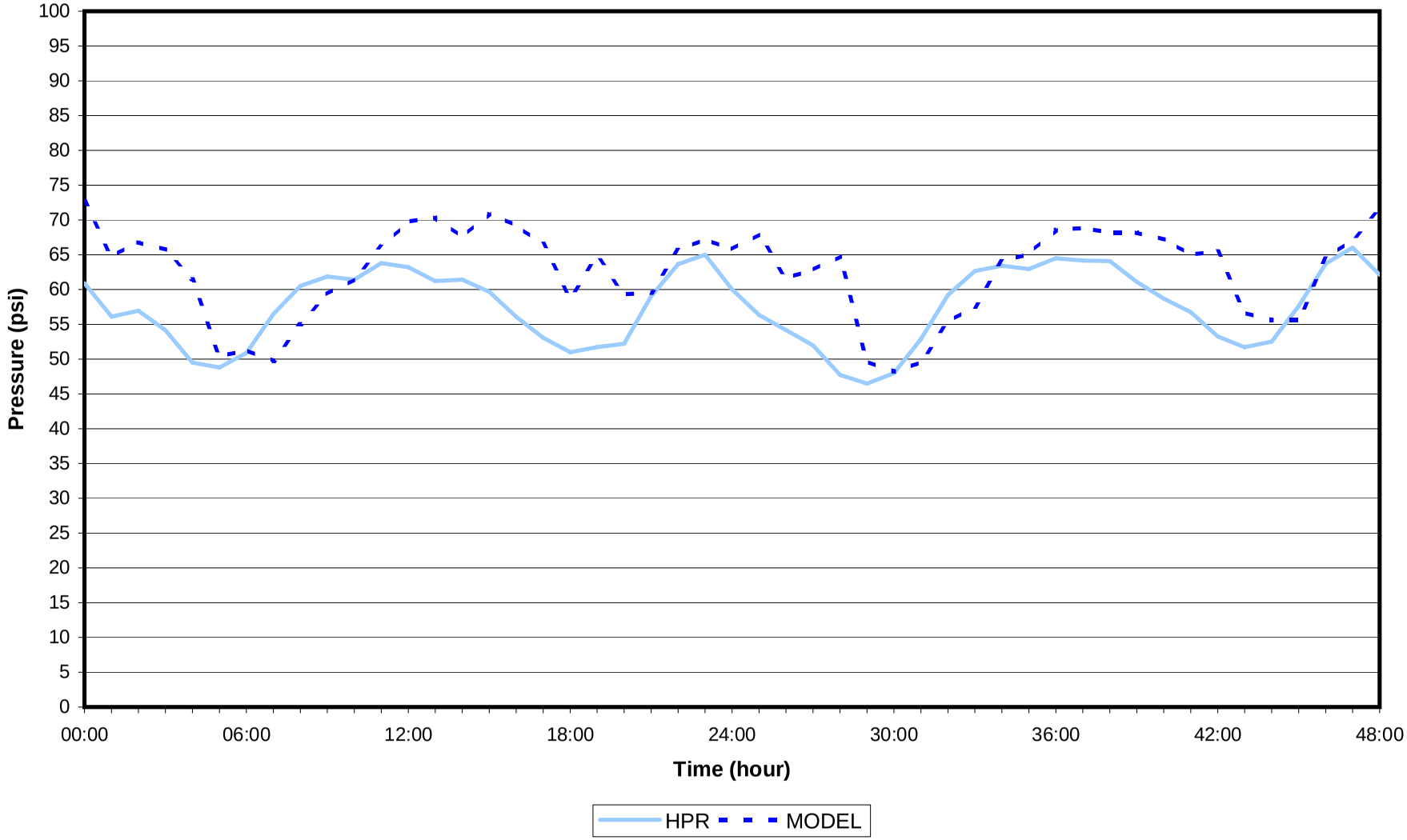



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071806-072506.xls\CH_B-28
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-29: Virginia Street
## Pressure Zone 350 - 07/20/06 to 7/21/06

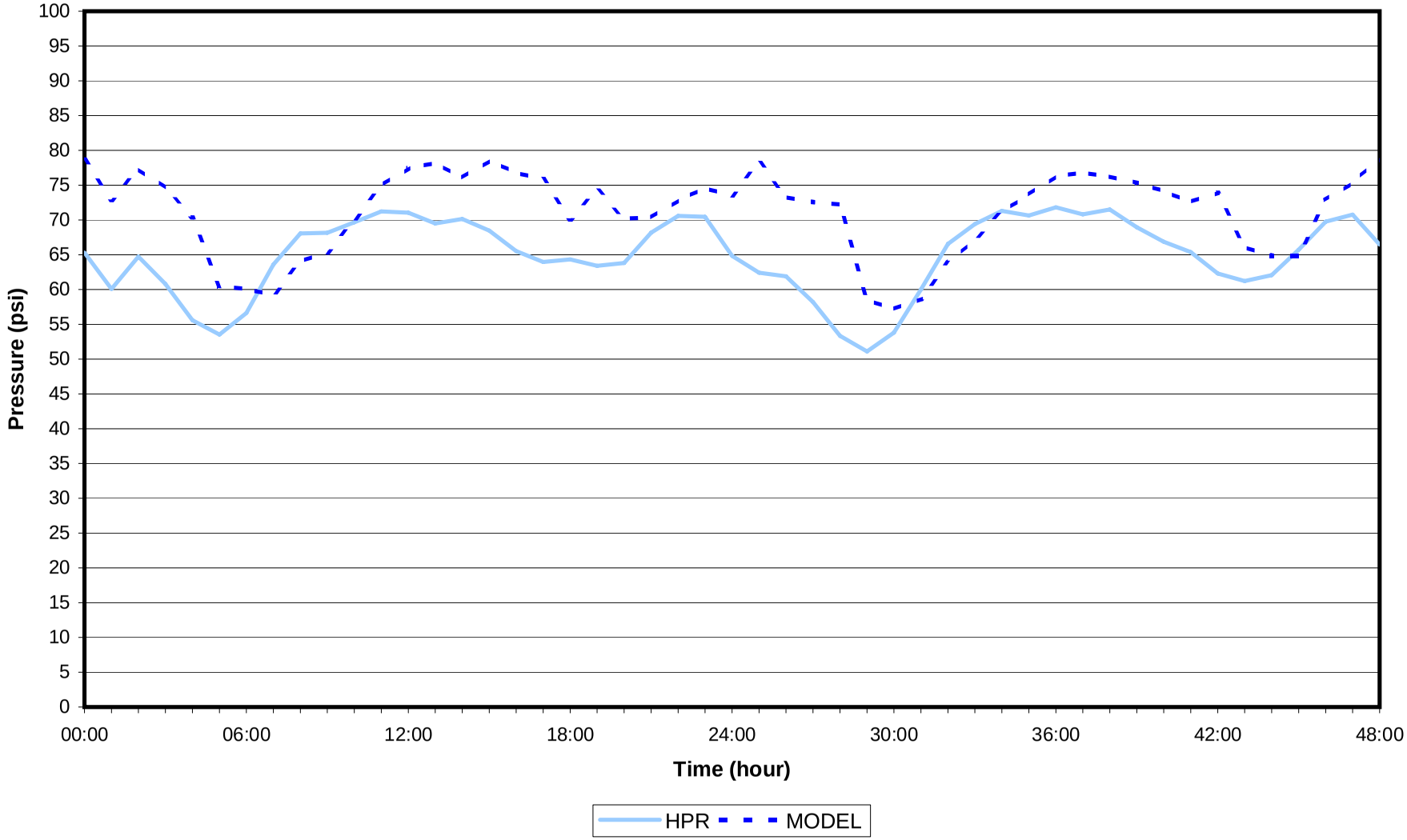



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071806-072506.xls\CH_B-29
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-30: Whitman Avenue
## Pressure Zone 350 - 07/20/06 to 7/21/06

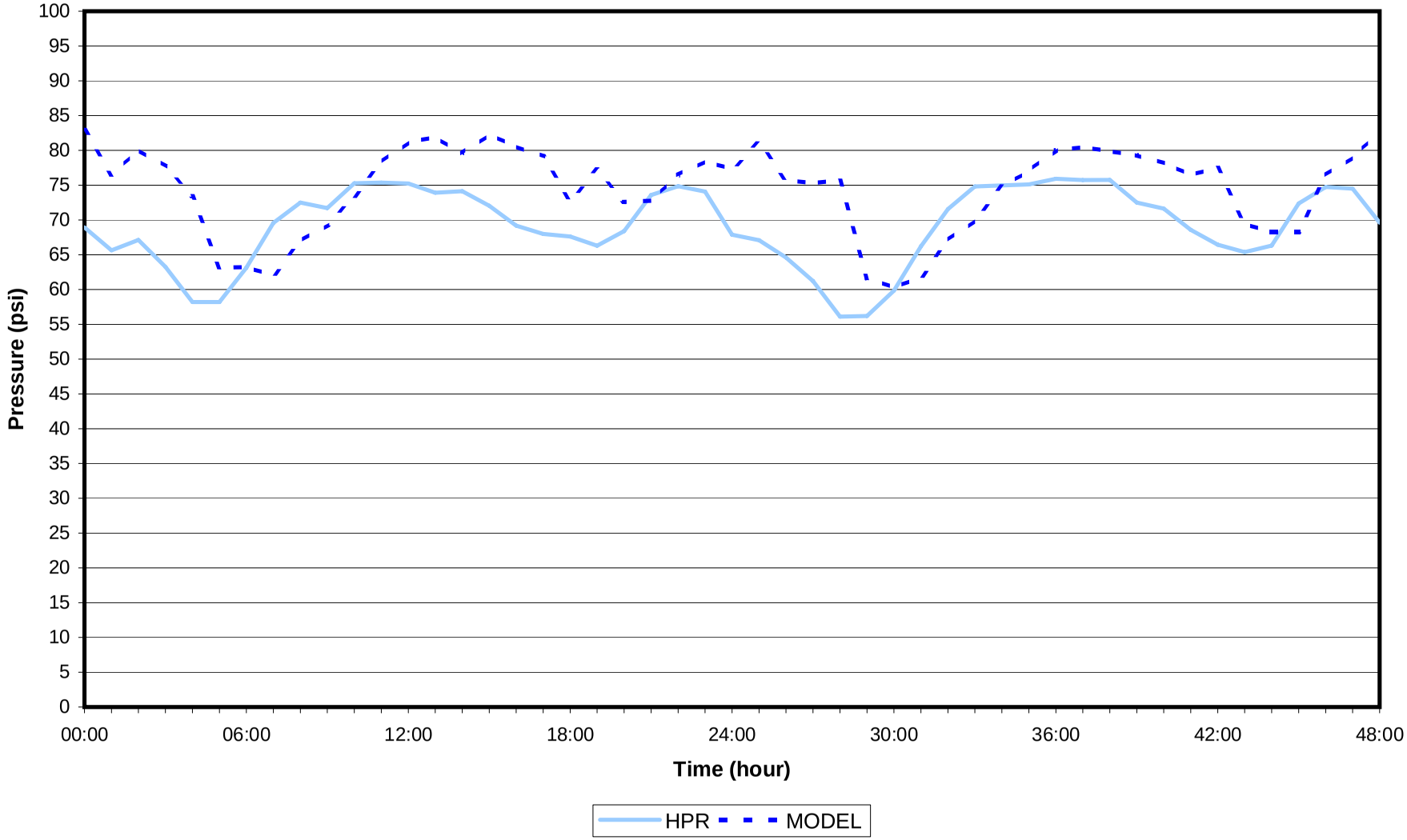



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071806-072506.xls\CH_B-30
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-31: Otterson Drive
## Pressure Zone 350 - 07/20/06 to 7/21/06

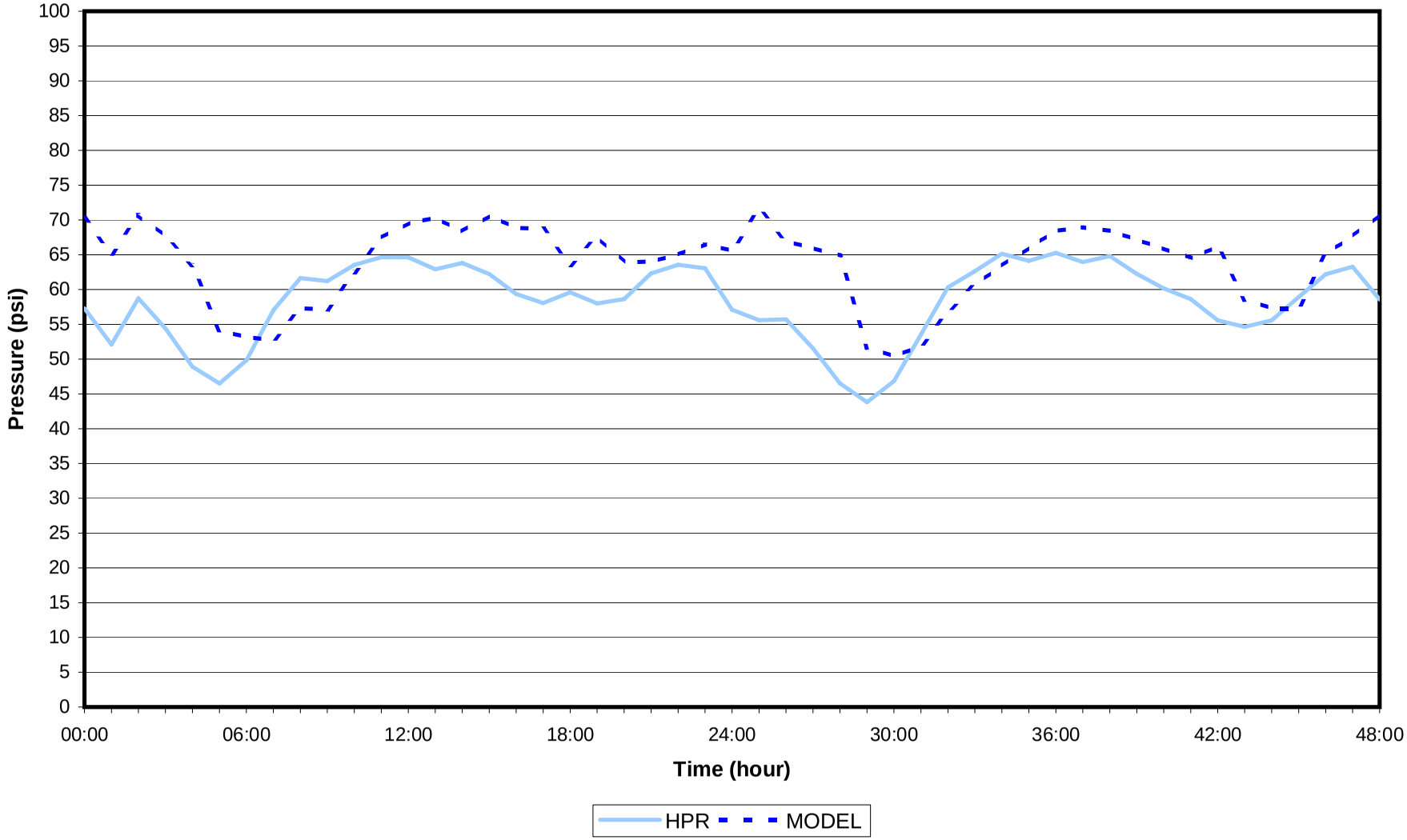



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071806-072506.xls\CH_B-31
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-32: Raley Boulevard
## Pressure Zone 350 - 07/20/06 to 7/21/06

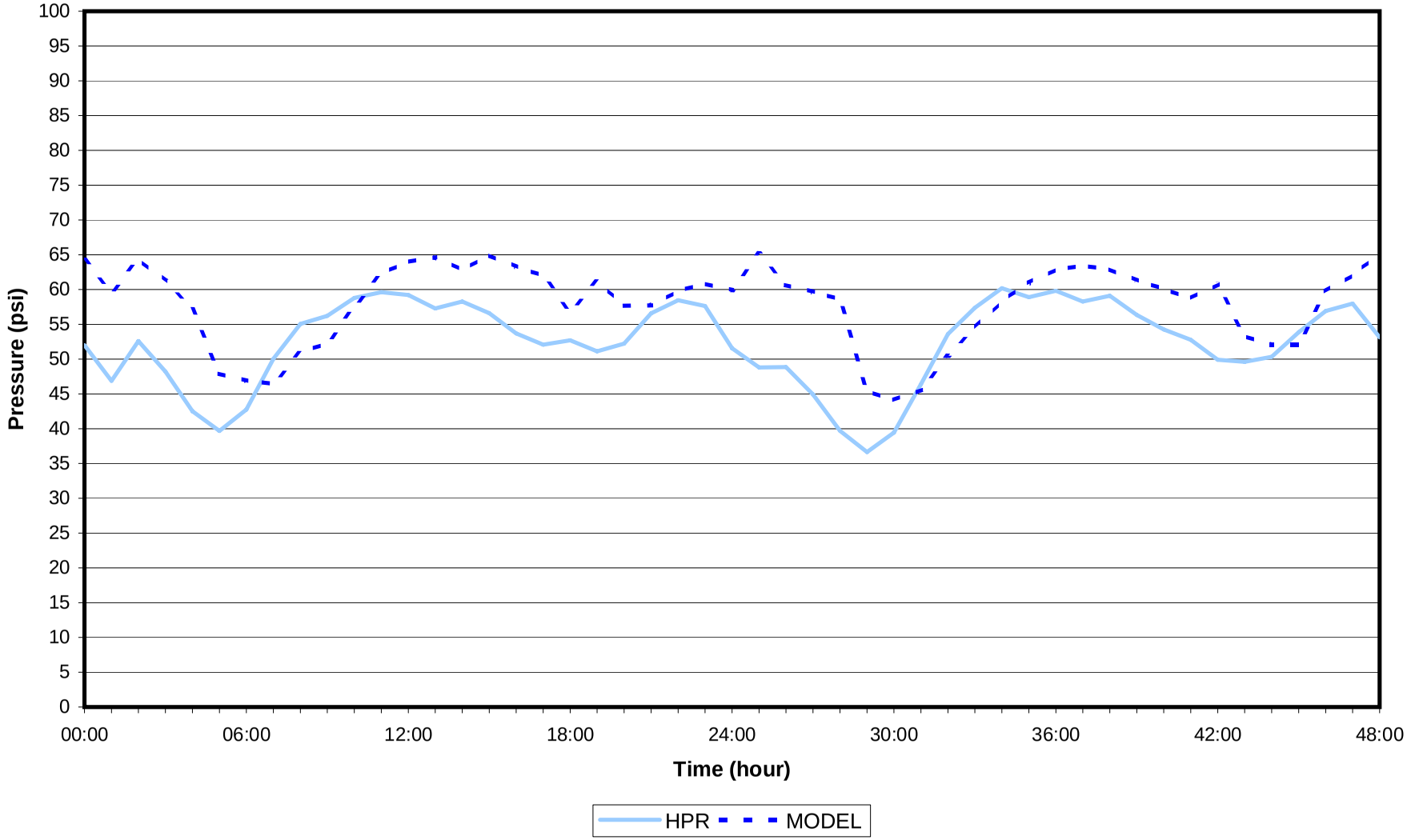



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071806-072506.xls\CH_B-32
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-33: Springfield Drive
## Pressure Zone 350 - 07/20/06 to 7/21/06

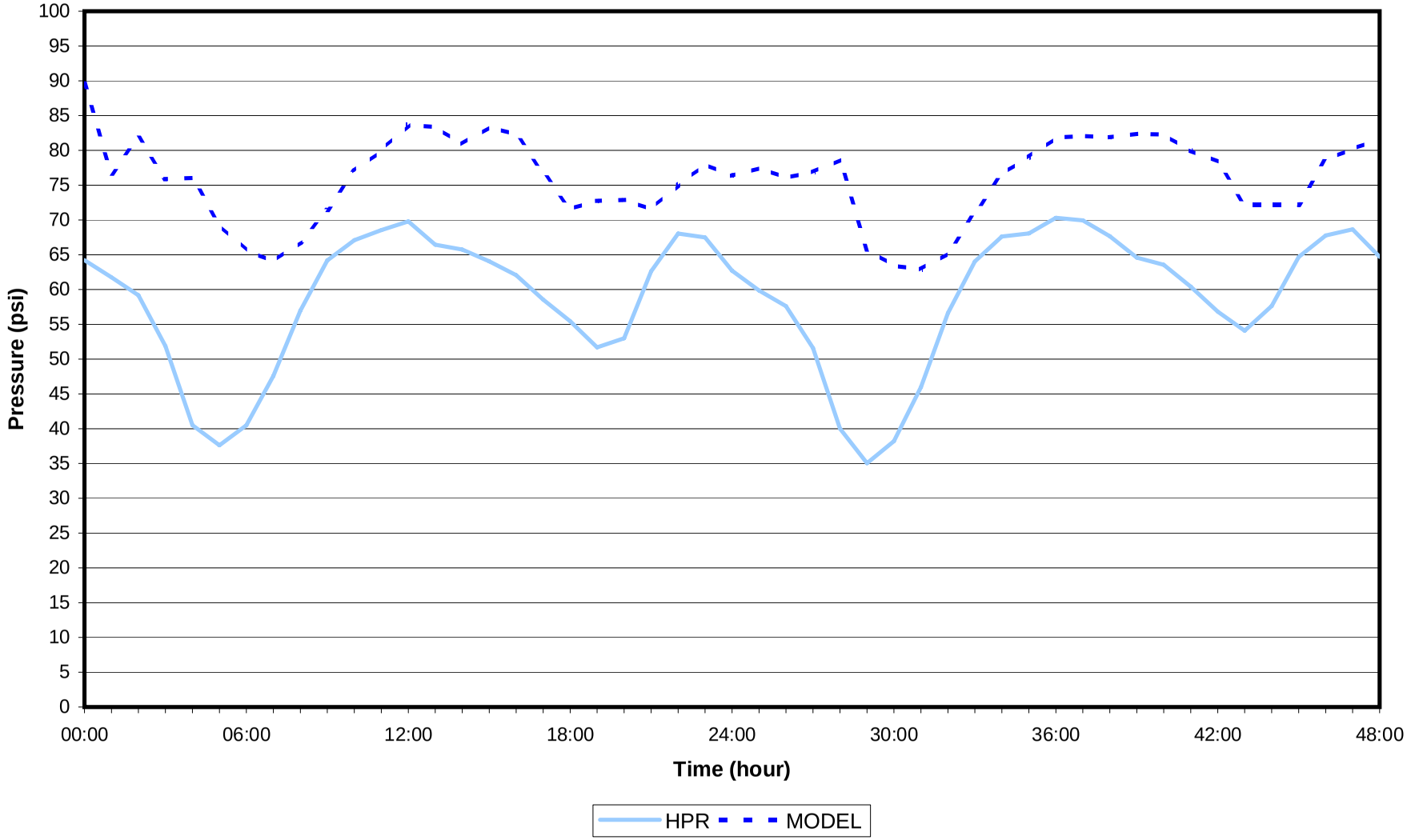



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071806-072506.xls\CH_B-33
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-34: Arch Way
## Pressure Zone 350 - 07/20/06 to 7/21/06

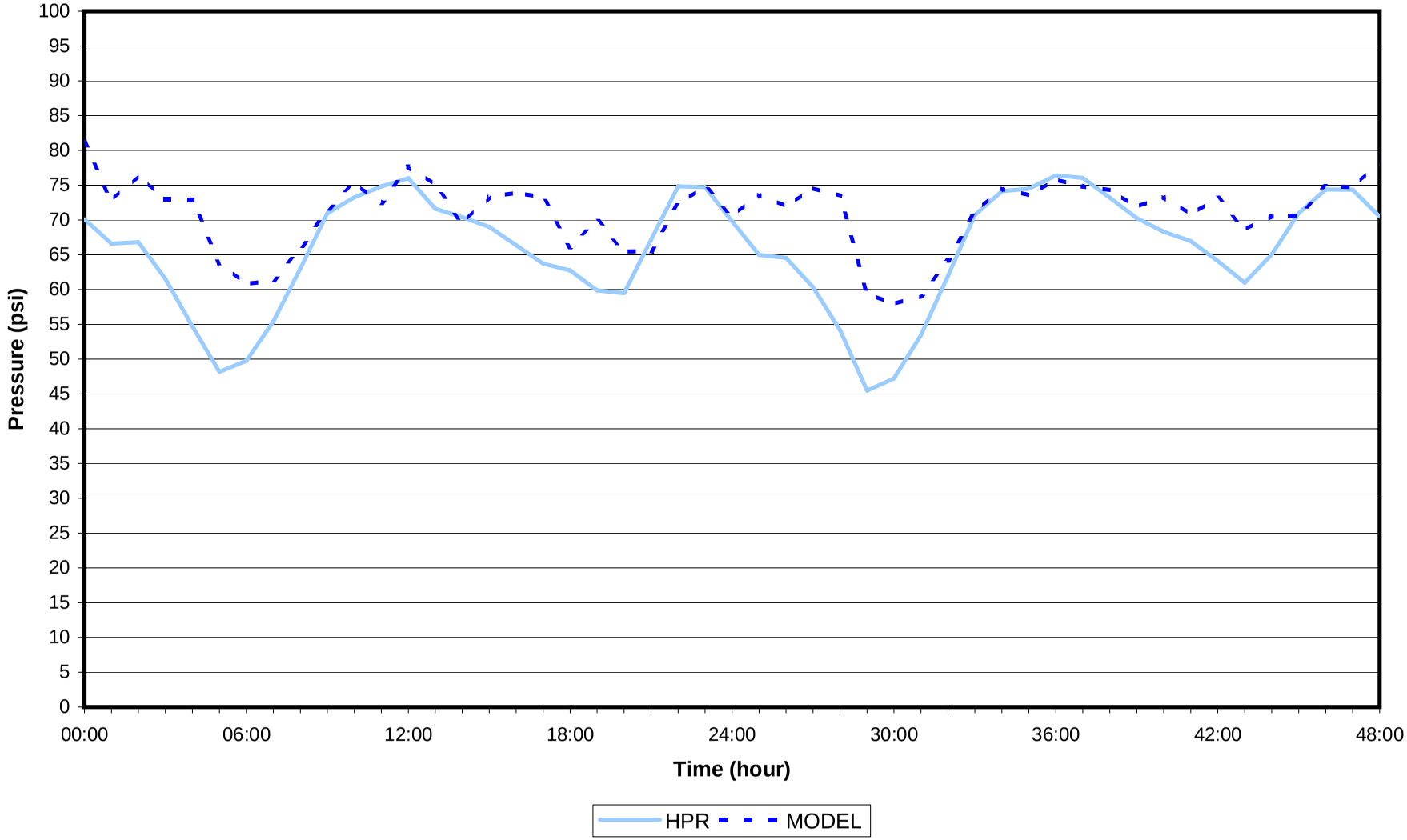



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071806-072506.xls\CH_B-34
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-35: North Avenue
## Pressure Zone 350 - 07/20/06 to 7/21/06

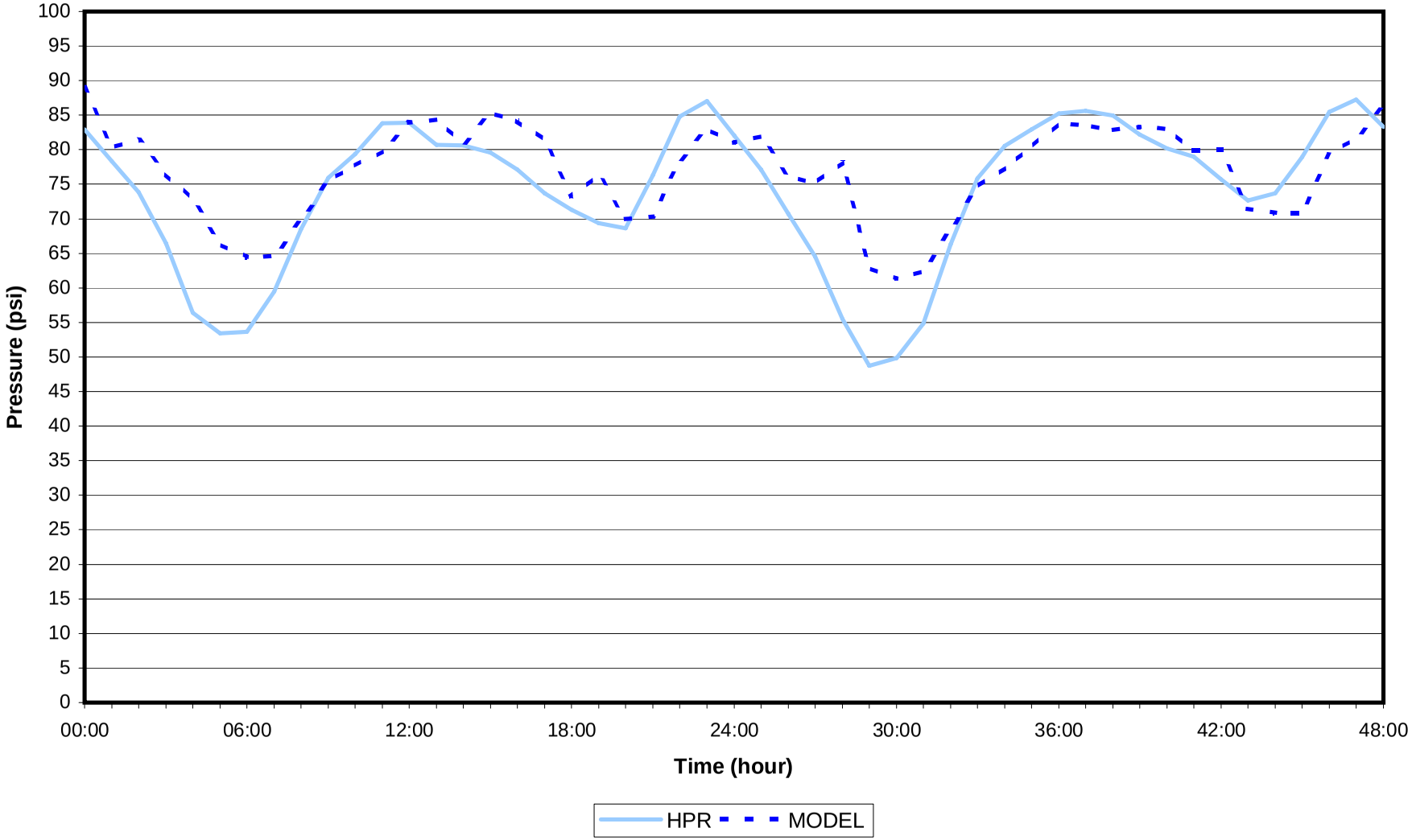



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071806-072506.xls\CH_B-35
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-36: West Wind Drive
## Pressure Zone 350 - 07/20/06 to 7/21/06

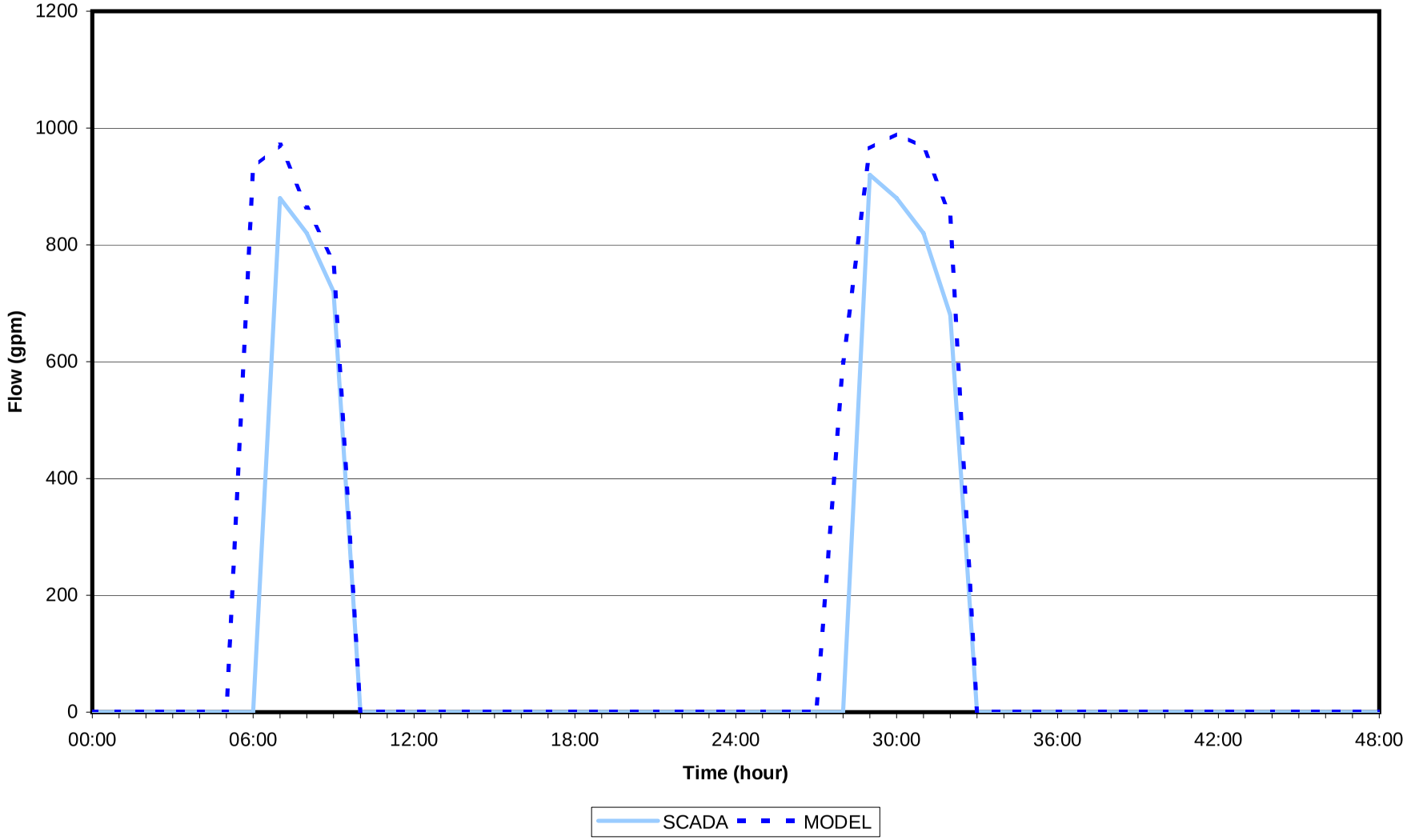



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071806-072506.xls\CH_B-36
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 5 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

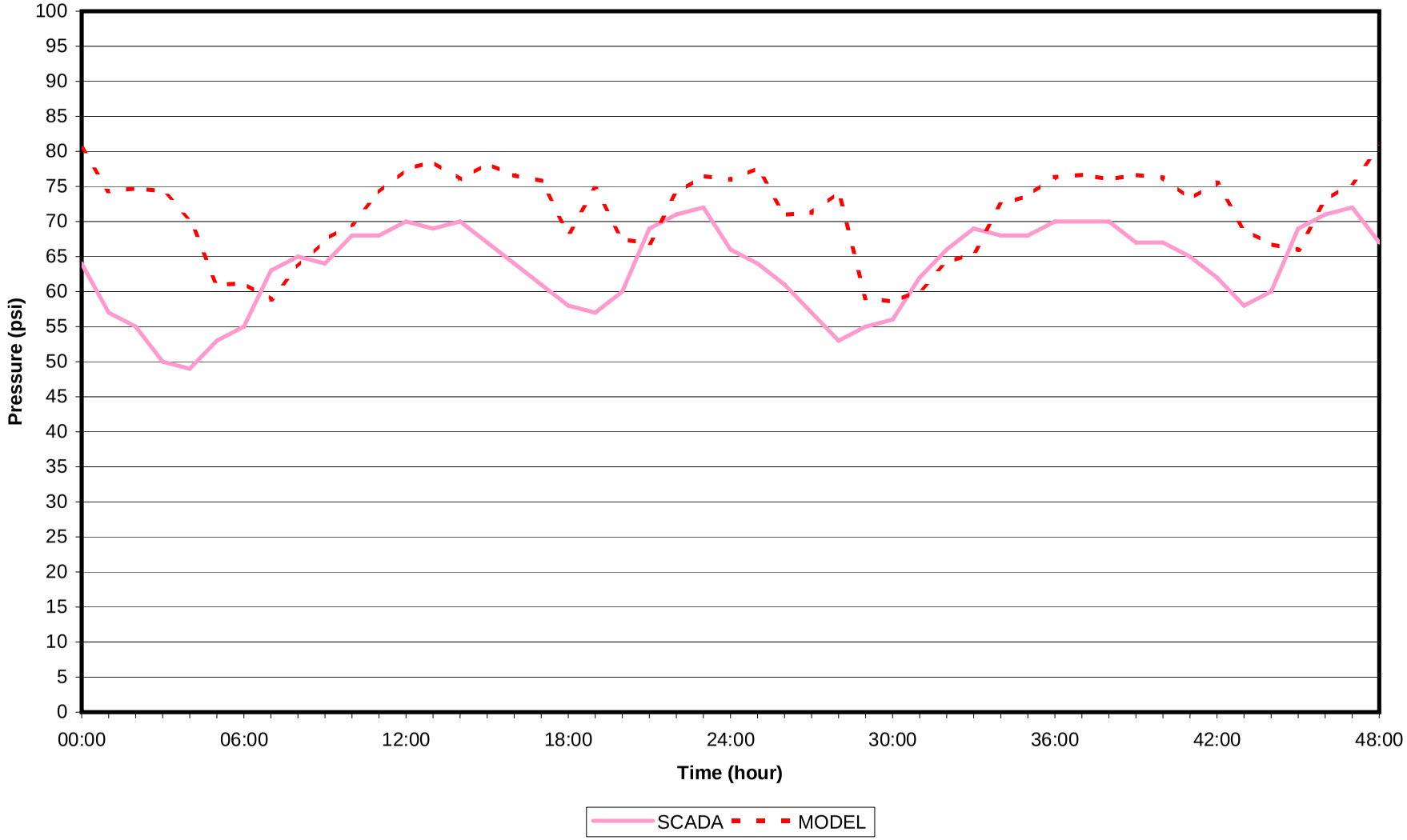



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST5-2Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 5 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

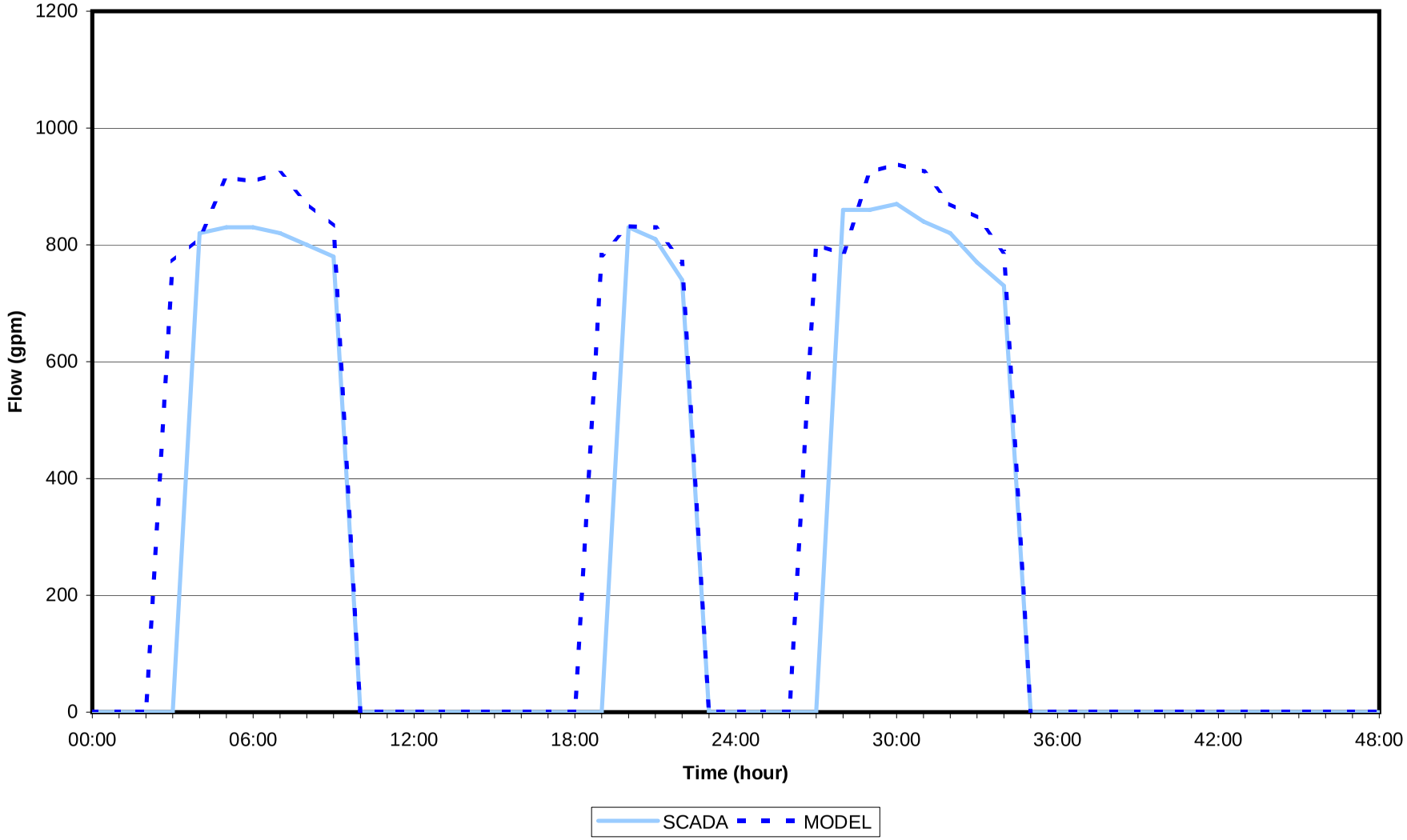



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST5-2P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 7 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

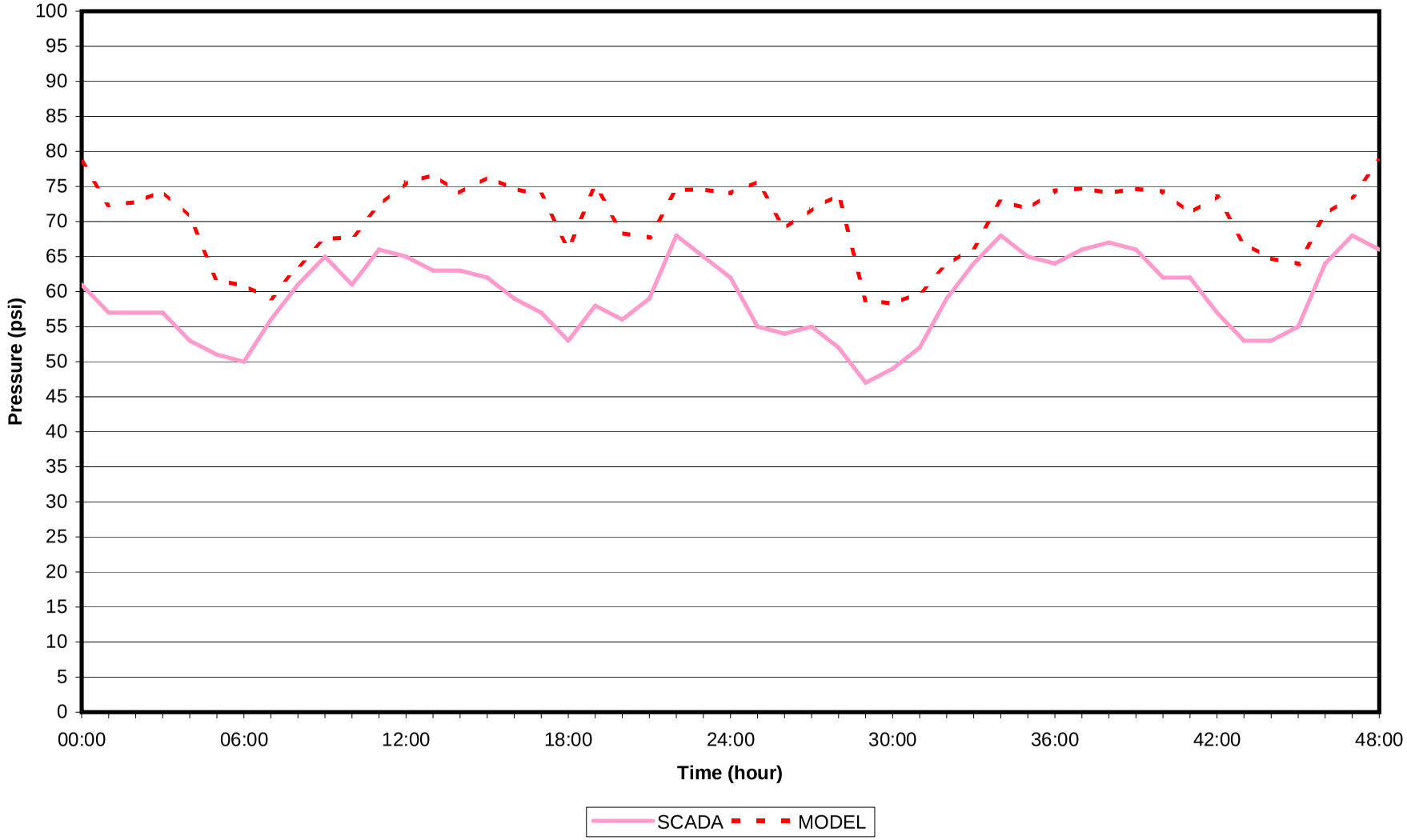



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST7-4Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 7 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

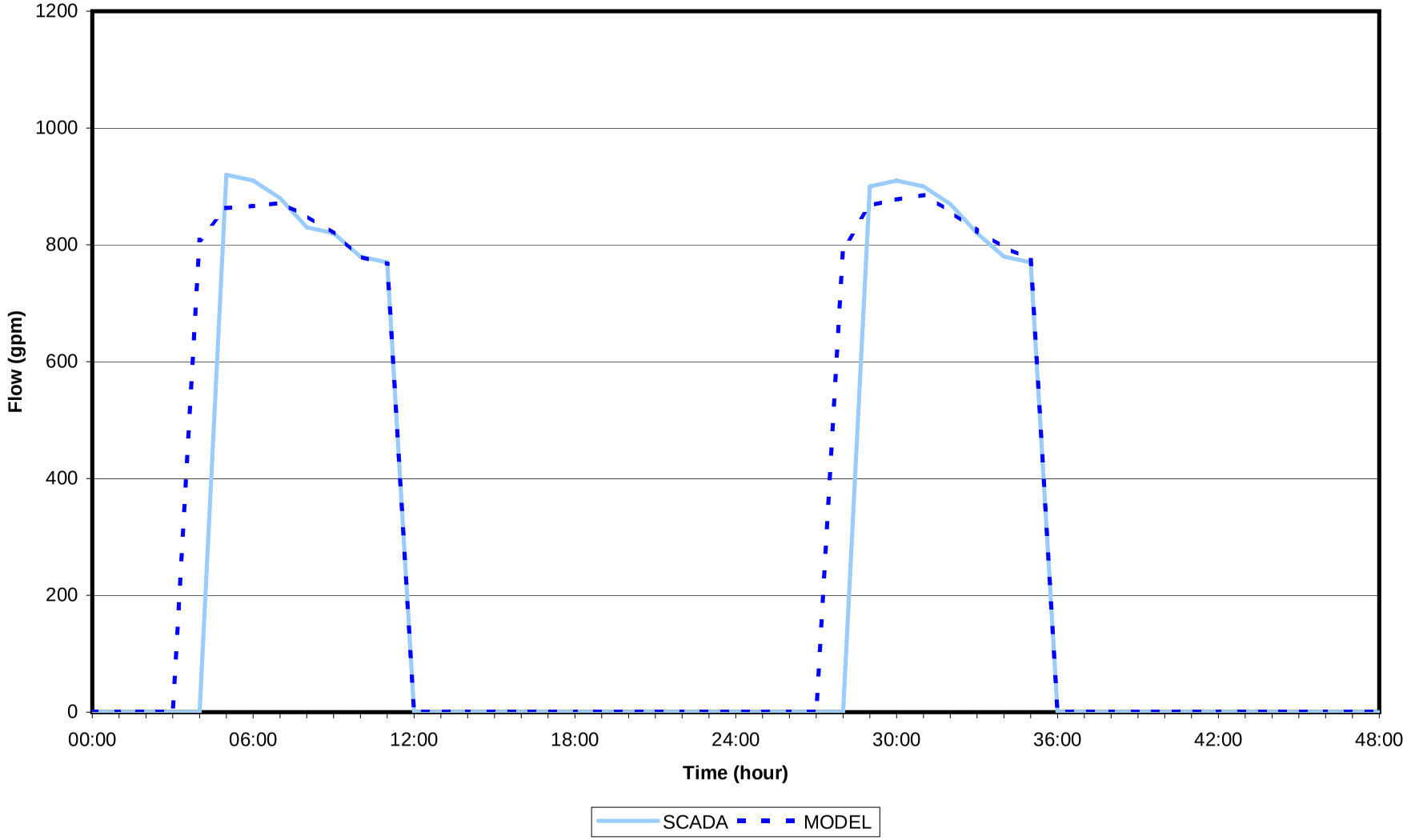



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST7-4P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 8 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

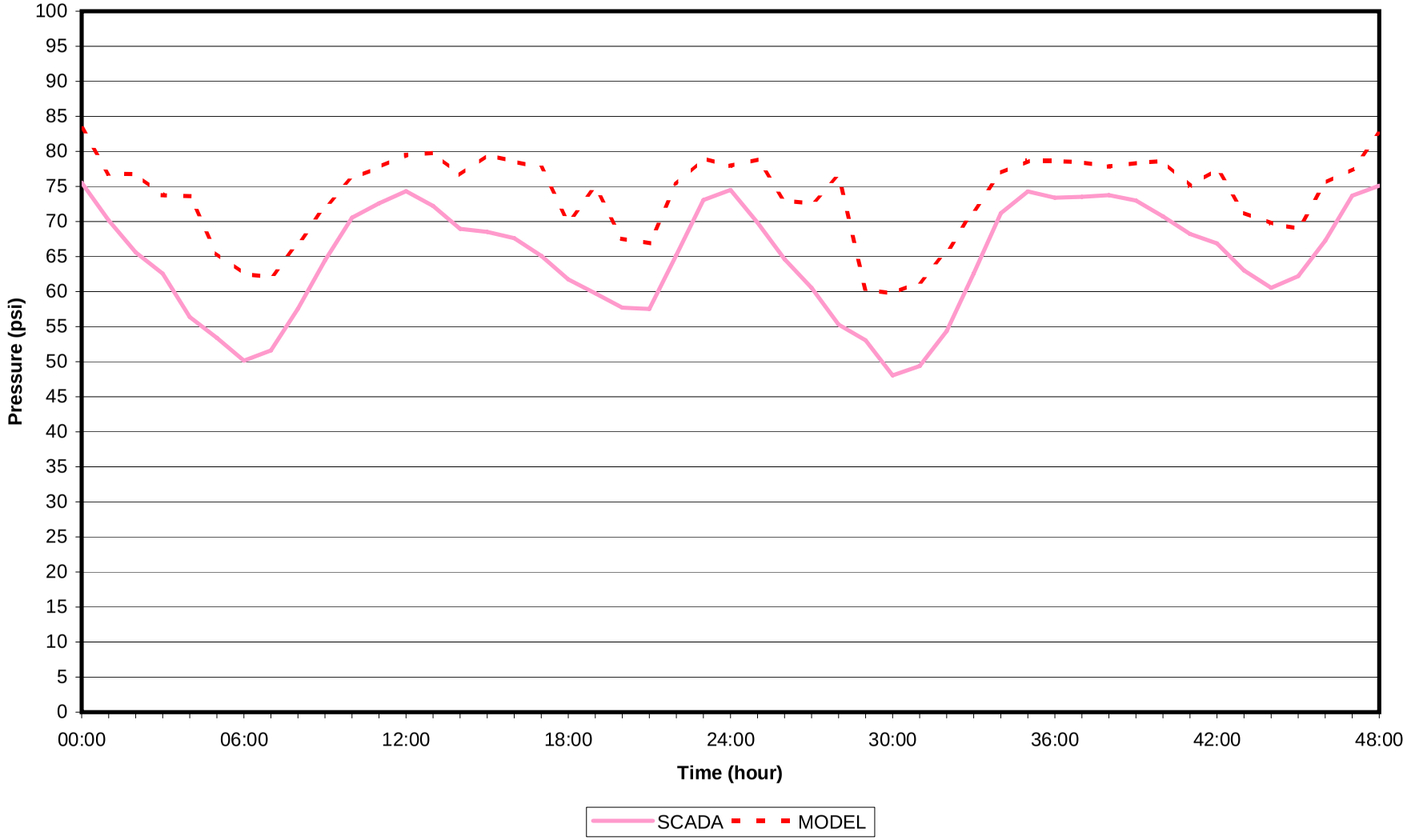



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST8-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 8 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

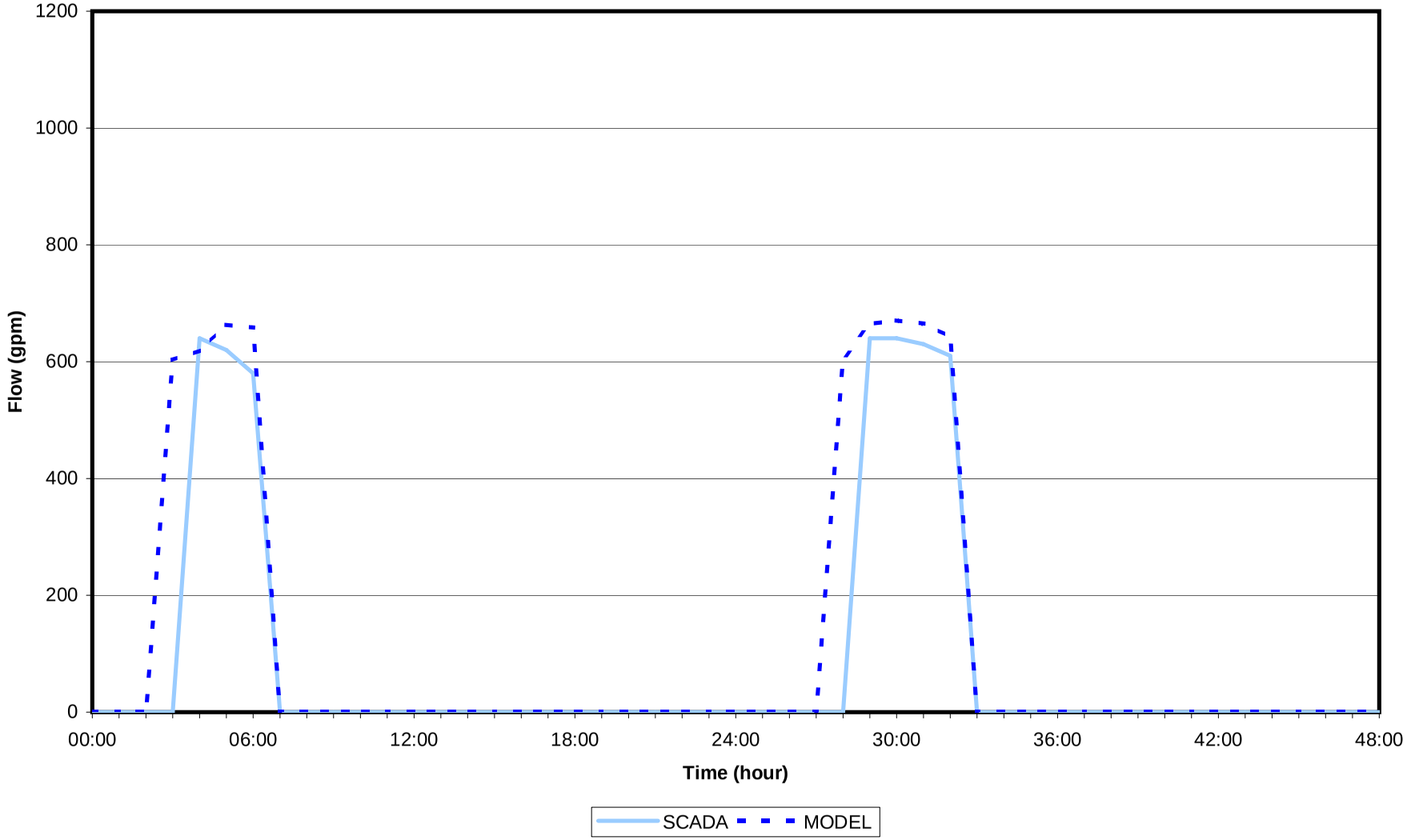



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST8-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 11 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

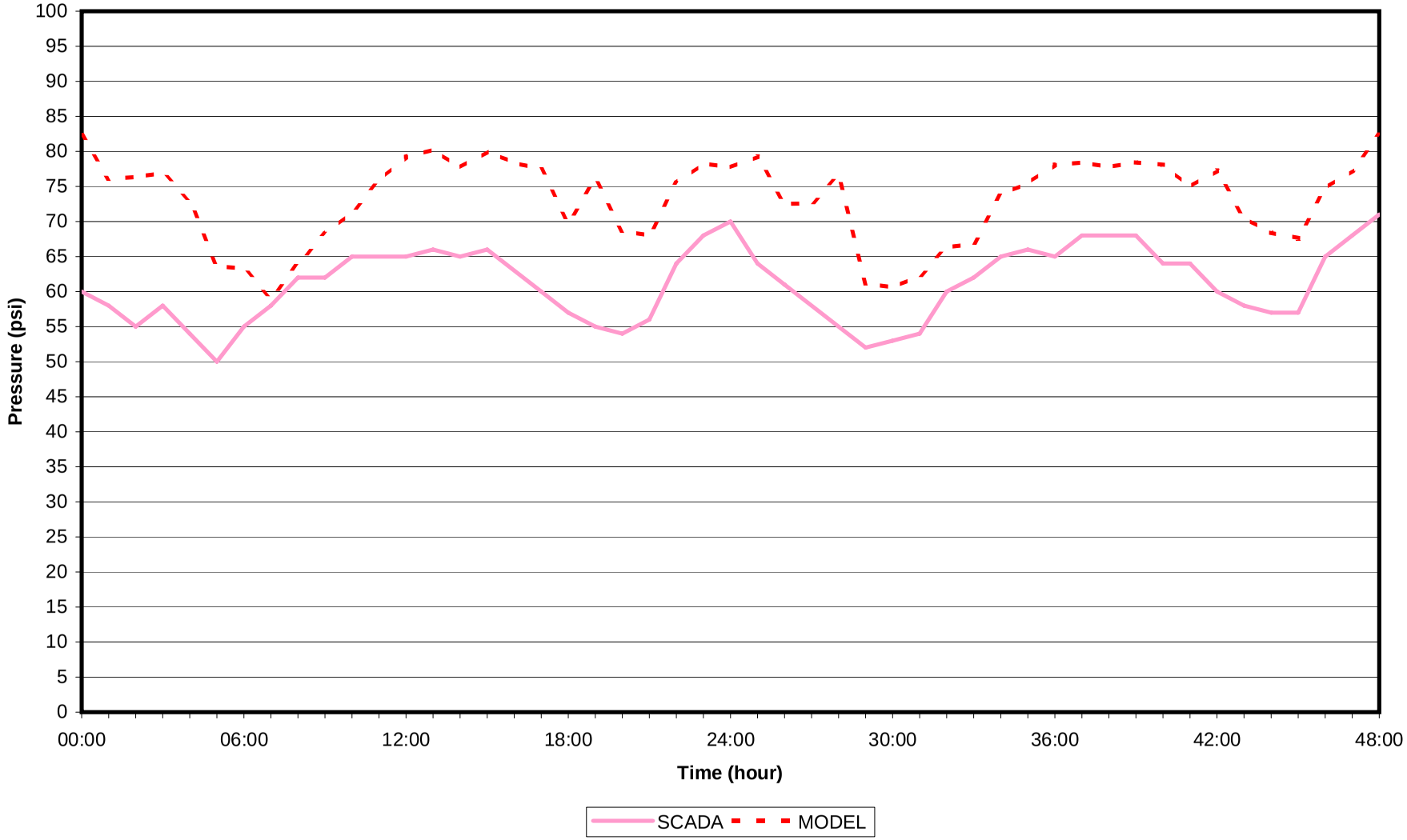



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST11-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 11 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

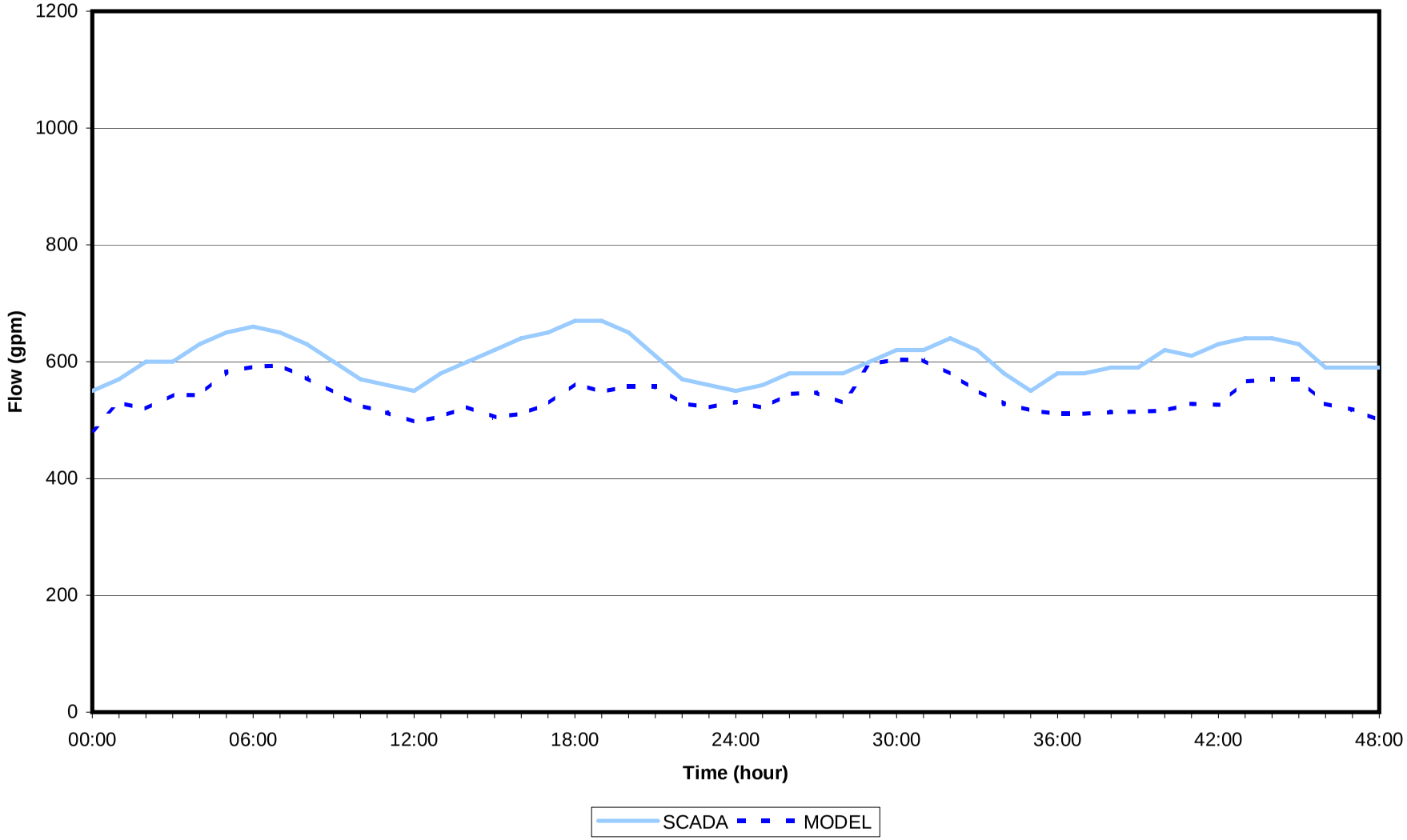



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST11-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 12 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

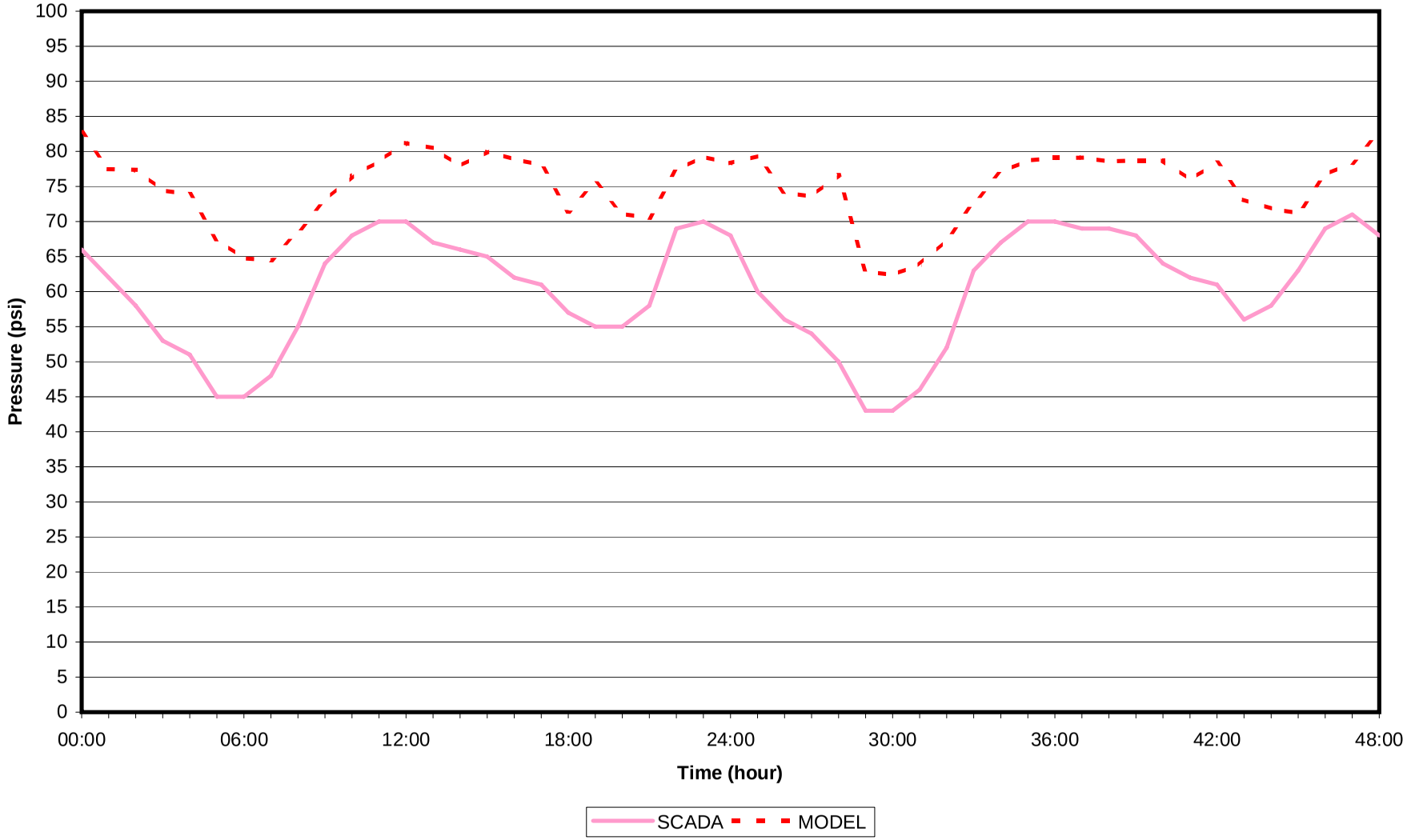



West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST12-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

## Station 12 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

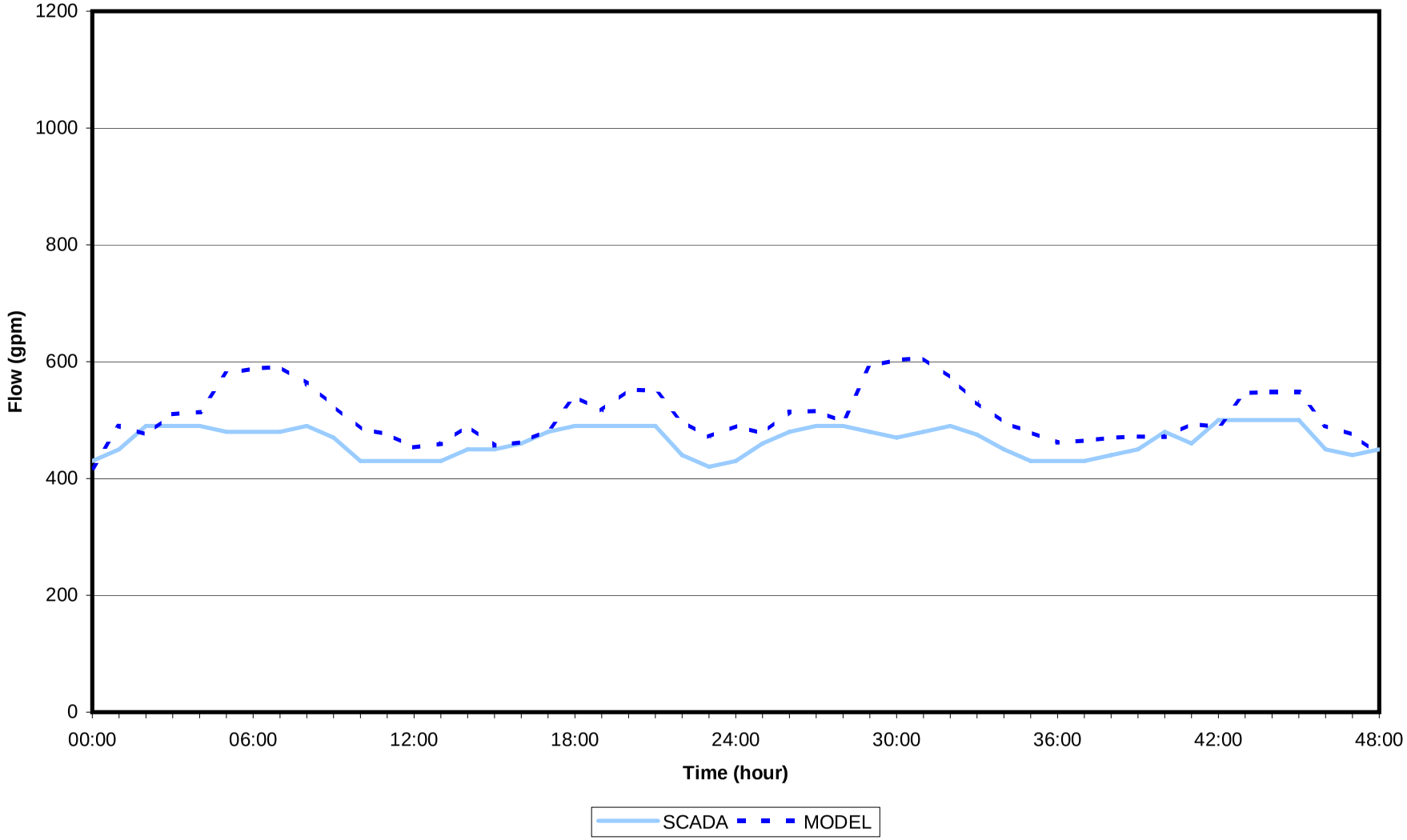



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST12-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 14 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

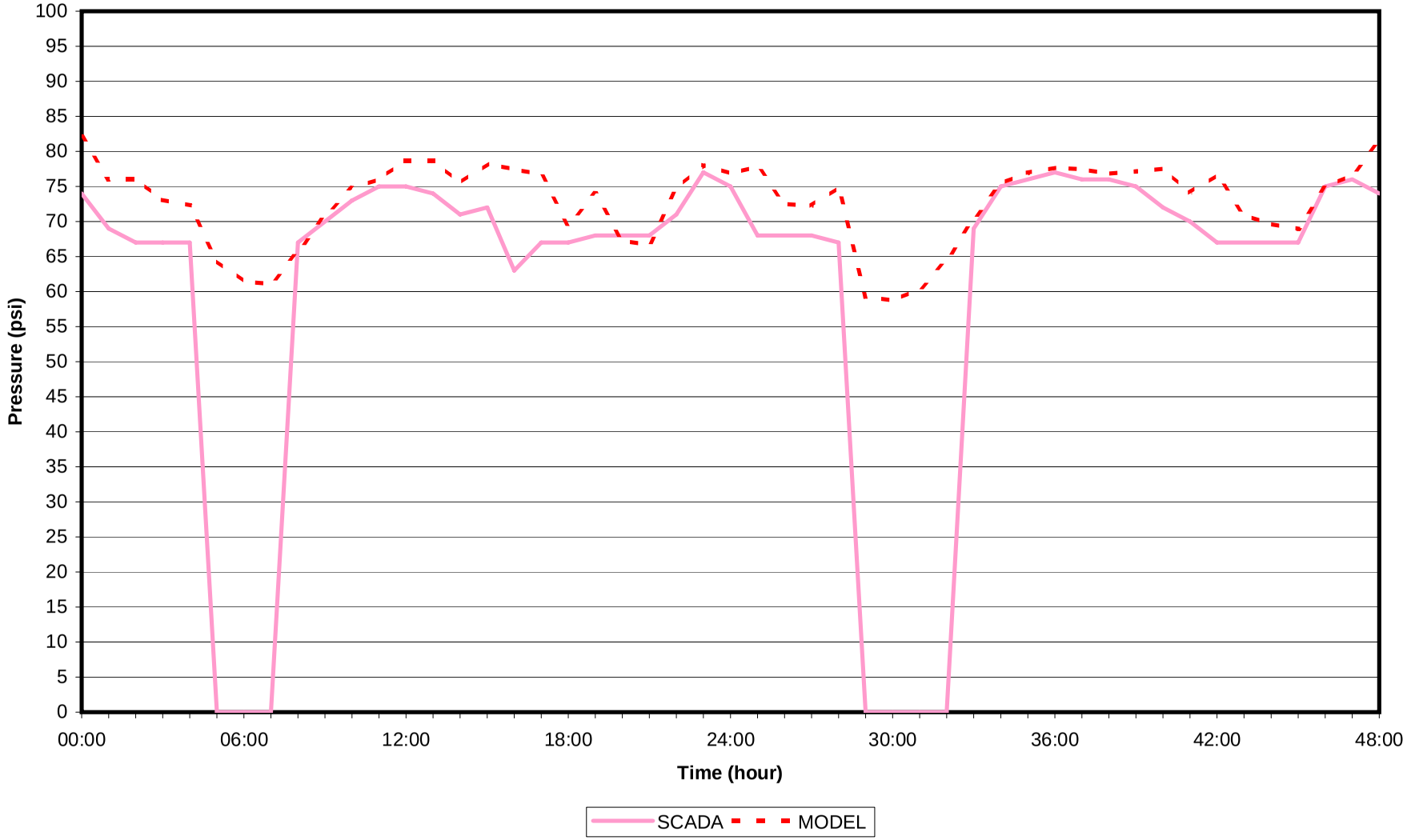



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST14-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 14 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

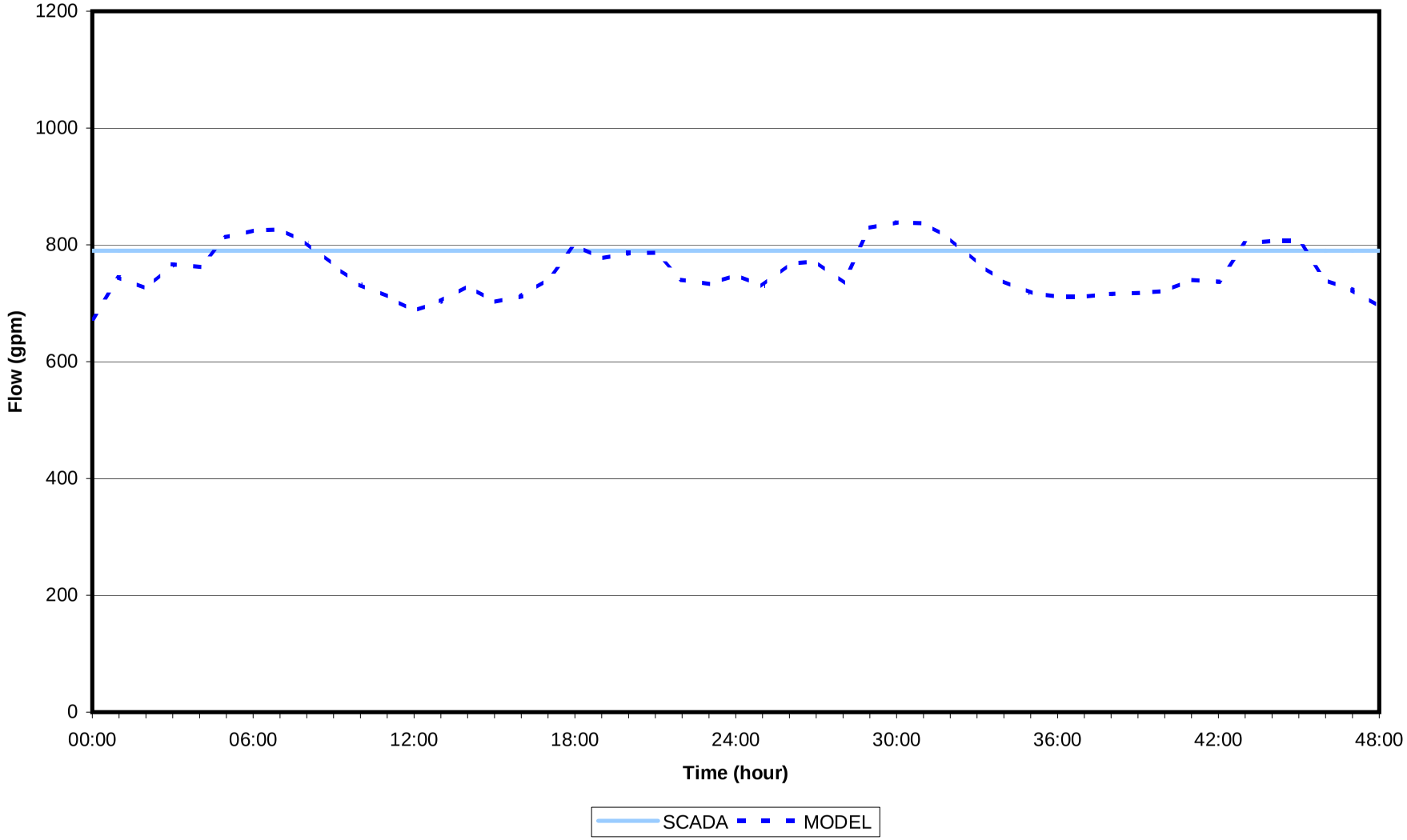



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST14-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 16 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

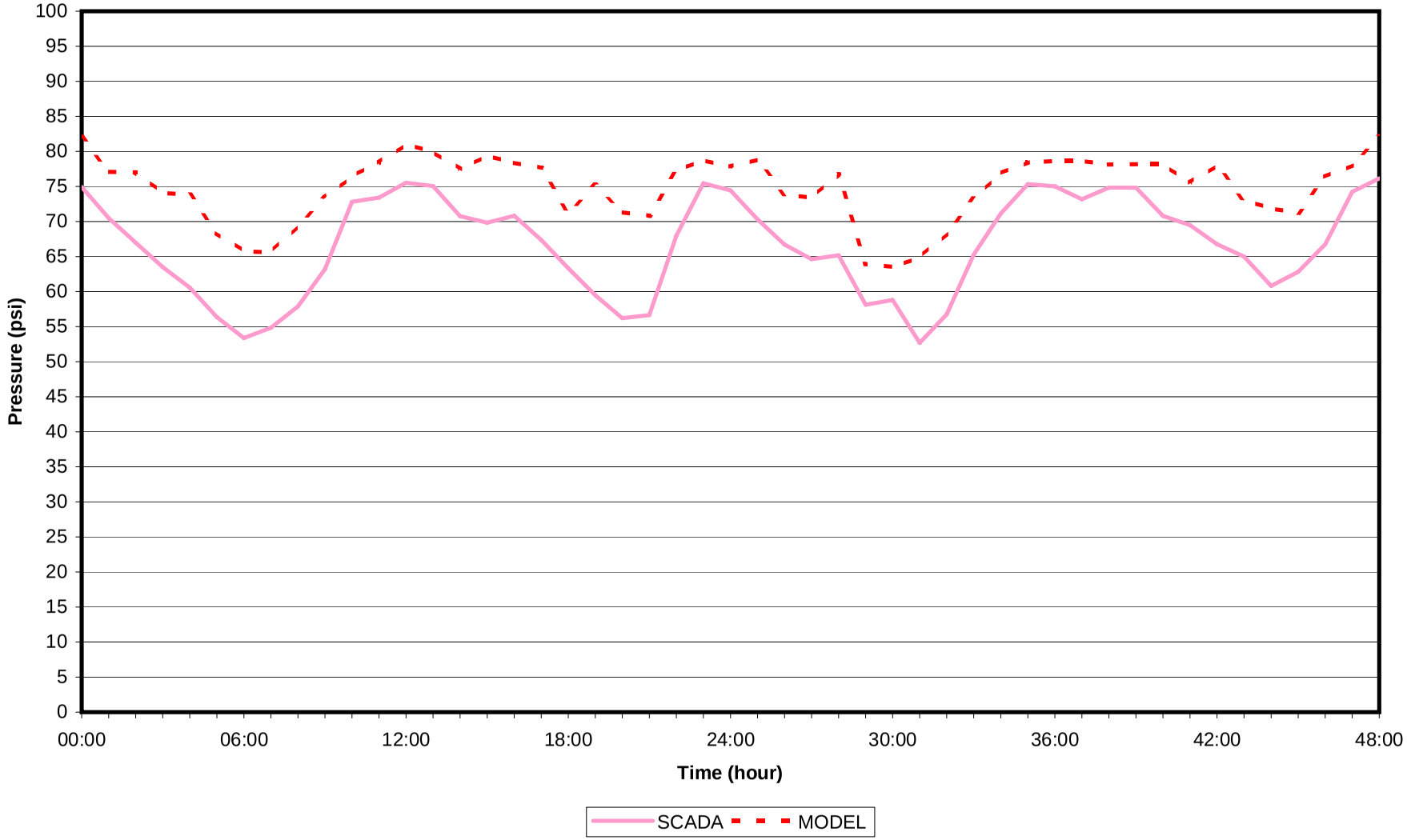



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST16-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 16 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

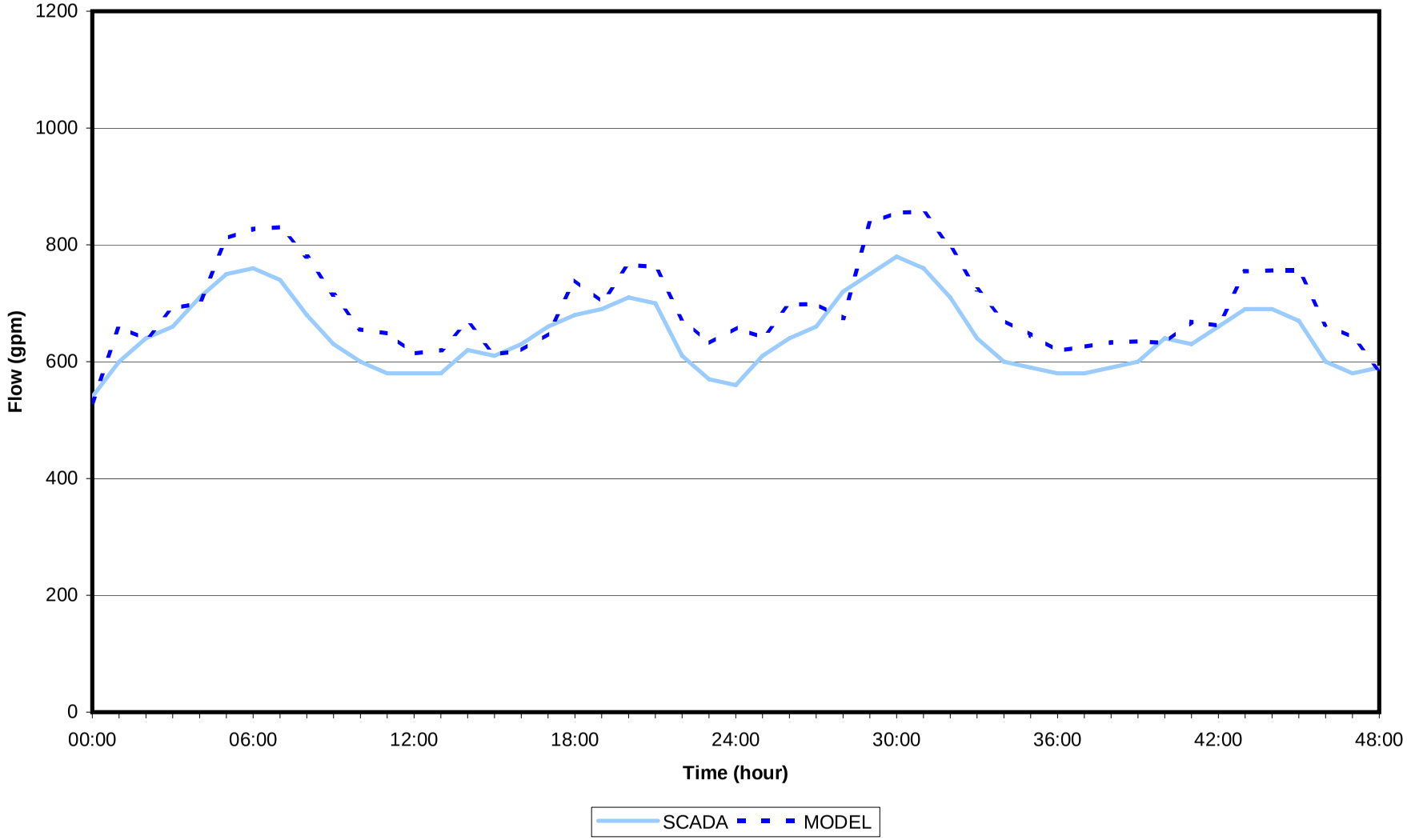



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST16-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 17 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

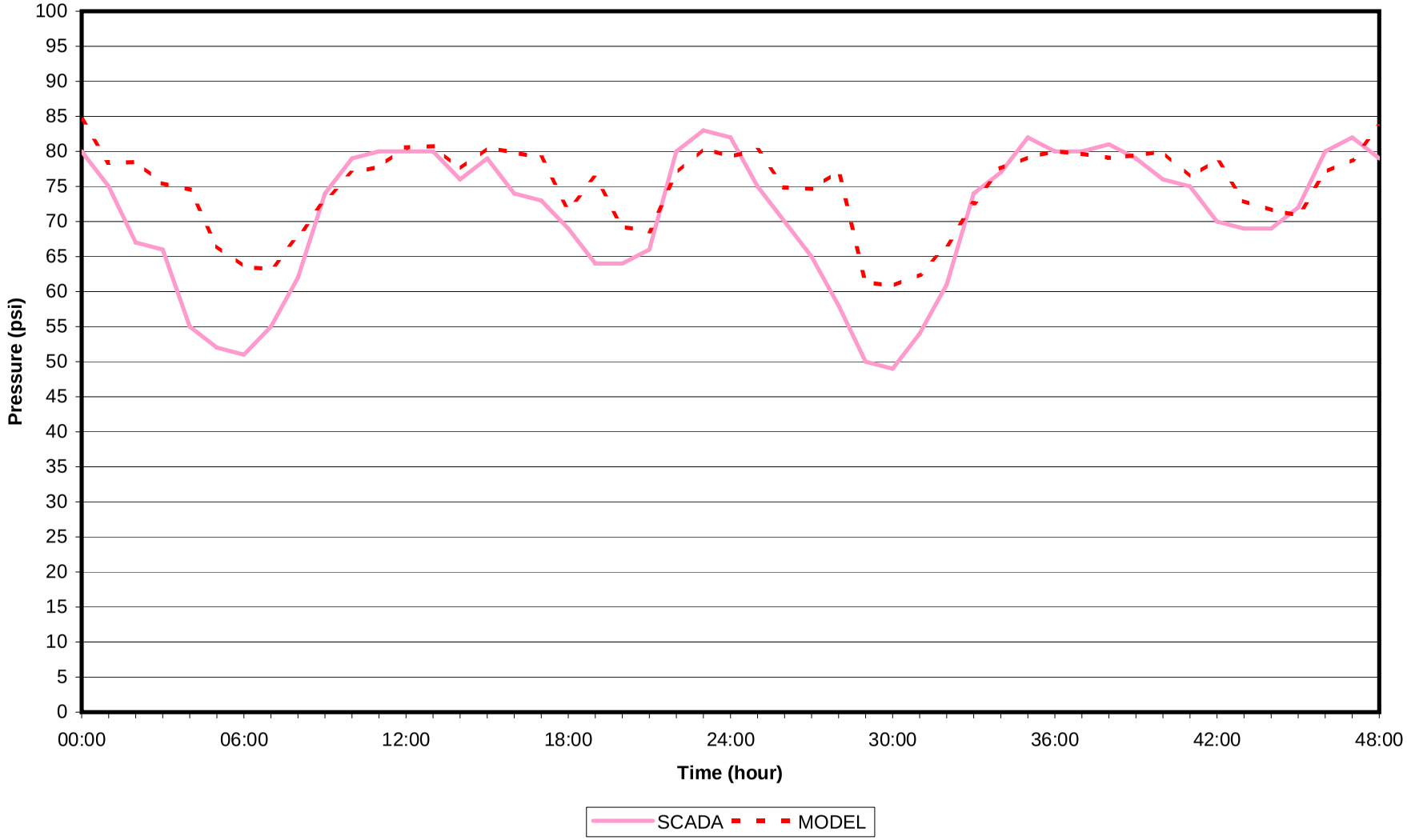



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST17-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 17 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

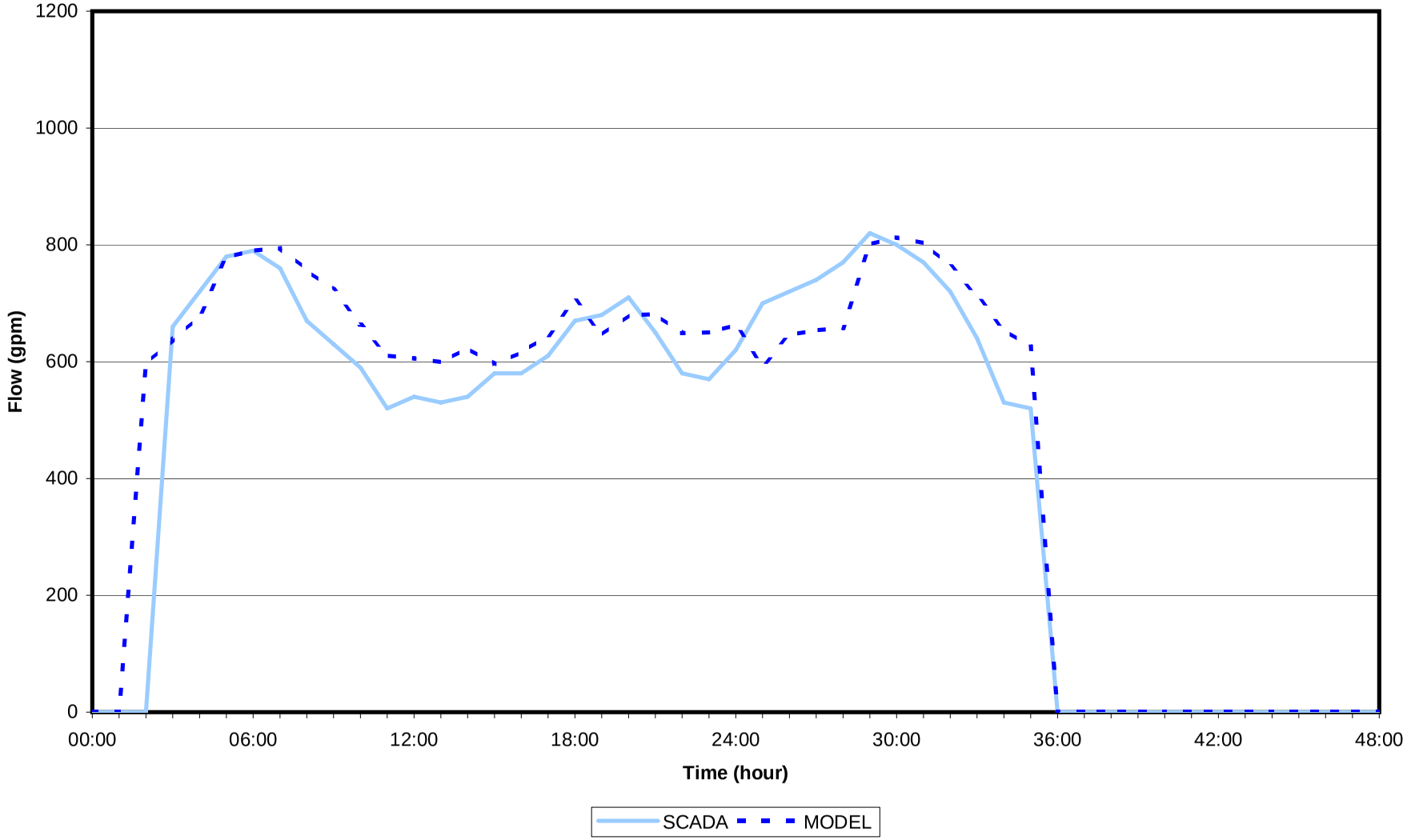



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST17-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 18 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

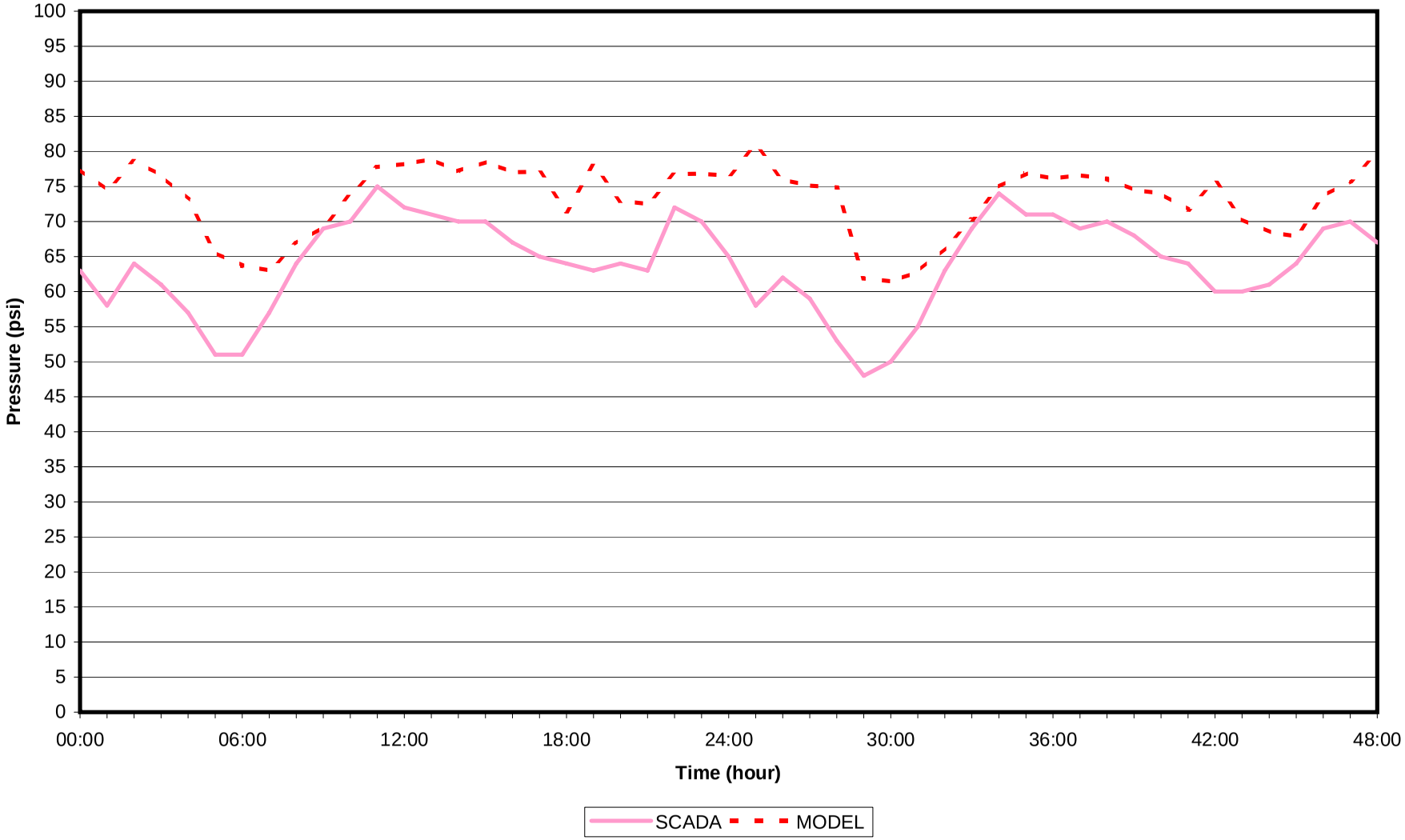



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST18-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 18 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

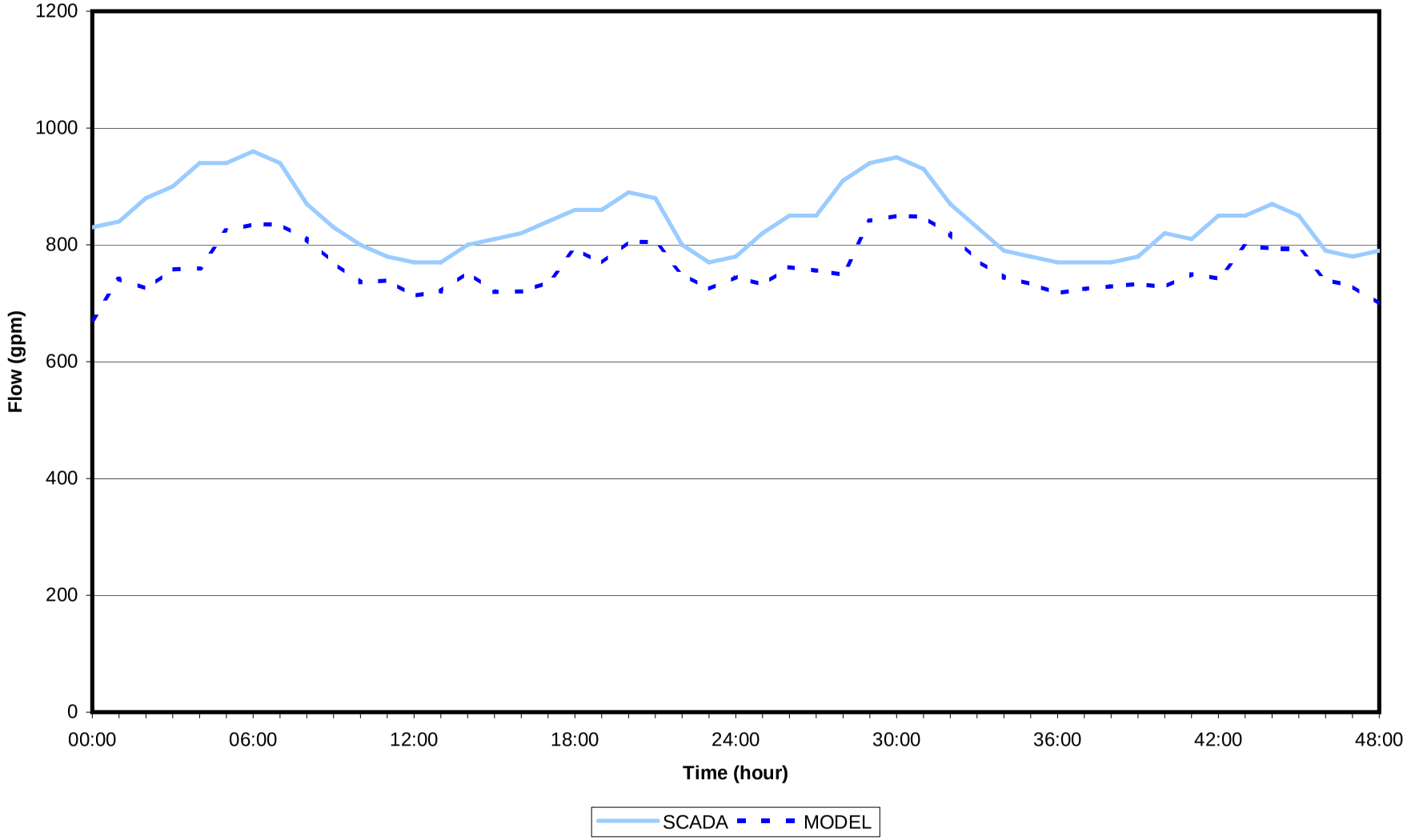



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST18-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 19 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

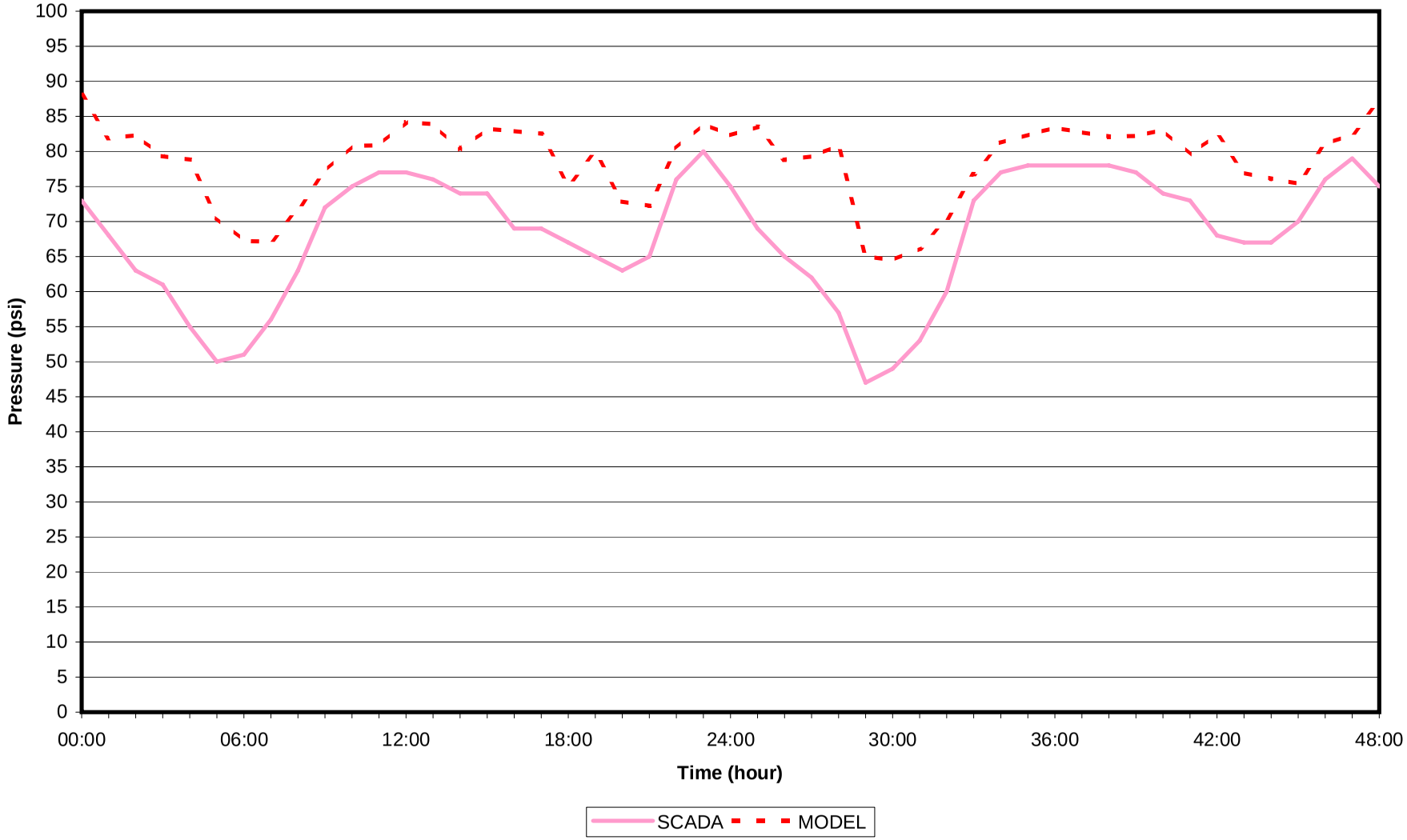



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST19-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 19 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

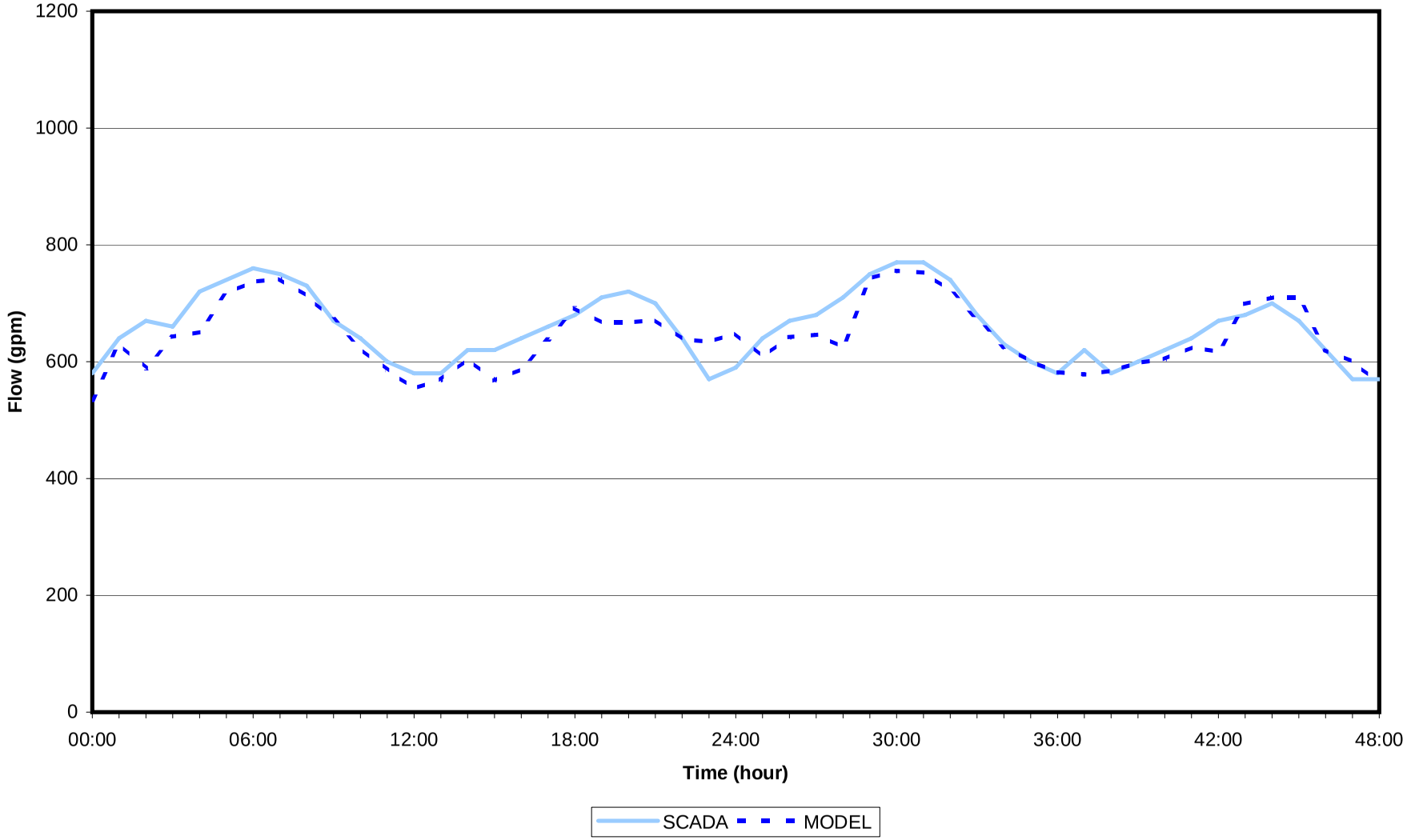



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST19-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 20 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

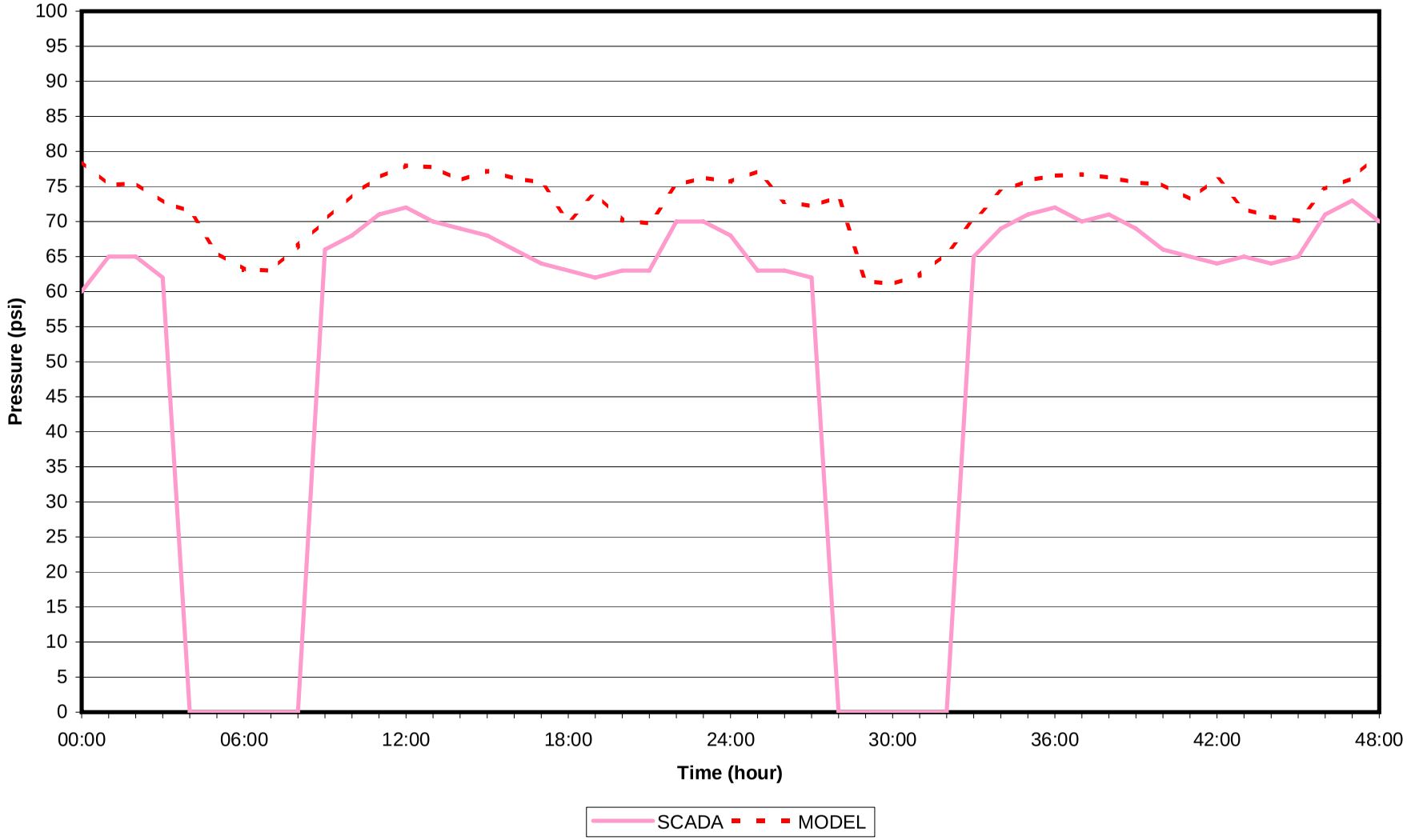



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST20-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 20 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

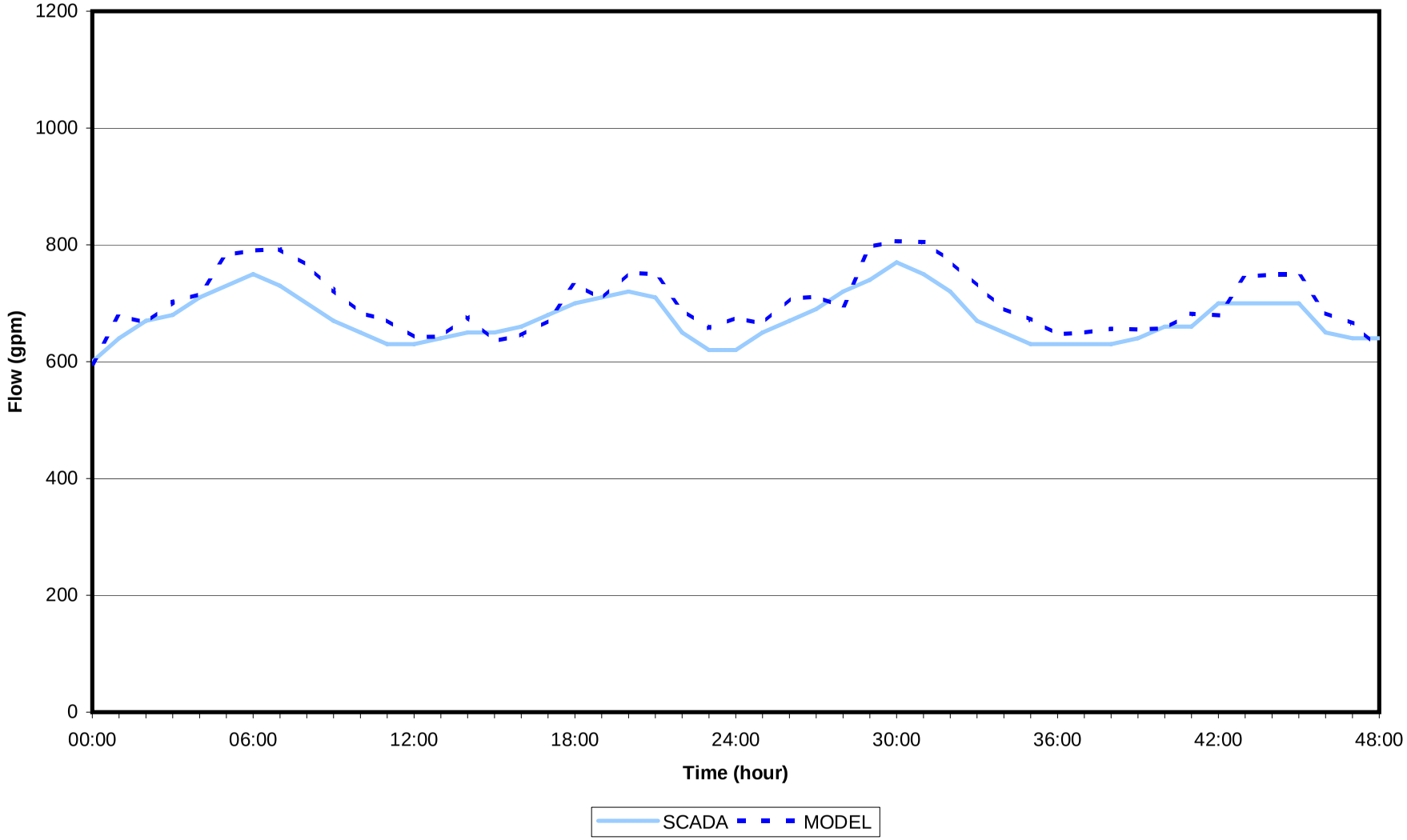



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST20-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 21 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

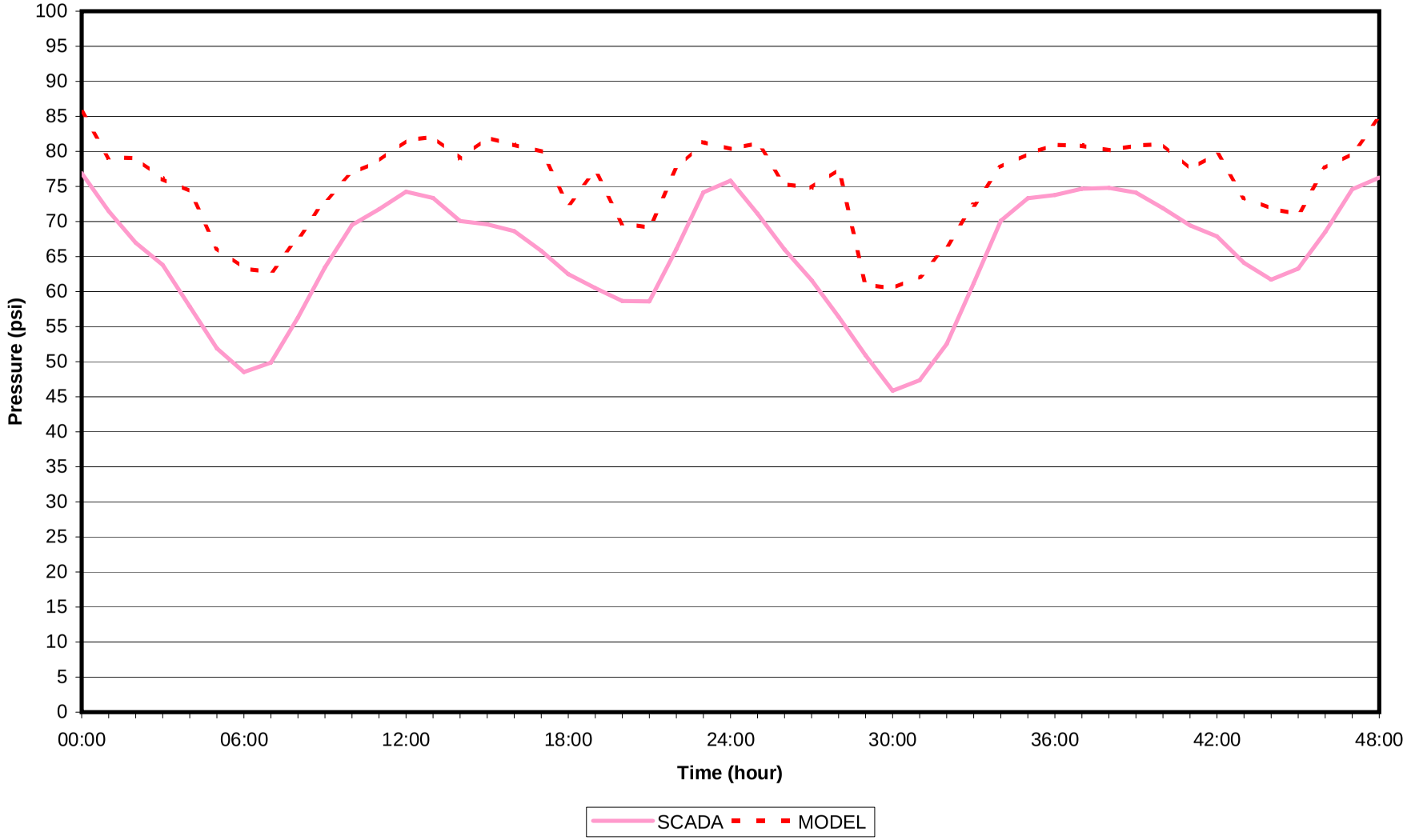



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST21-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 21 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

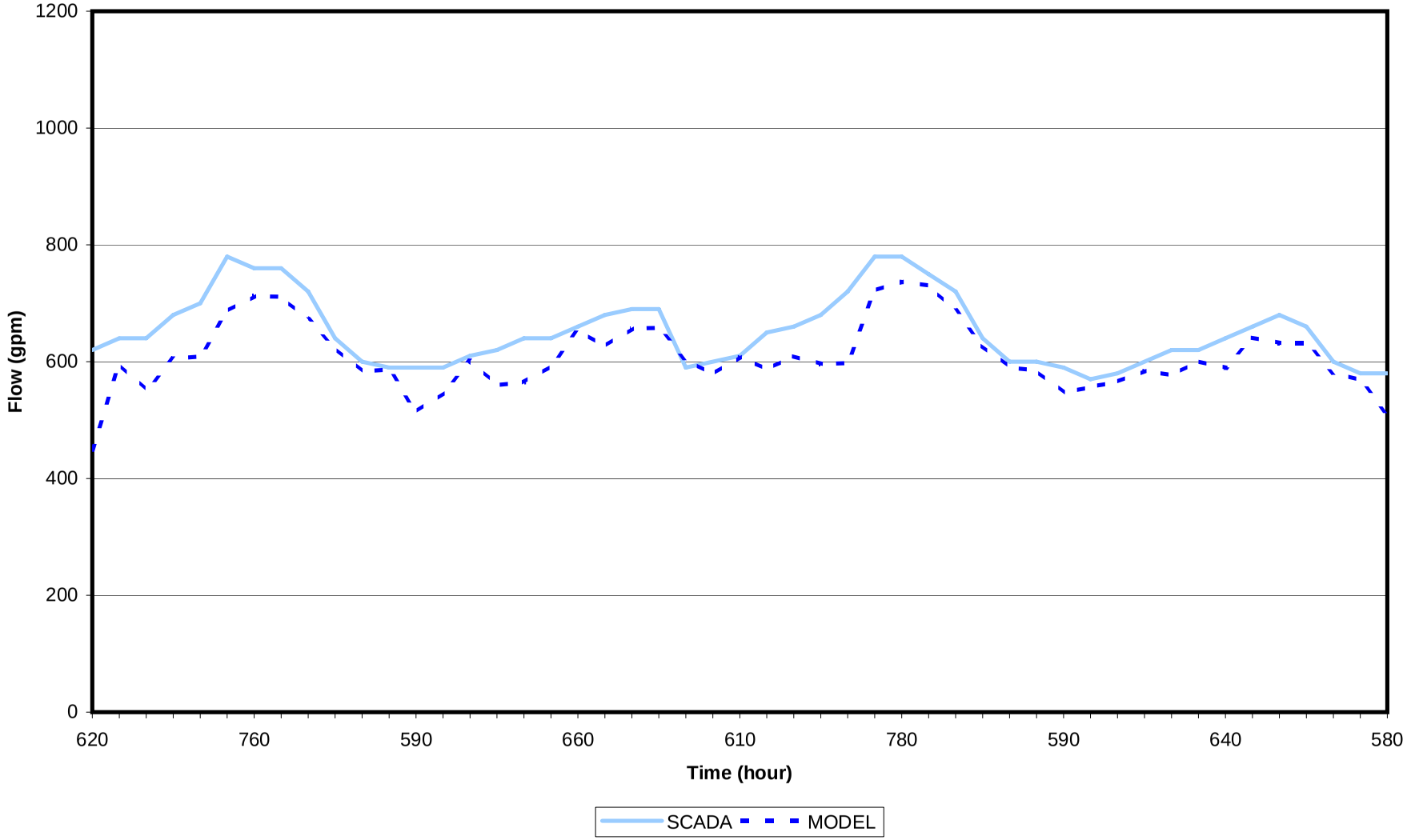



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST21-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 22 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

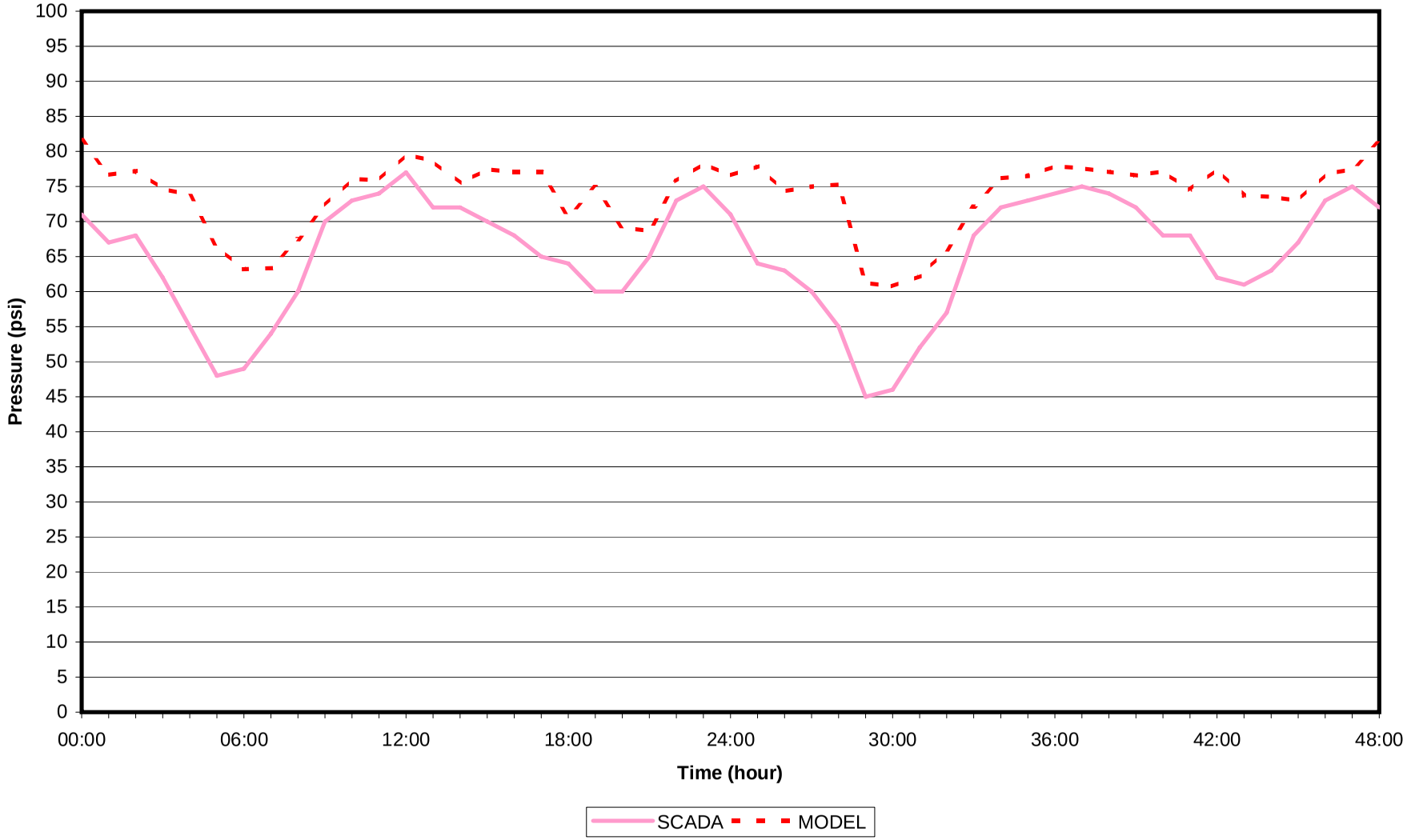



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST22-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 22 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

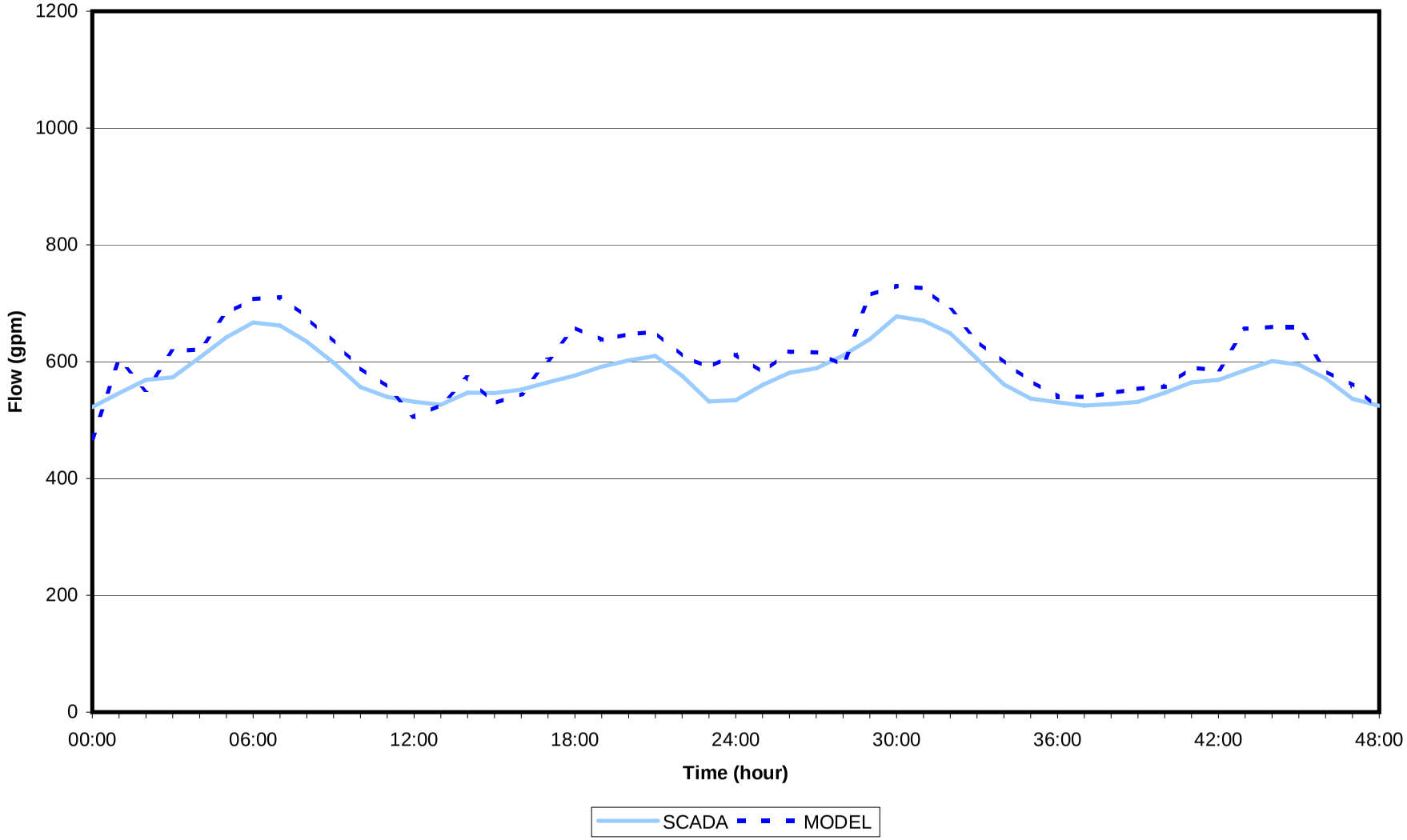



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST22-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 24 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

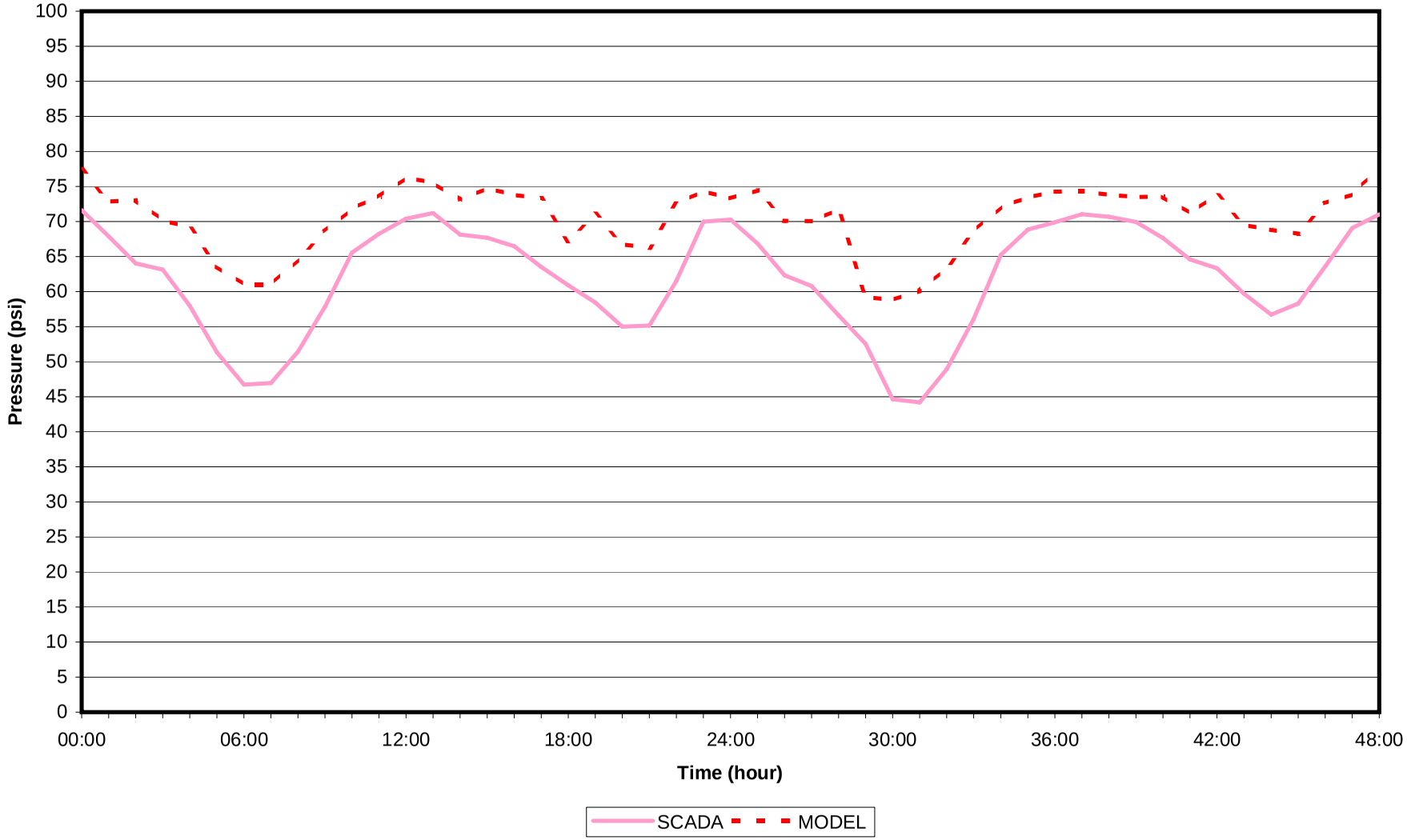



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST24-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 24 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

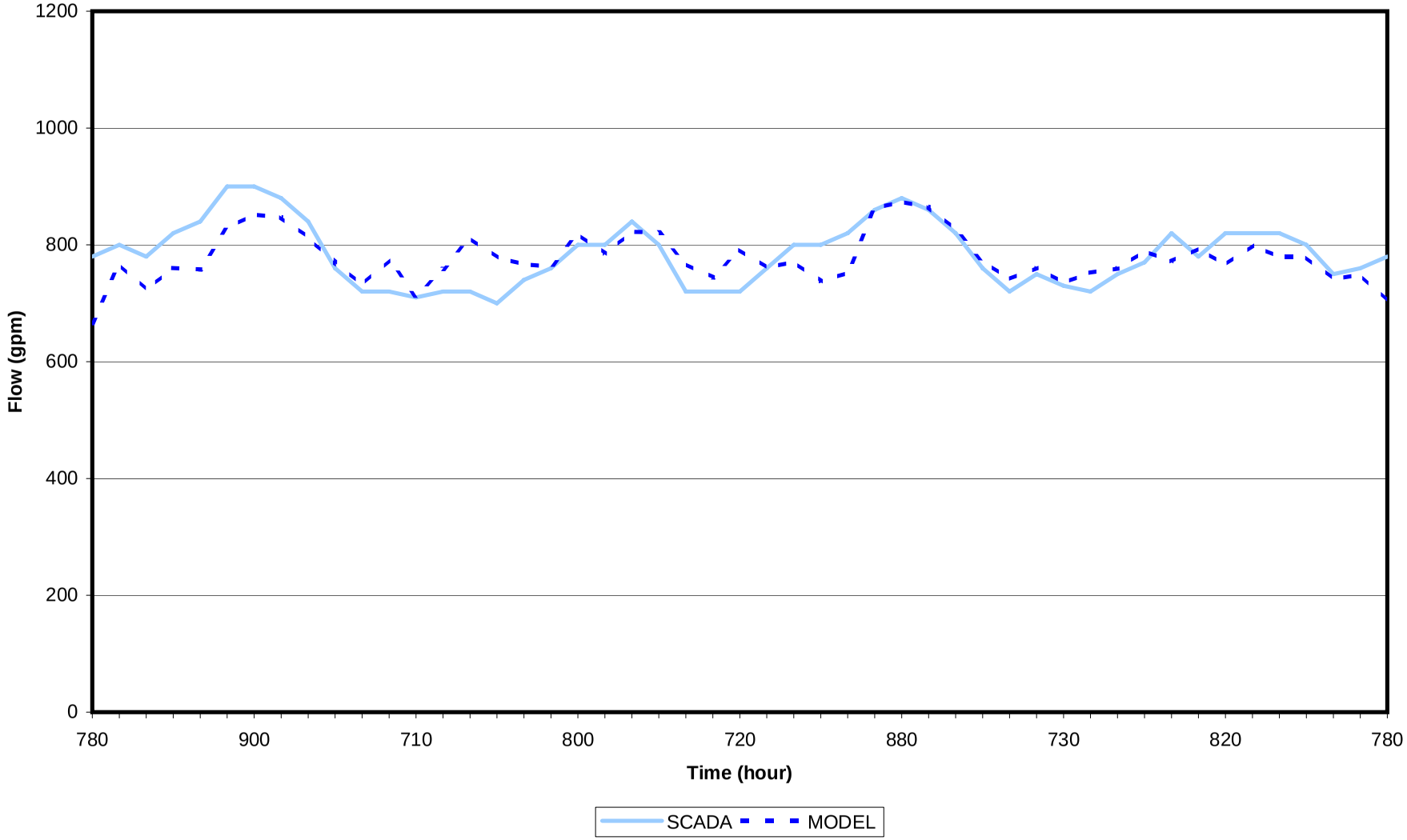



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST24-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 25 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

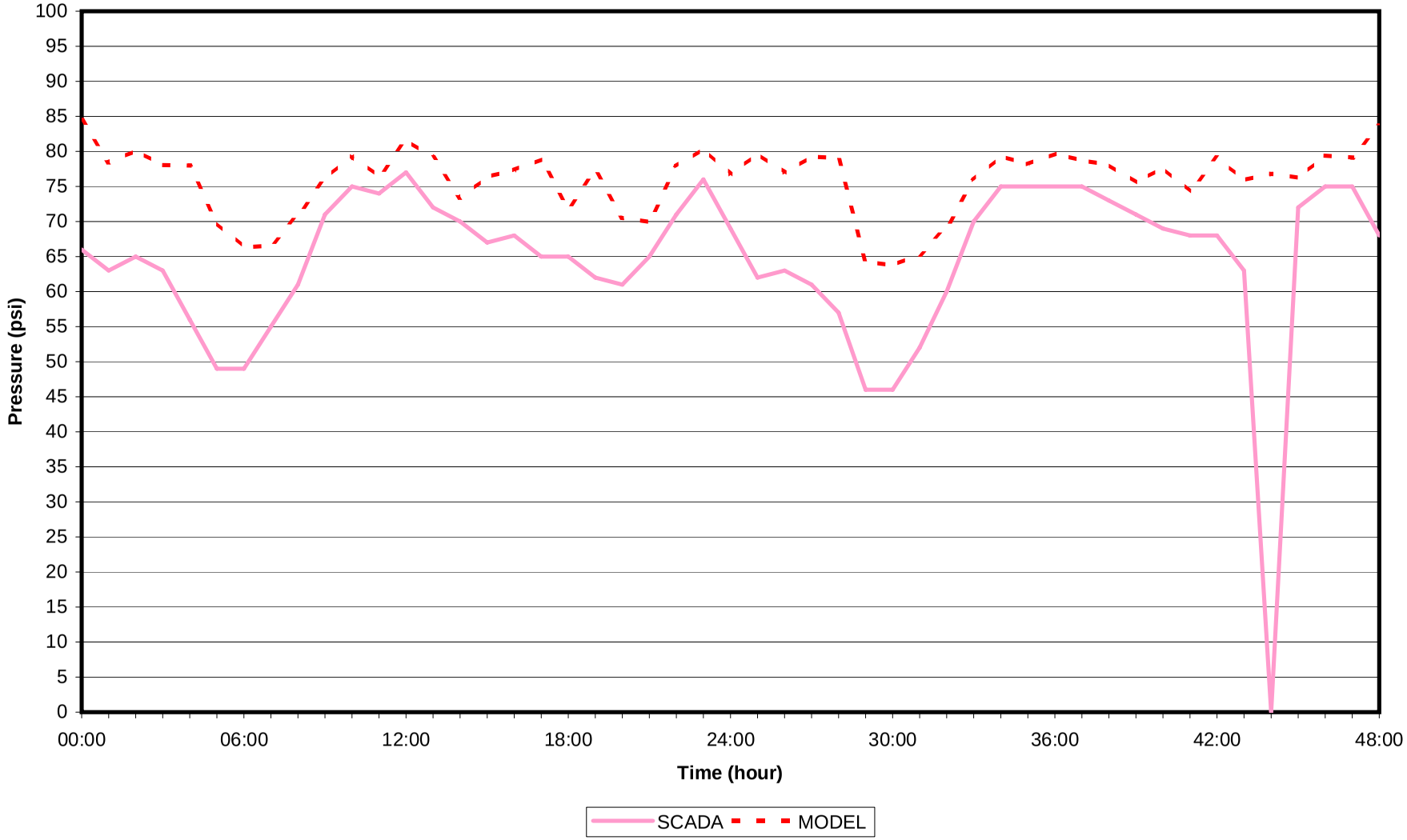



West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST25-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

## Station 25 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

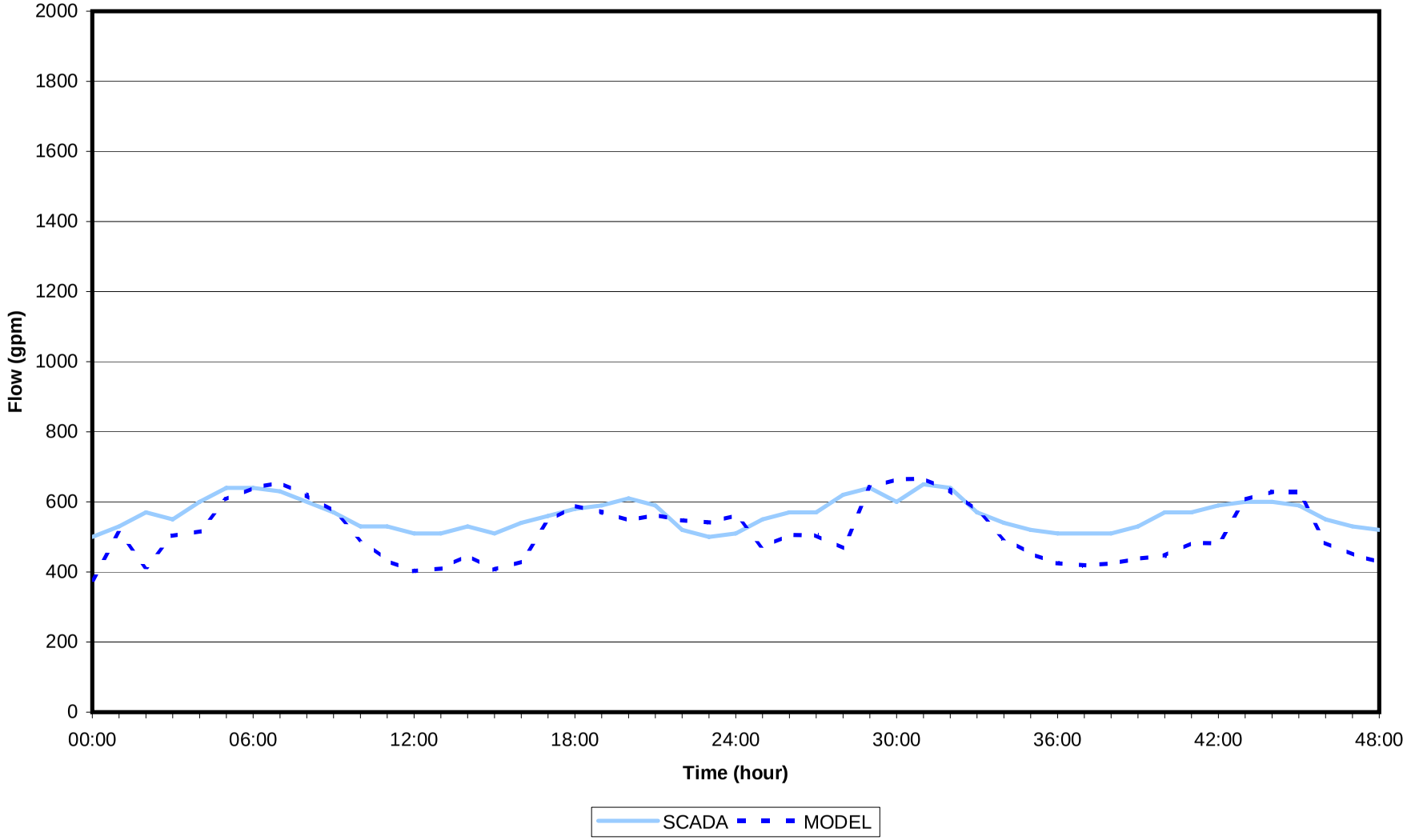



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST25-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 26 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

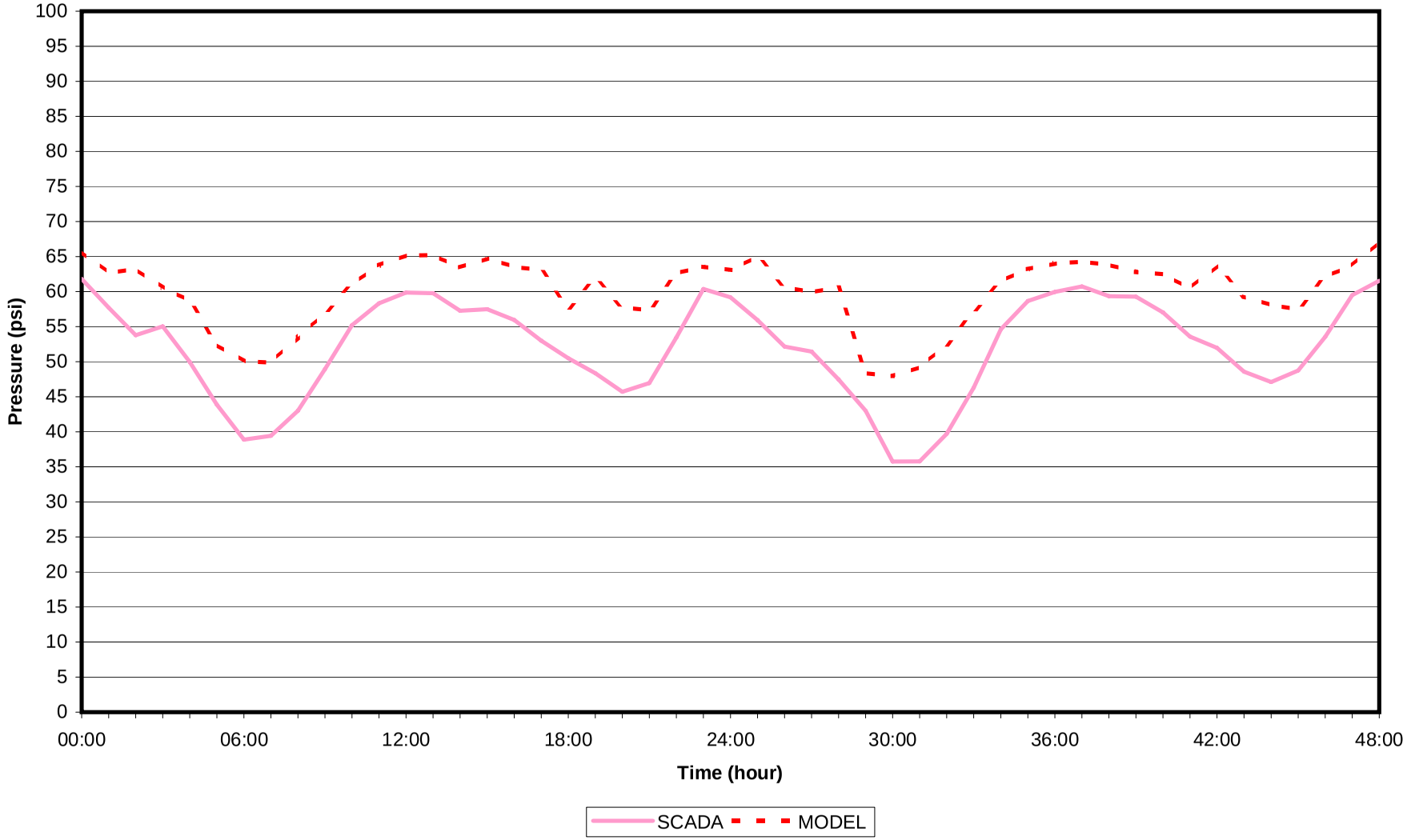



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST26-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 26 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

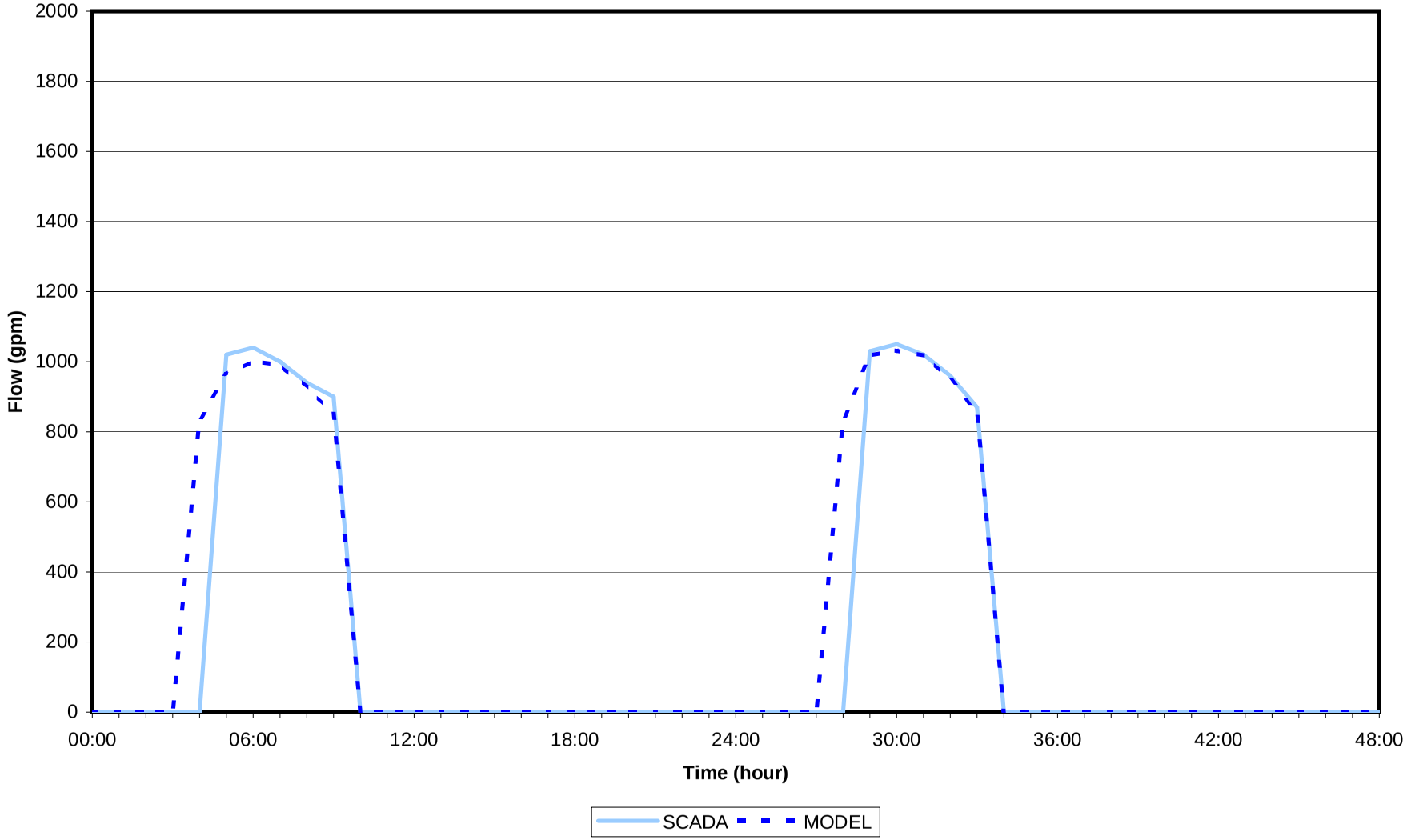



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST26-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 27 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

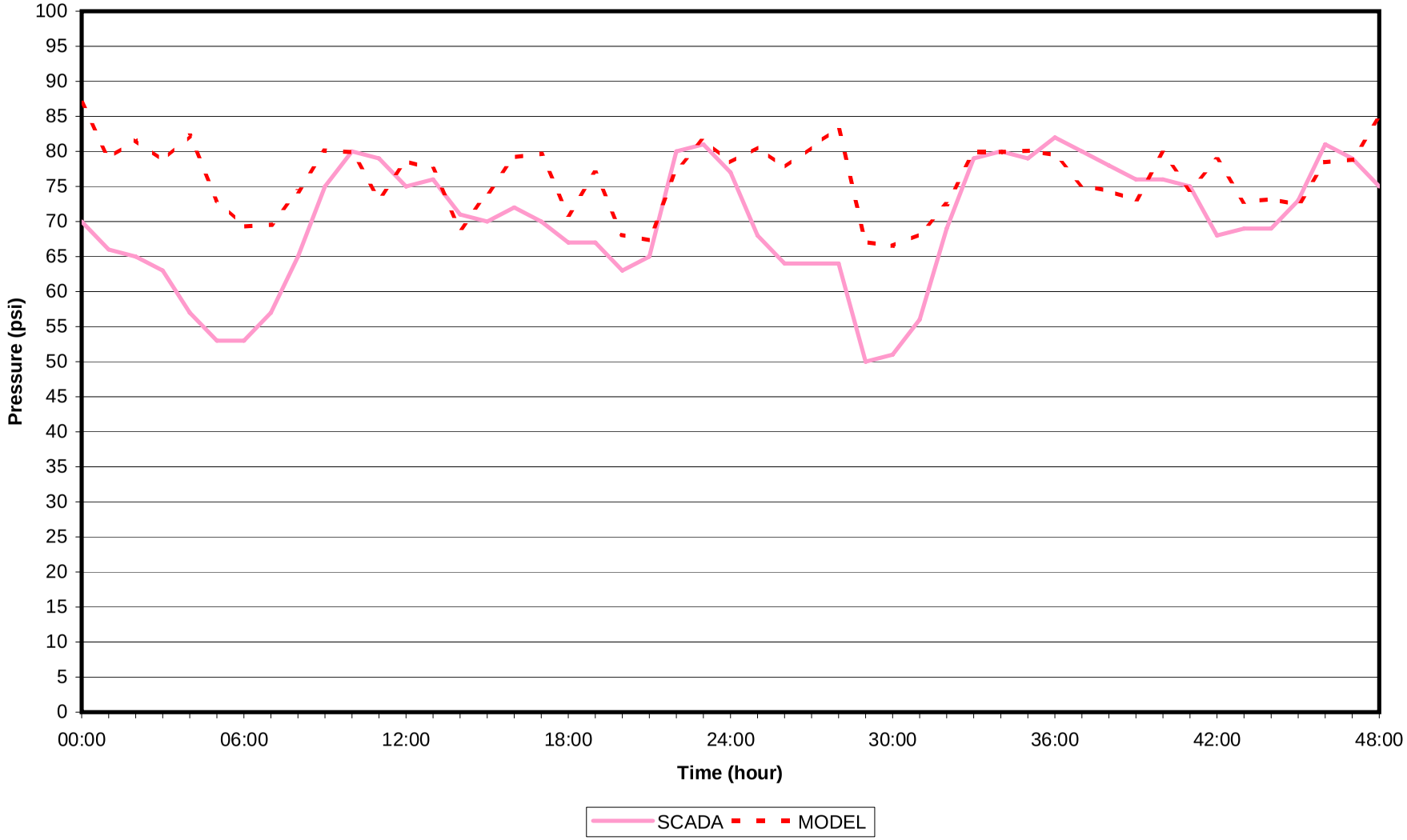



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST27-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 27 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

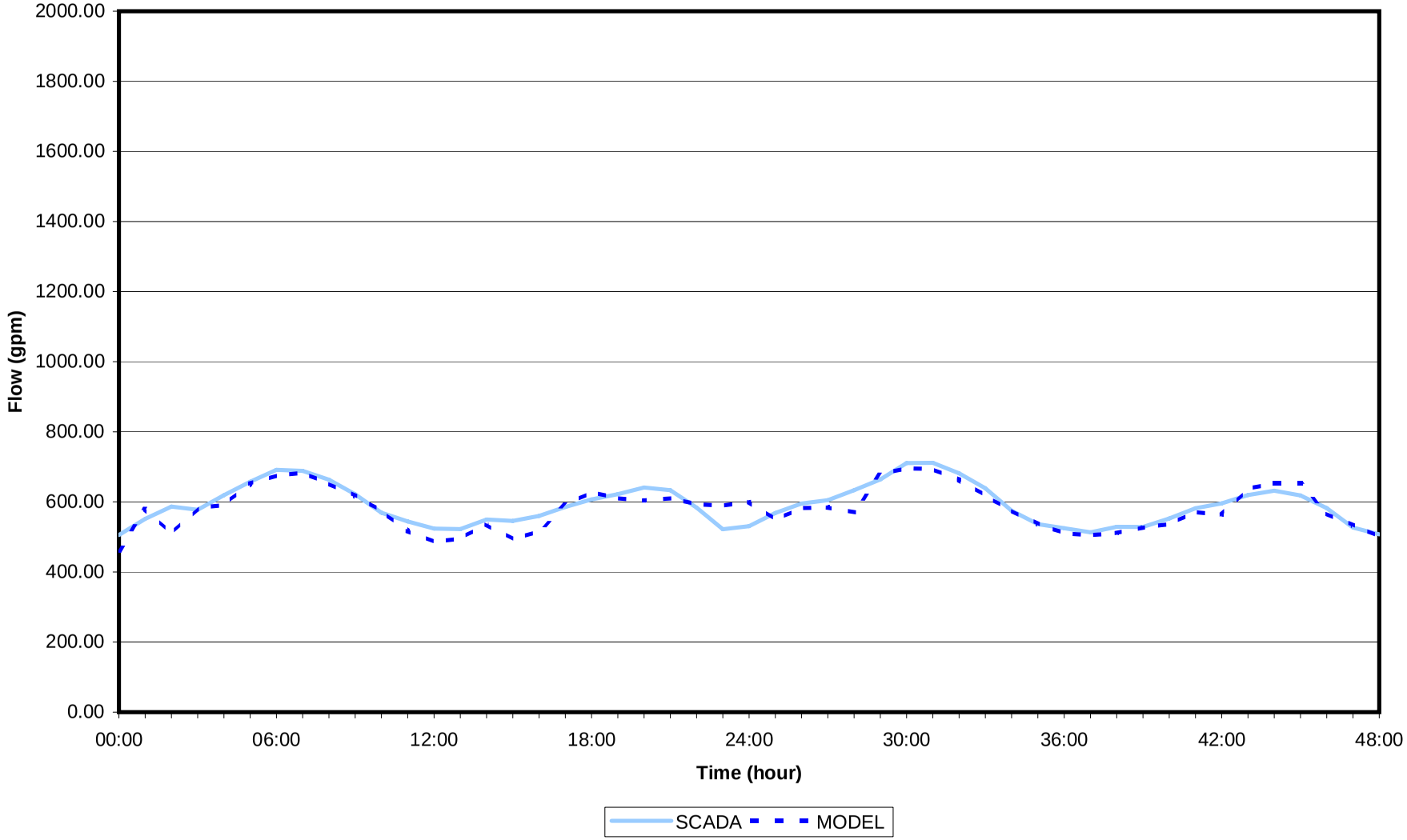



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST27-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 28 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

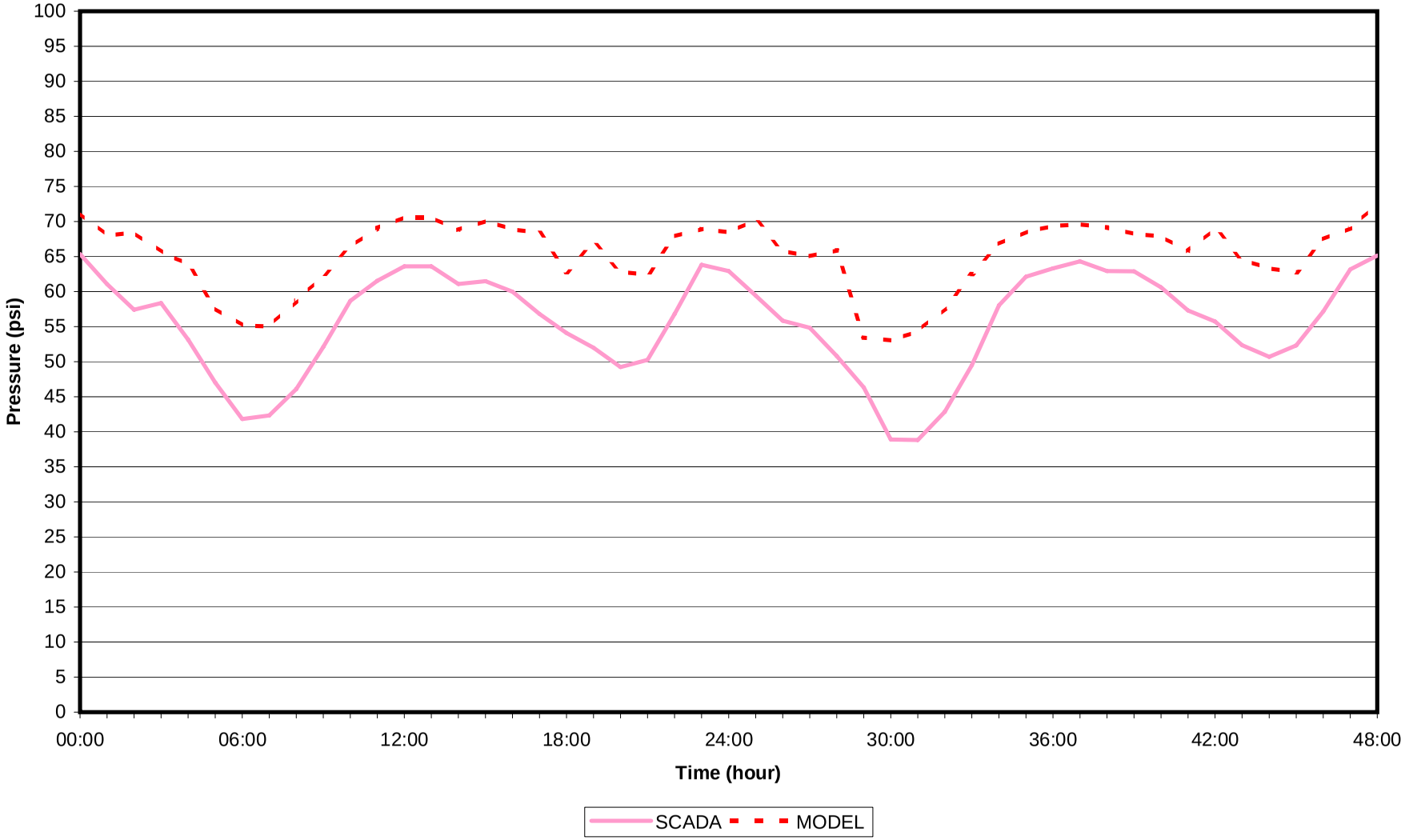



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST28-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 28 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

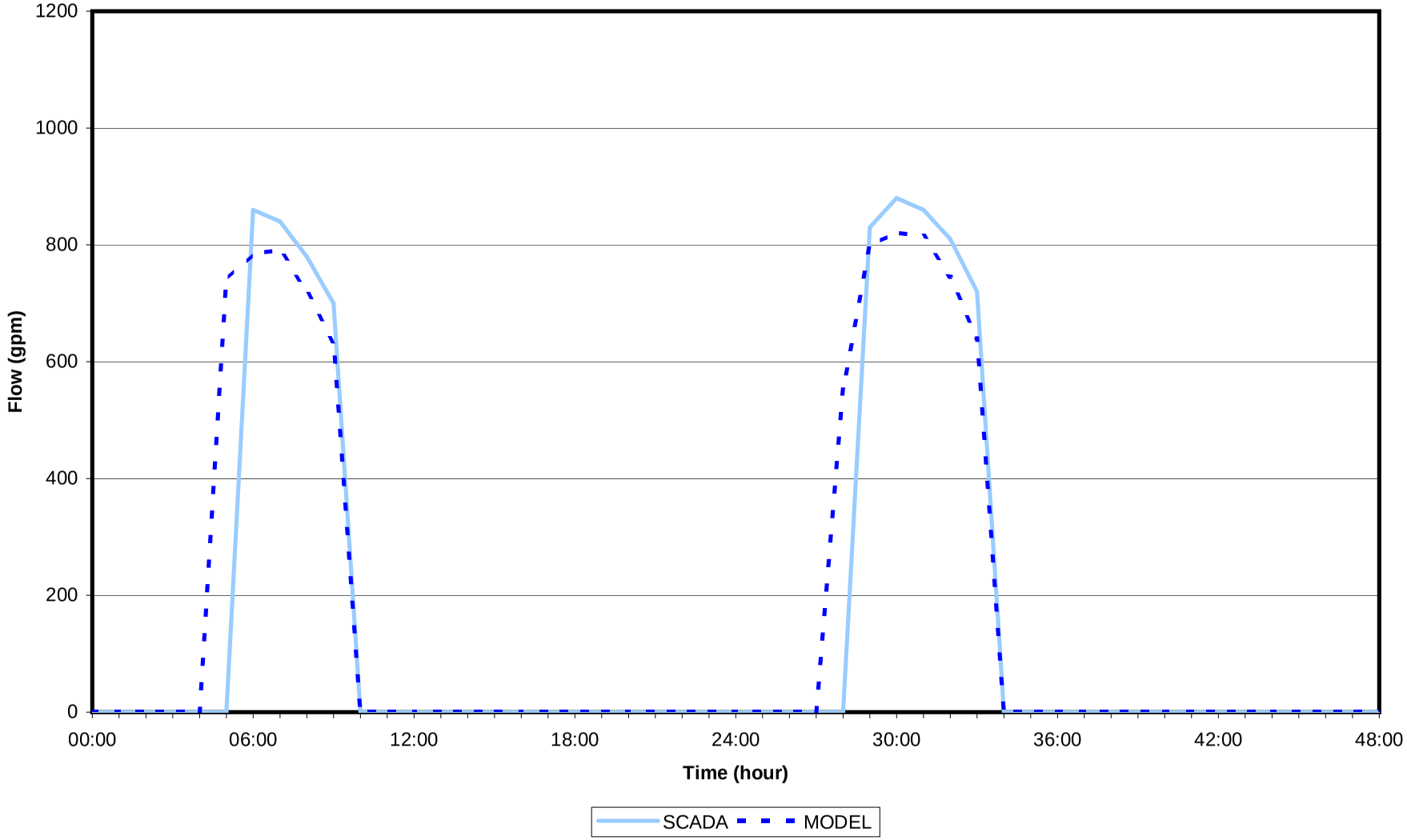



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST28-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 29 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

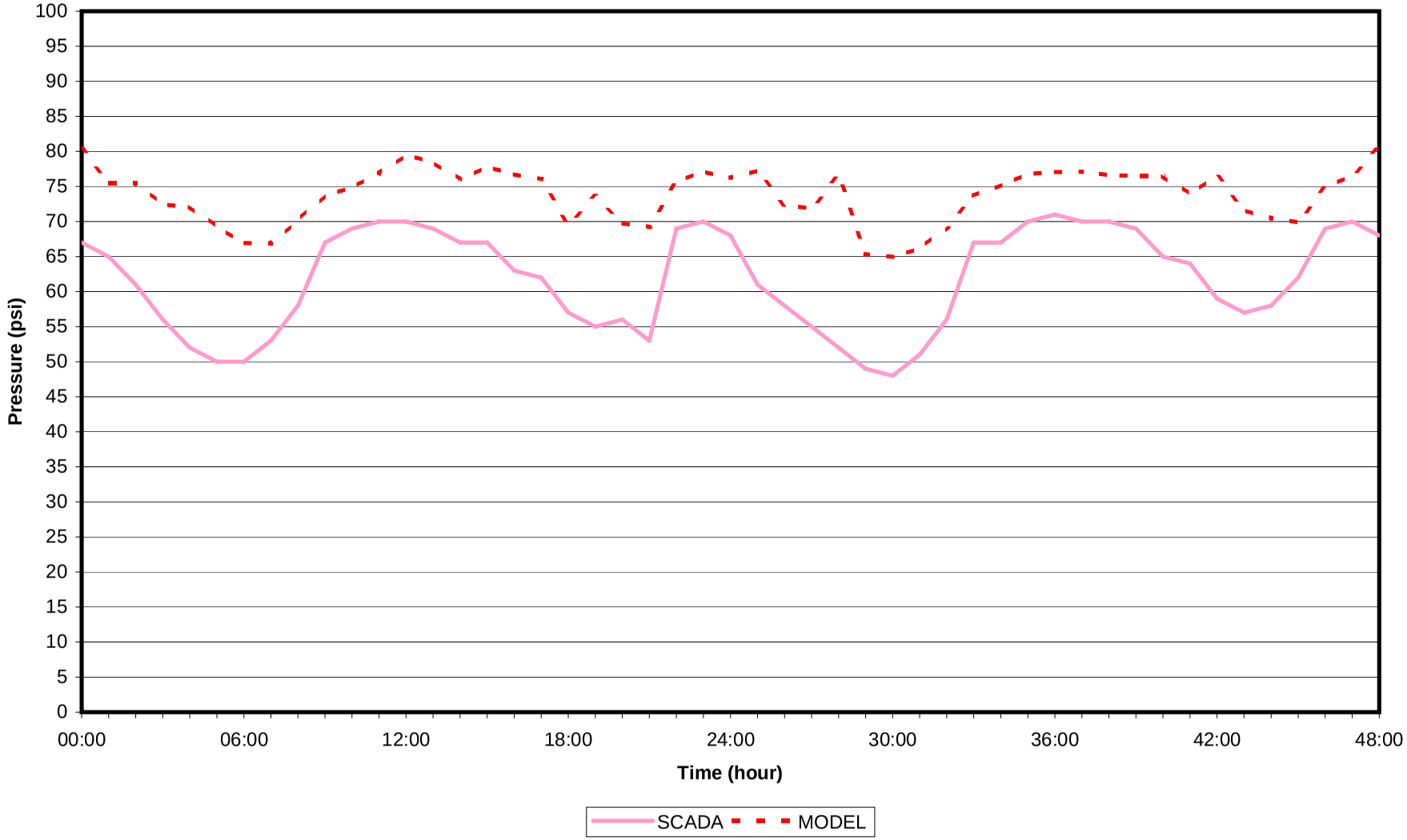



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST29-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 29 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

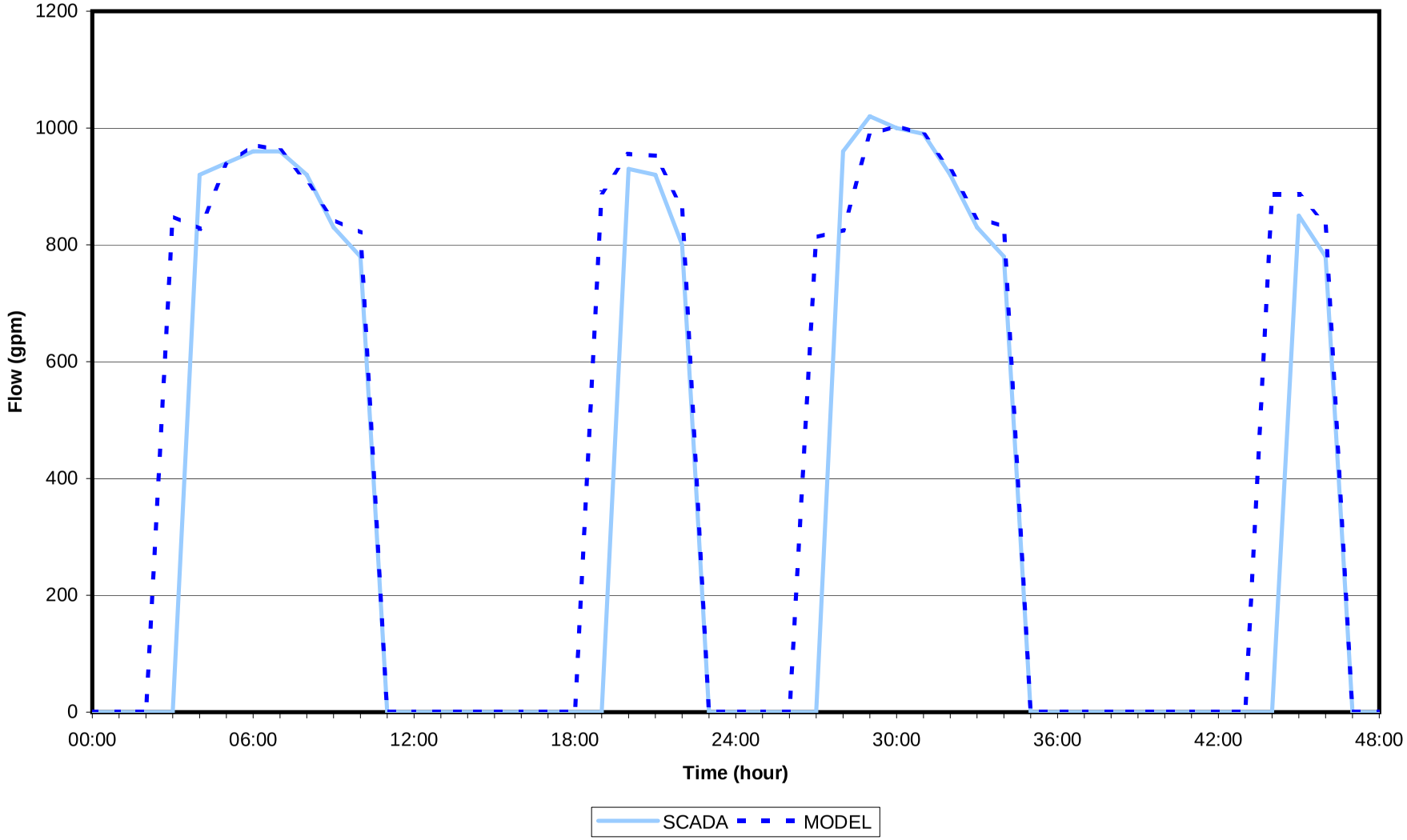



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST29-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 30 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

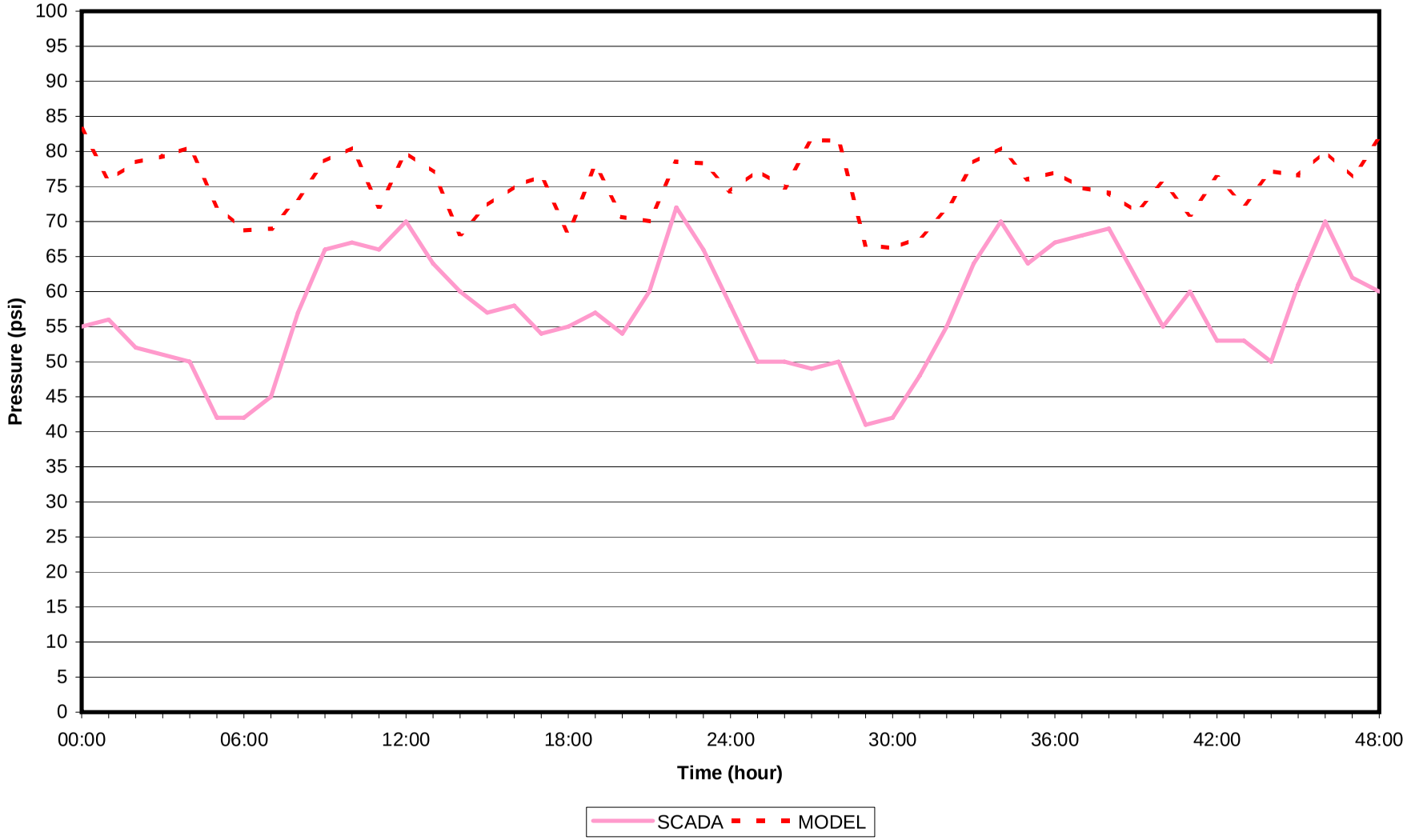



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST30-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 30 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

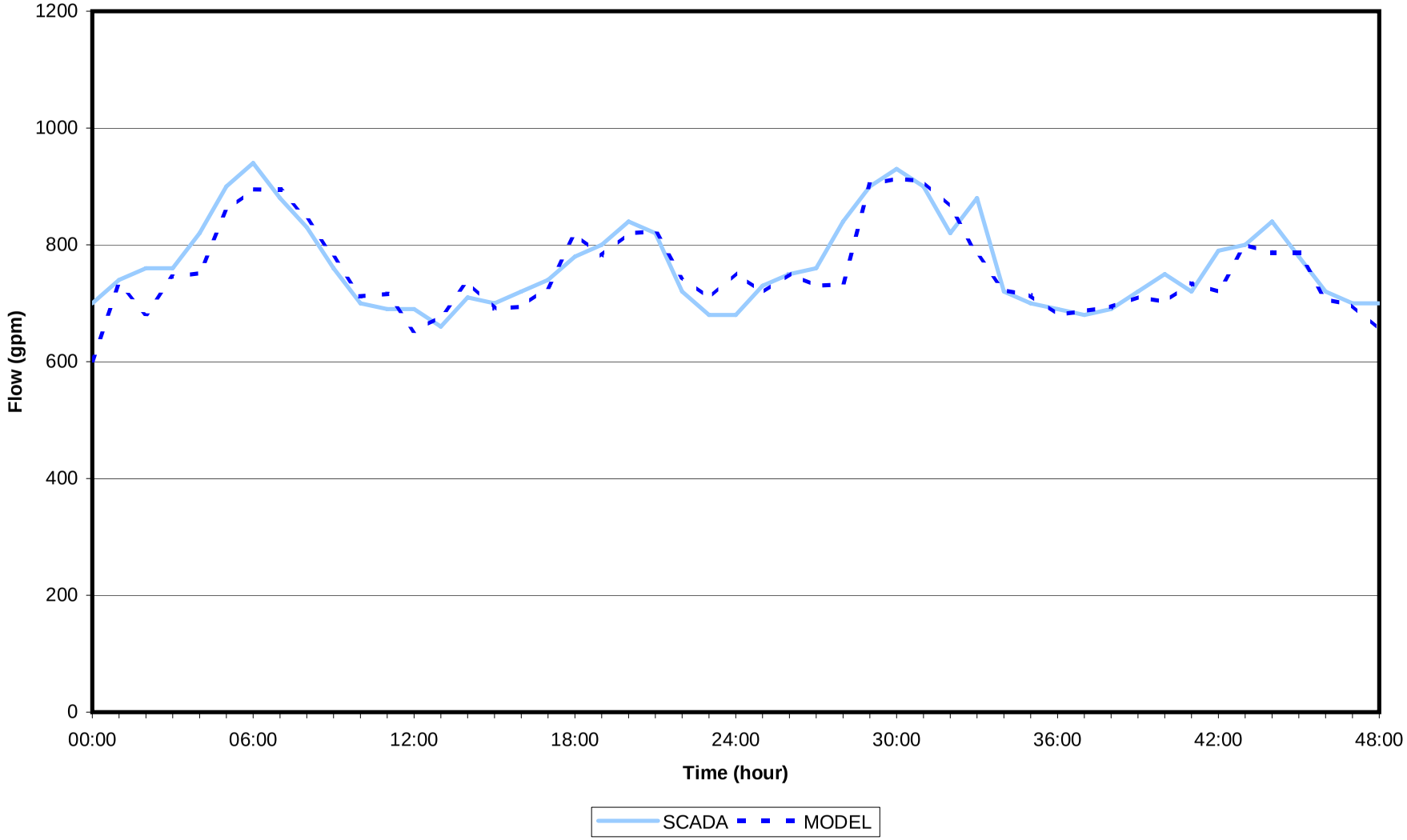



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST30-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 31 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

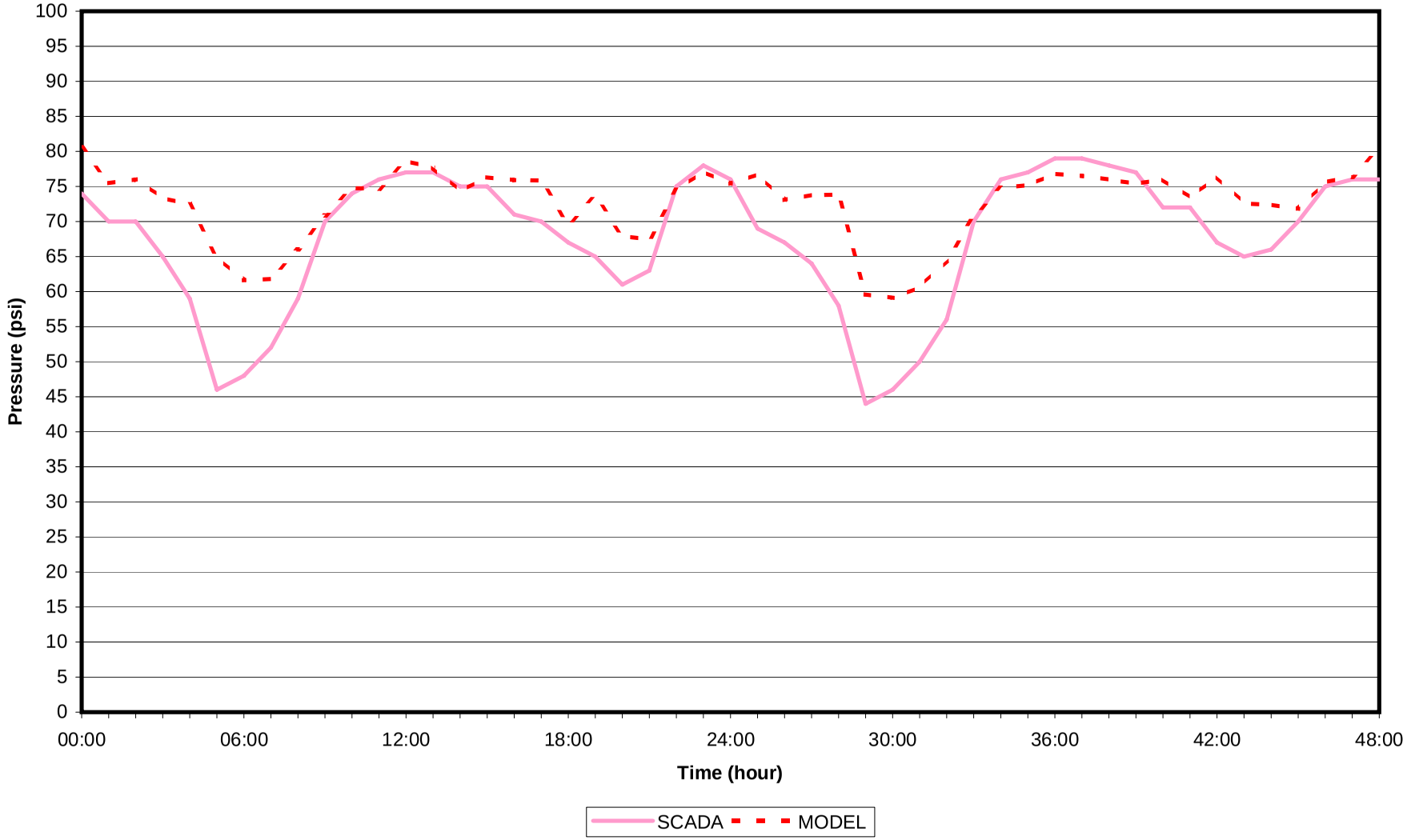



West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST31-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

## Station 31 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

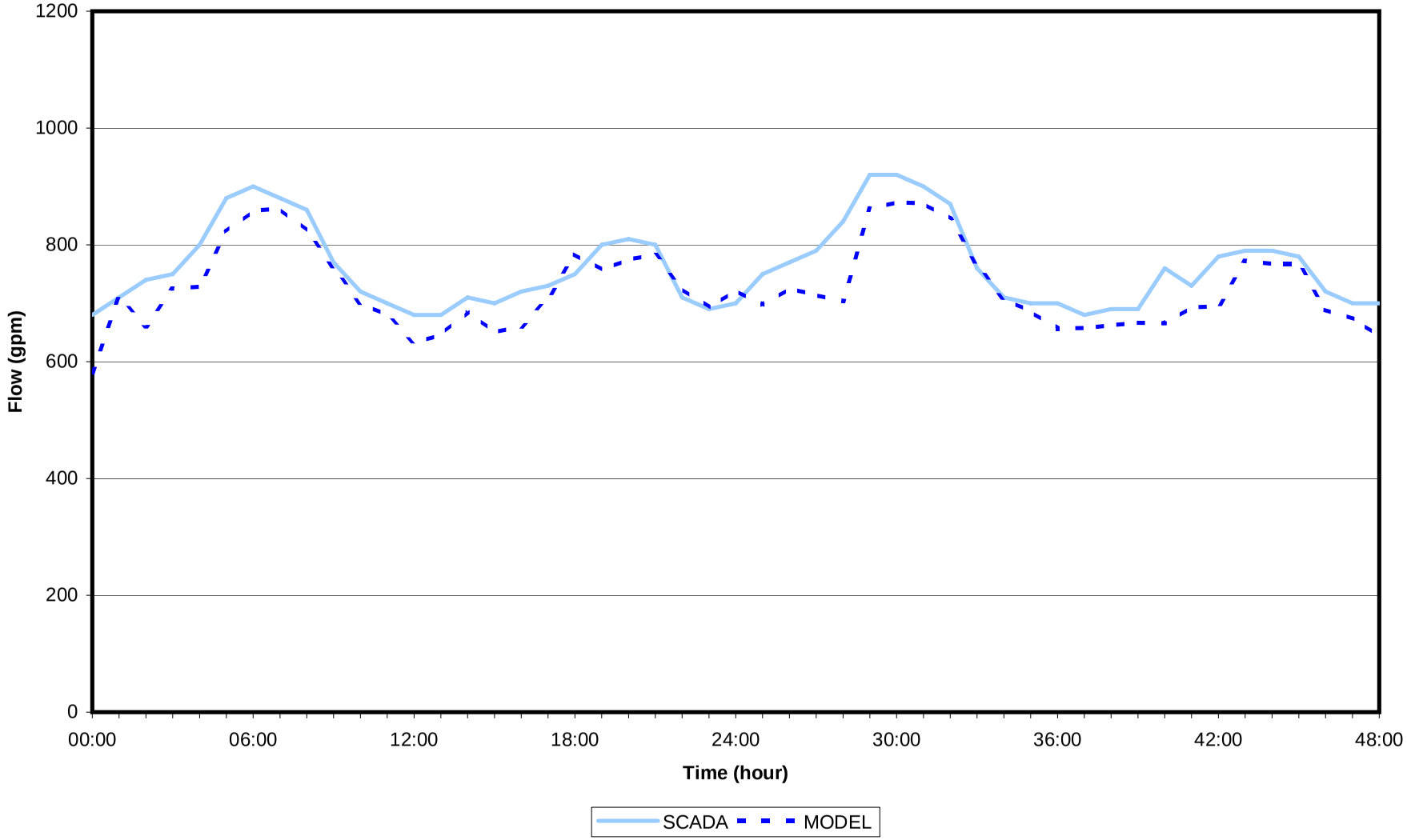



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST31-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 32 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

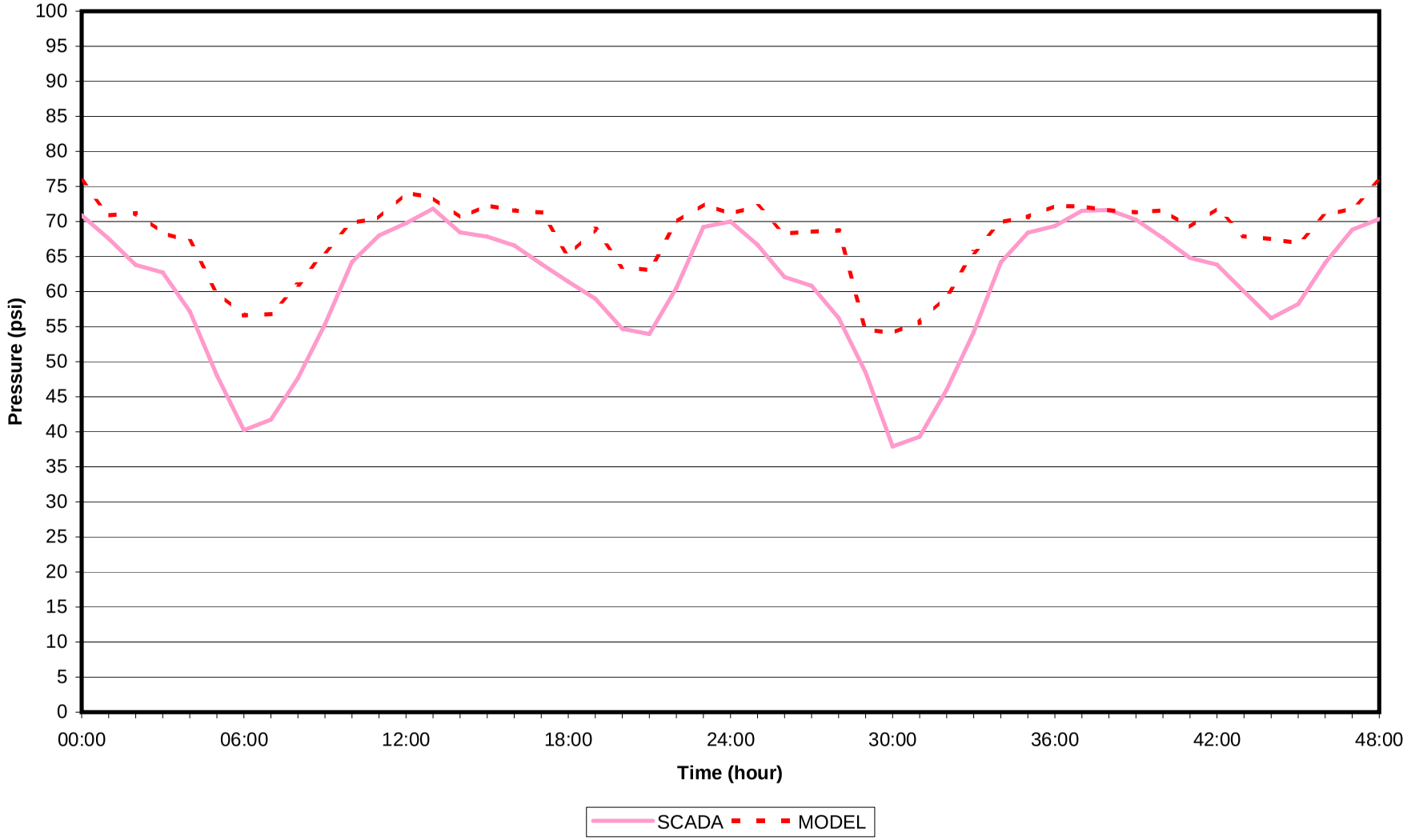



West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST32-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

## Station 32 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

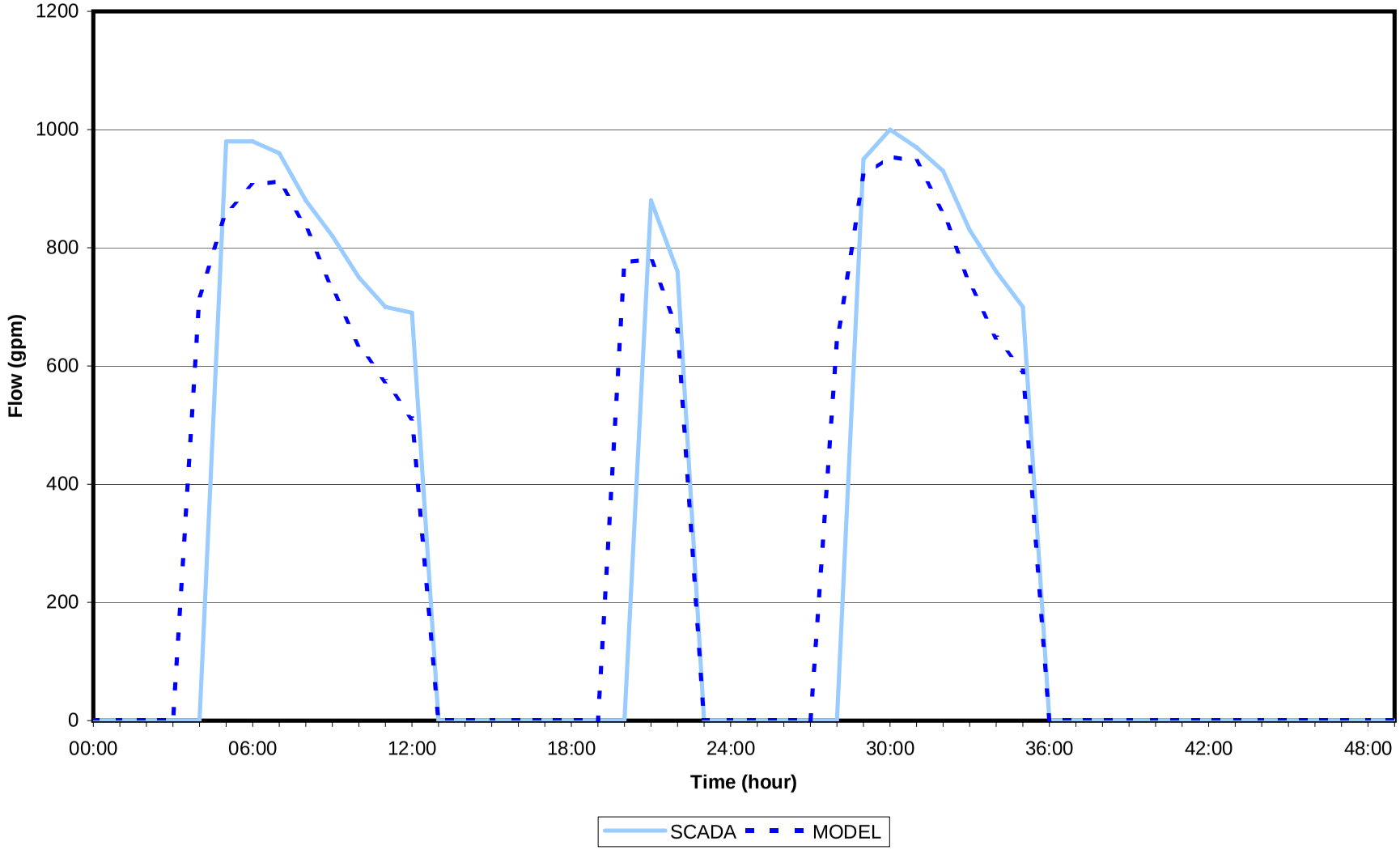



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST32-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 34 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

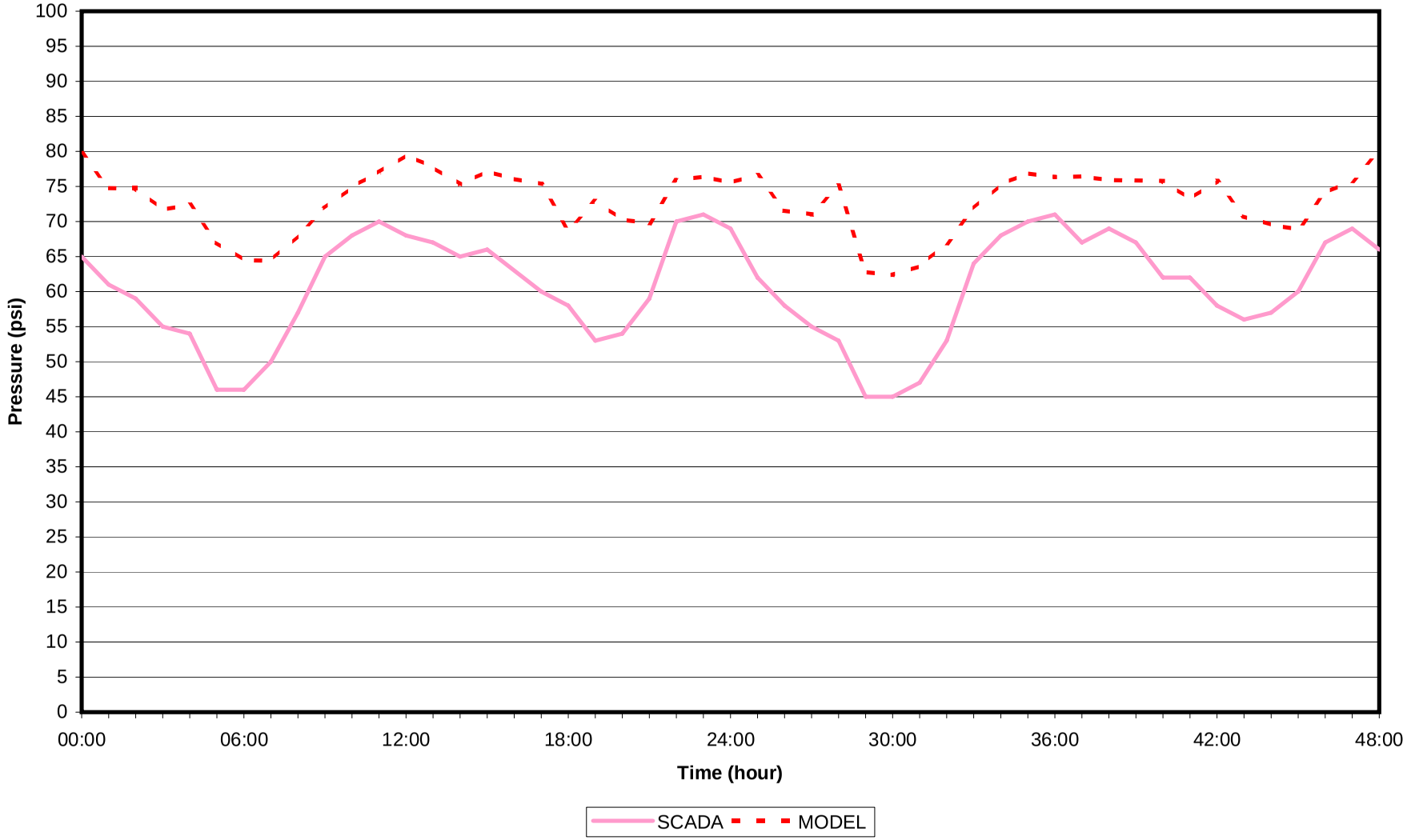



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST34-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

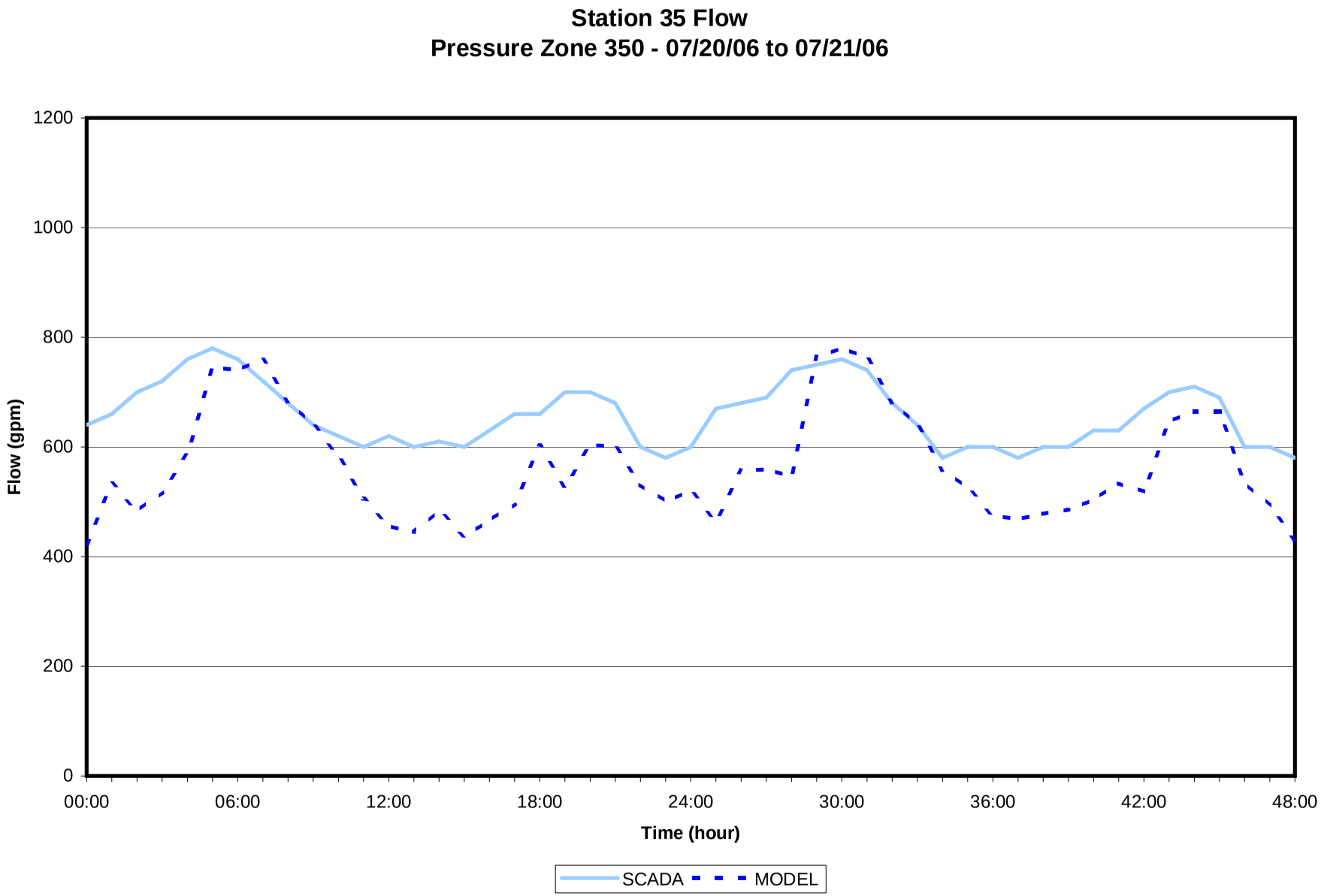
## Station 34 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06




Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST34-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

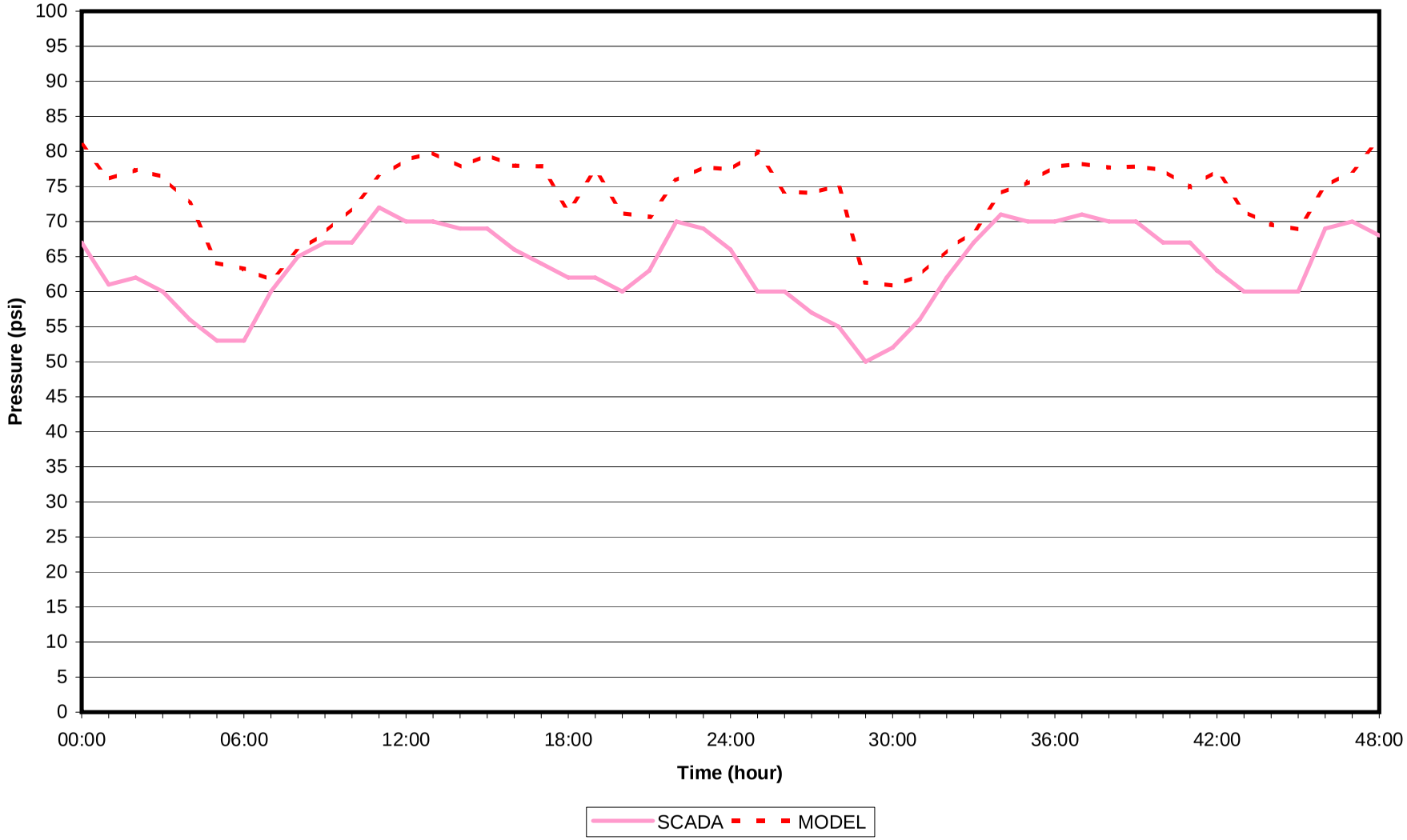



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST35-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 35 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

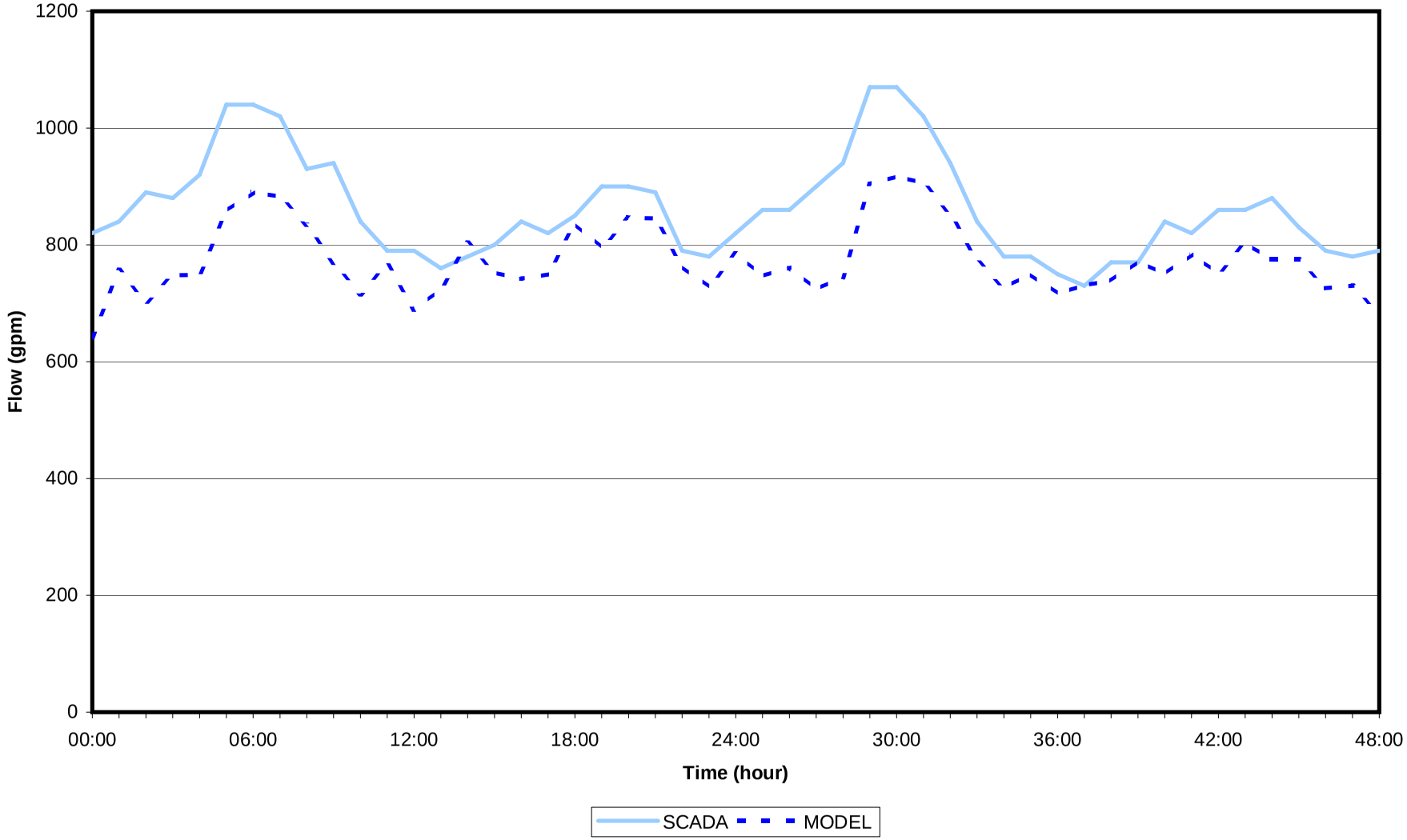



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST35-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 37 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

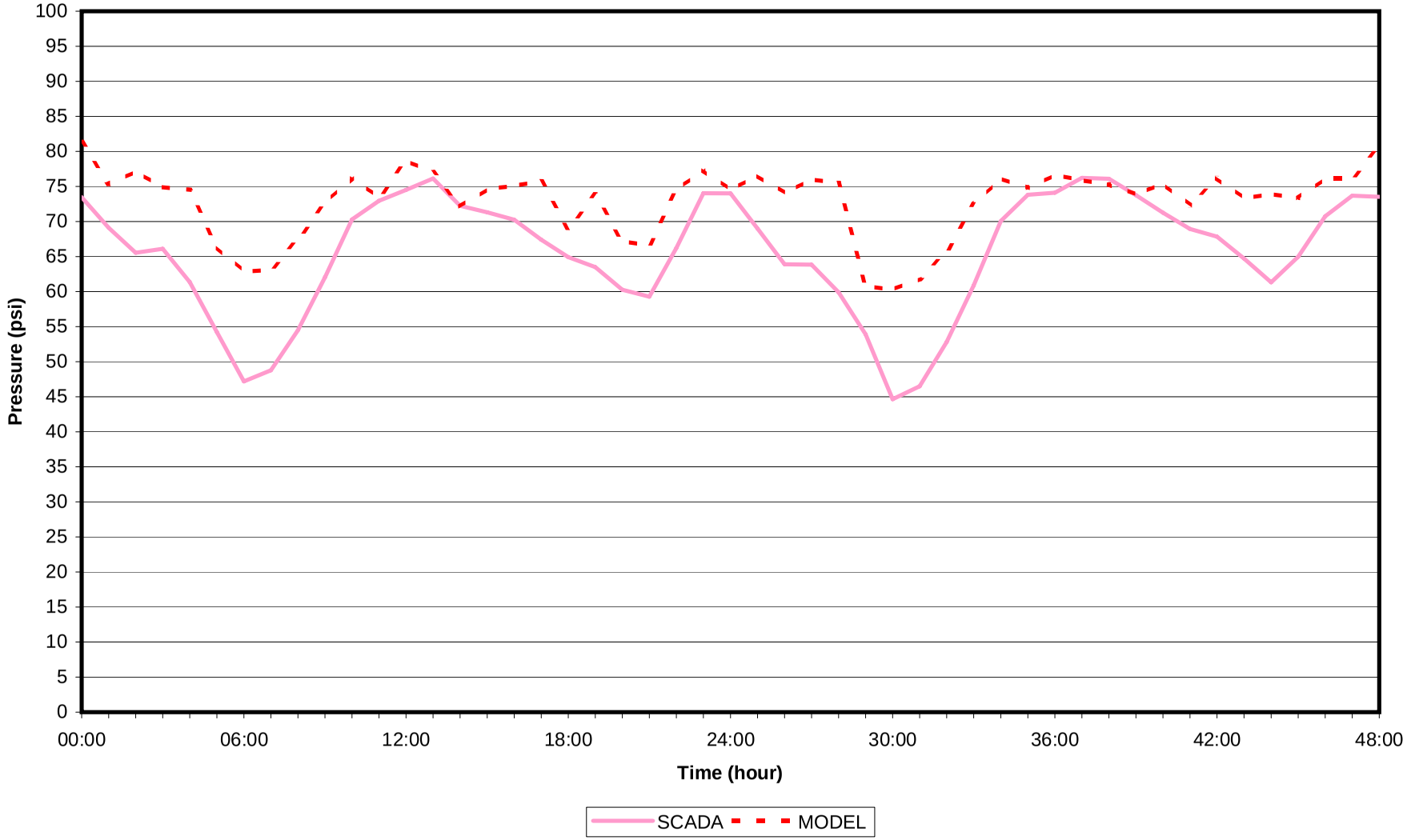



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST37-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

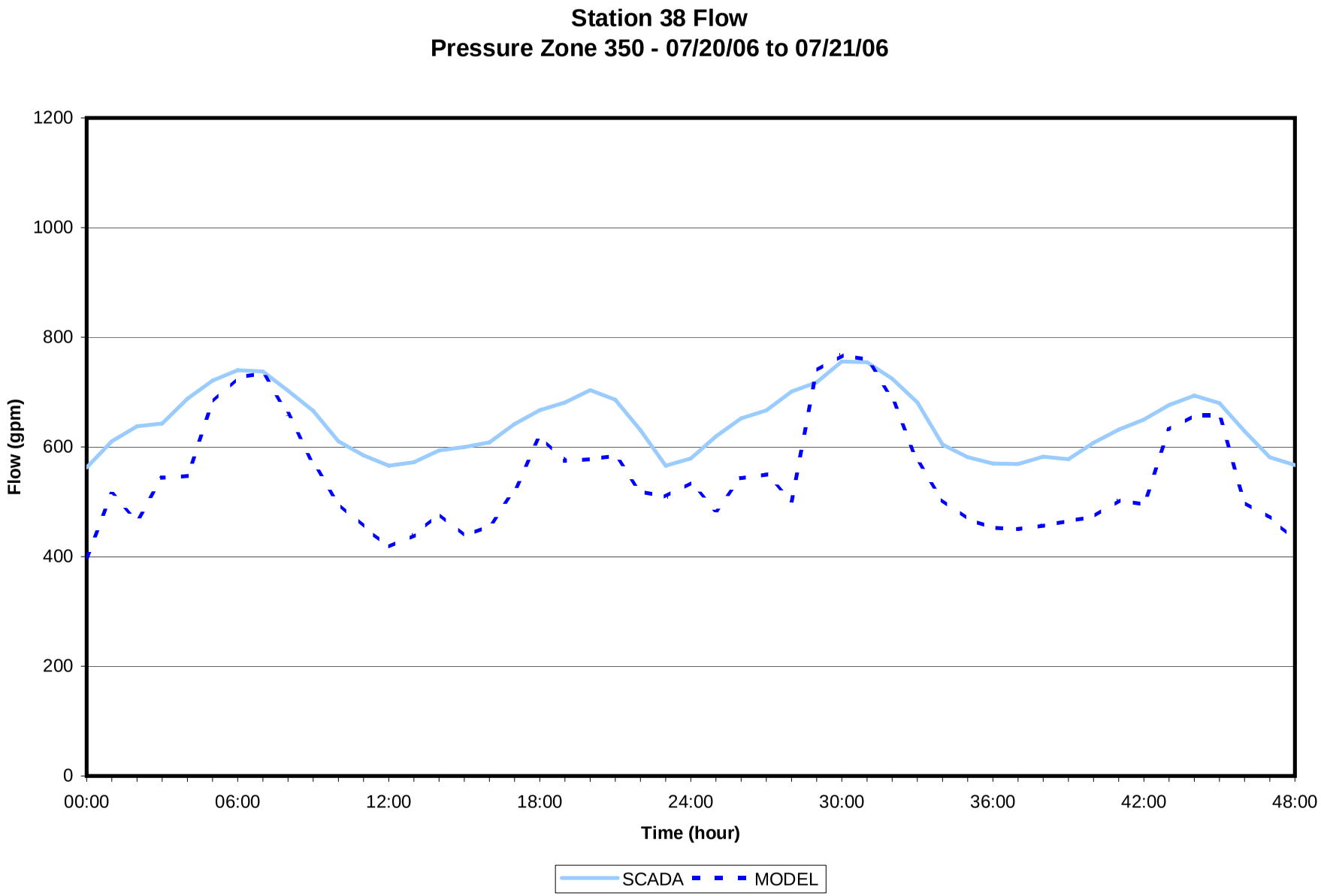
## Station 37 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06




Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST37-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

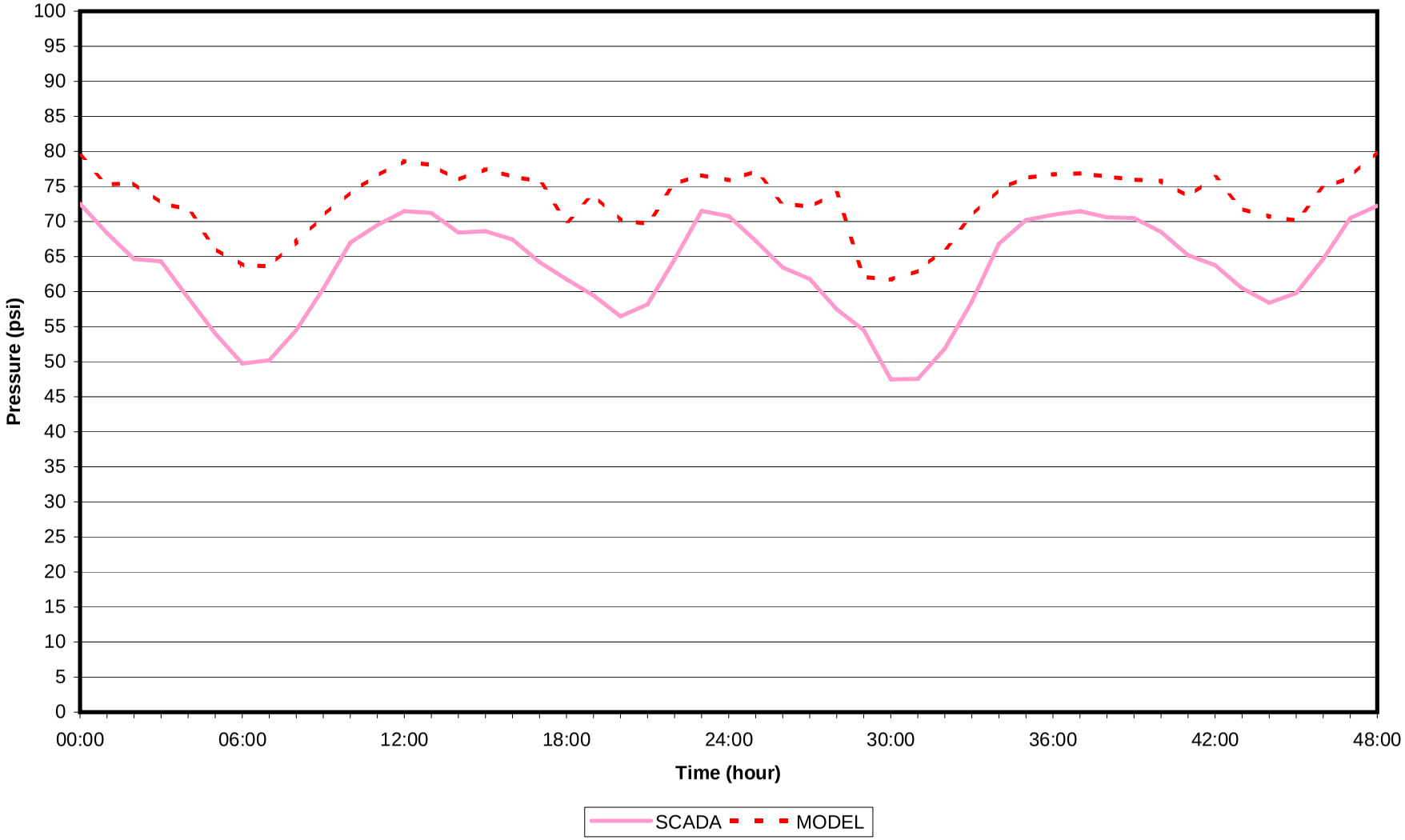



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST38-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 38 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

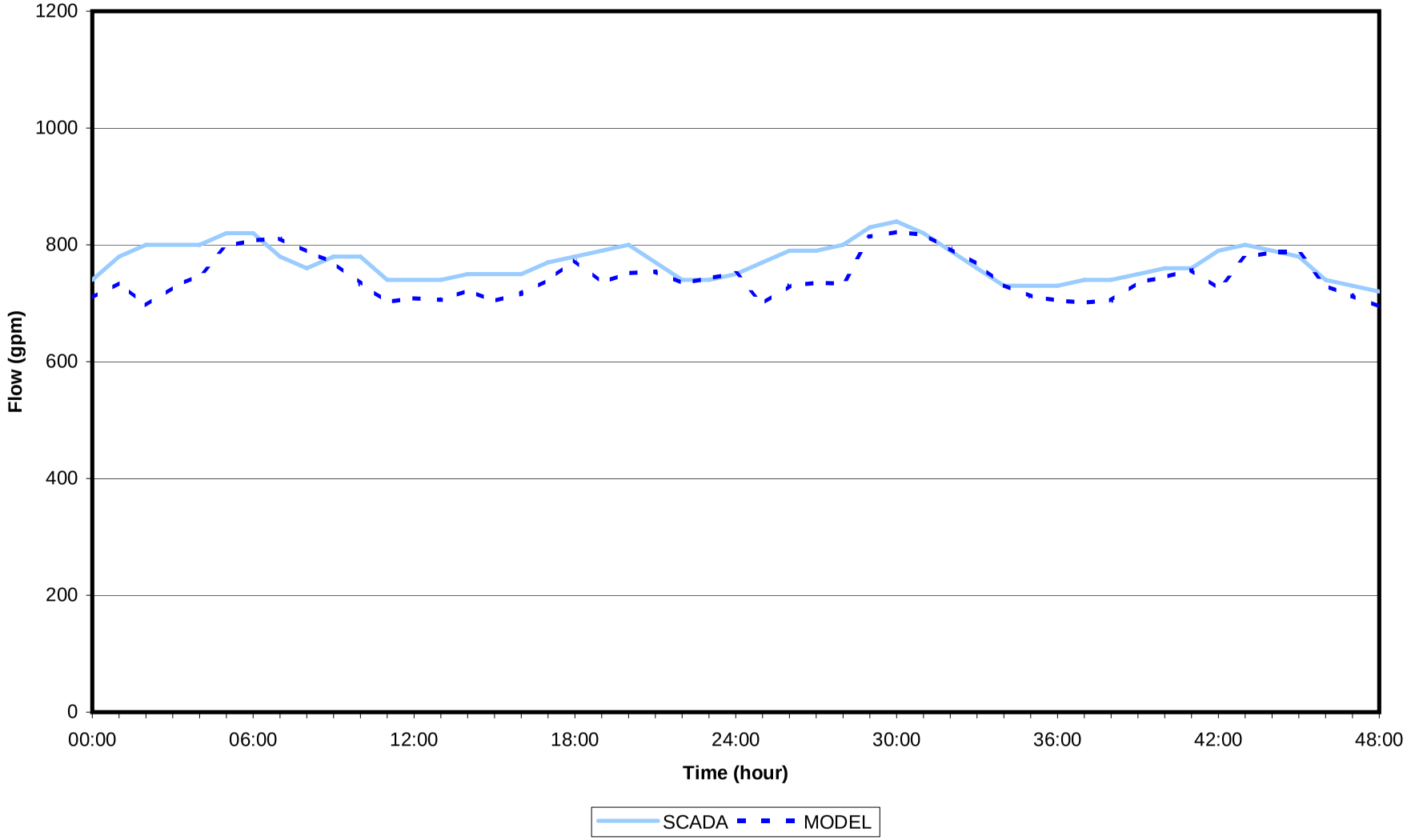



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST38-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 39 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

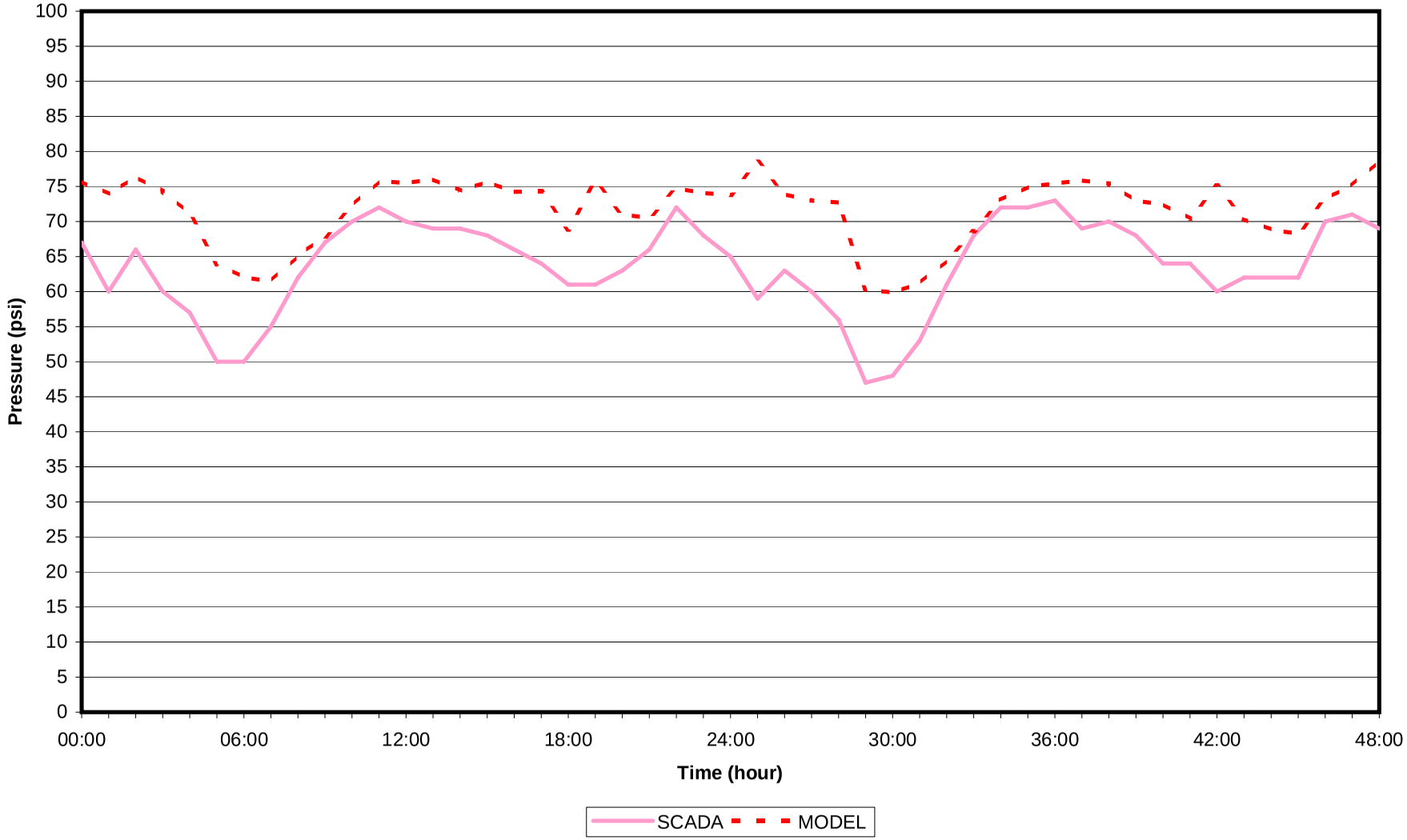



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST39-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 39 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

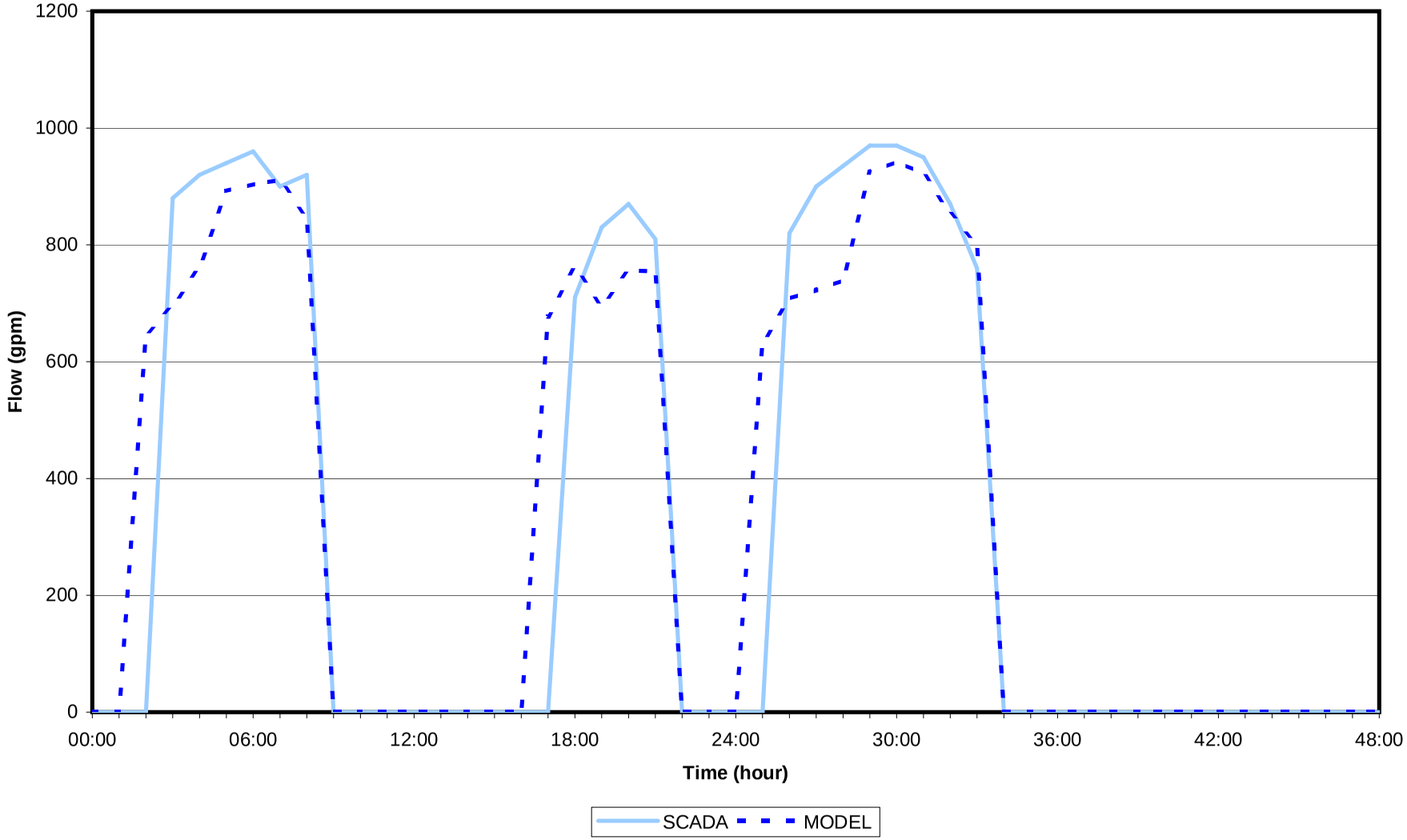



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST39-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 41 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

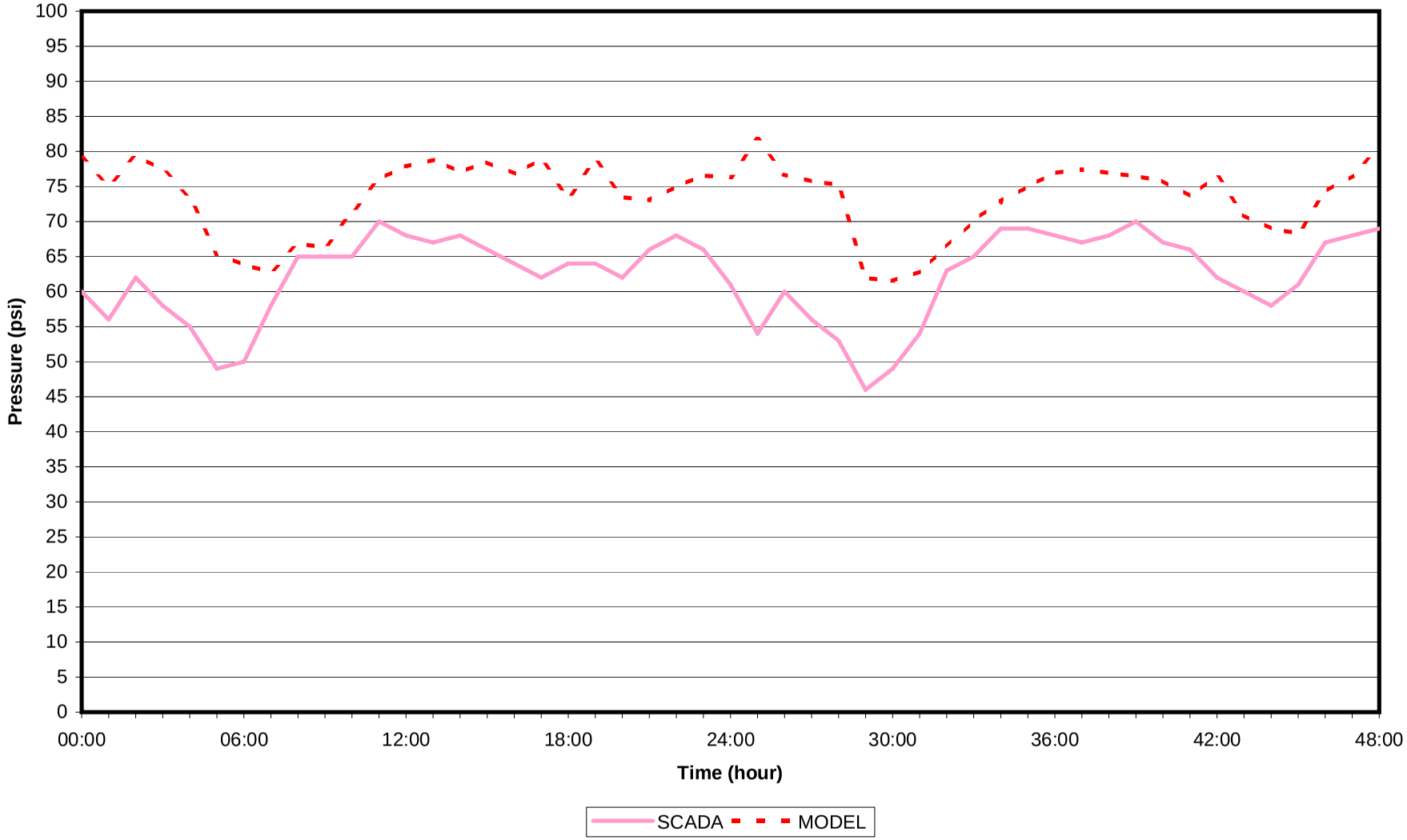



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST41-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 41 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

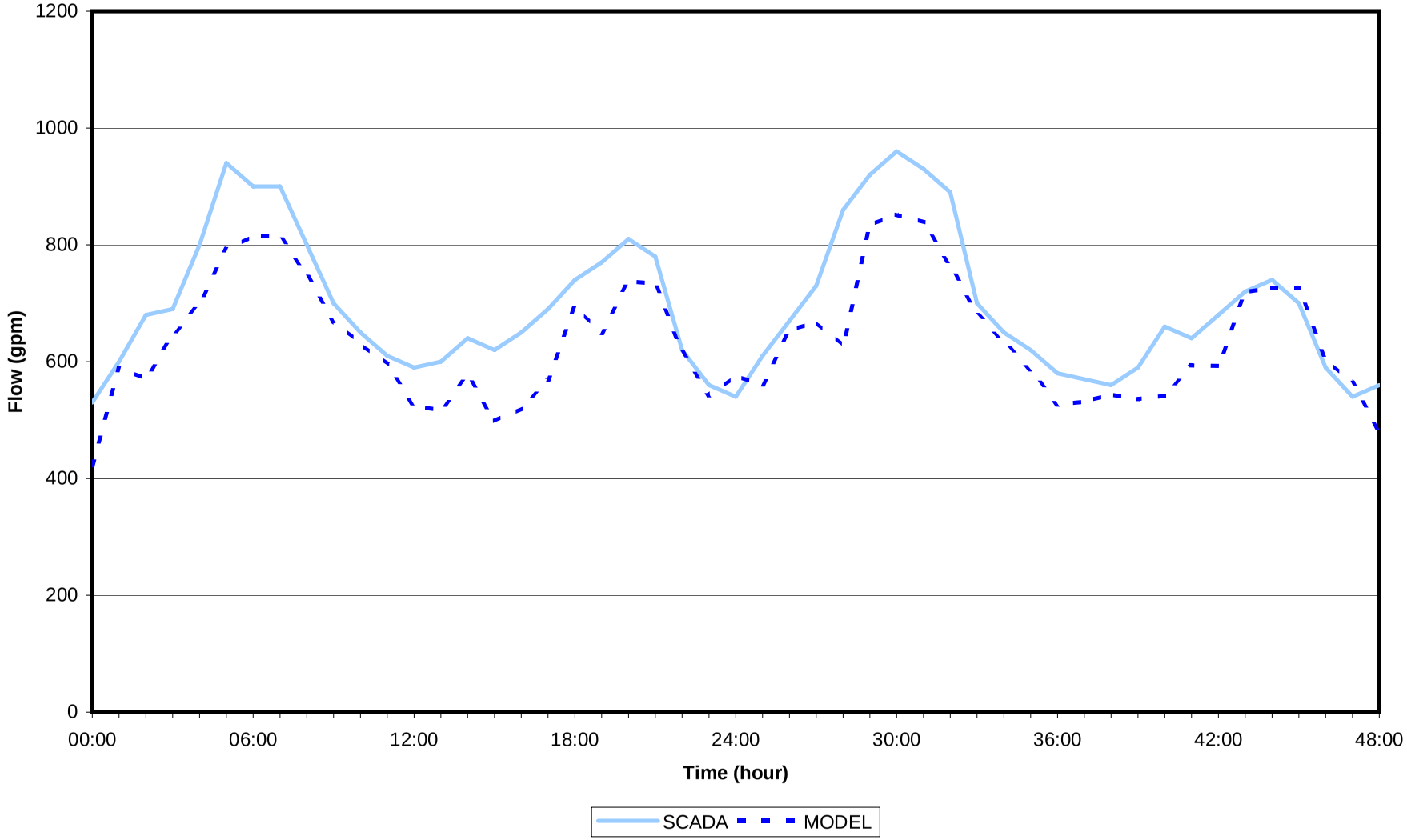



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST41-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 42 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

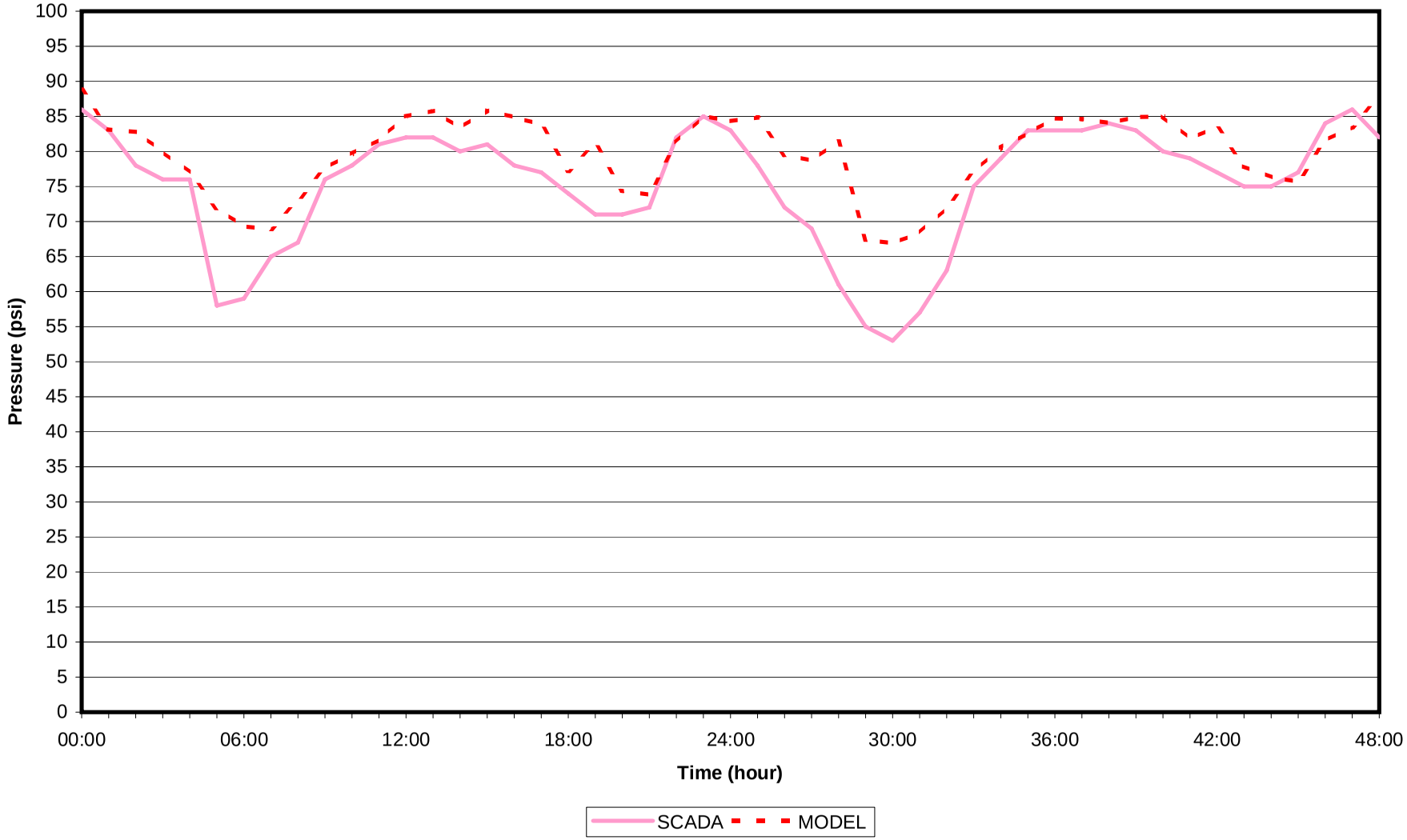



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST42-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 42 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

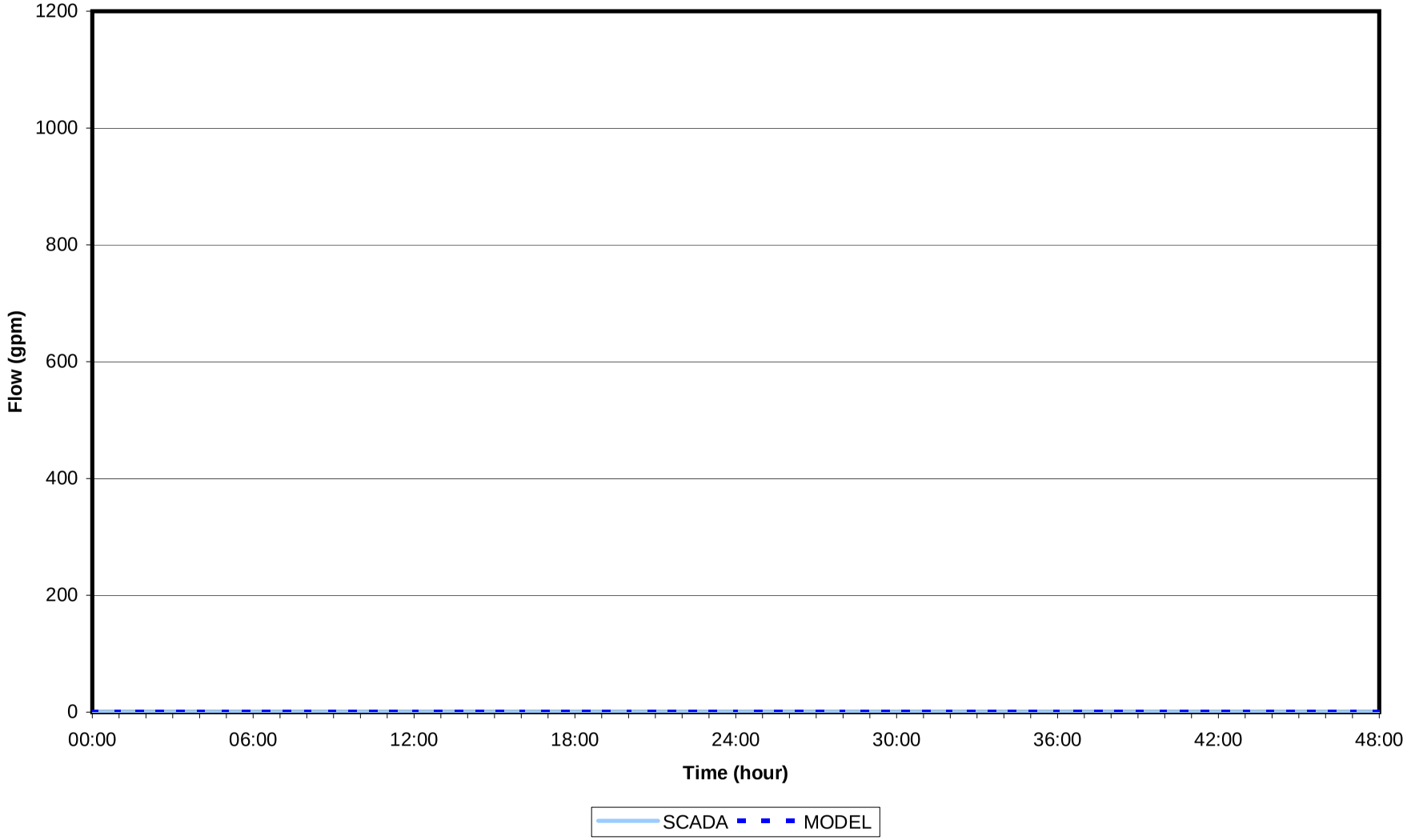



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST42-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 46 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

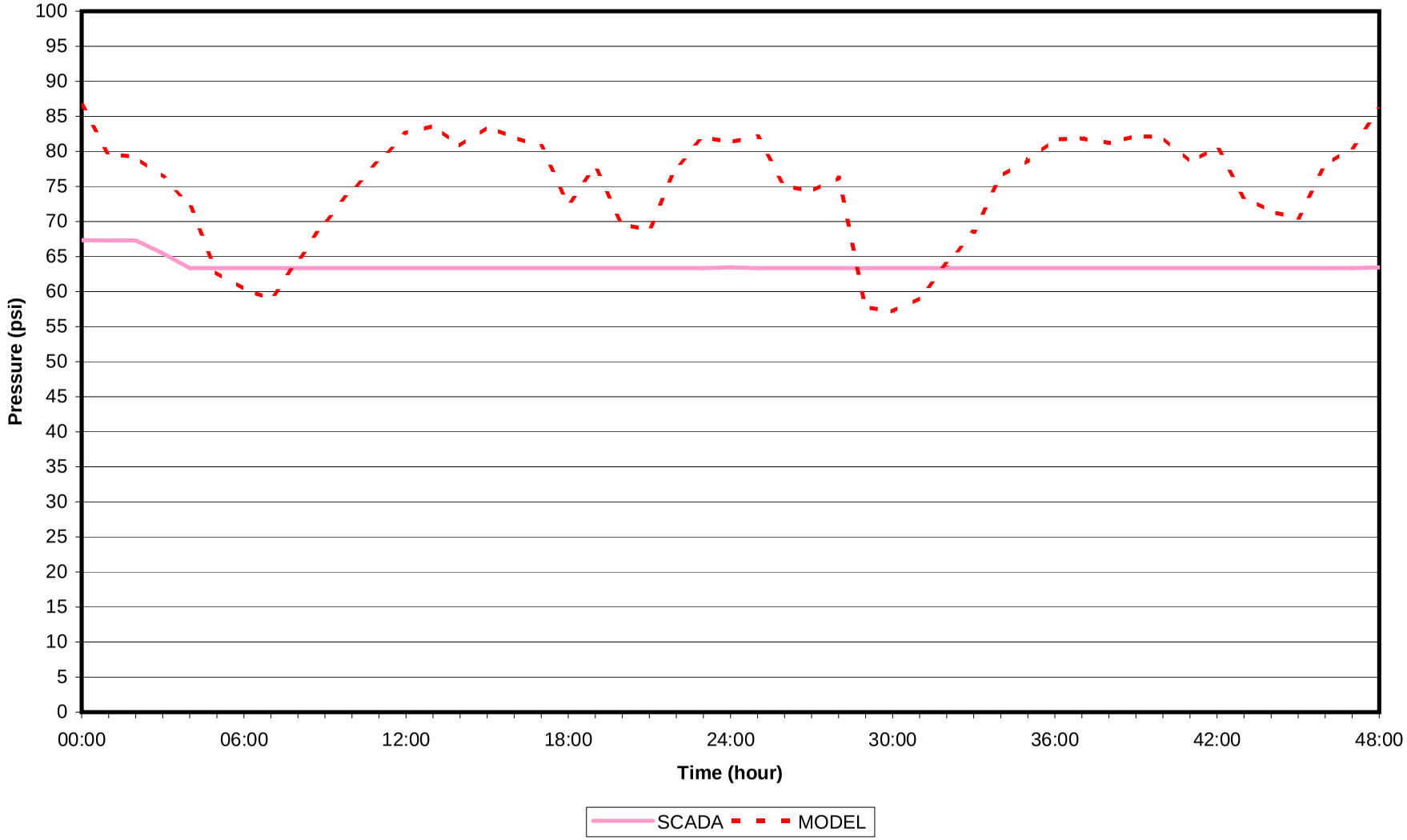



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST46-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 46 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

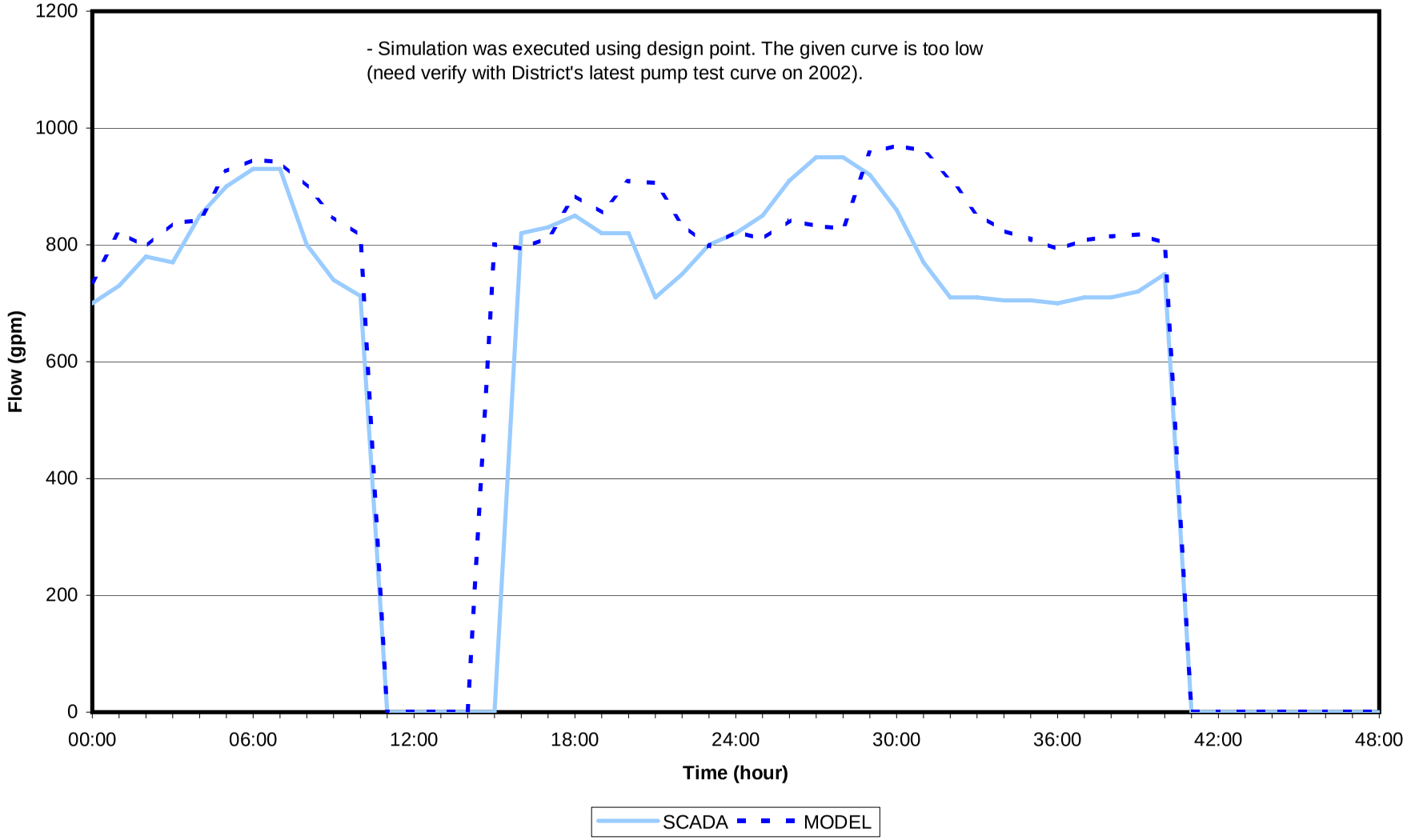



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST46-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 47 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

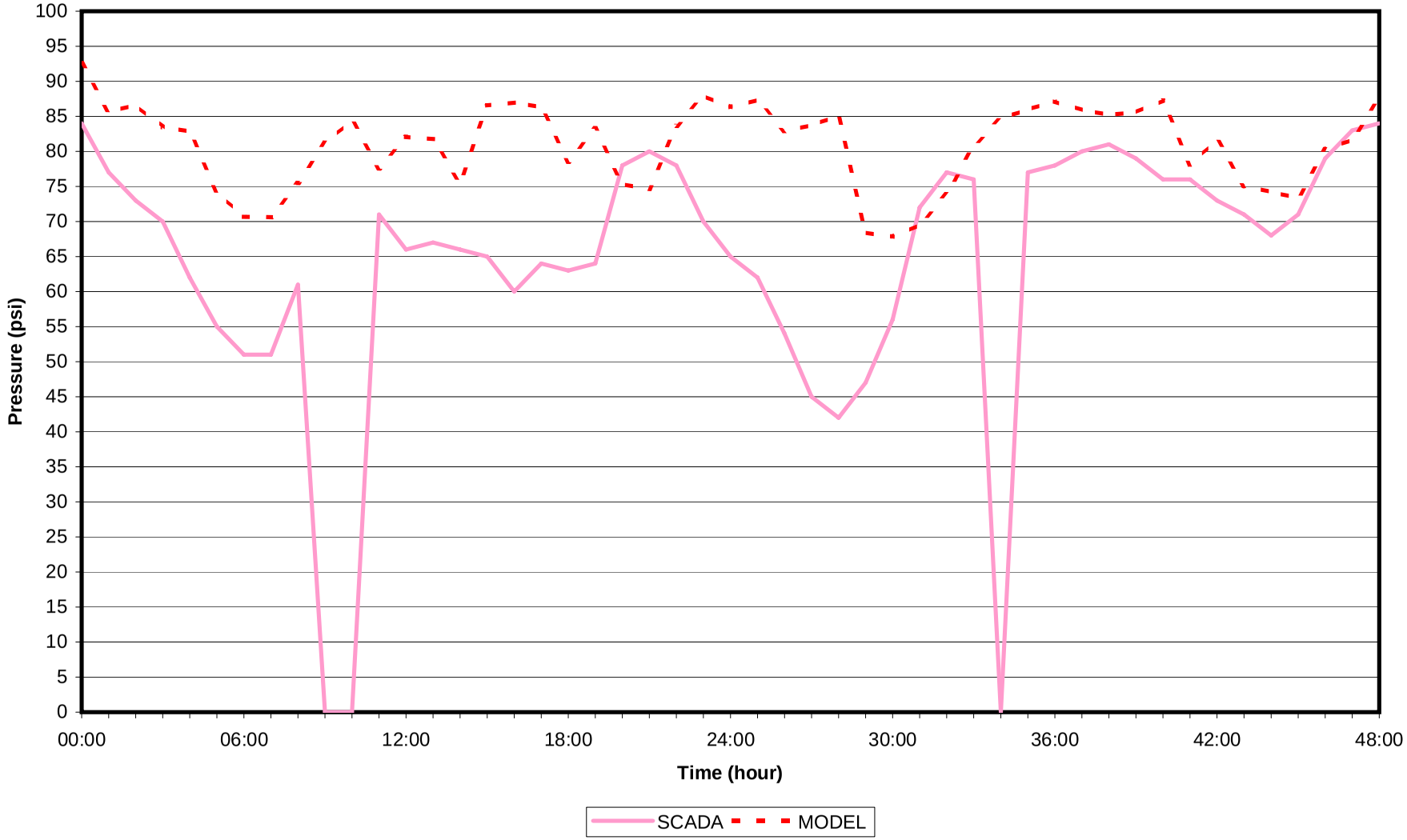



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST47-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 47 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

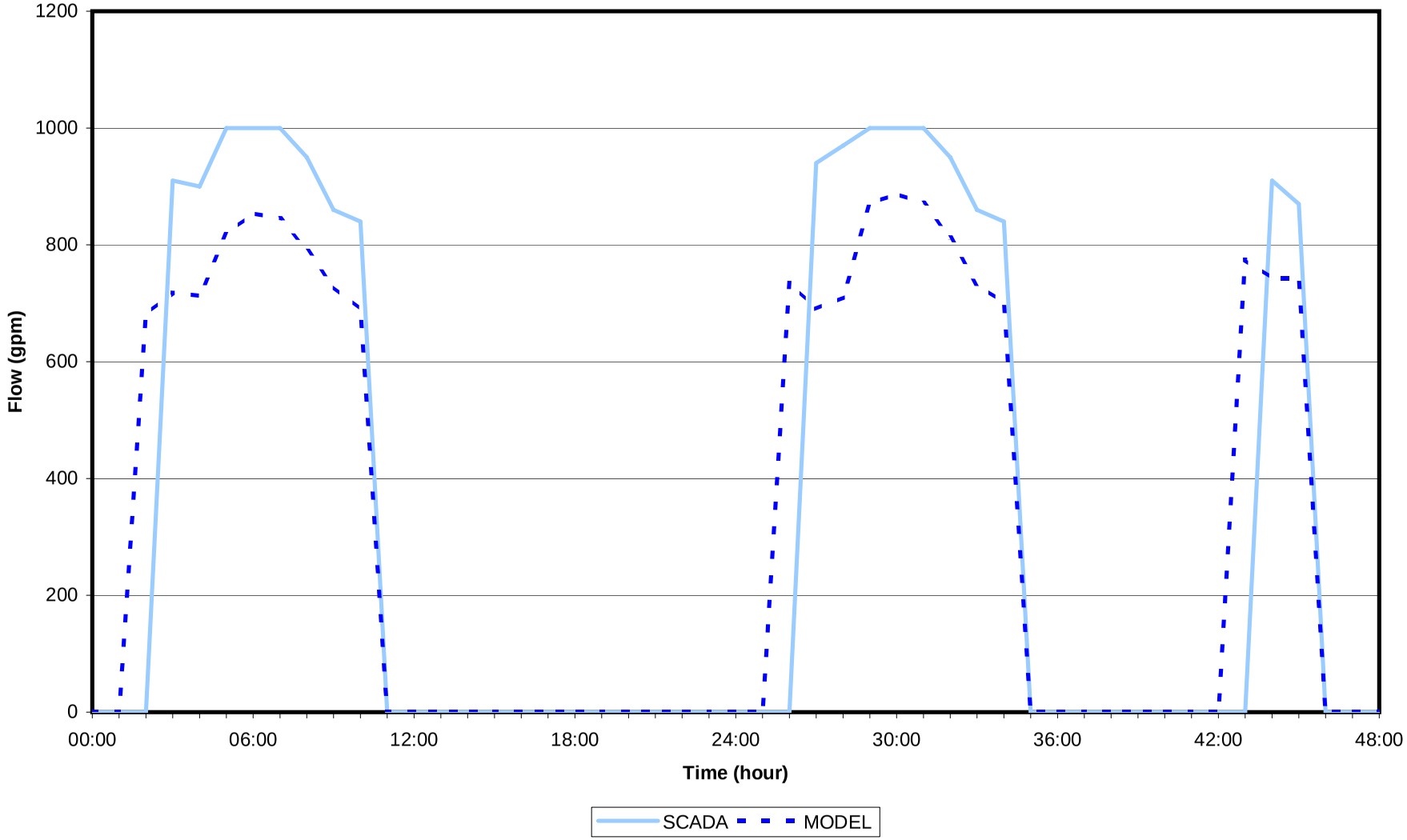



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST47-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 48 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

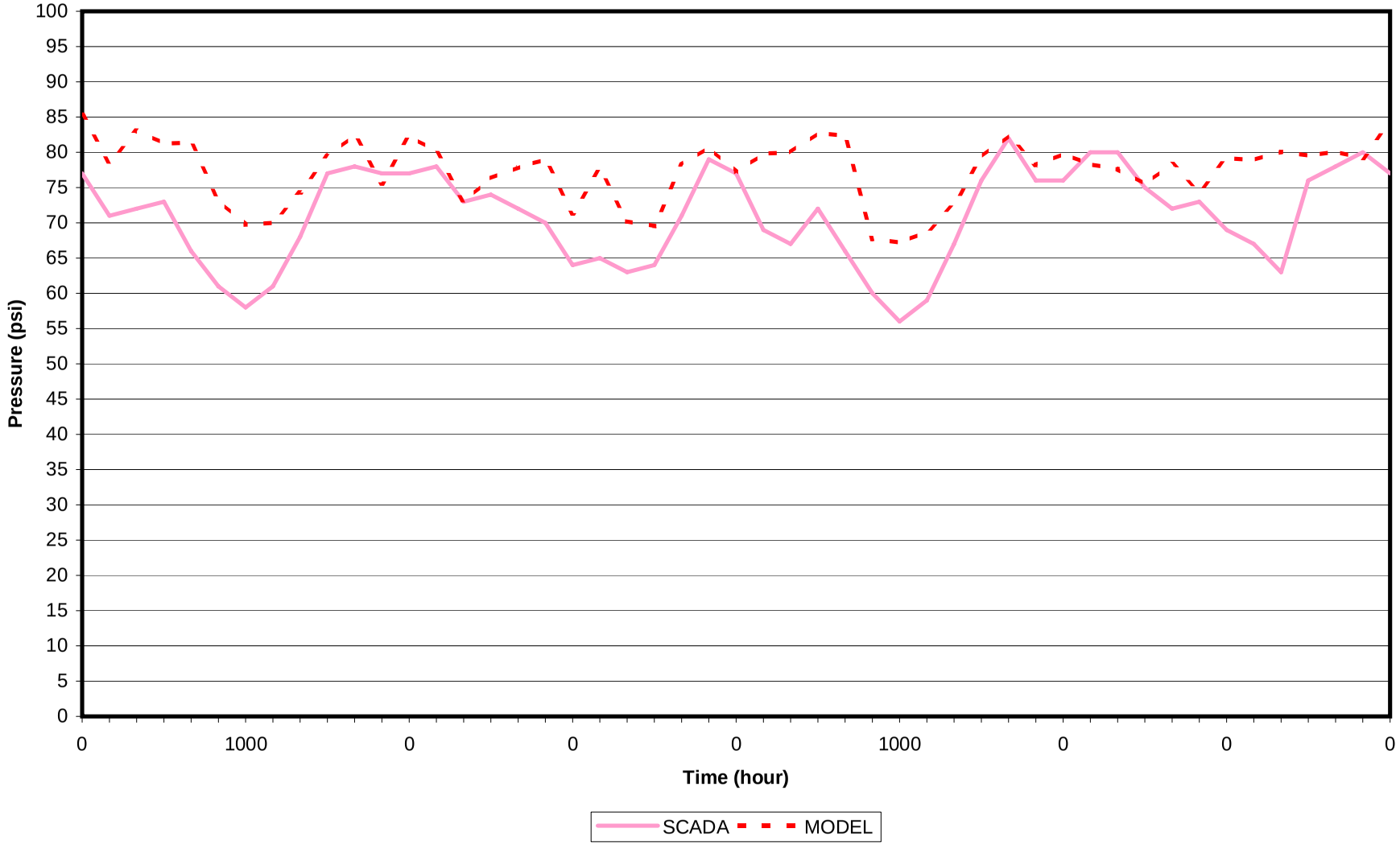



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST48-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 48 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

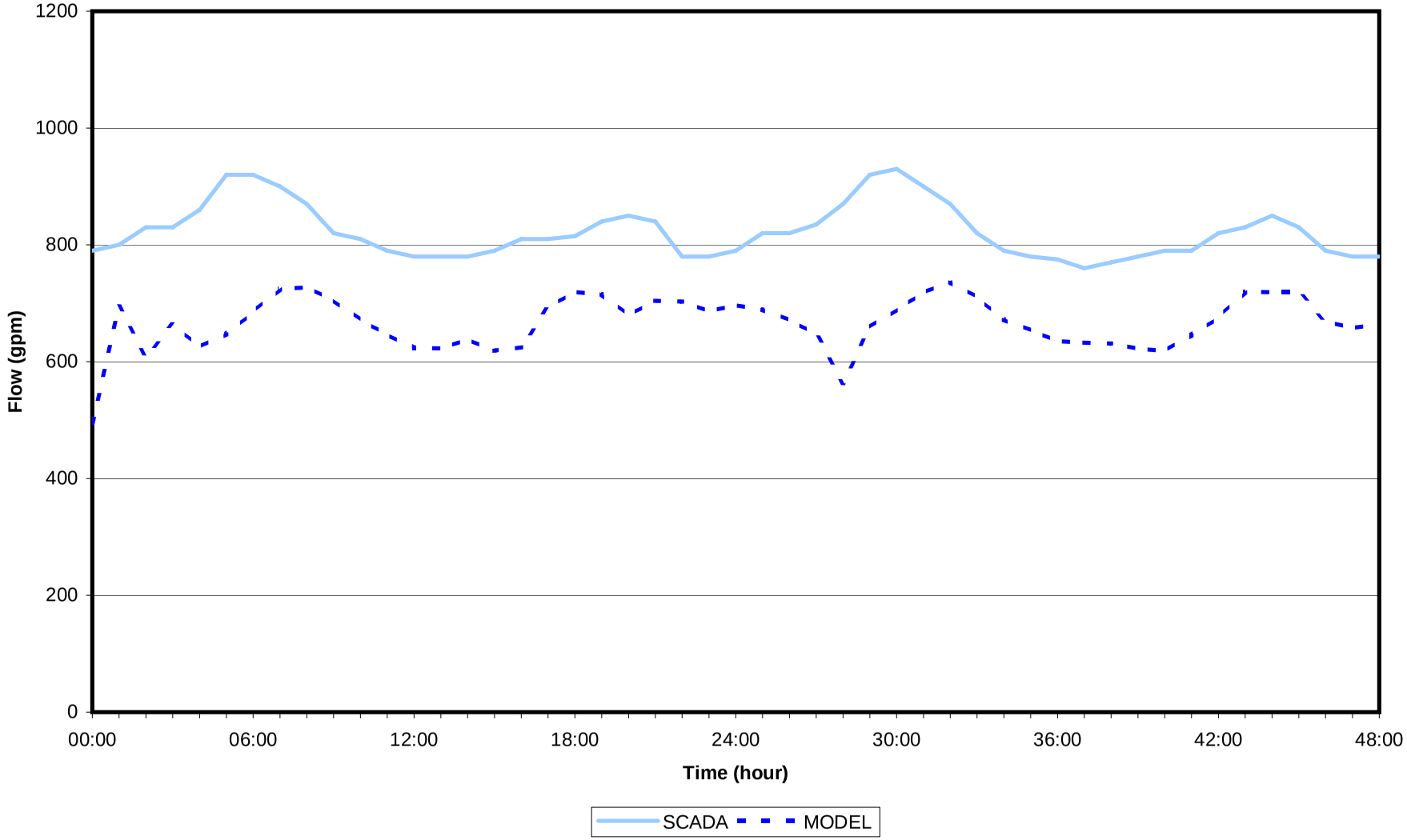



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST48-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 49 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

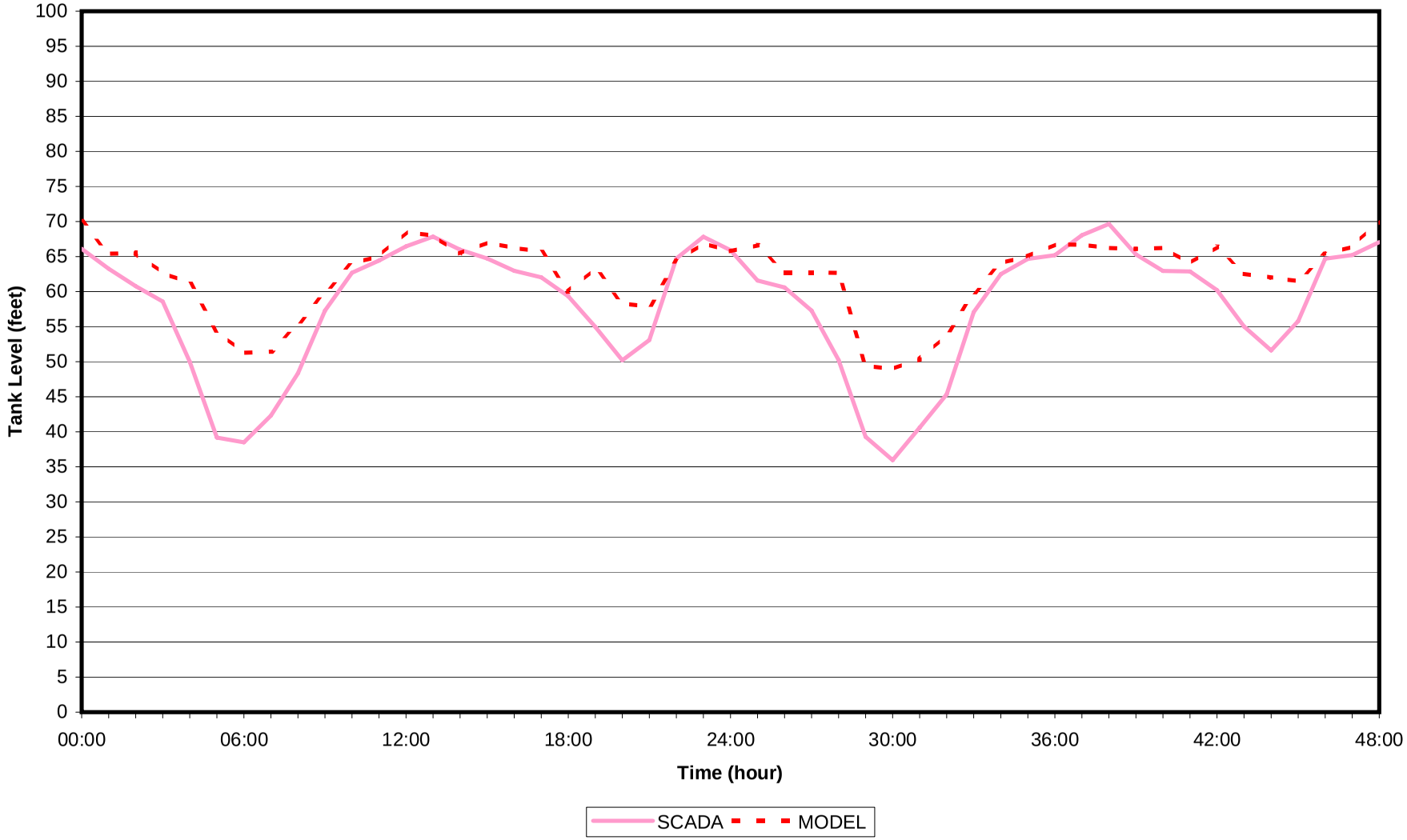



West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST49-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

## Station 49 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

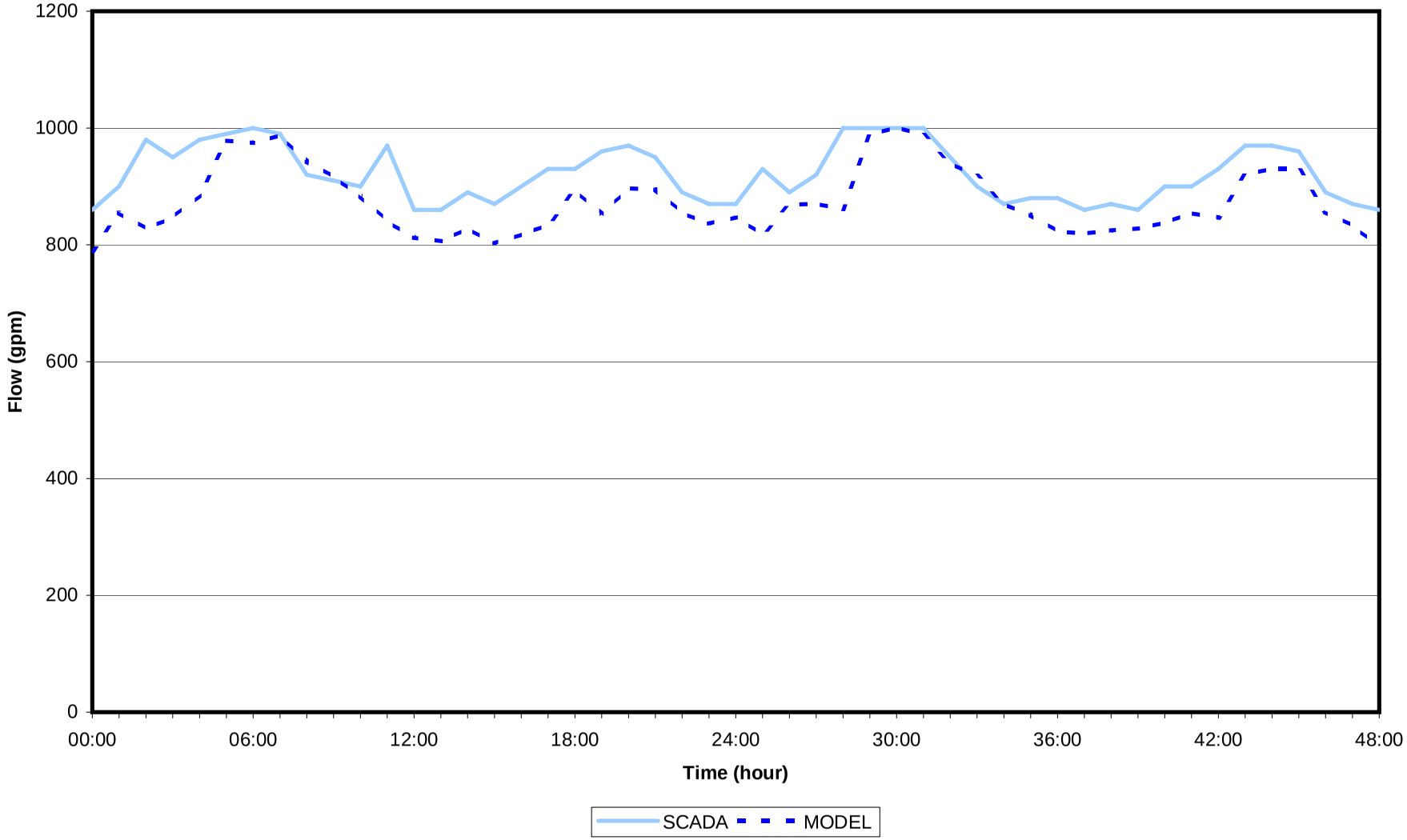



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST49-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 51 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

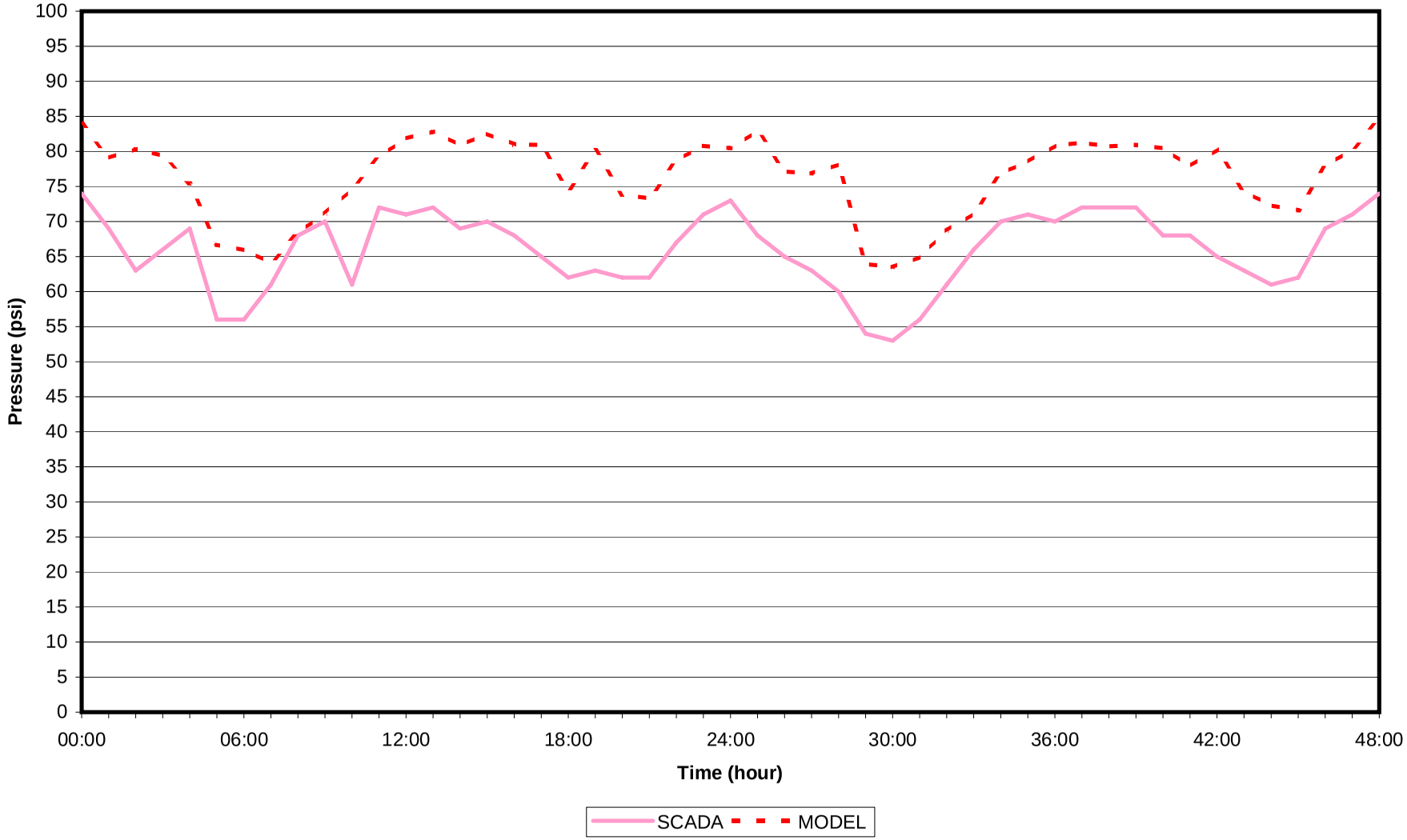



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST51-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 51 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

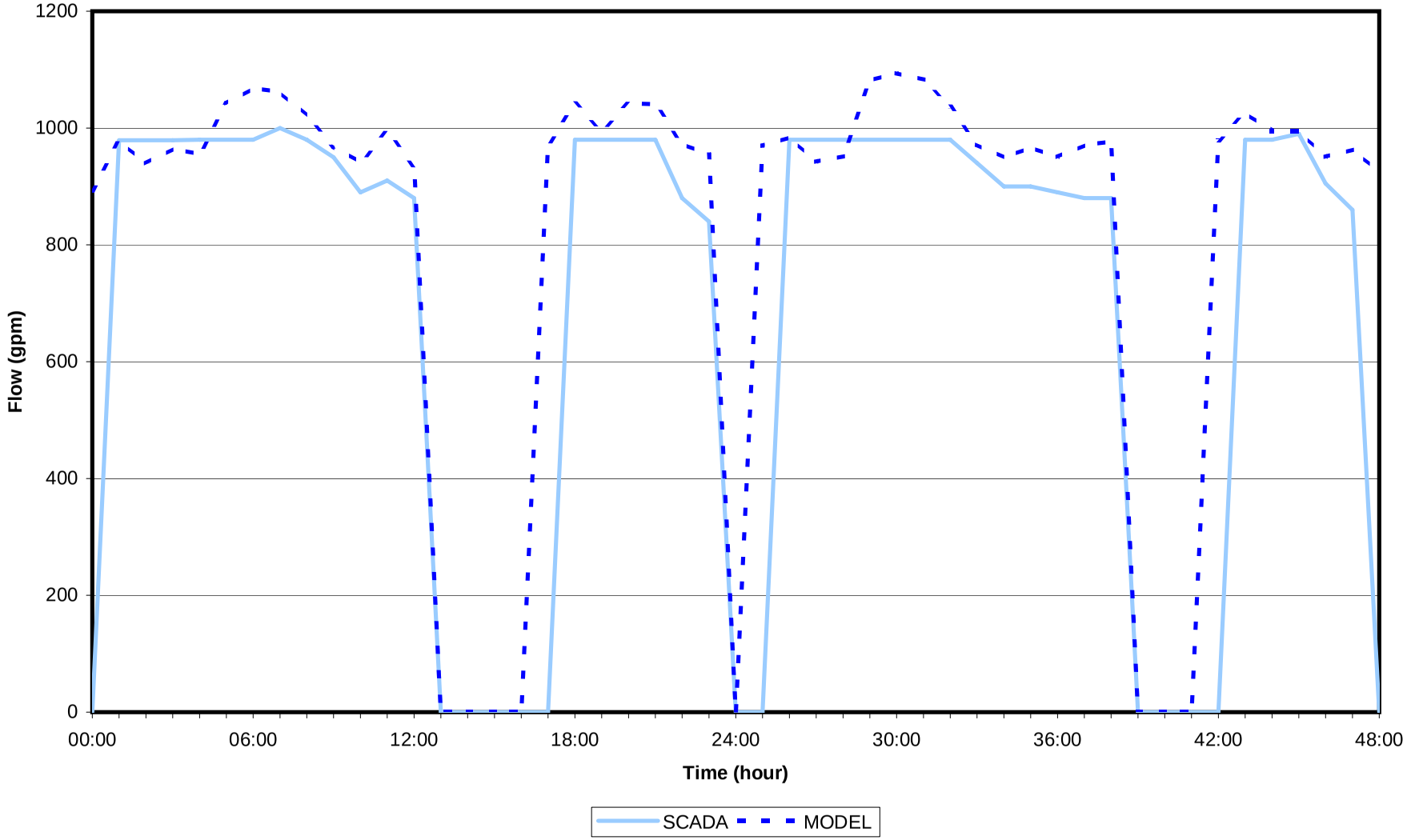



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST51-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 52 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

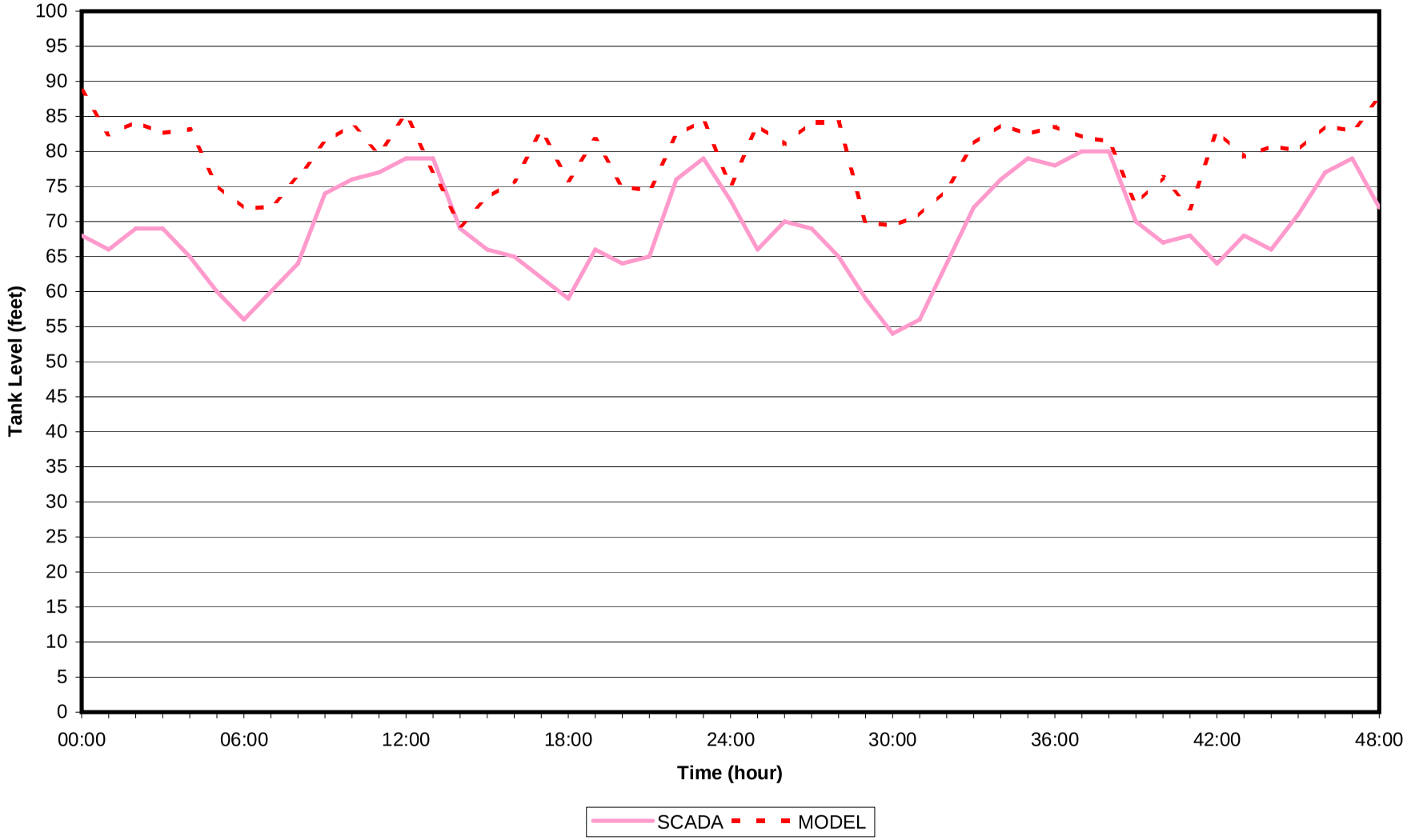



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST52-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 52 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

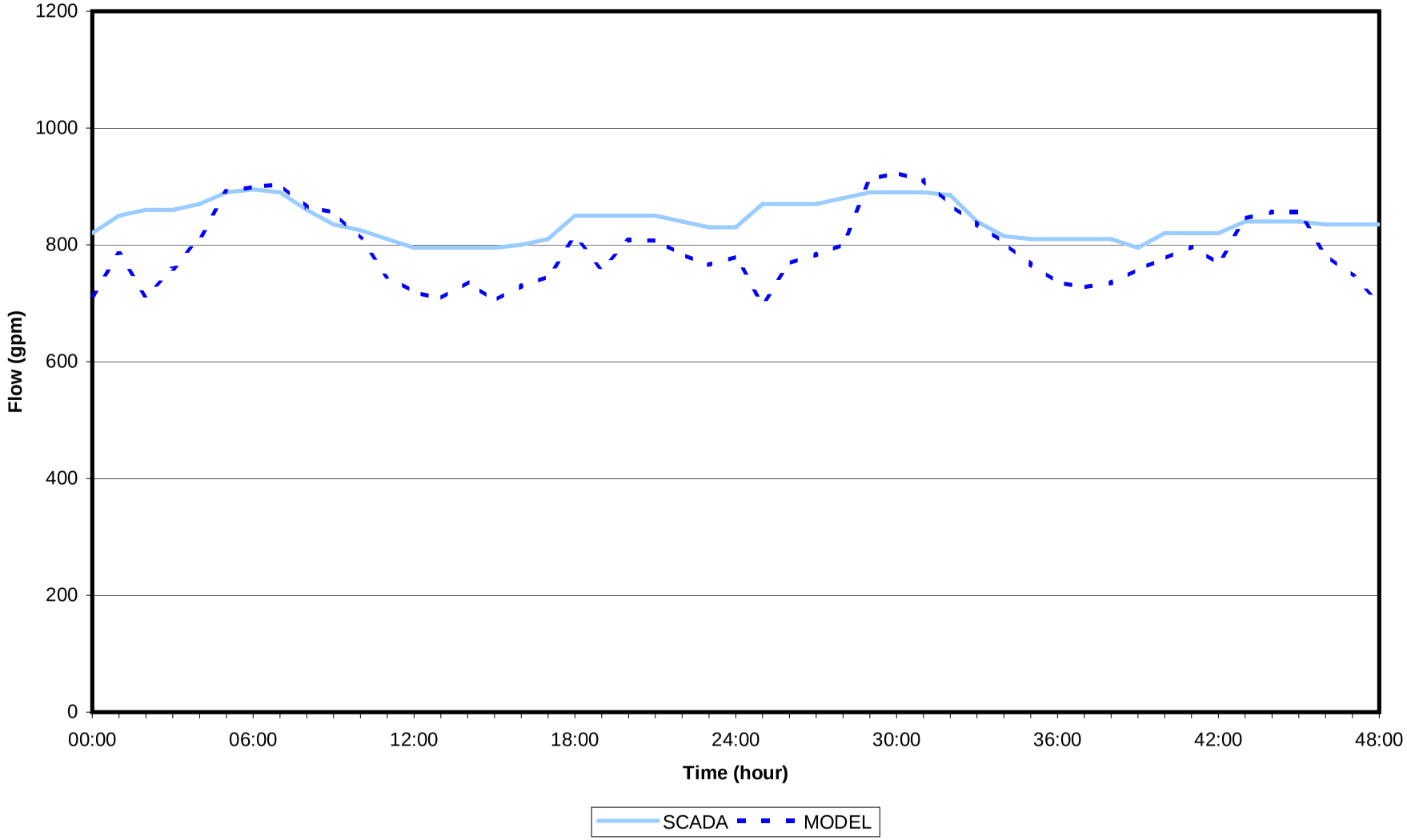



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST52-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 53 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

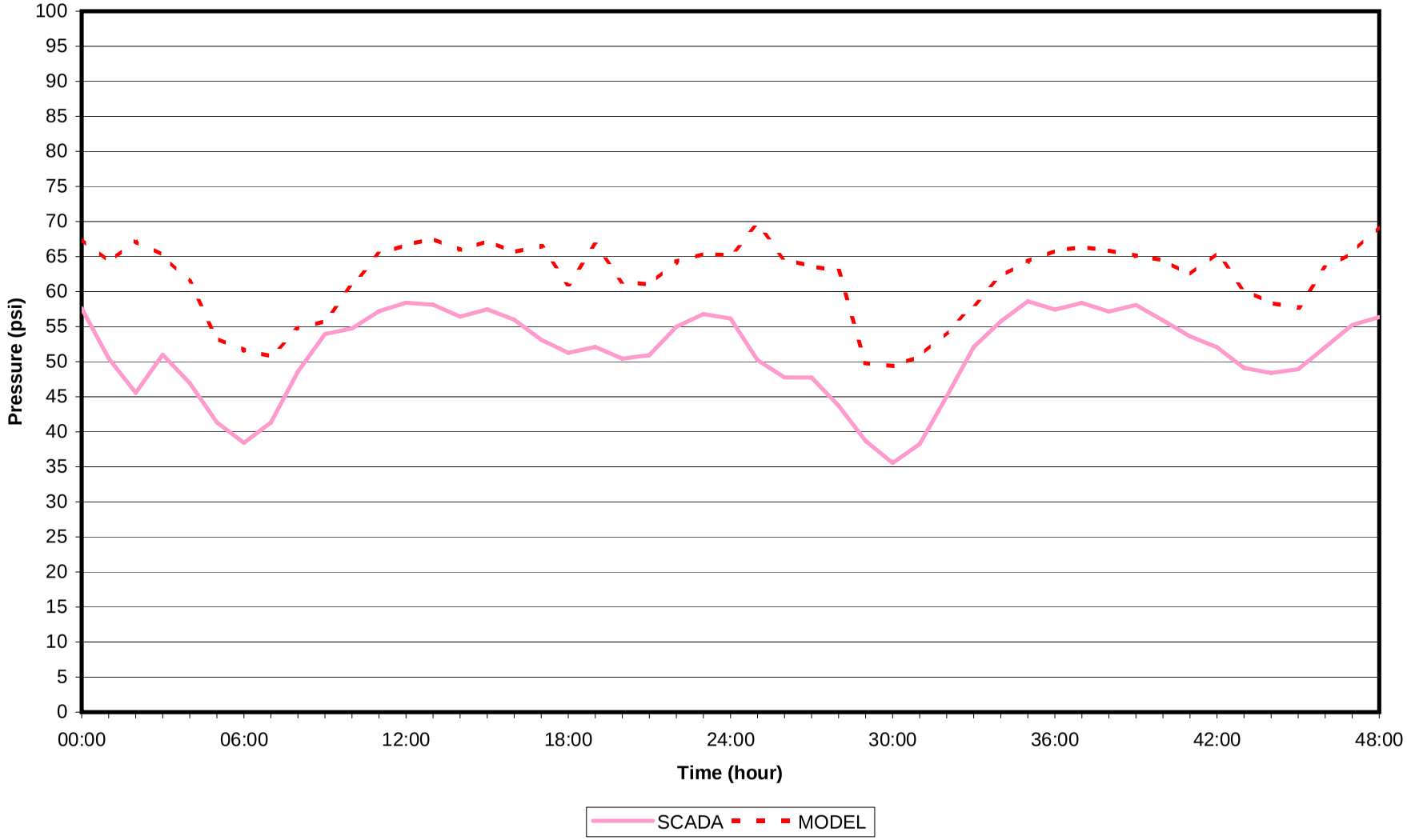



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST53-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 53 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

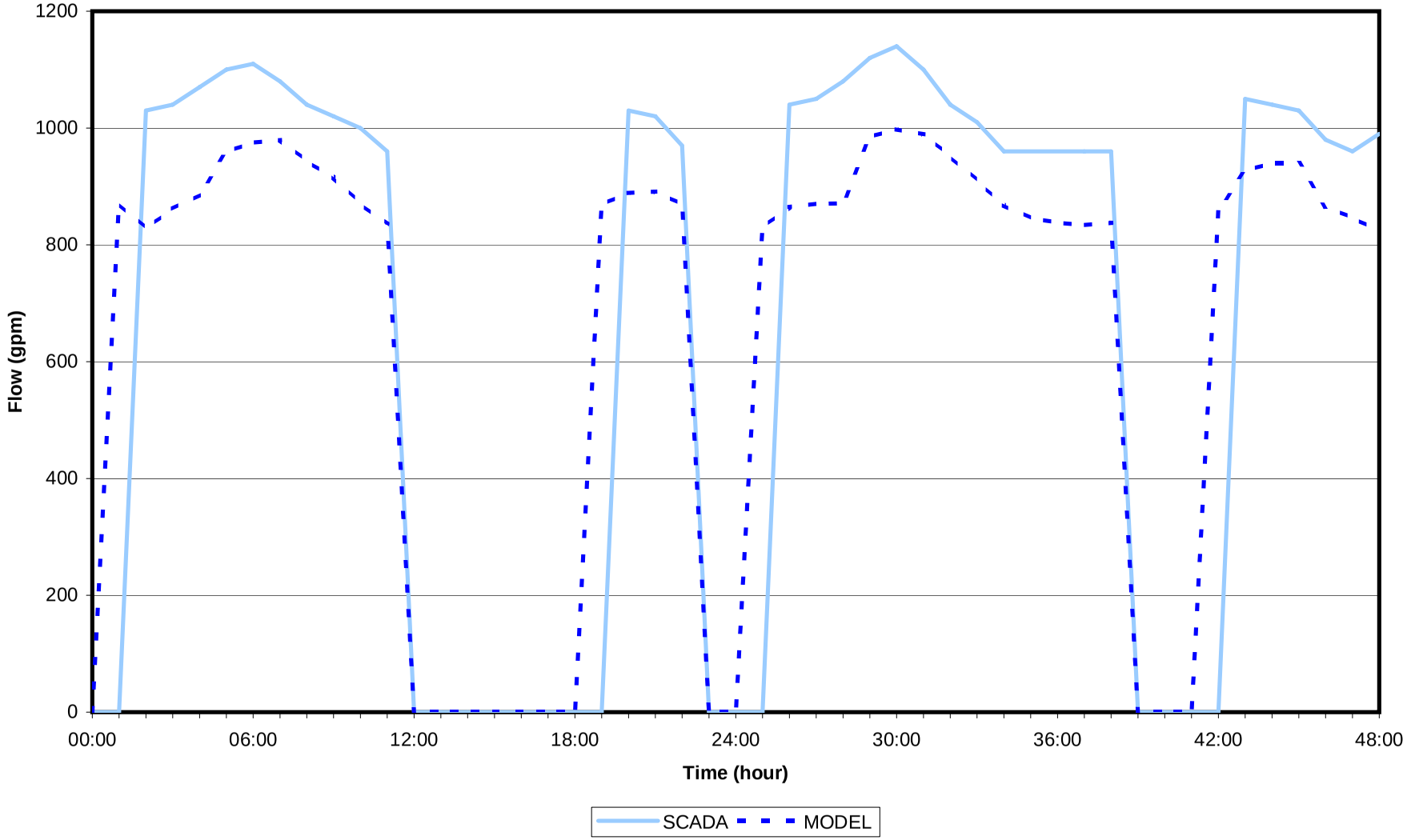



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST53-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 54 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

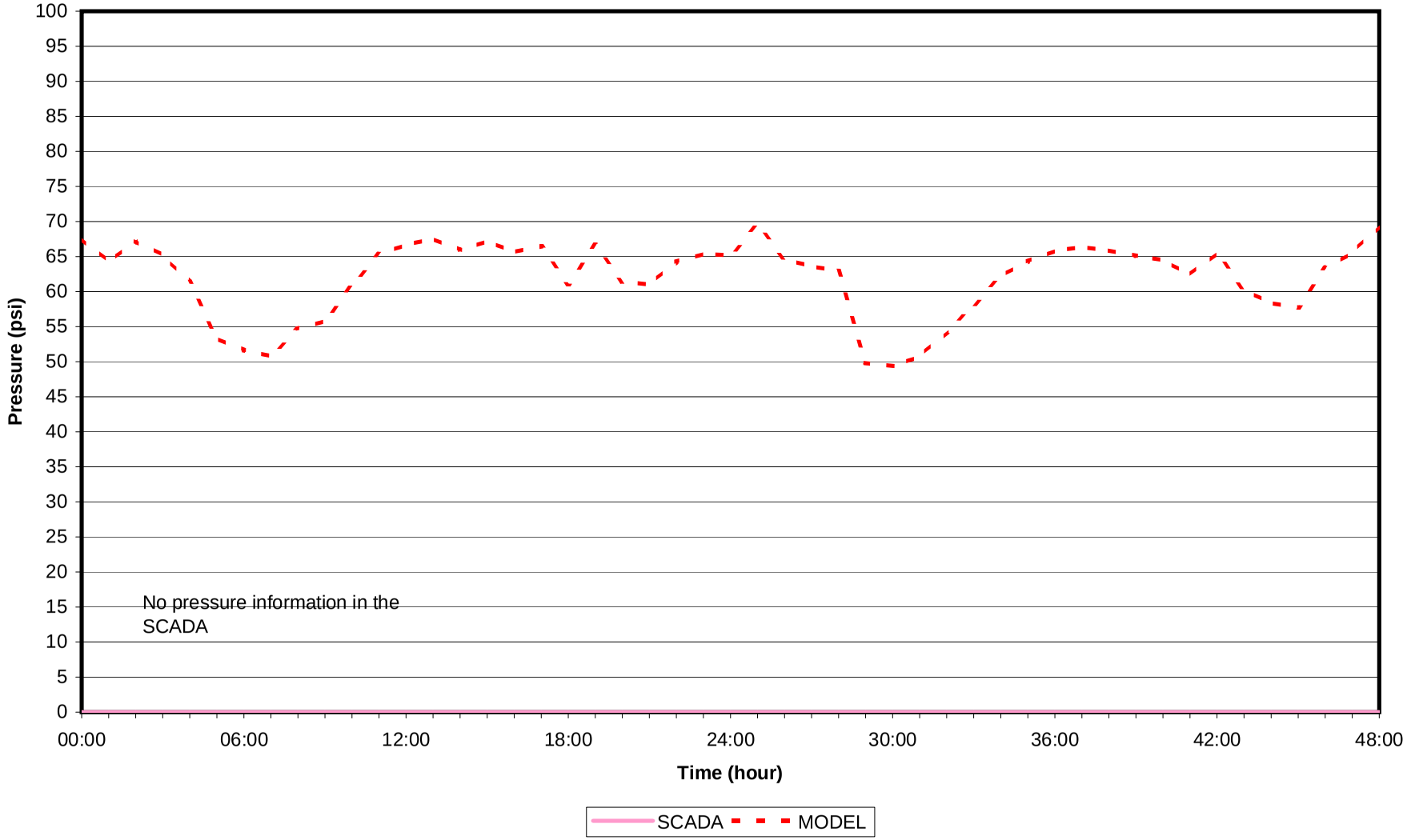



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST54-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 54 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

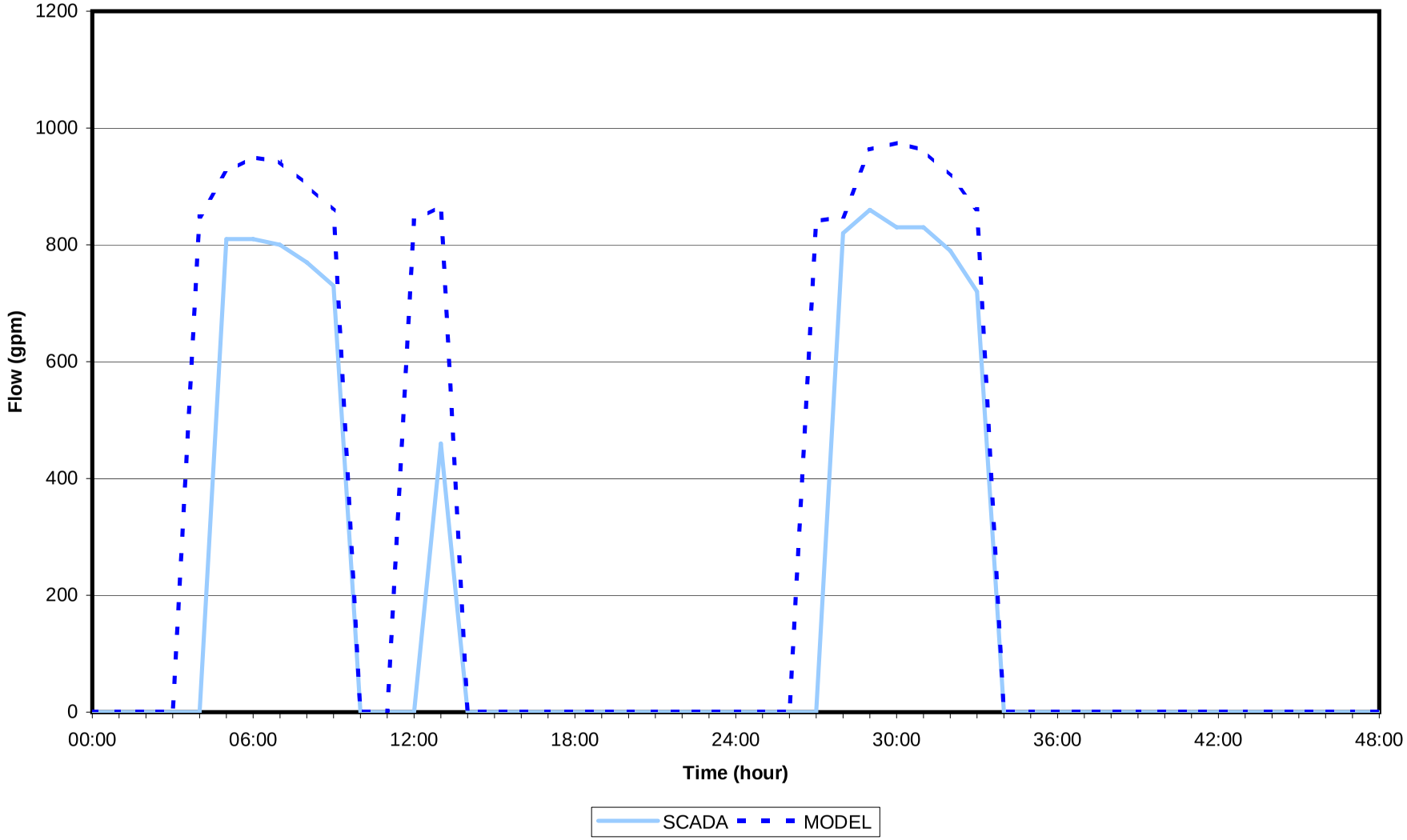



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST54-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 56 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

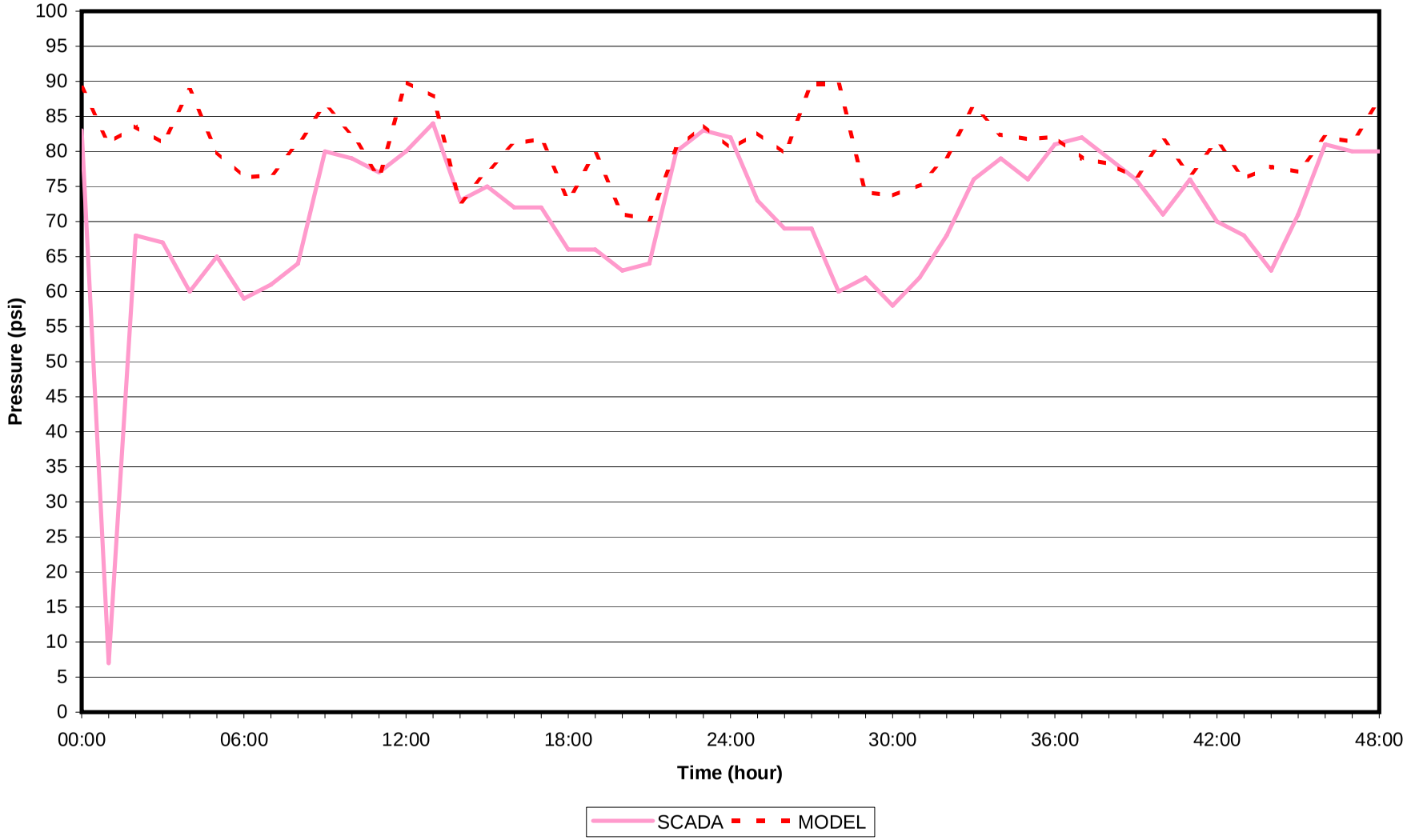



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST56-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 56 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

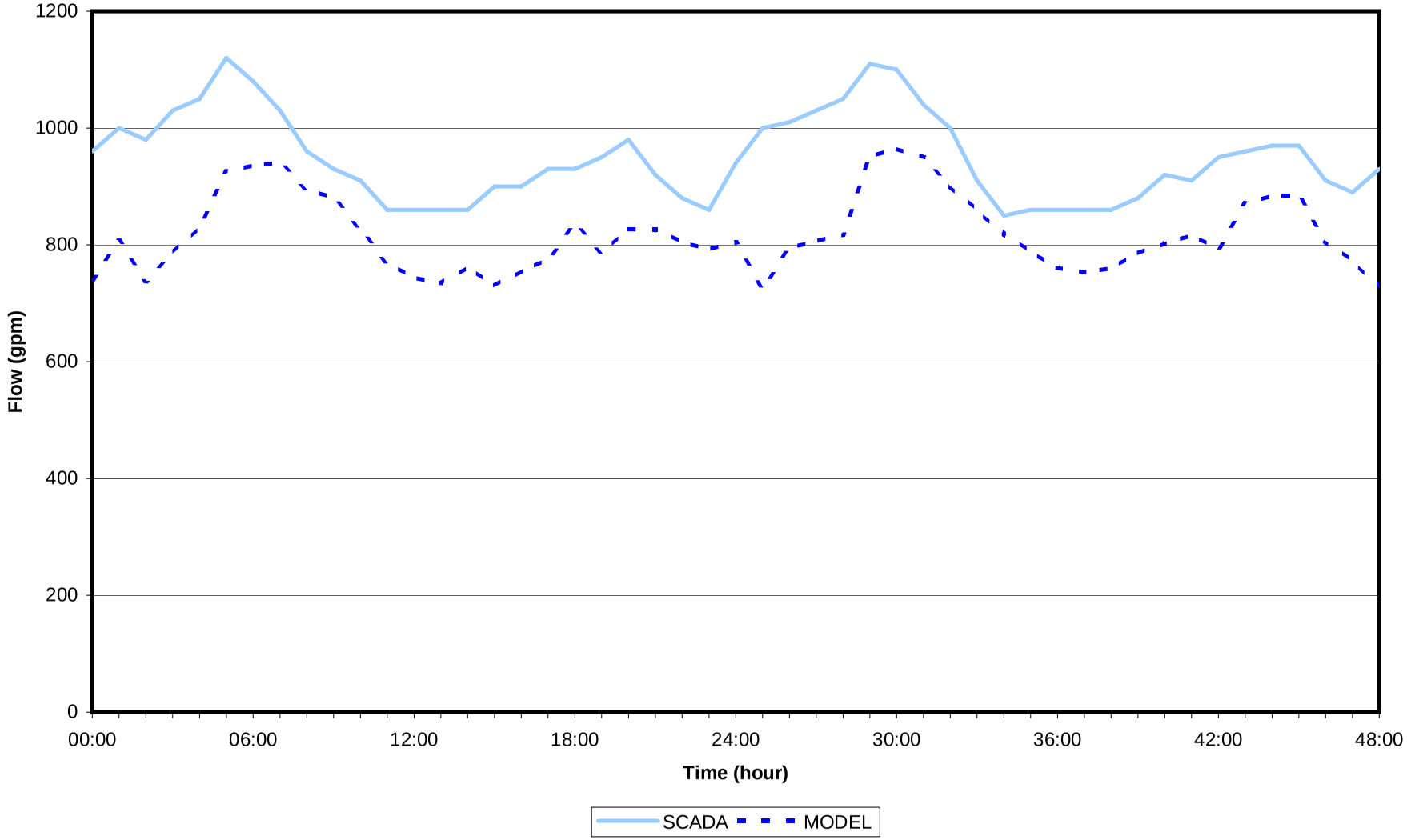



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST56-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 57 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

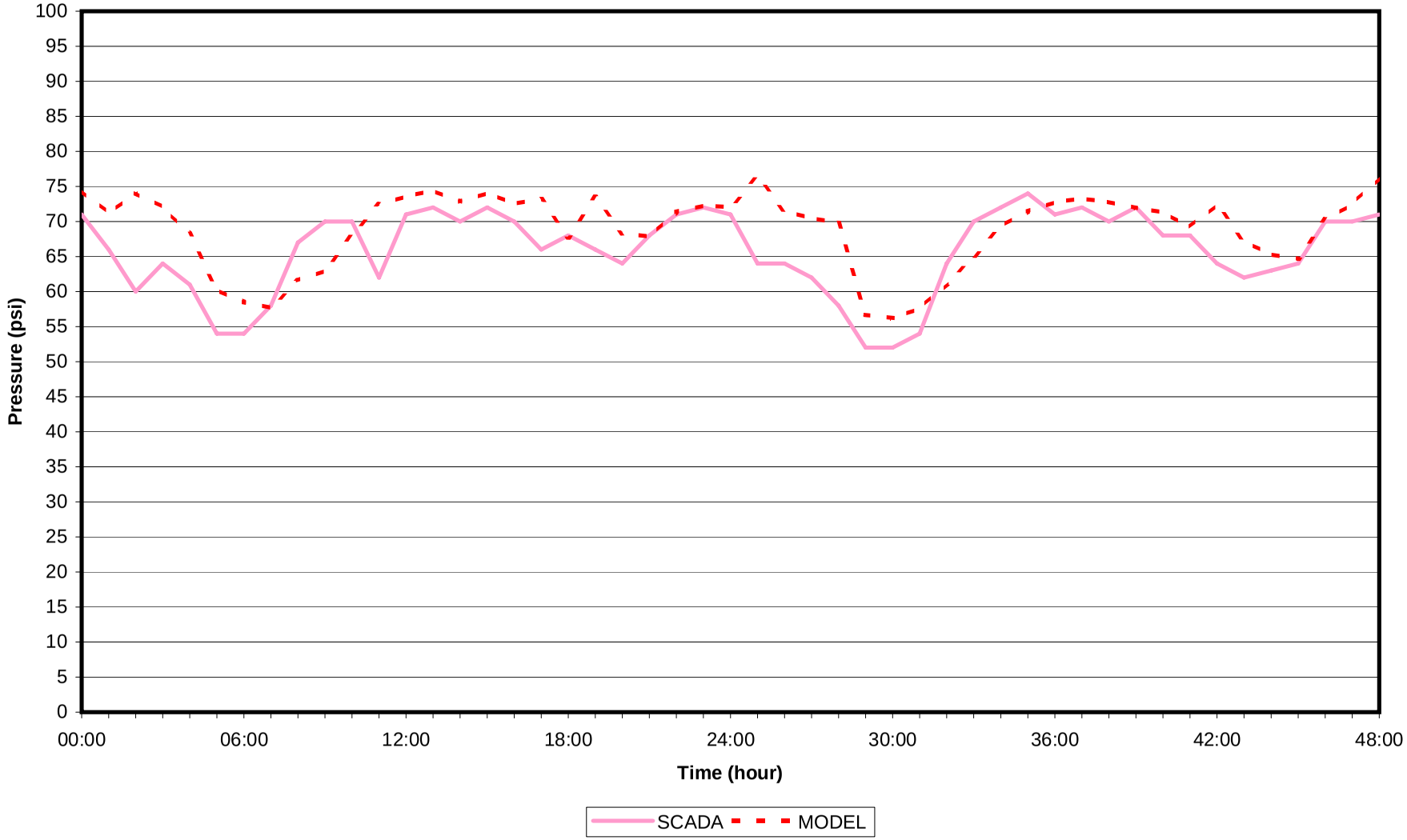



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST57-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 57 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

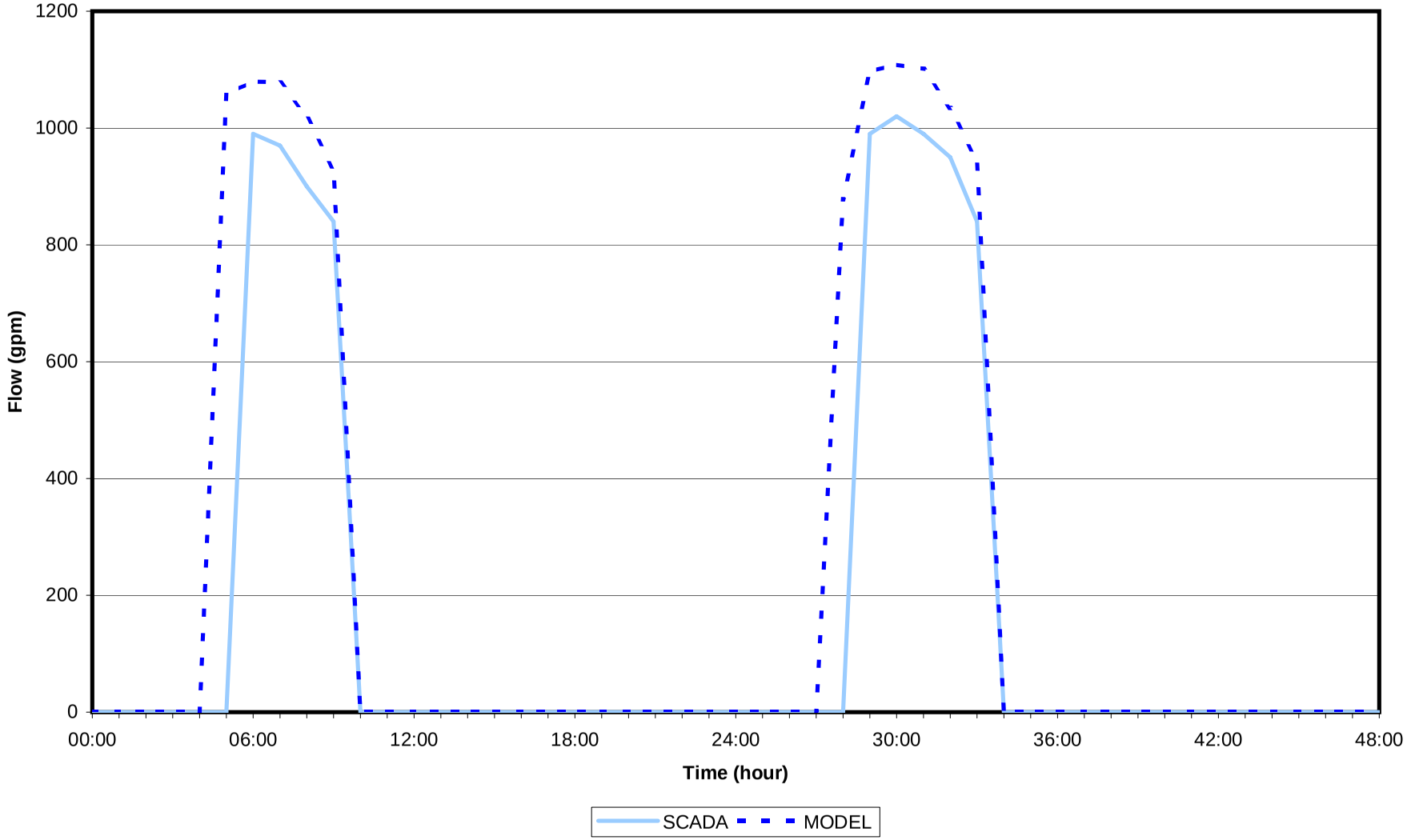



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST57-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 59 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

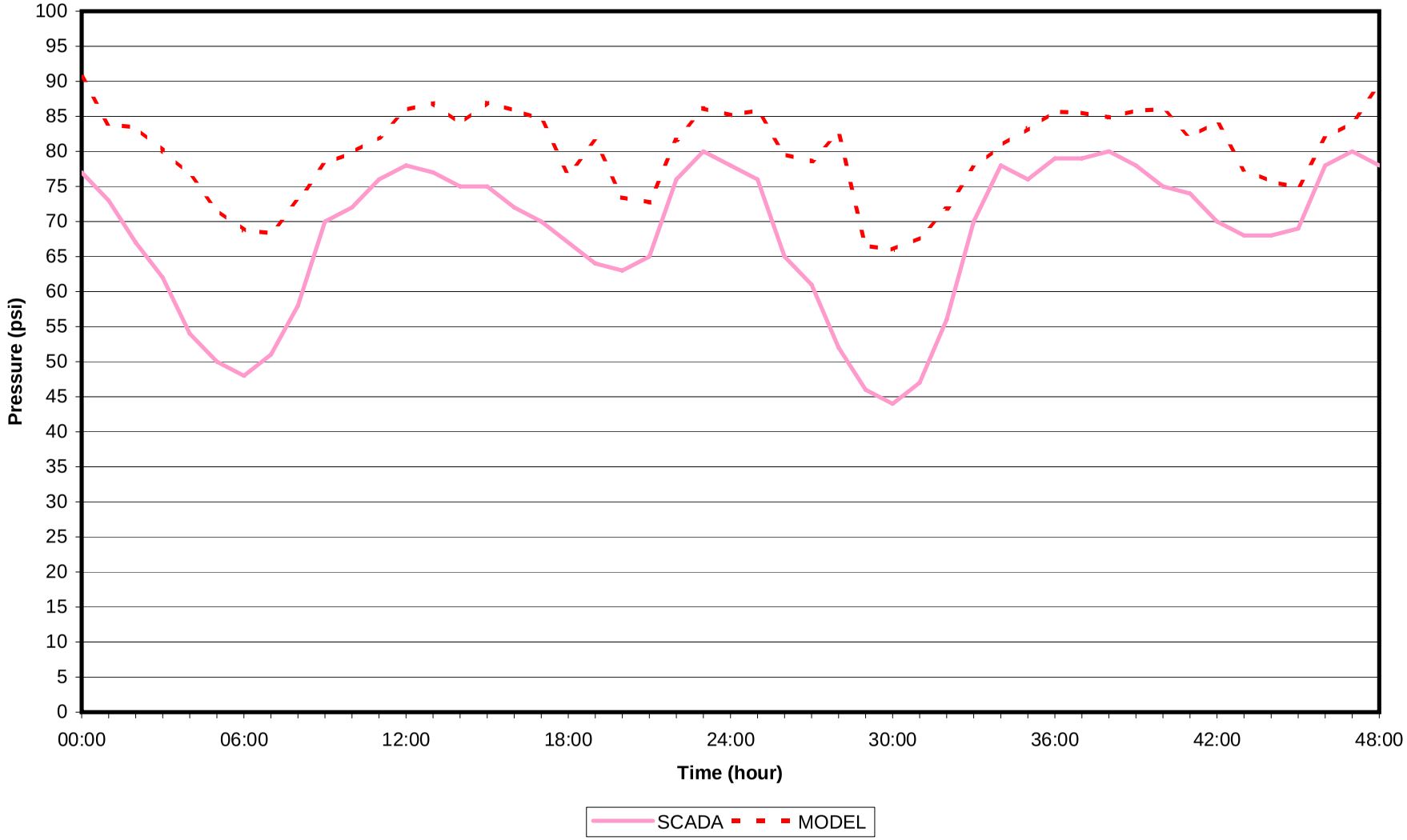



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST59-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 59 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

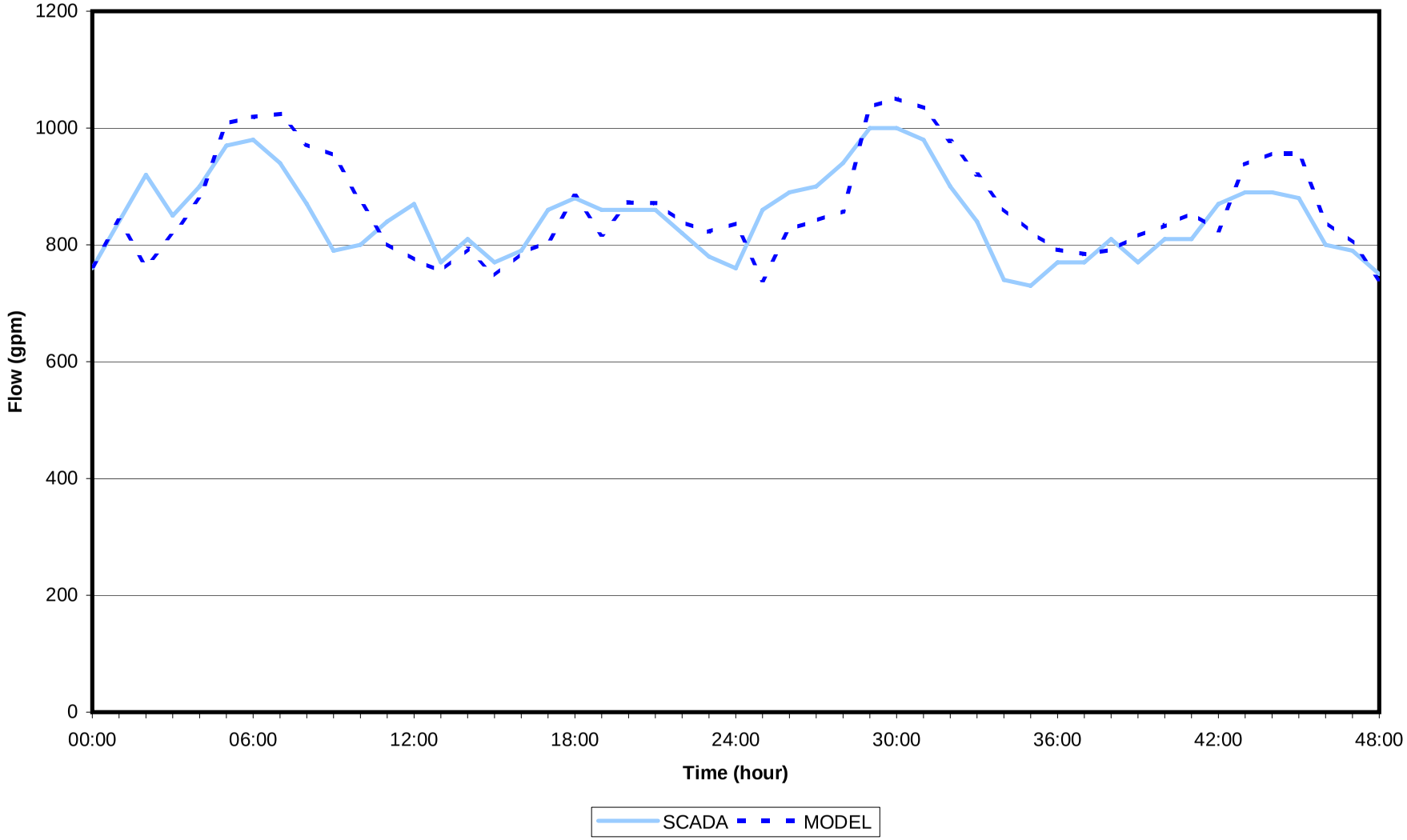



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST59-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 61 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

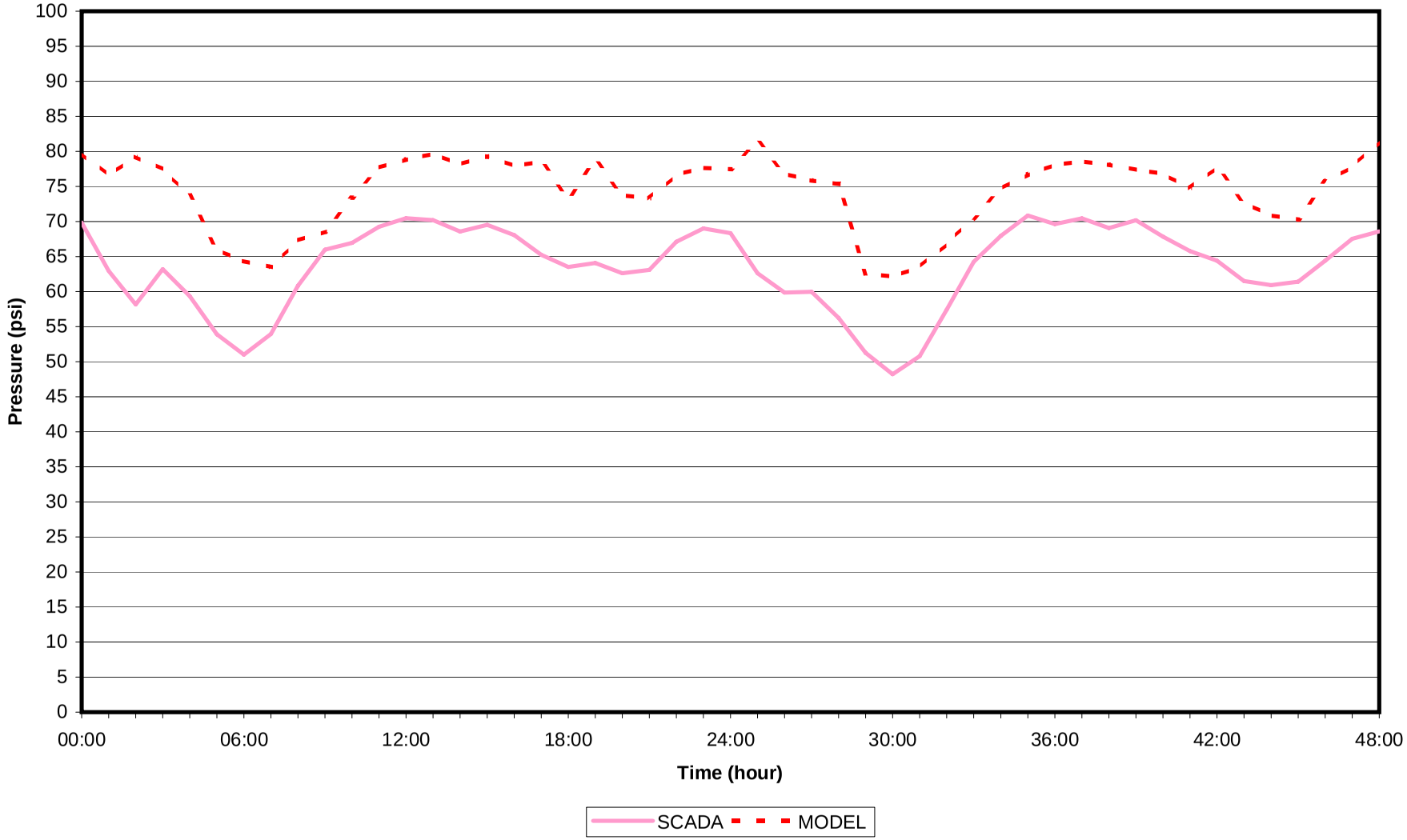



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST61-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 61 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

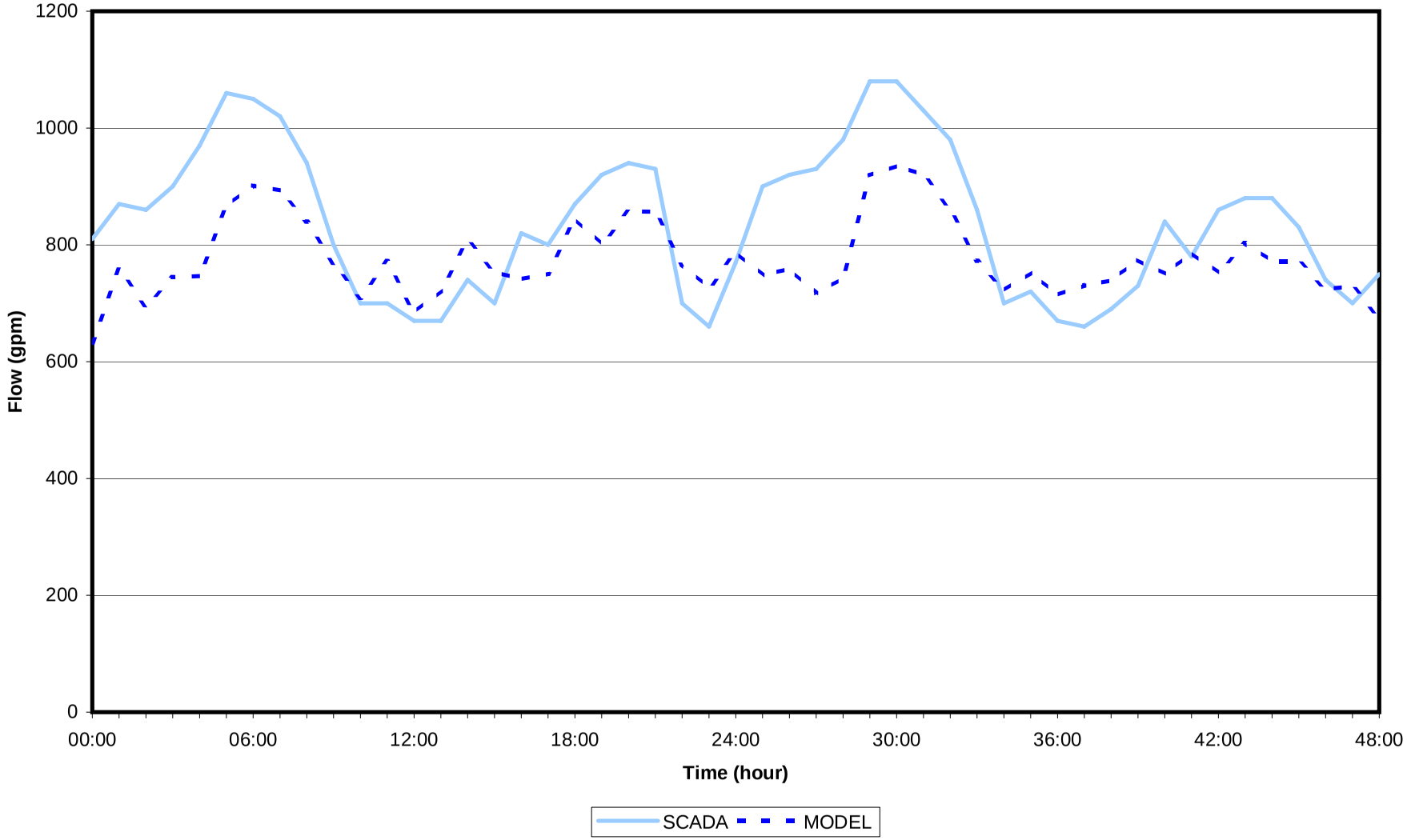



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST61-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 62 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

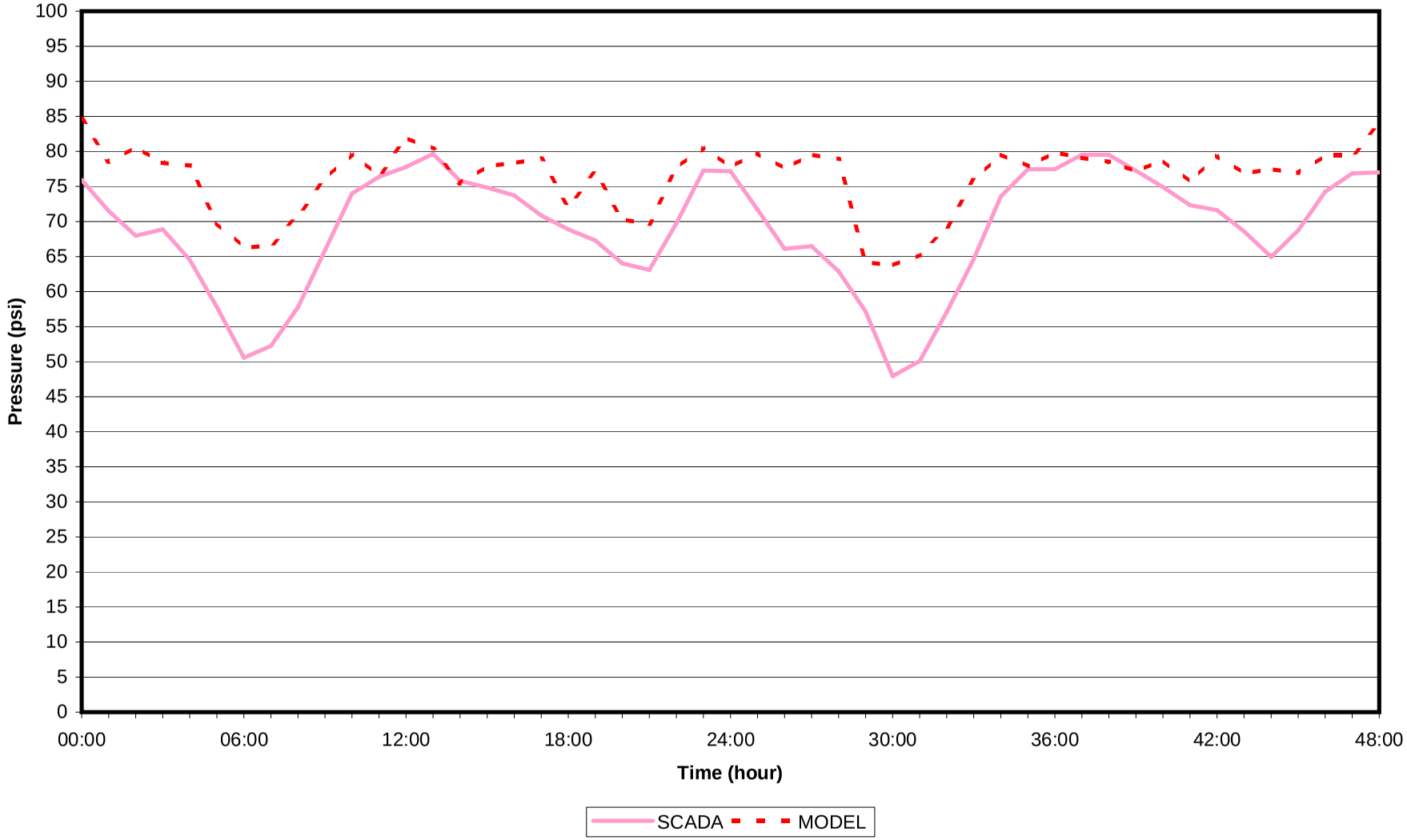



West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST62-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

## Station 52 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

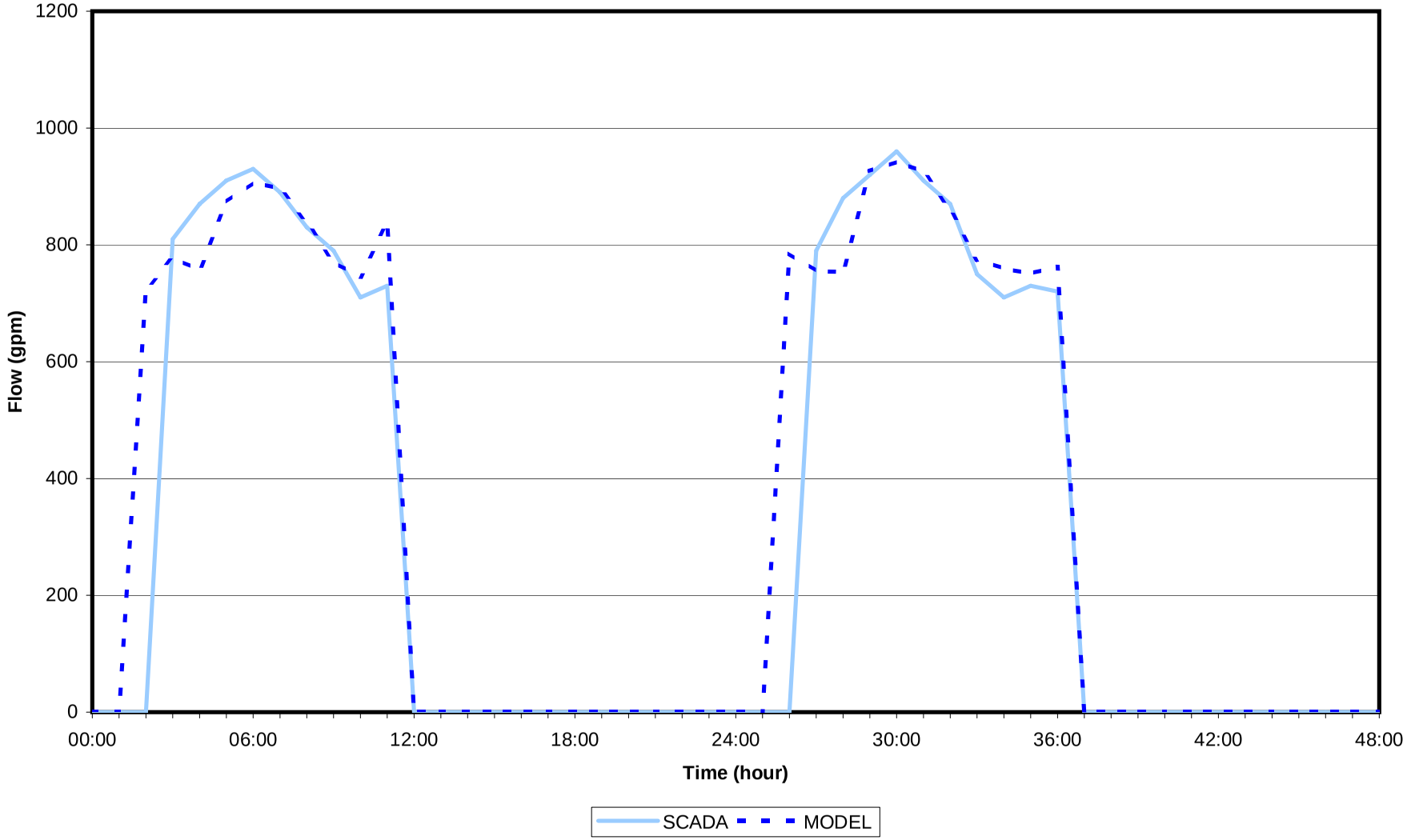



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST62-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 63 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

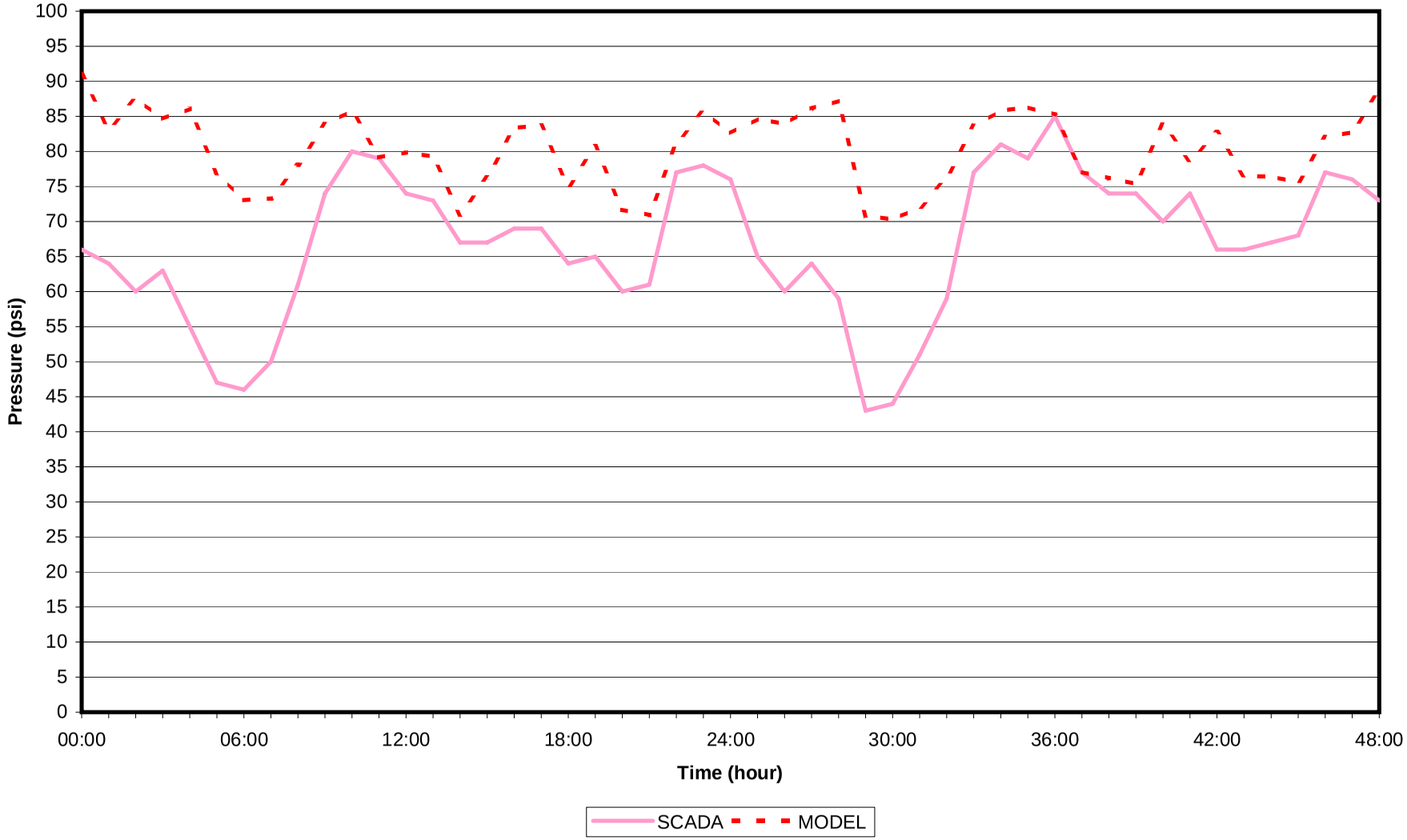



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST63-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 63 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

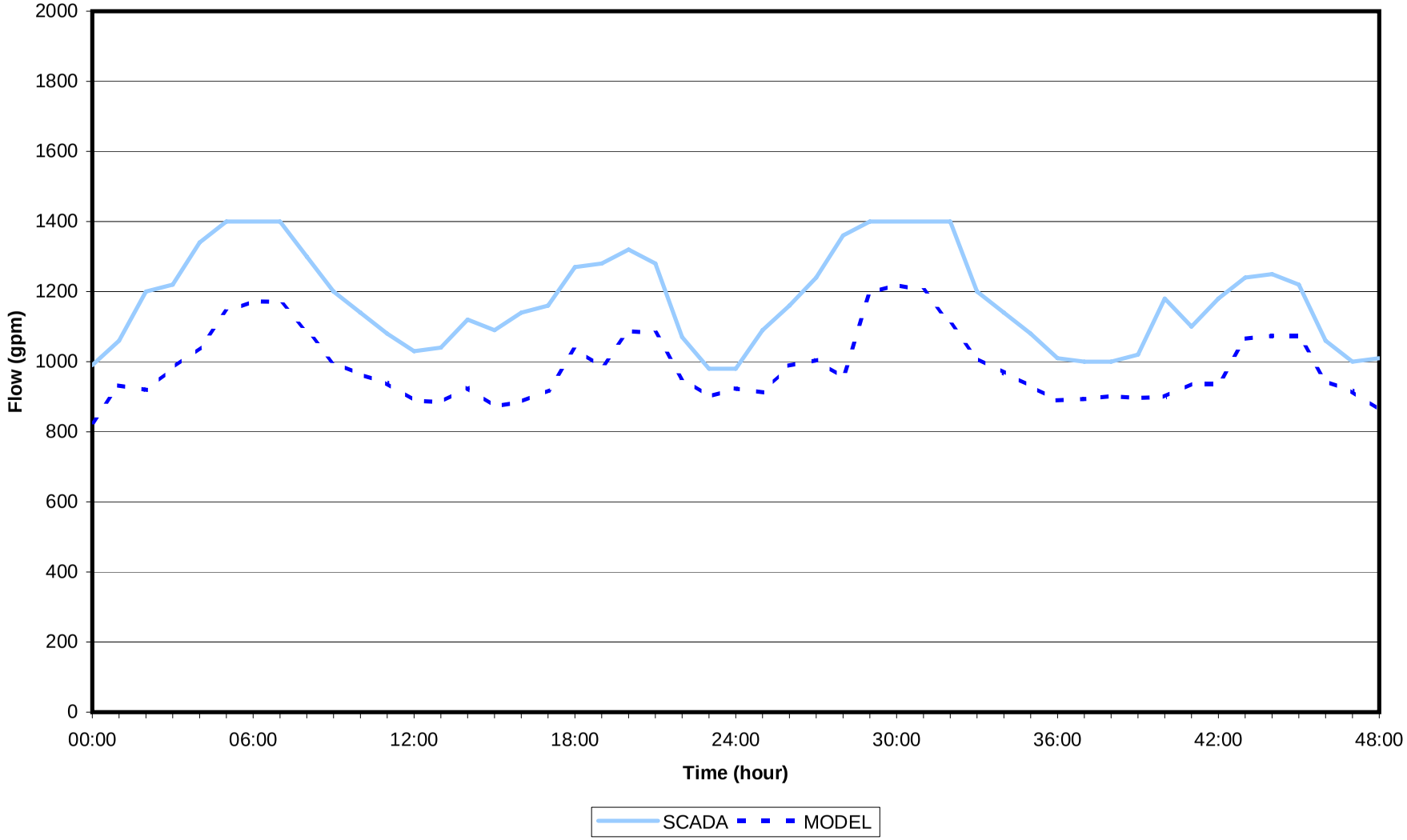



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST63-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 68 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

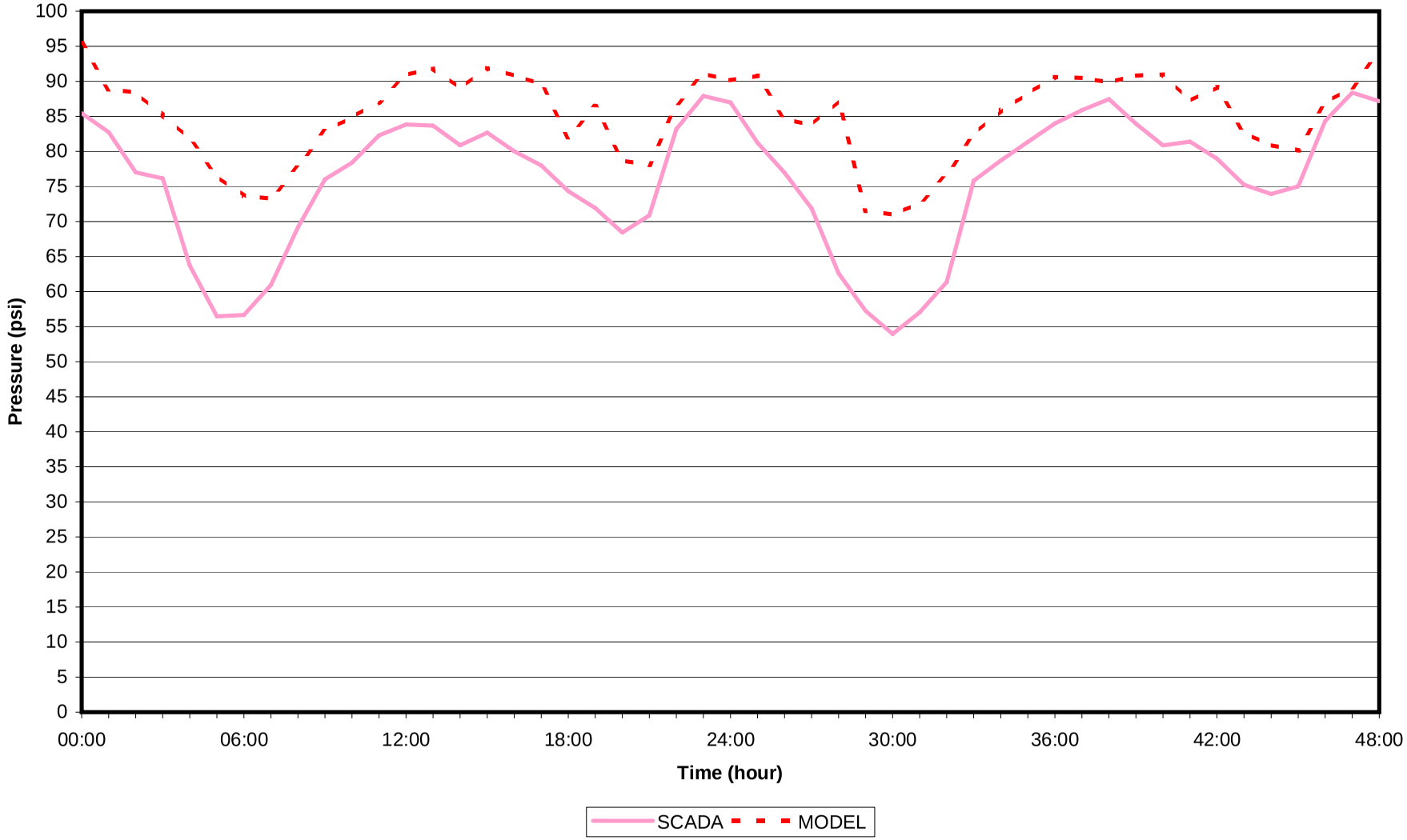



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST68-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 68 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

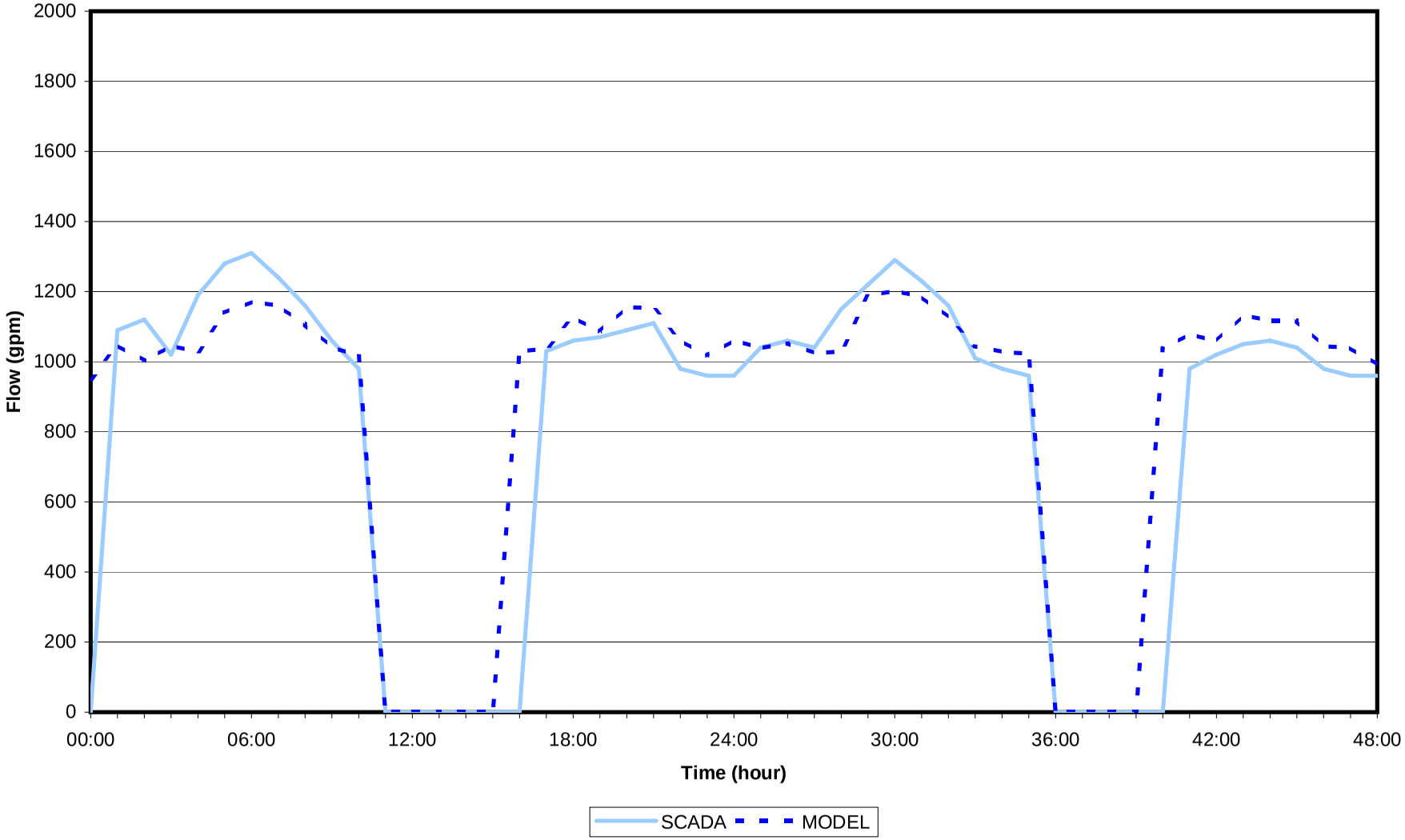



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST68-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 69 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

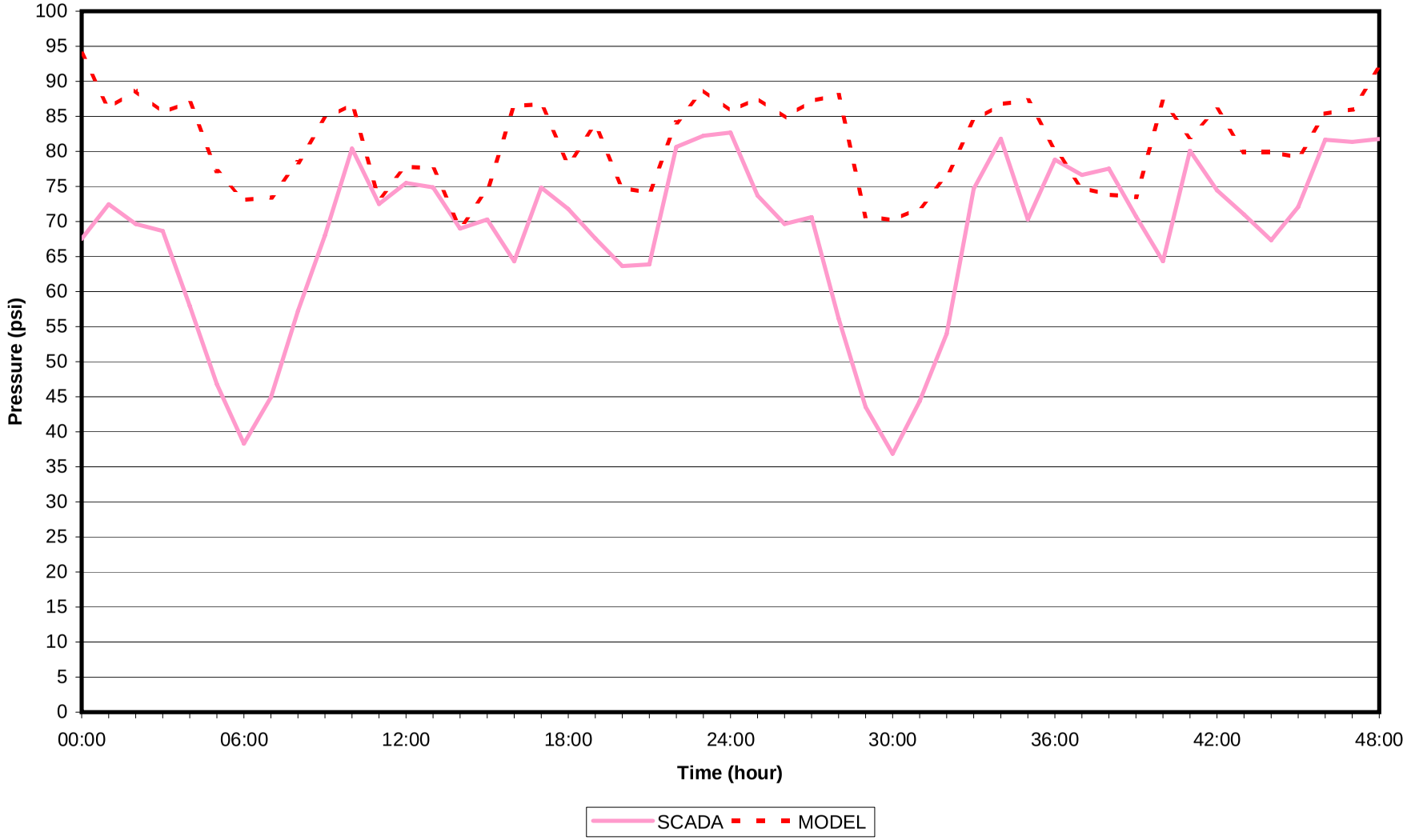



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST69-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 69 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

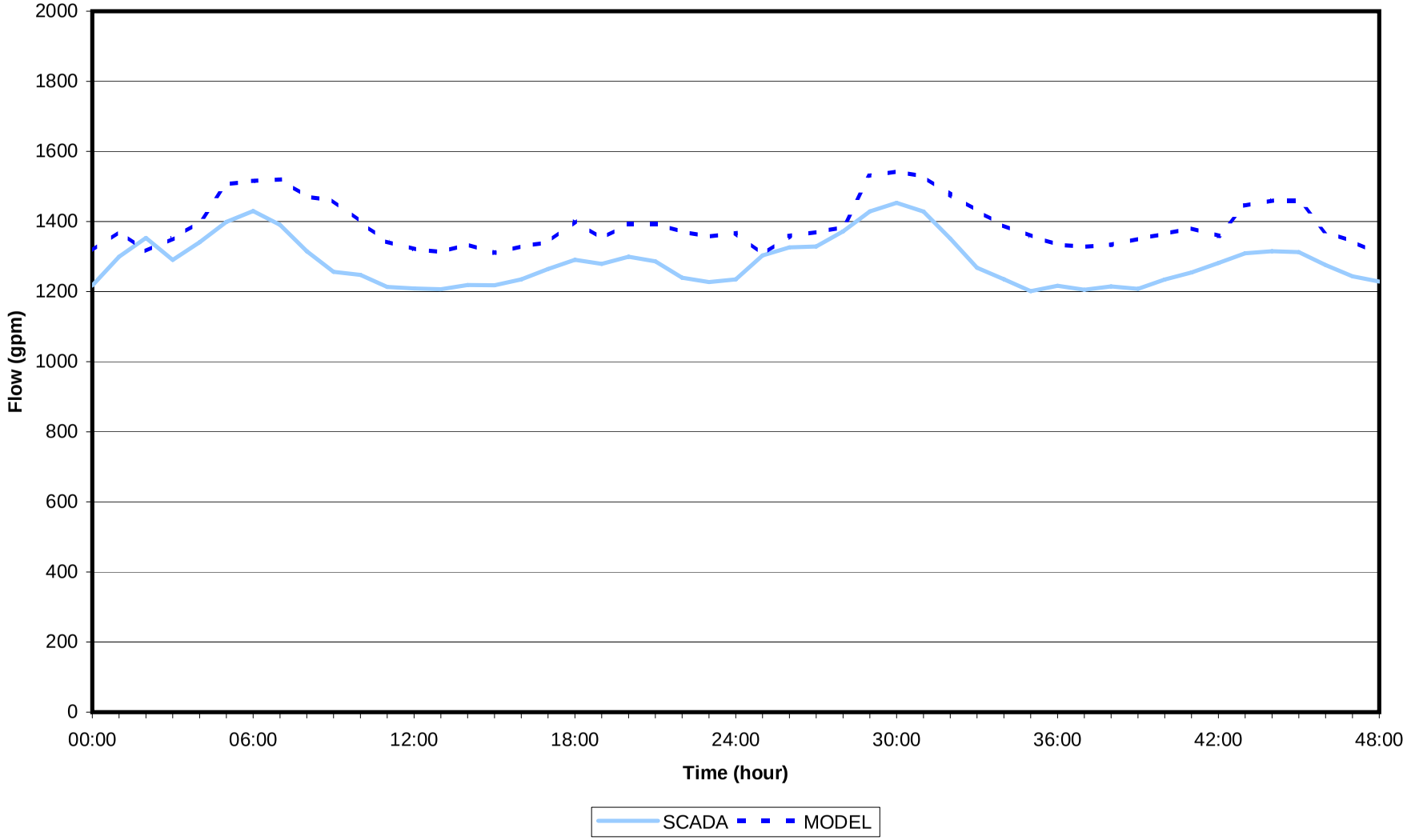



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST69-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 71 Flow
## Pressure Zone 350 - 07/20/06 to 07/21/06

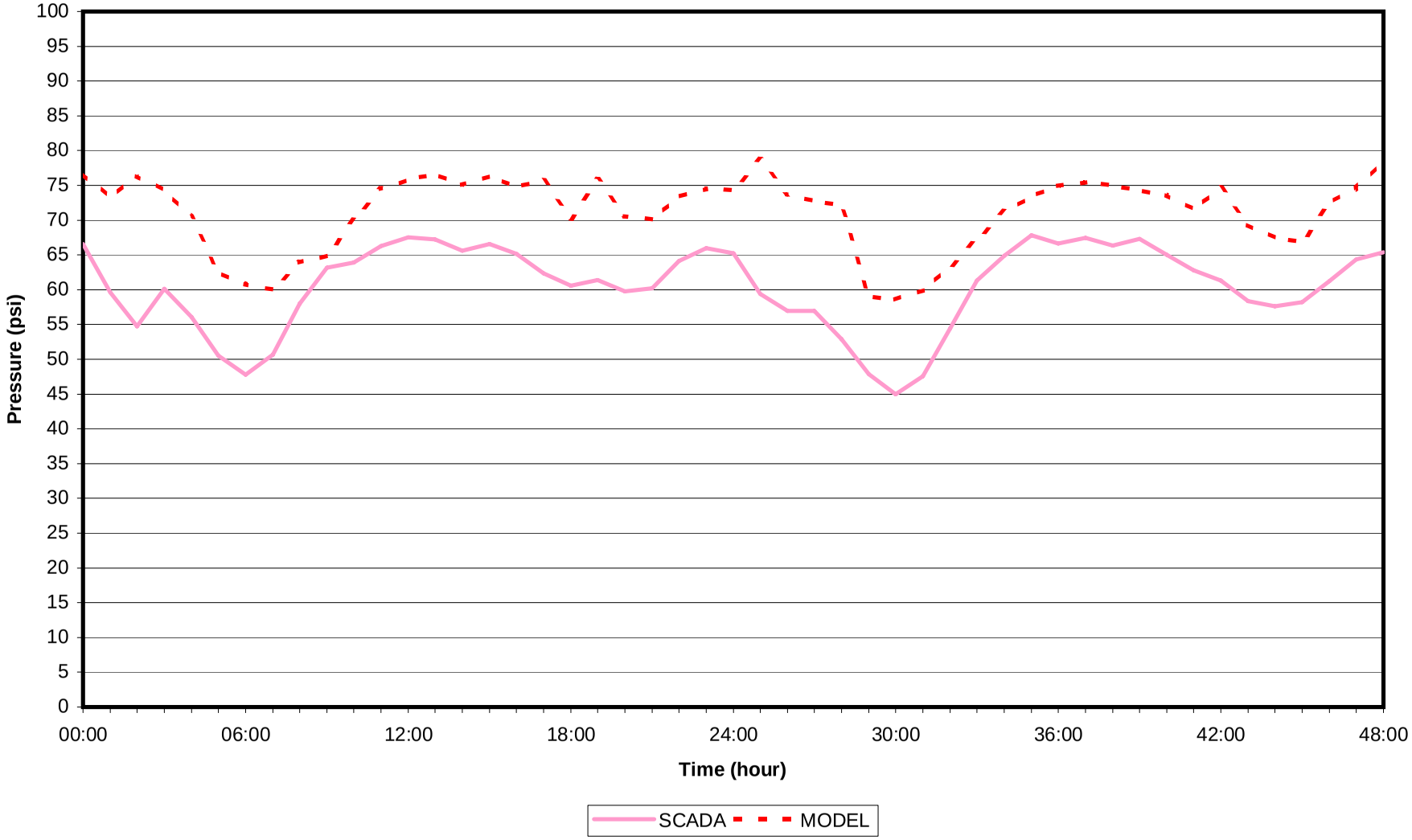



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST71-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 71 Pressure
## Pressure Zone 350 - 07/20/06 to 07/21/06

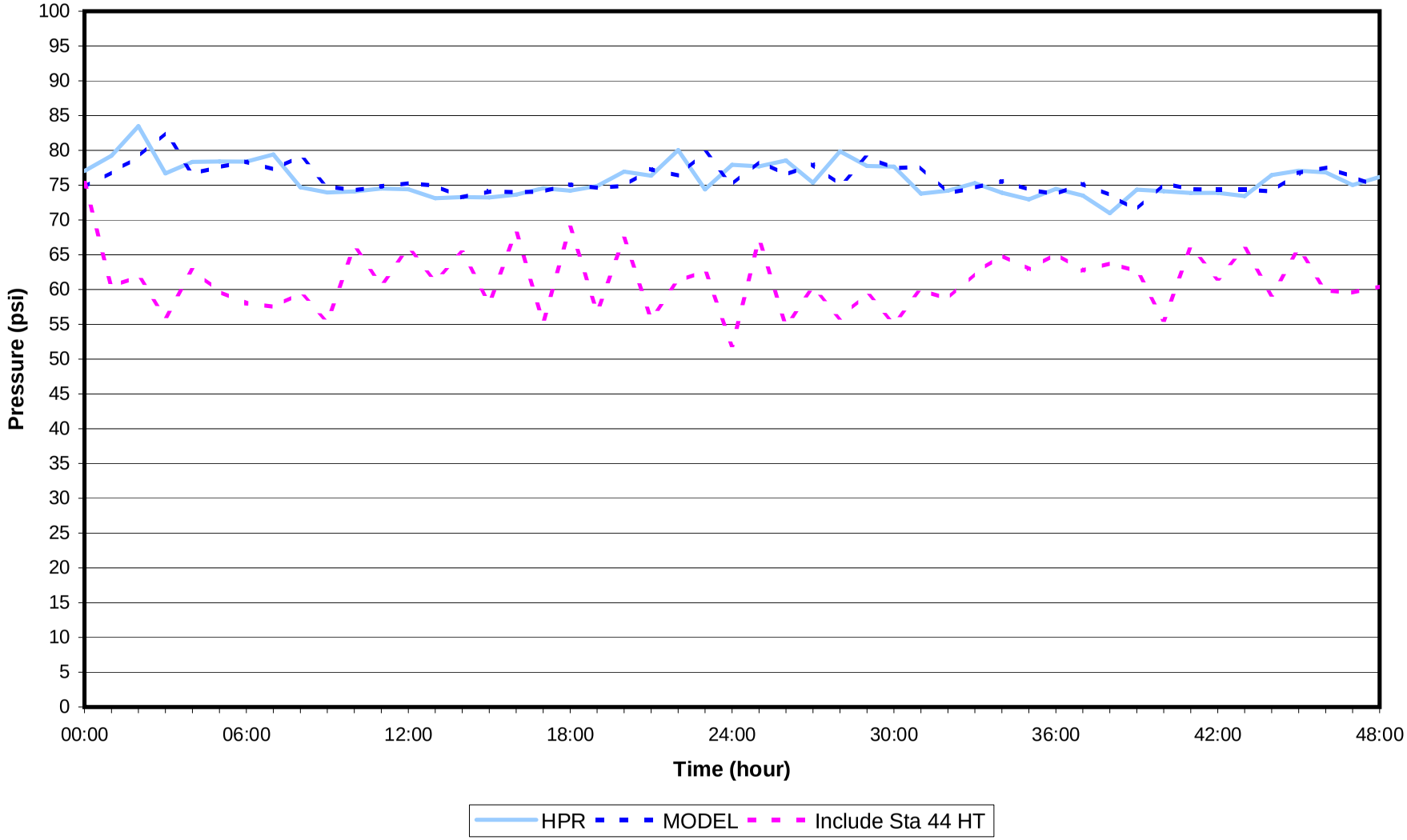



Public Version

West Yost Associates
O:\c\436\02-06-03\E\T4\diurnal\ZONE 350.xlsCH_ST71-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-1: Fortress Street
## Pressure Zone 400 - 07/12/06 to 7/13/06

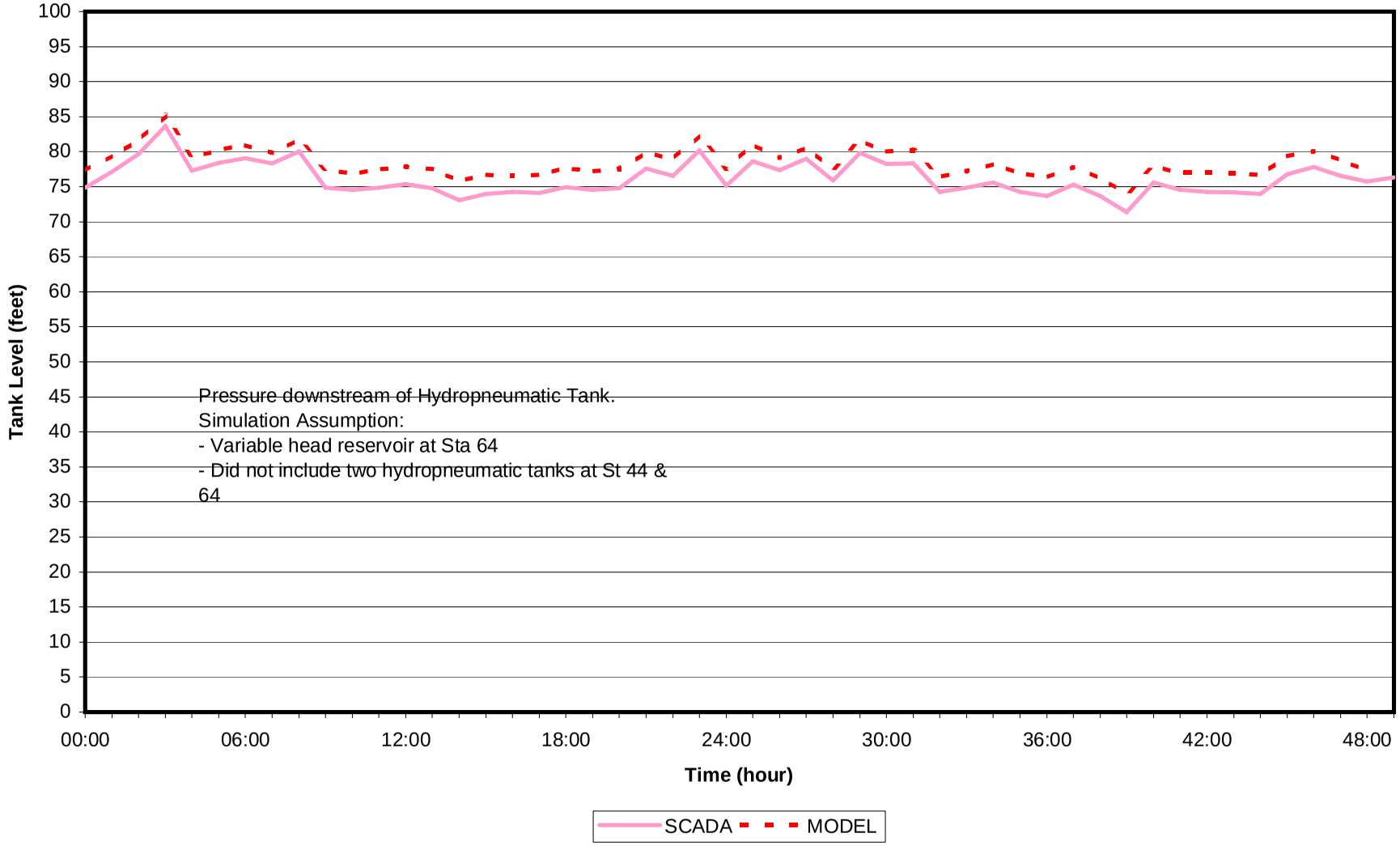



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071106-071806.xls\CH_B-1
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 44 Pressure
## Pressure Zone 400 - 07/11/06 to 07/12/06

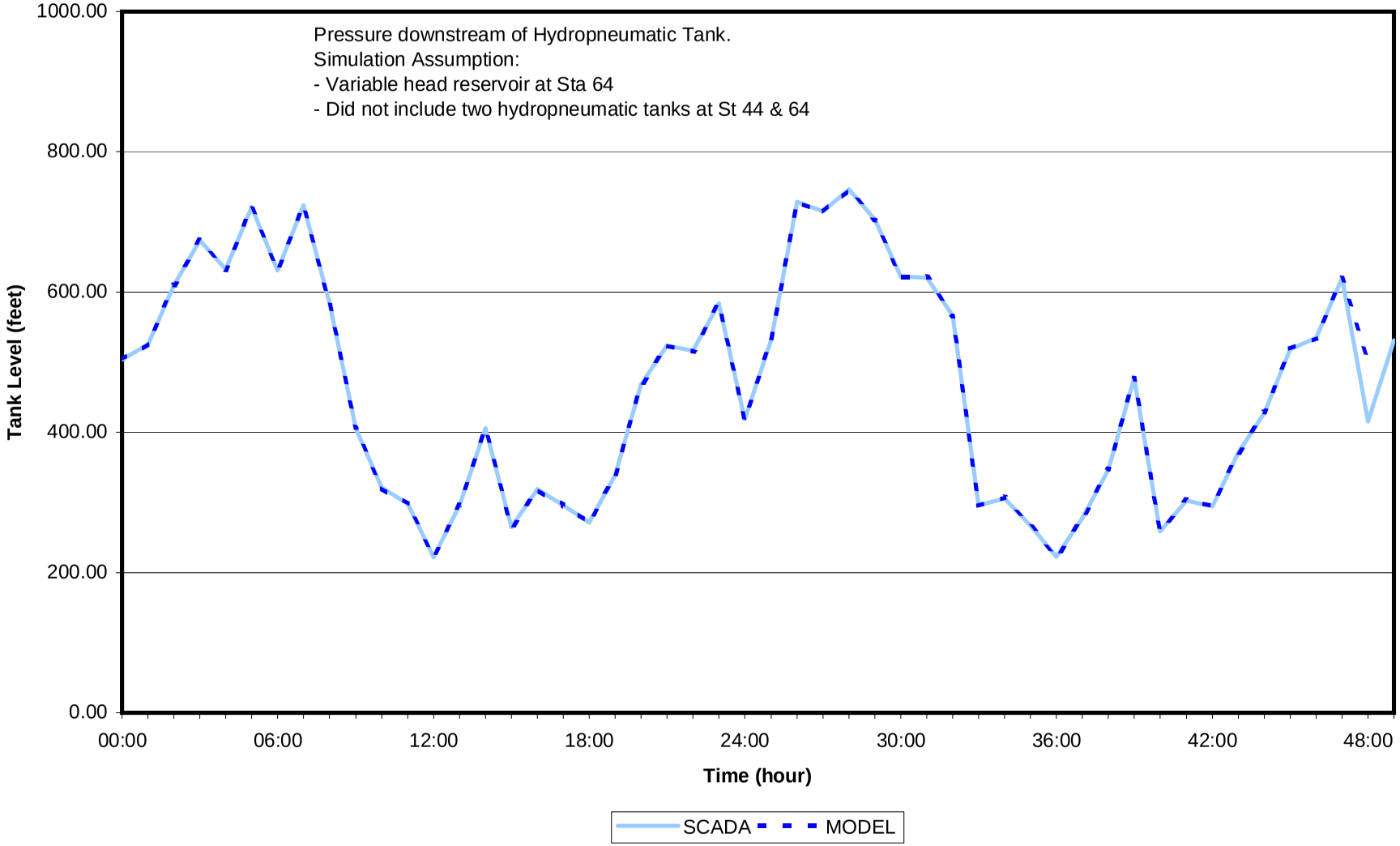



Public Version

West Yost Associates
o:\c\436\02-06-03\E\T4\diurnal\ZONE 400.xlsCH_ST44-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 64 Flow
## Pressure Zone 400 - 07/11/06 to 07/12/06

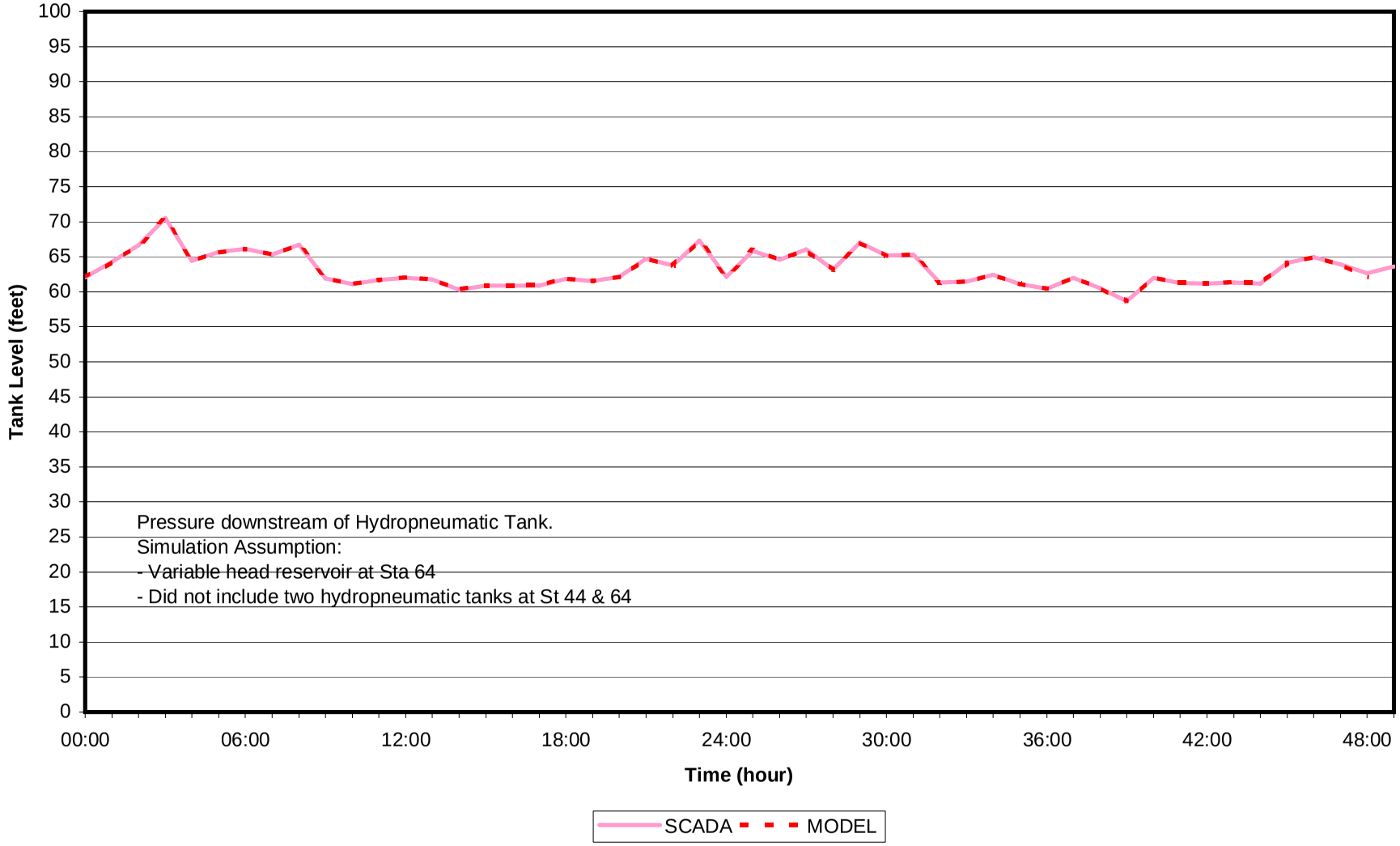



West Yost Associates
o:\c\436\02-06-03\E\T4\diurnal\ZONE 400.xlsCH_ST64-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

## Station 64 Pressure
## Pressure Zone 400 - 07/11/06 to 07/12/06

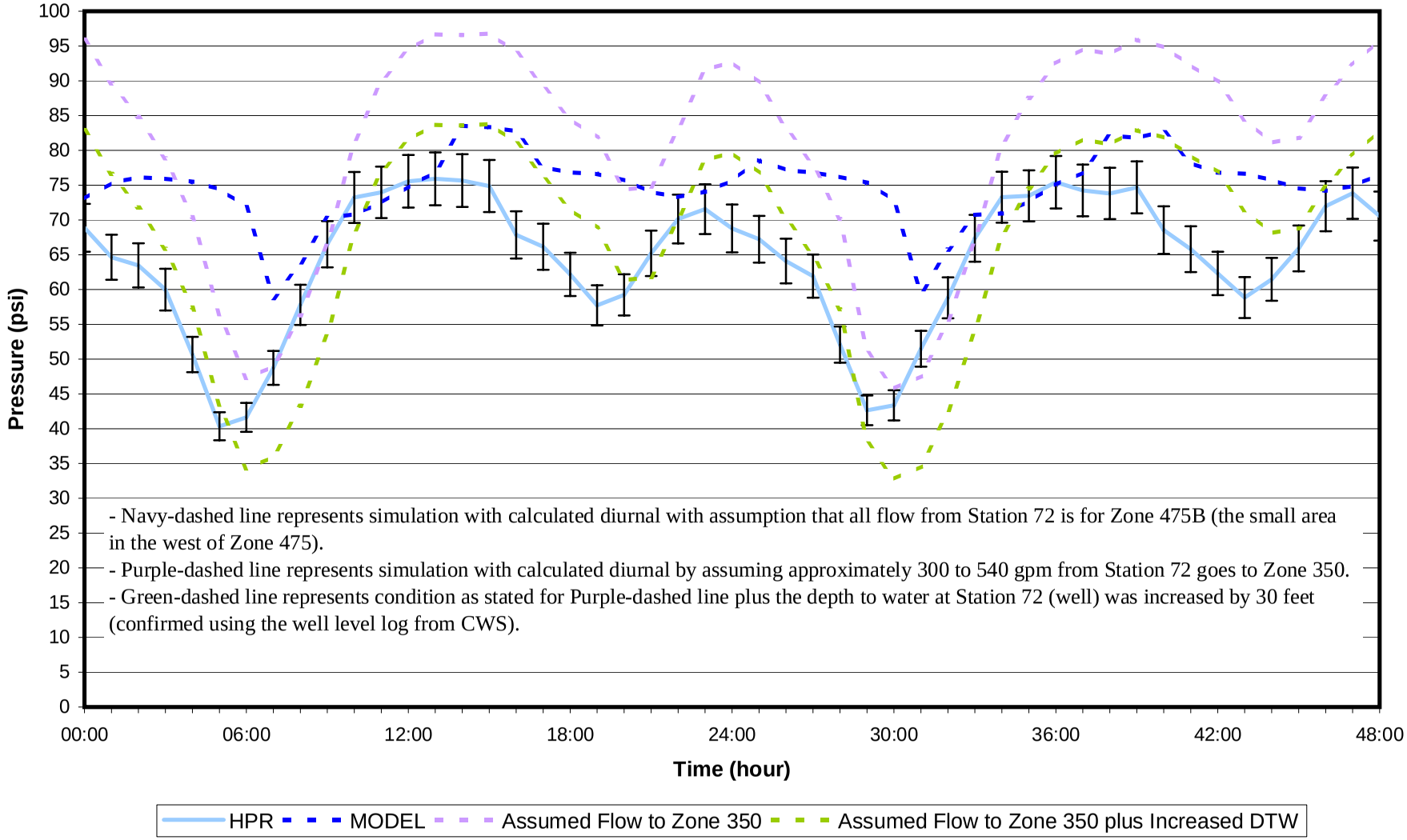



Public Version

West Yost Associates
o:\c\436\02-06-03\E\T4\diurnal\ZONE 400.xlsCH_ST64-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-2: Hancock Drive
## Pressure Zone 475 - 07/12/06 to 7/13/06

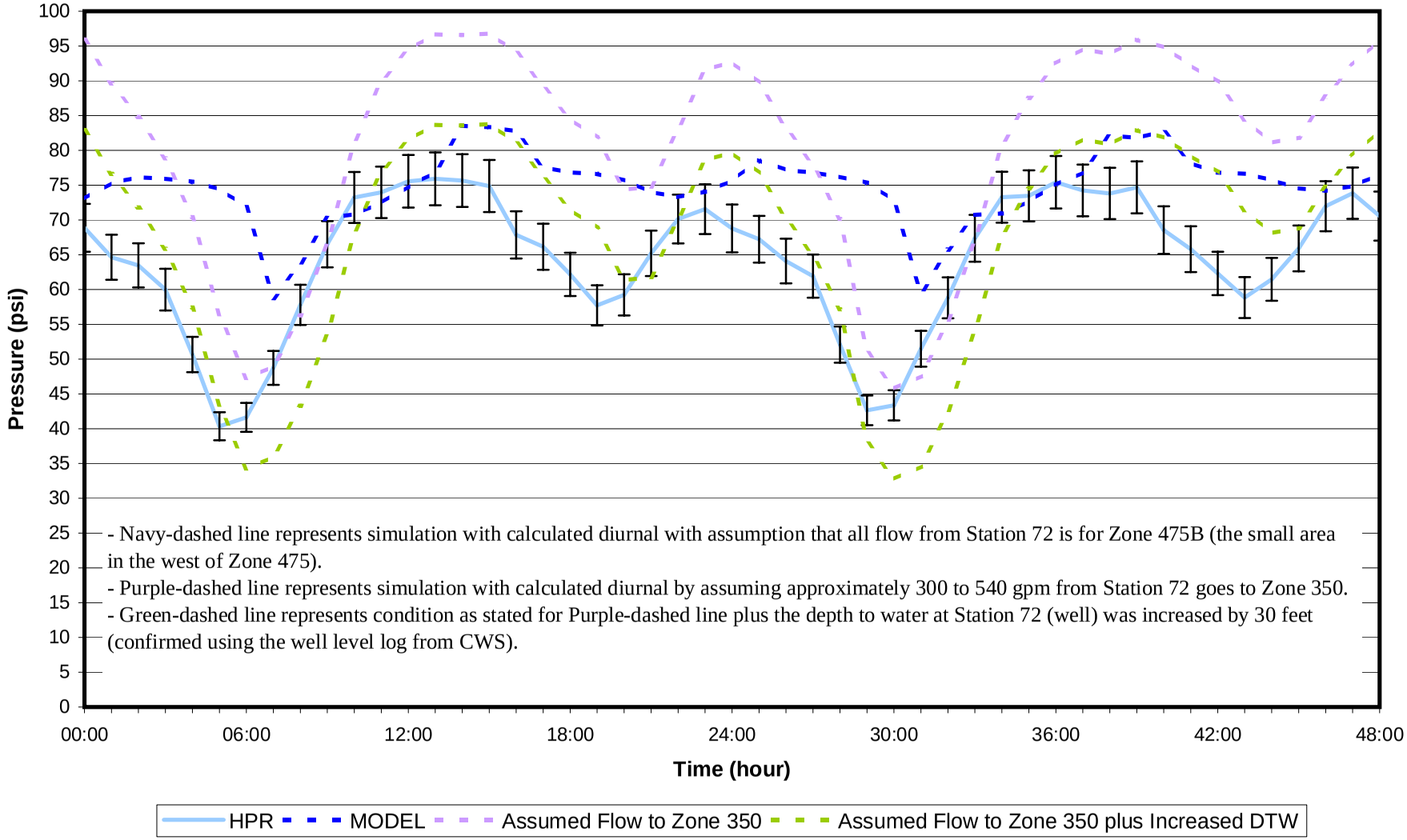



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071106-071806.xls\CH_B-2
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-2: Hancock Drive
## Pressure Zone 475 - 07/12/06 to 7/13/06

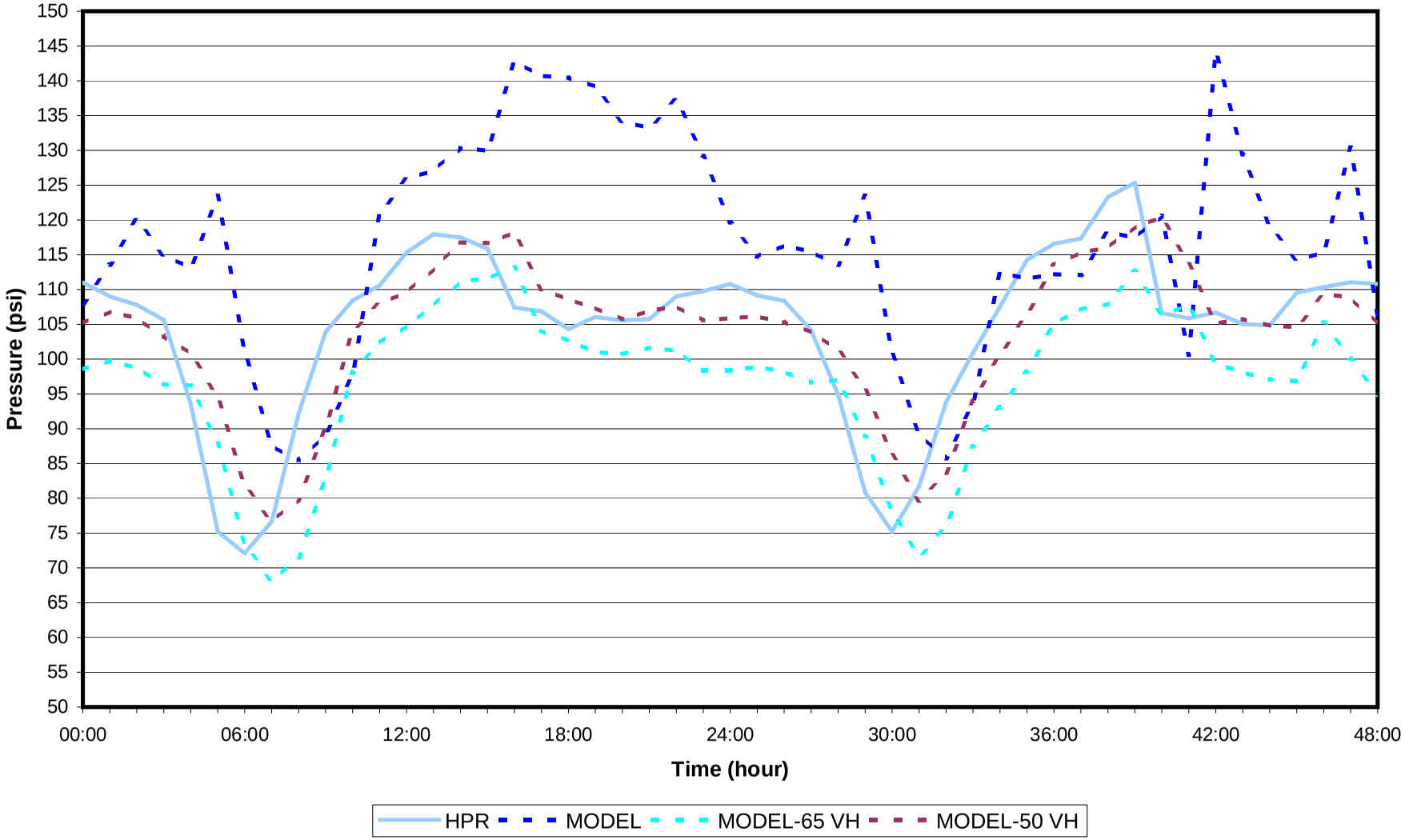



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071106-071806.xls\CH_B-2 (2)
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-3: Noyo Court
## Pressure Zone 475 - 07/12/06 to 7/13/06

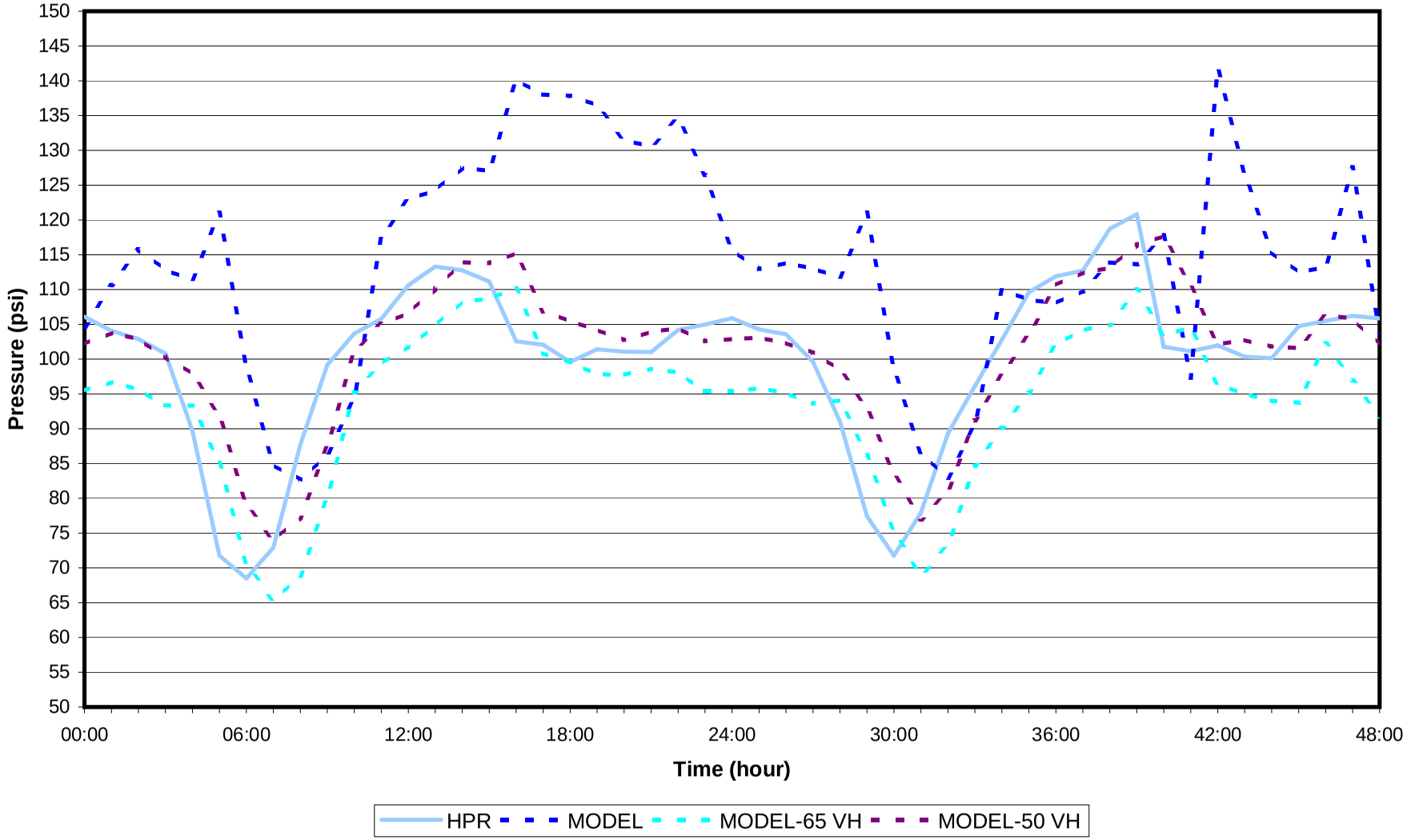



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071106-071806.xls\CH_B-3
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-4: Vallombrosa Avenue
## Pressure Zone 475 - 07/12/06 to 7/13/06

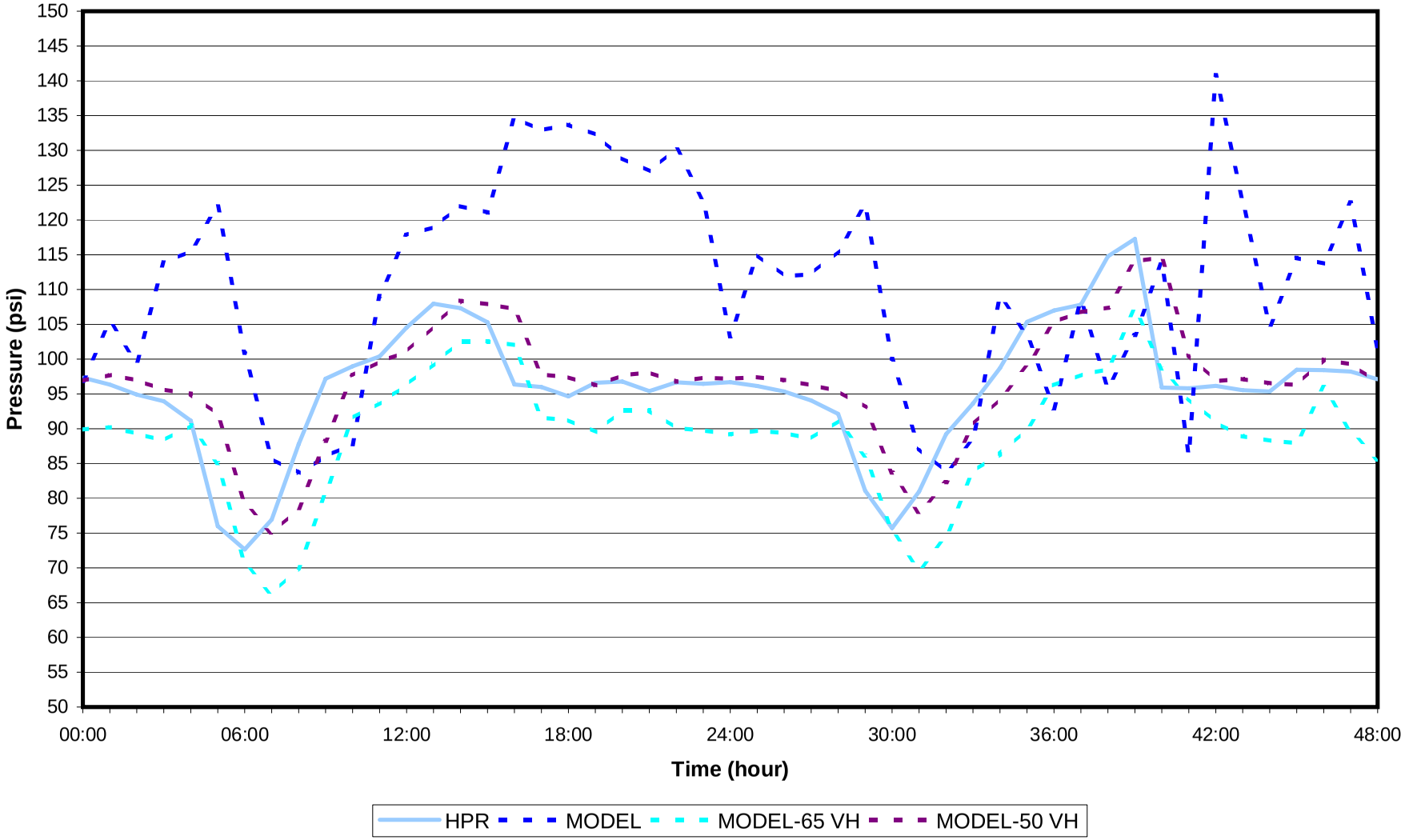



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071106-071806.xls\CH_B-4
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-5: Walnut Park Drive
## Pressure Zone 475 - 07/12/06 to 7/13/06

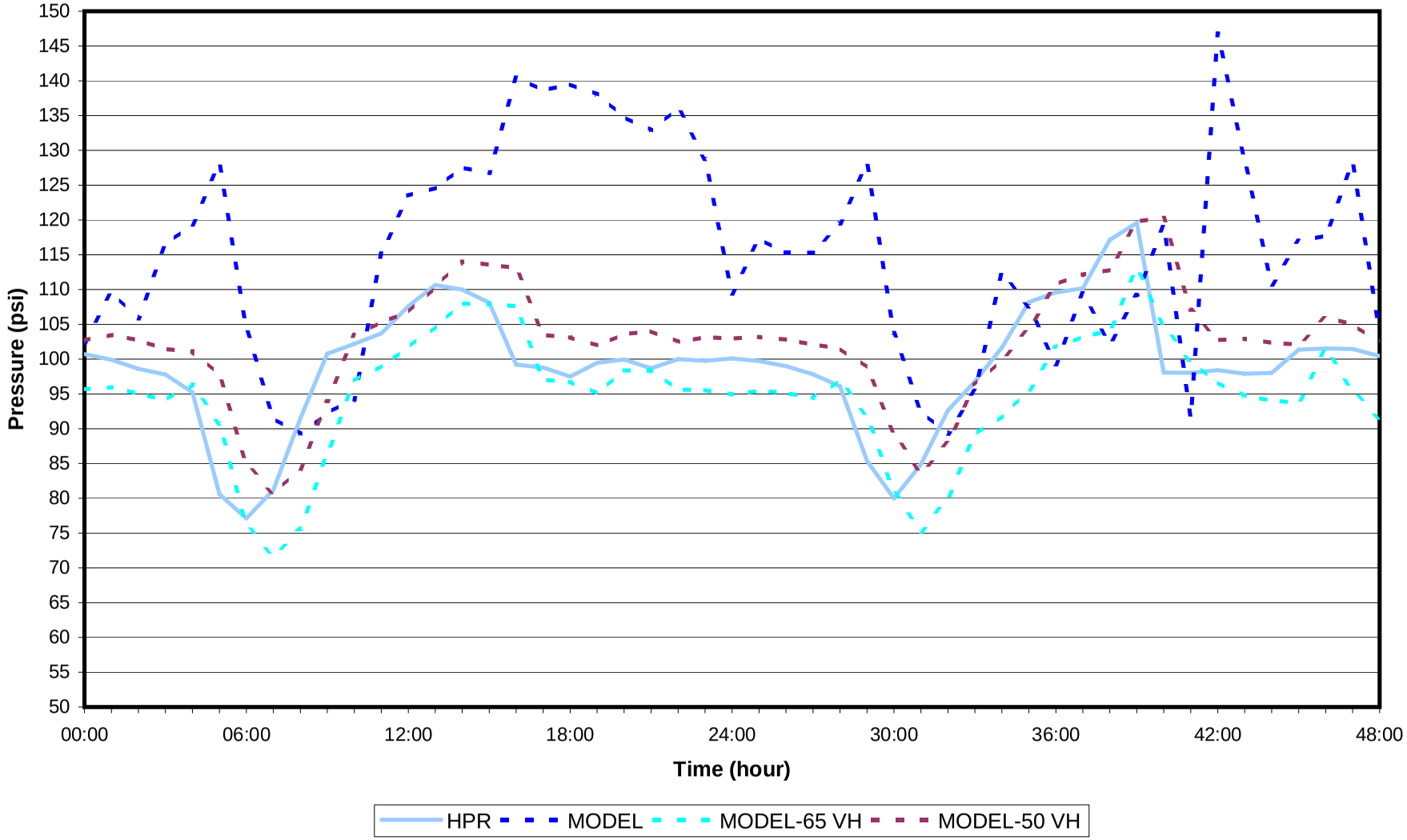



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071106-071806.xls\CH_B-5
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-6: South of Sterling Oaks Drive
## Pressure Zone 475 - 07/12/06 to 7/13/06

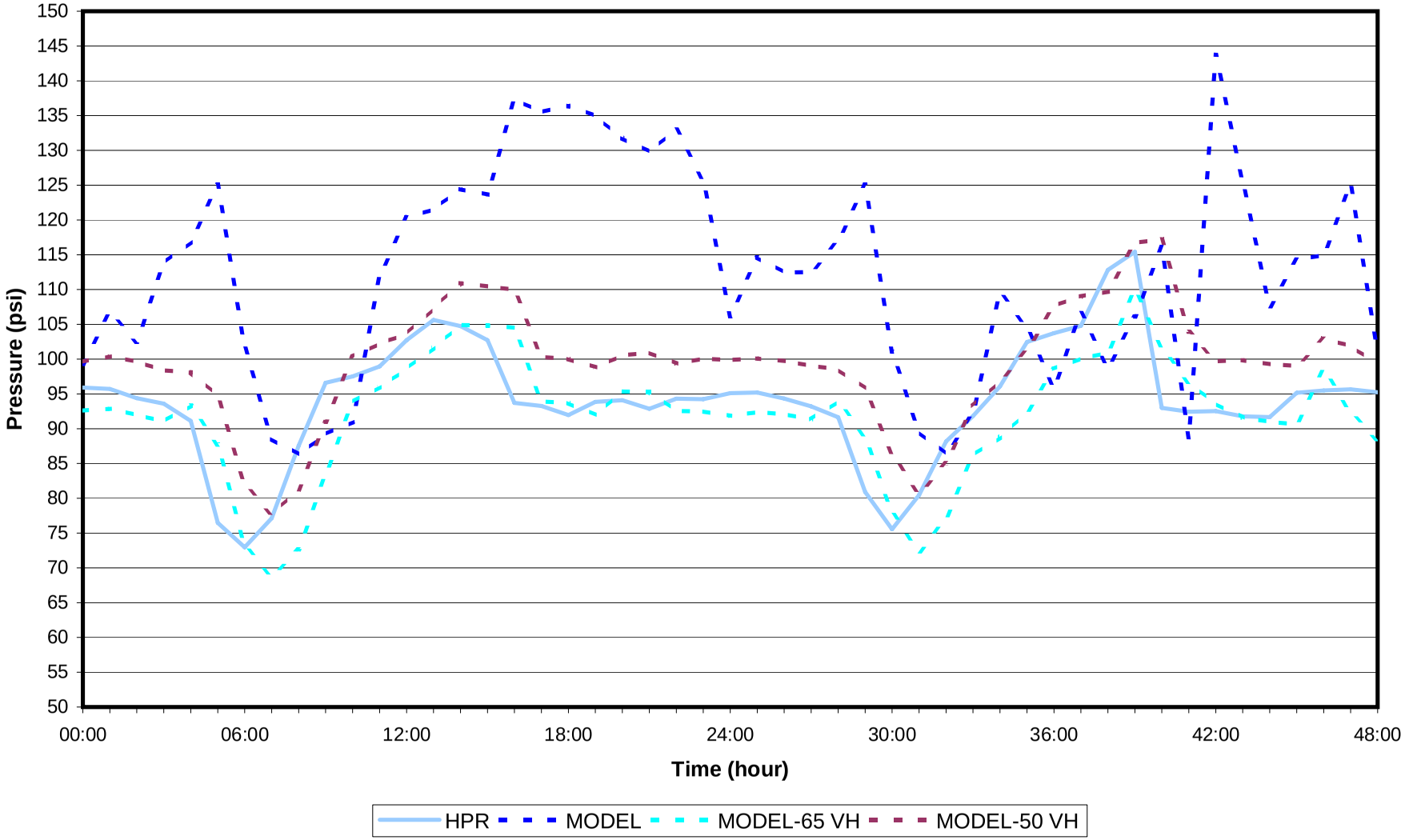



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071106-071806.xls\CH_B-6
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-7: Lakewest Drive
## Pressure Zone 475 - 07/12/06 to 7/13/06

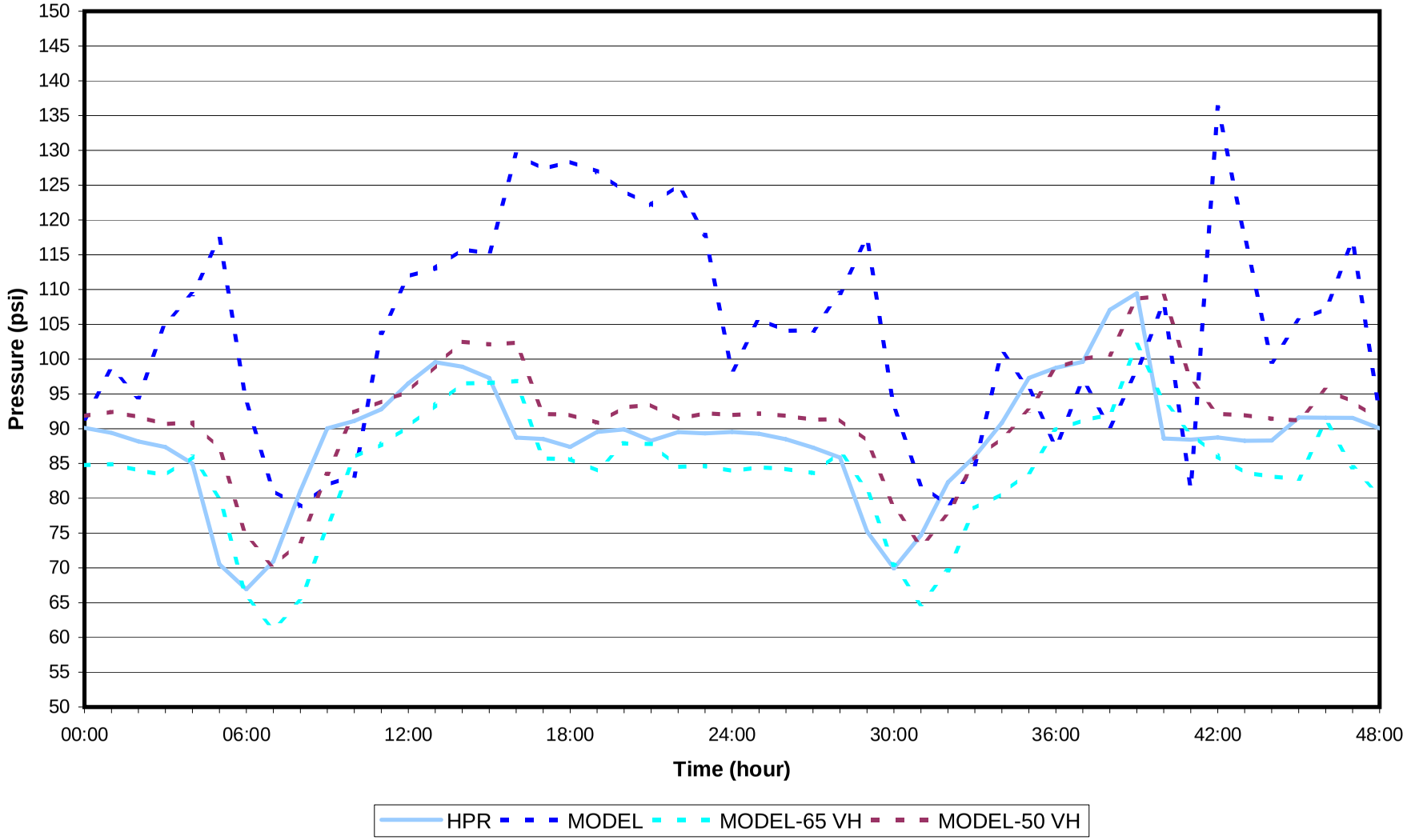



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071106-071806.xls\CH_B-7
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-8: Sierra Sunrise Terrace
## Pressure Zone 475 - 07/12/06 to 7/13/06

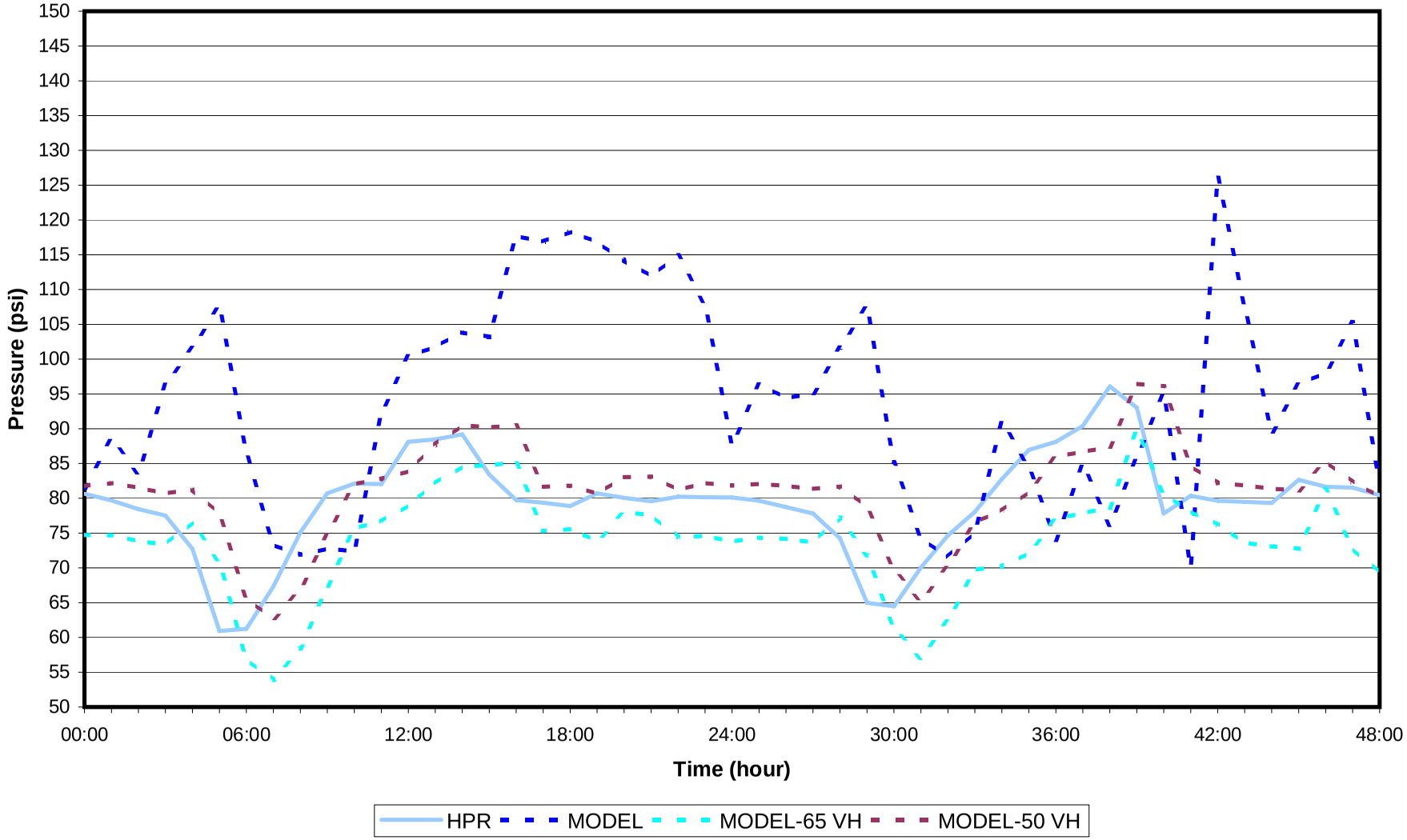



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071106-071806.xls\CH_B-8
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-9: Yosemite Drive
## Pressure Zone 475 - 07/12/06 to 7/13/06

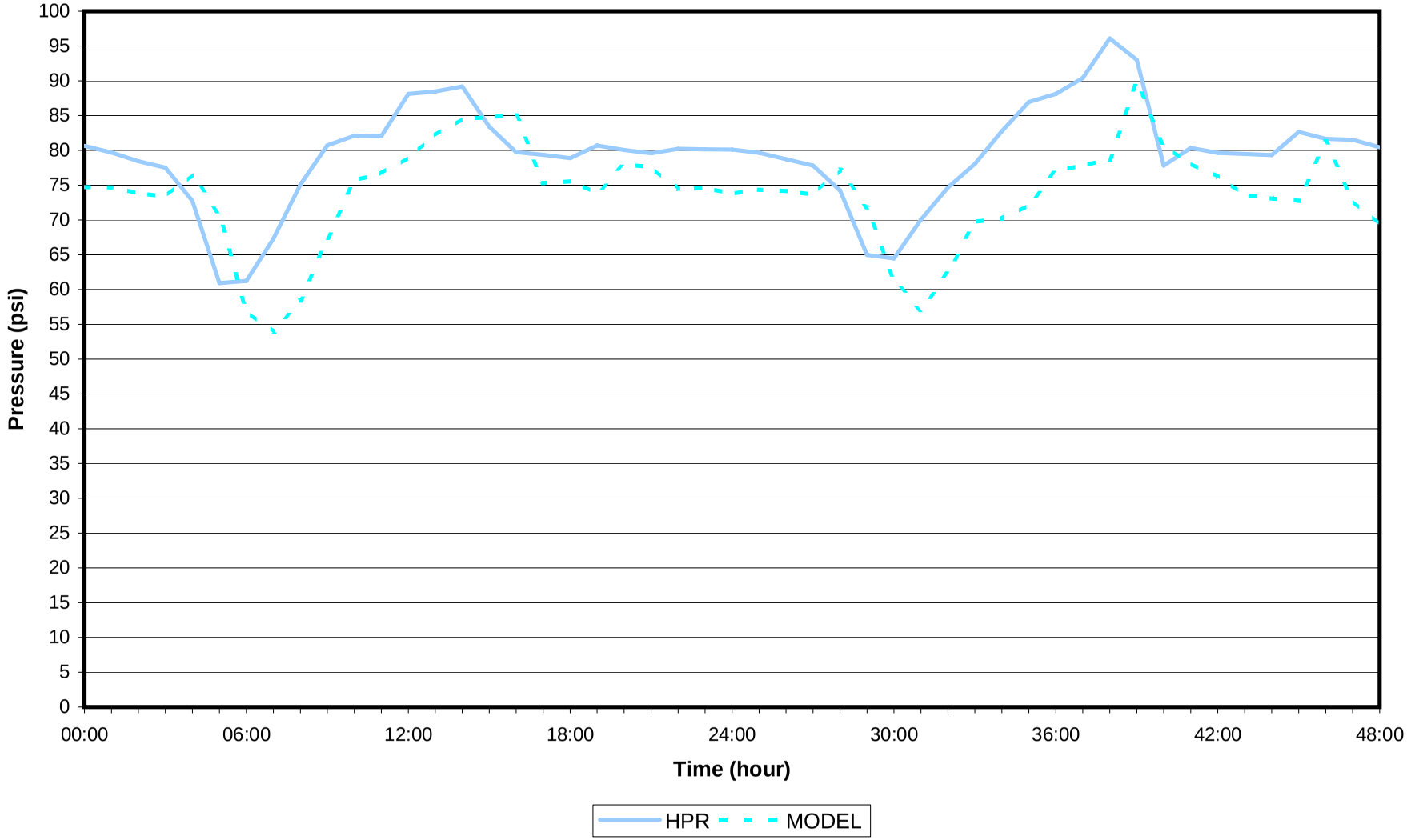



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071106-071806.xls\CH_B-9
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-9: Yosemite Drive
## Pressure Zone 475 - 07/12/06 to 7/13/06

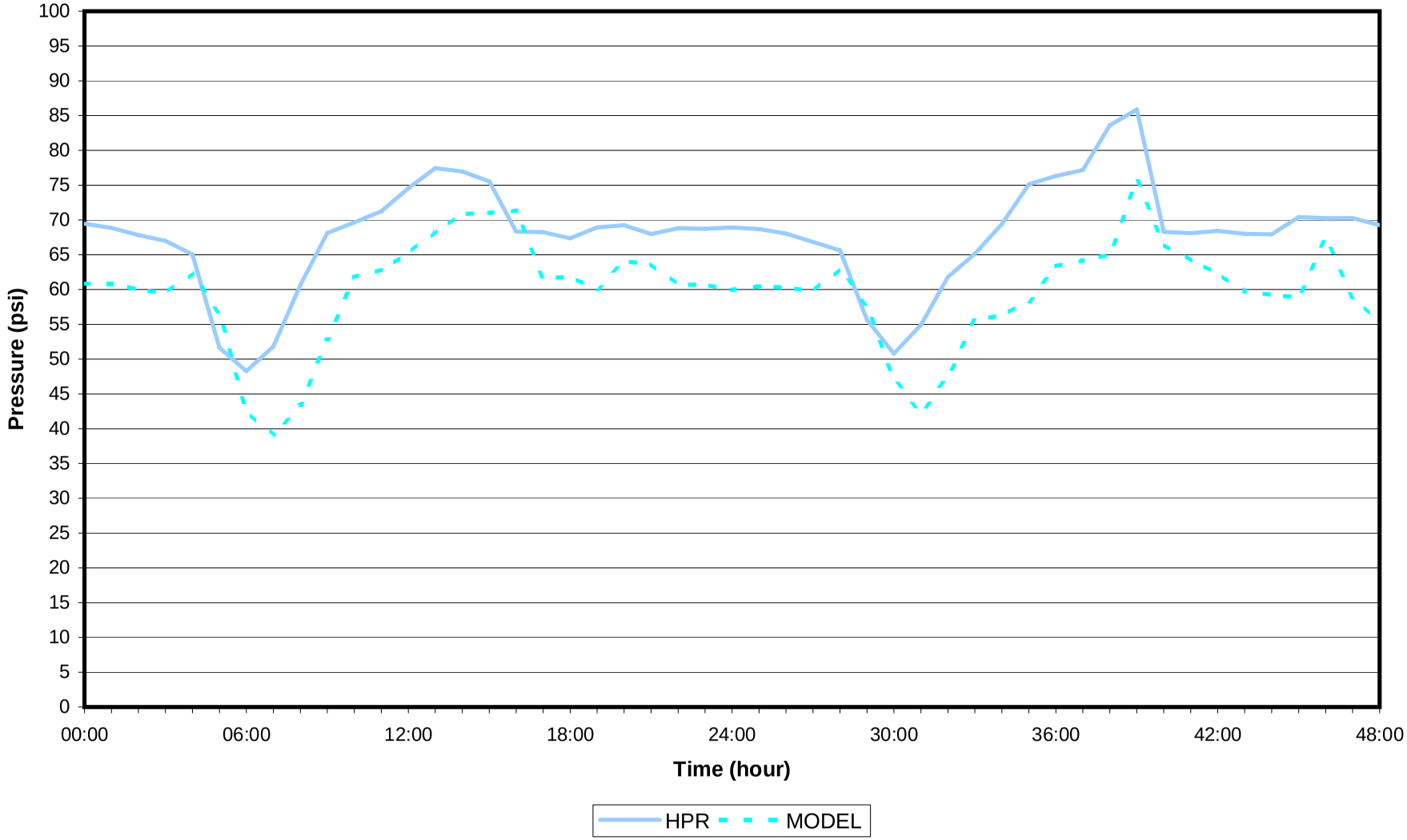



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071106-071806.xls\CH_B-9 (2)
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-10: Sparrow Hawk Lane
## Pressure Zone 475 - 07/12/06 to 7/13/06

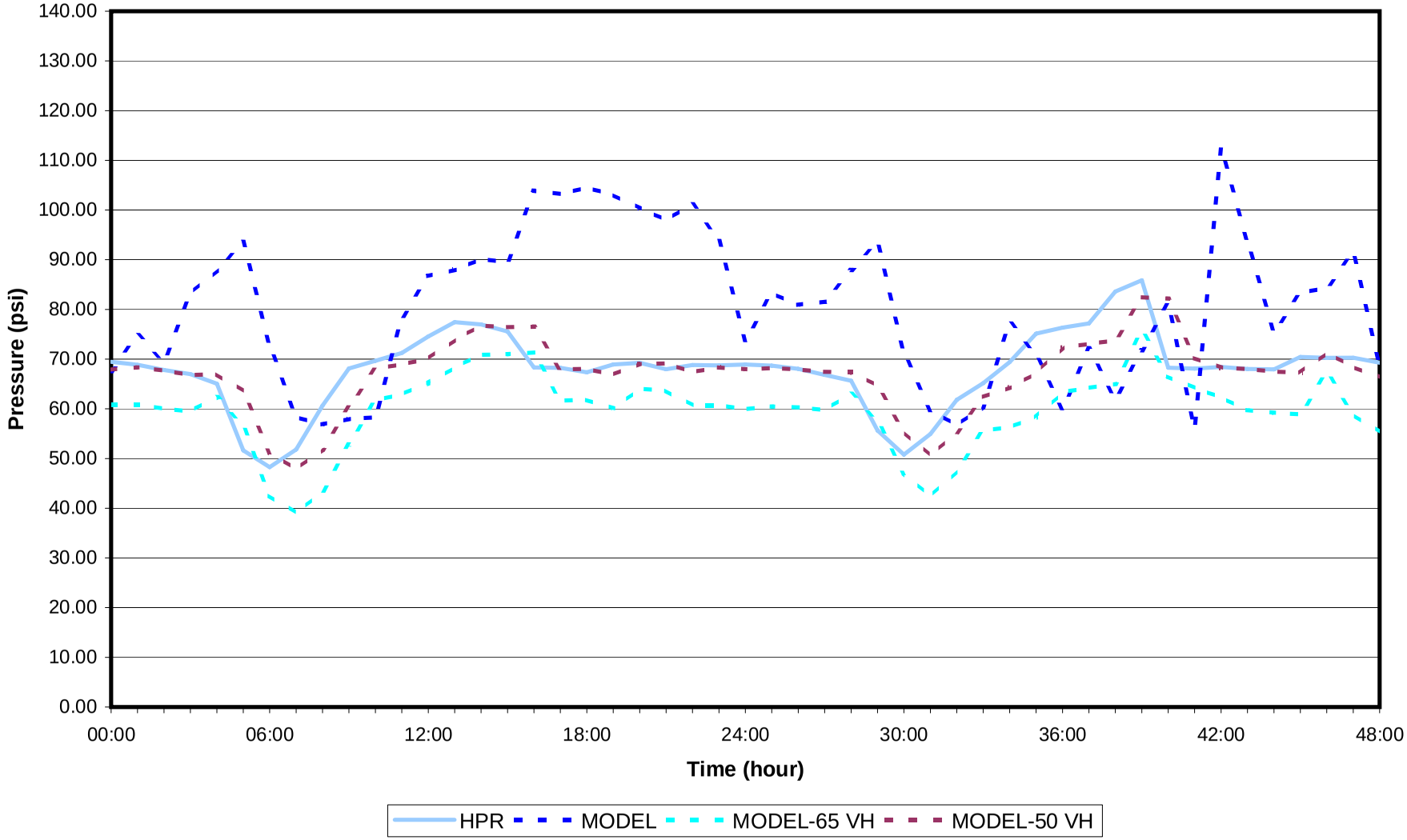



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071106-071806.xls\CH_B-10
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-10: Sparrow Hawk Lane
## Pressure Zone 475 - 07/12/06 to 7/13/06

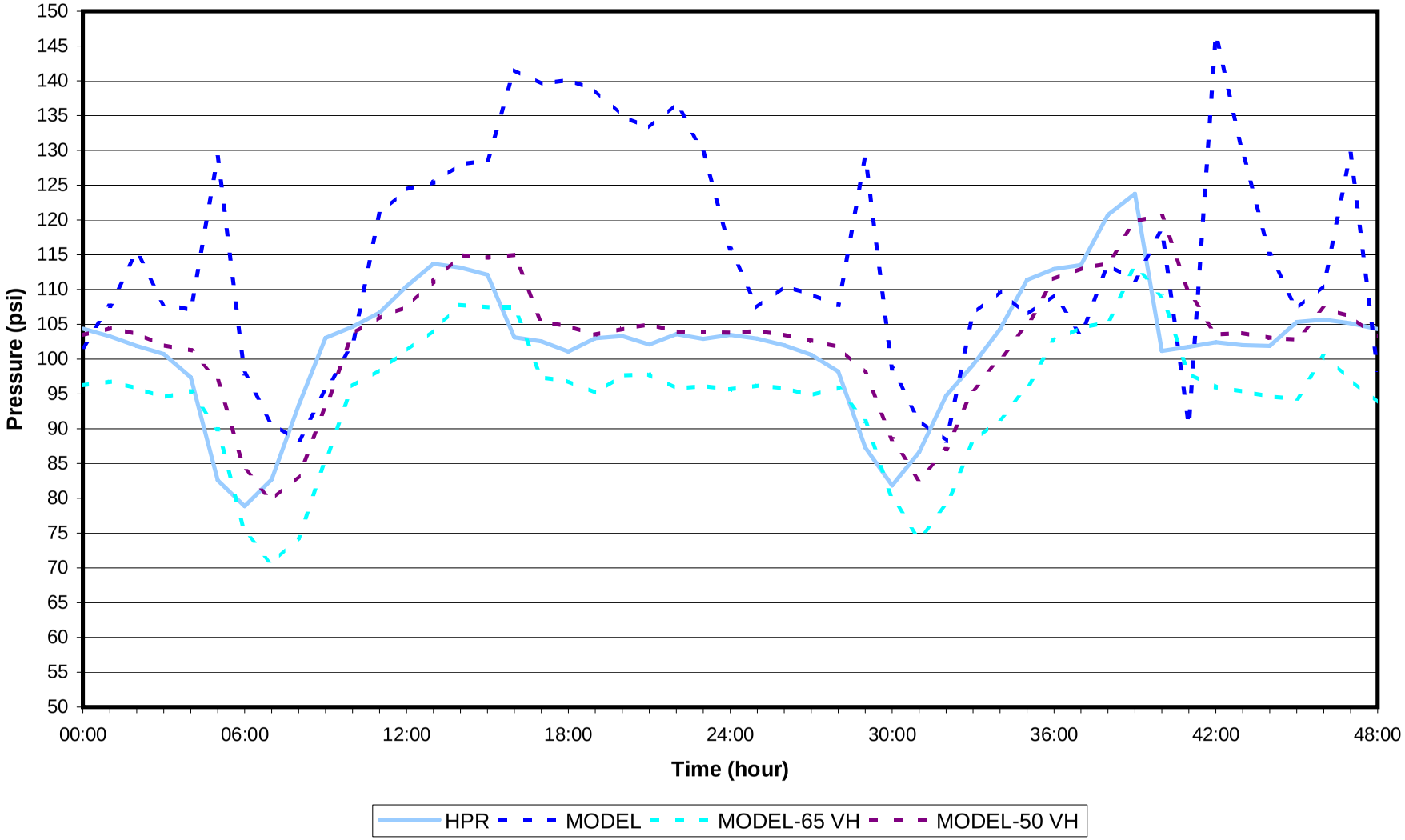



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071106-071806.xls\CH_B-10 (2)
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-13: El Monte Avenue
## Pressure Zone 475 - 07/12/06 to 7/13/06

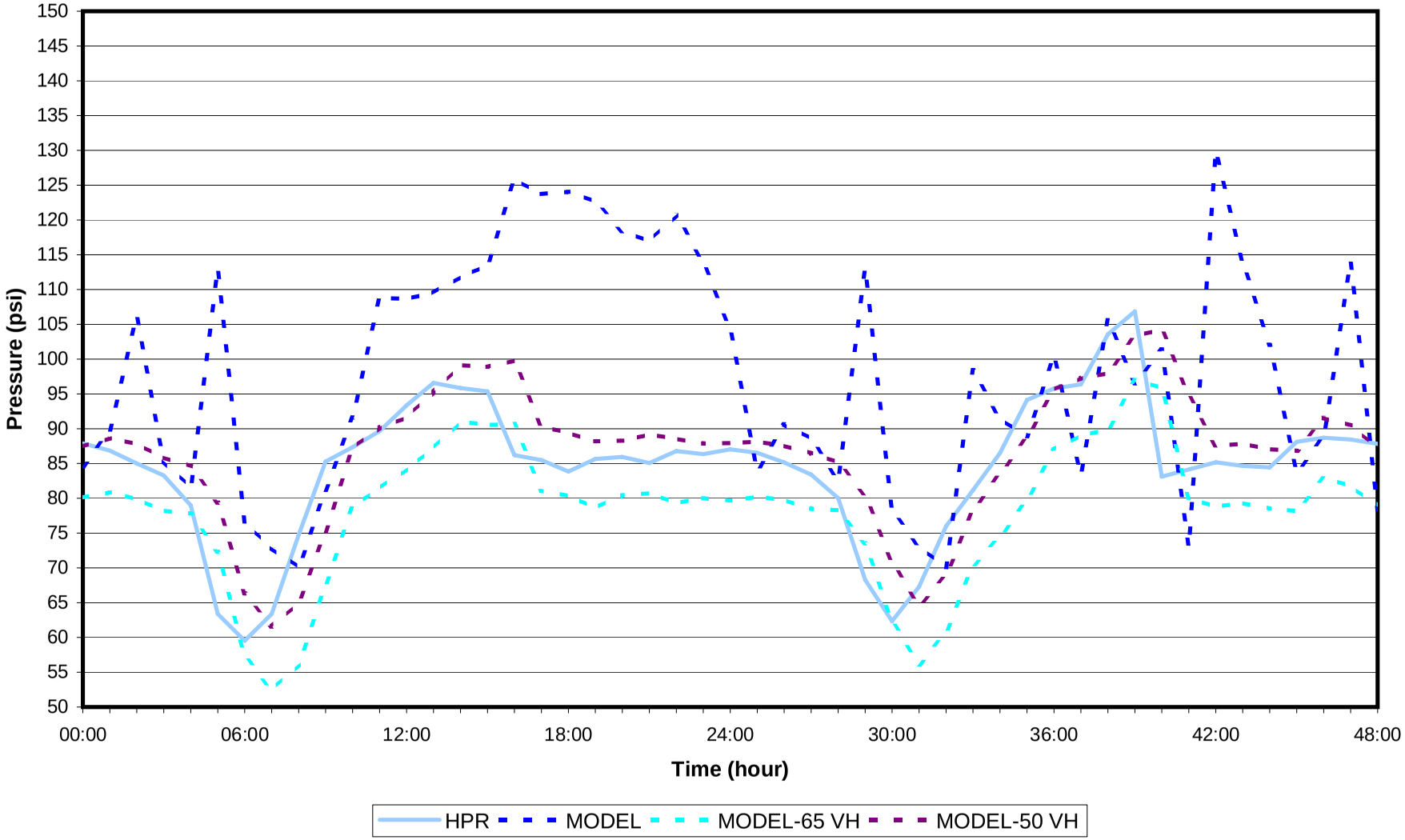



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071106-071806.xls\CH_B-13
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-14: Augustine Drive
## Pressure Zone 475 - 07/12/06 to 7/13/06

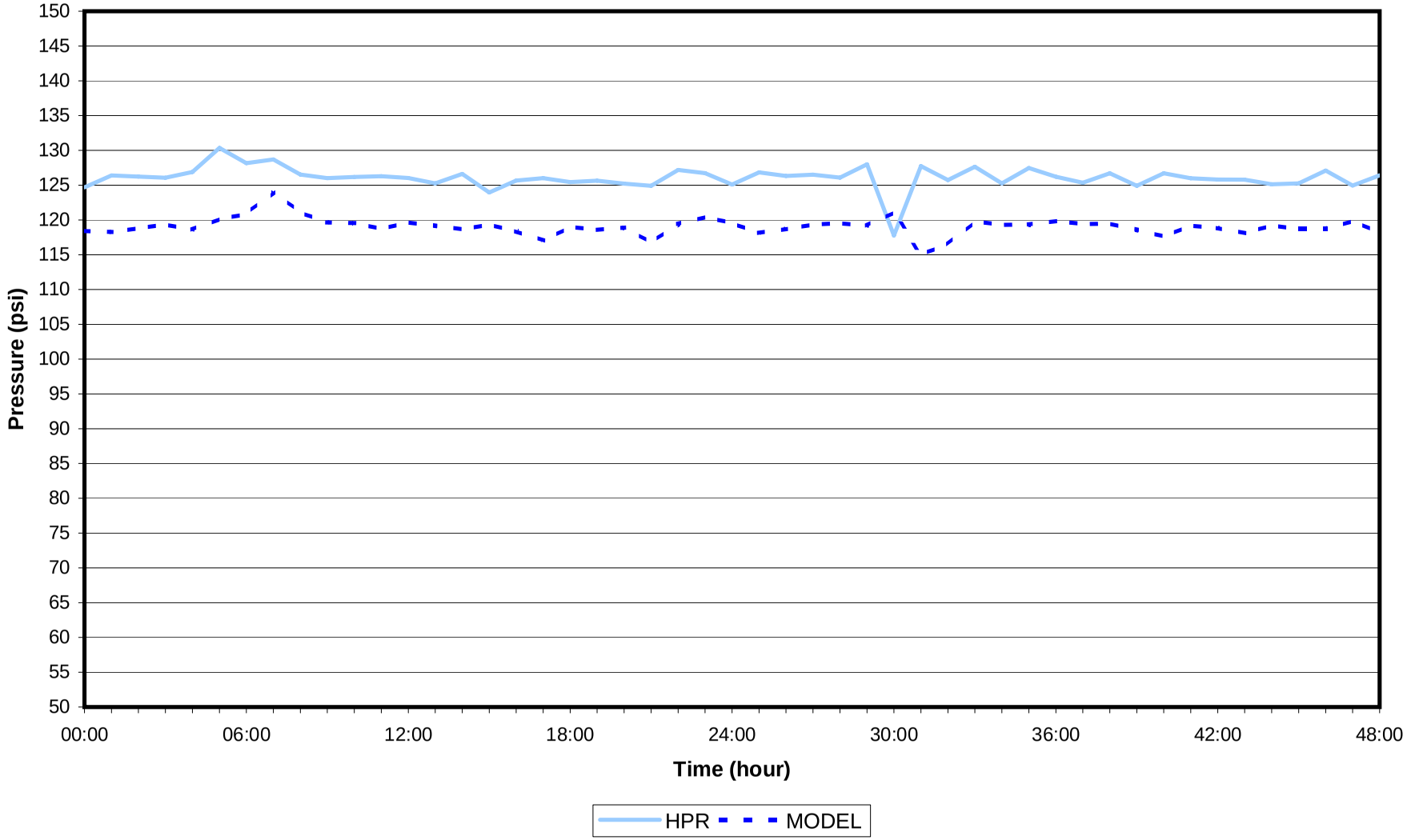



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071106-071806.xls\CH_B-14
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-37: Inside Station 66
## Pressure Zone 475 - 07/12/06 to 7/13/06

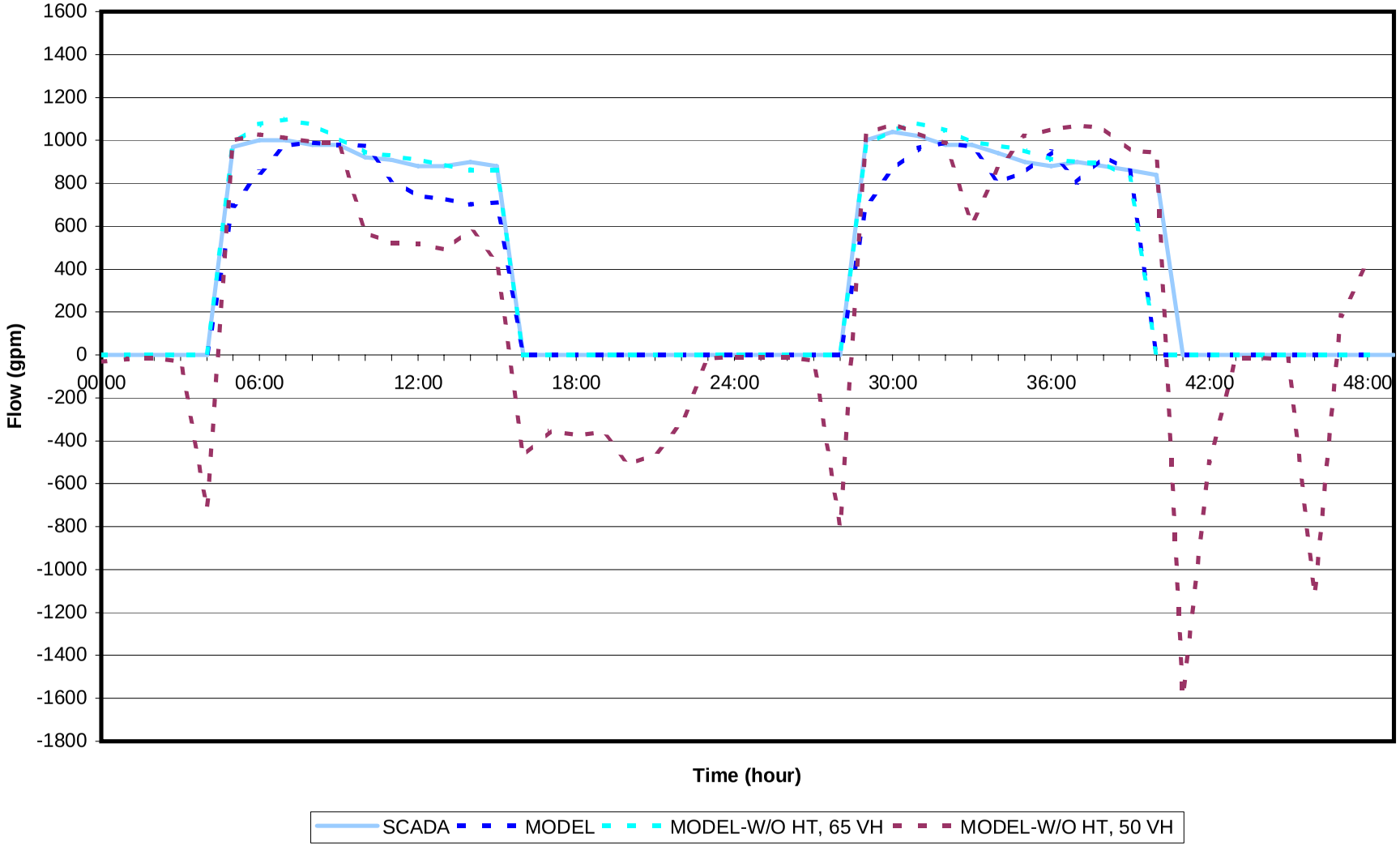



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071106-071806.xls\CH_B-37
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 50 Flow
## Pressure Zone 475 - 07/12/06 to 07/13/06

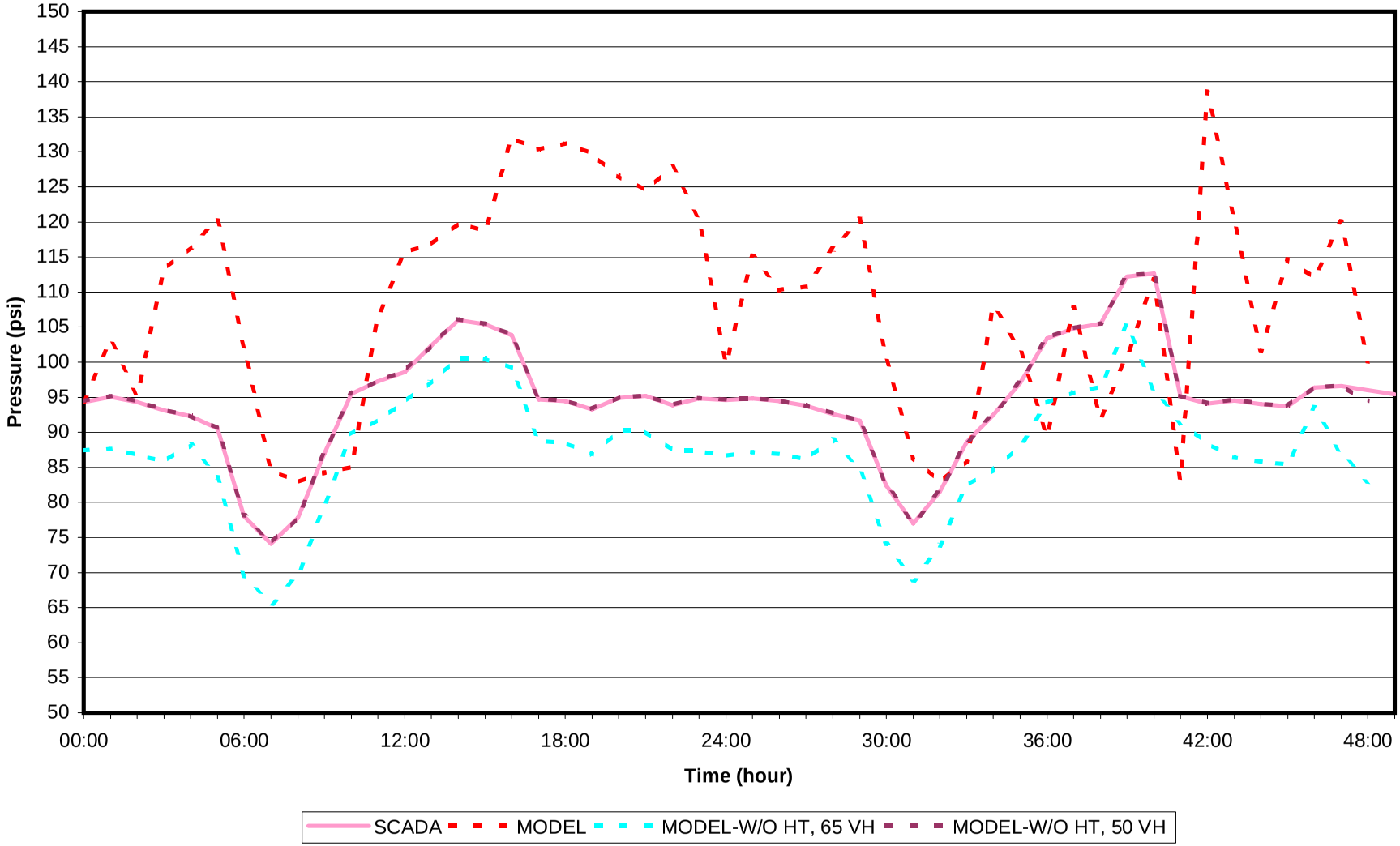



Public Version

West Yost Associates
o:\c\436\02063\E\4\diur\ZONE 475.xlsCH_ST50-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 50 Pressure
## Pressure Zone 475 - 07/12/06 to 07/13/06

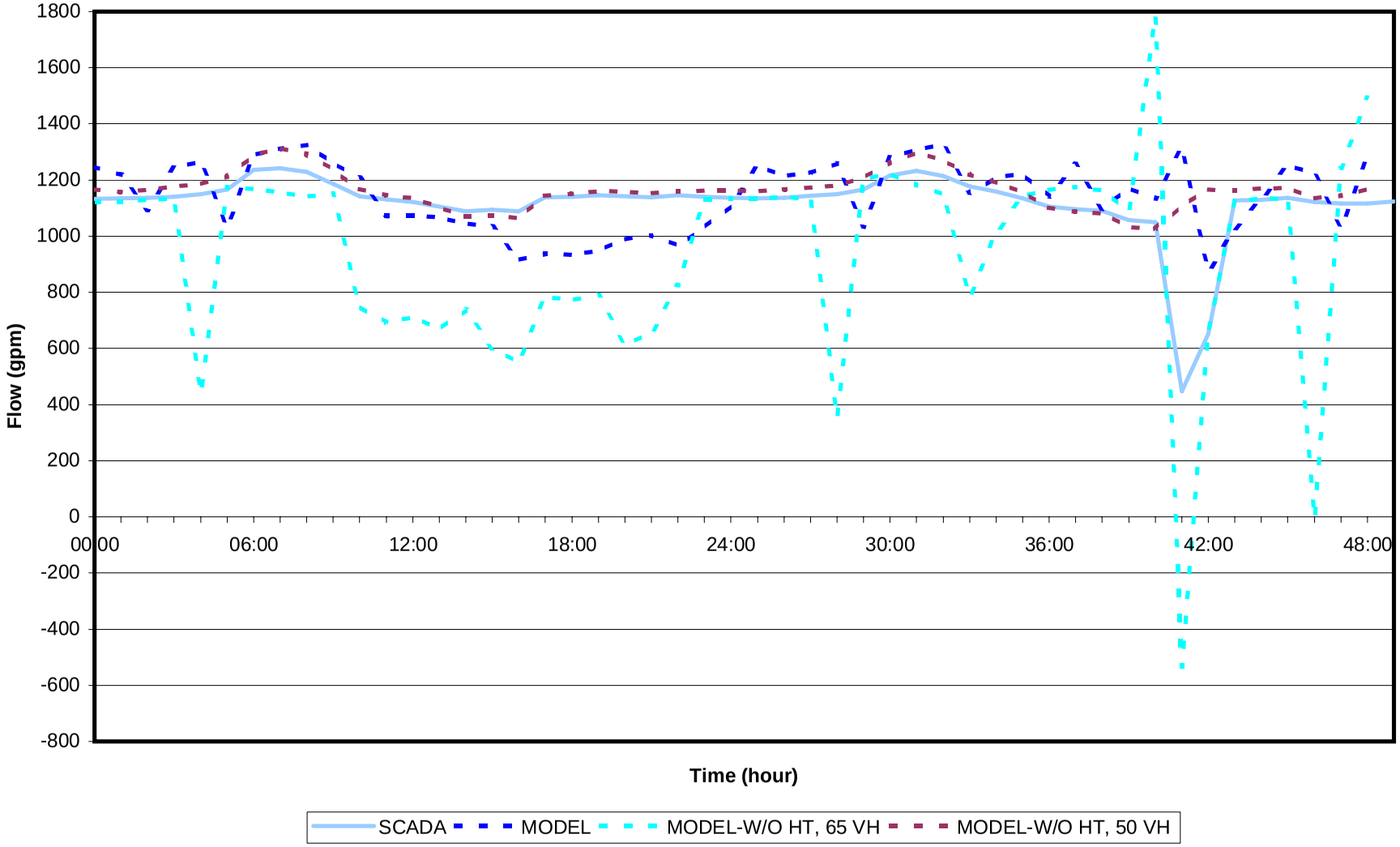



Public Version

West Yost Associates
o:\c\436\02063\E\4\diur\ZONE 475.xlsCH_ST50-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 65 Flow
## Pressure Zone 475 - 07/12/06 to 07/13/06

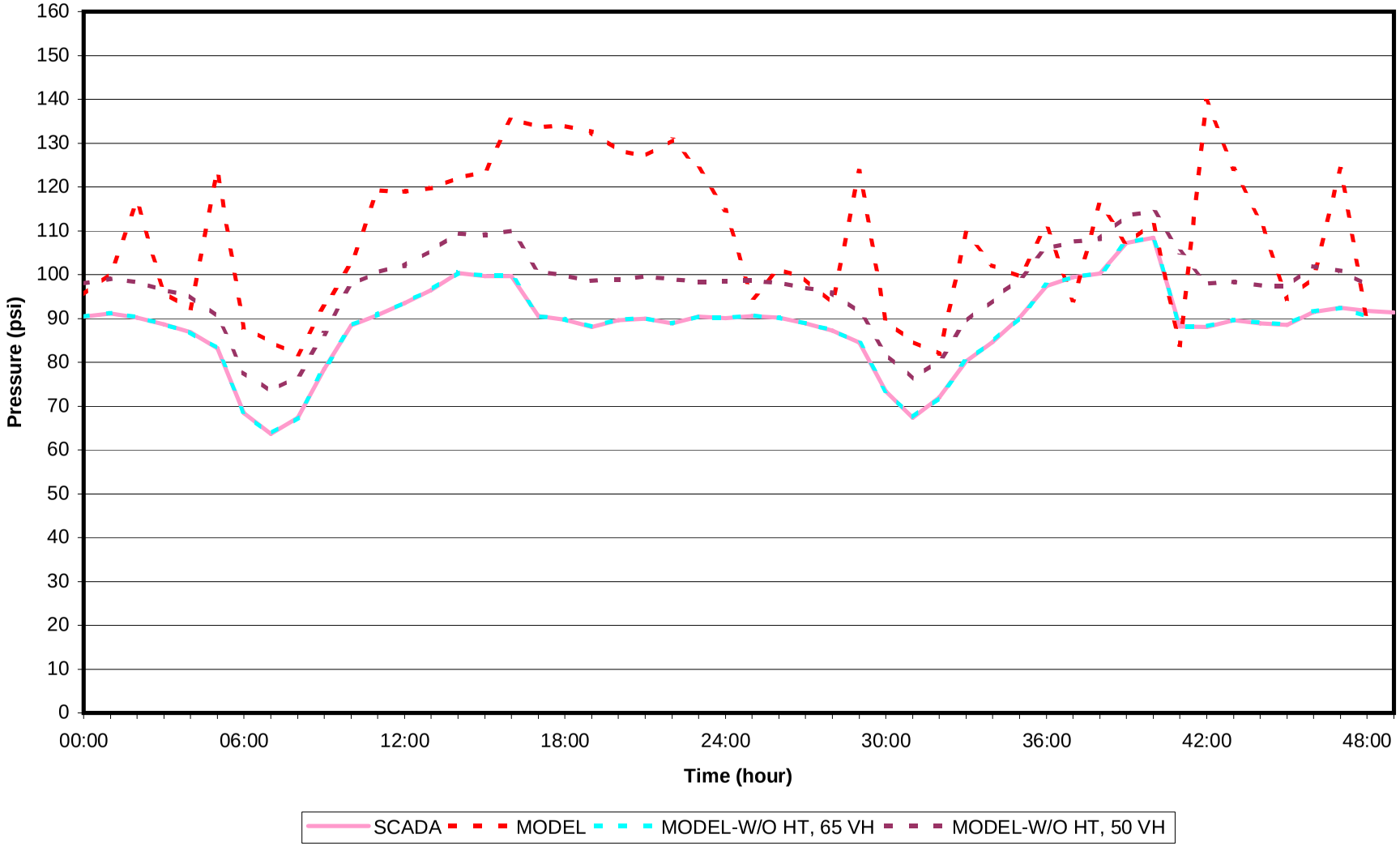



Public Version

West Yost Associates
o:\c\436\02063\E\4\diur\ZONE 475.xlsCH_ST65-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 65 Pressure
## Pressure Zone 475 - 07/12/06 to 07/13/06

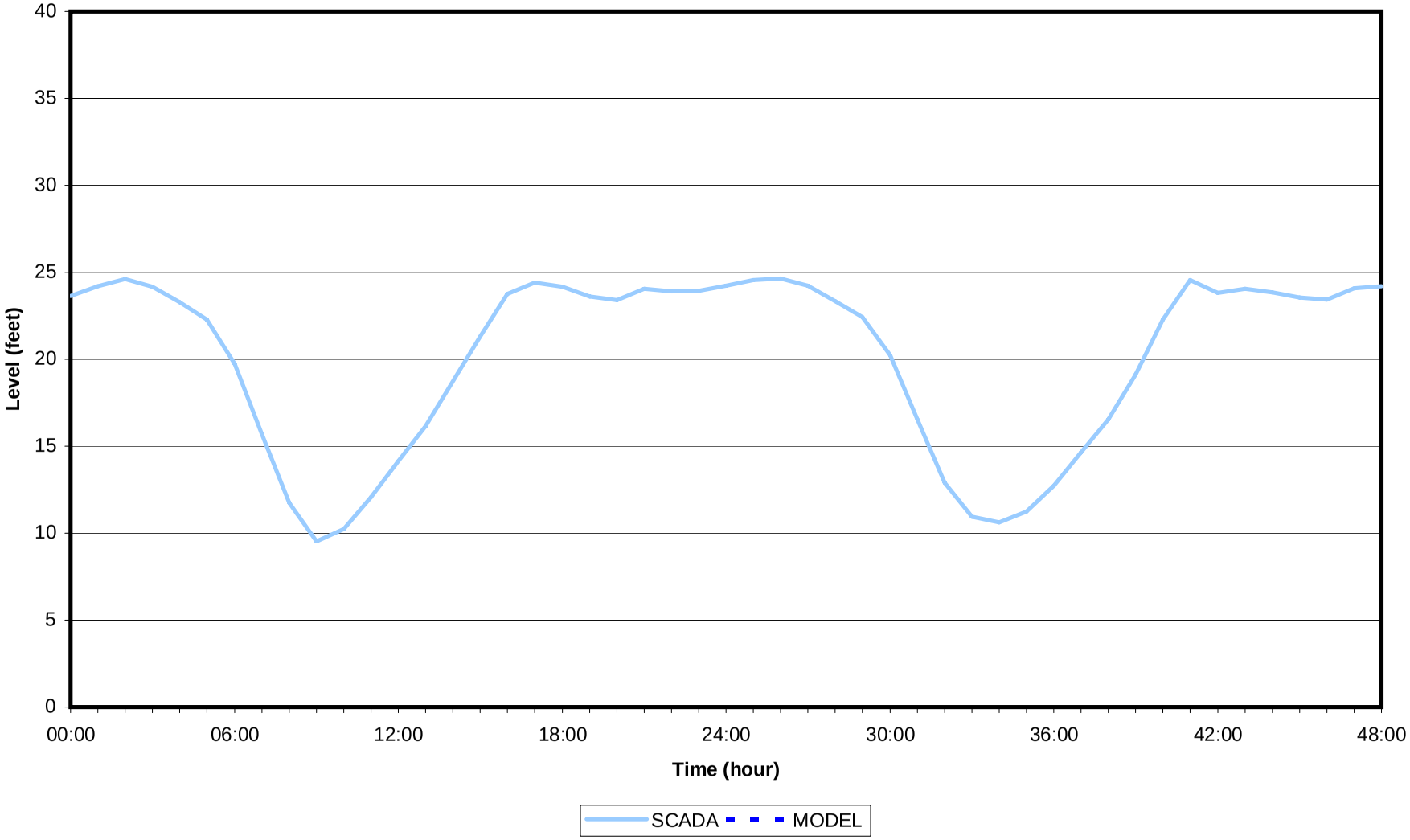



Public Version

West Yost Associates
o:\c\436\02063\E\4\diur\ZONE 475.xlsCH_ST65-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 66 Tank Level
## Pressure Zone 475 - 07/12/06 to 07/13/06

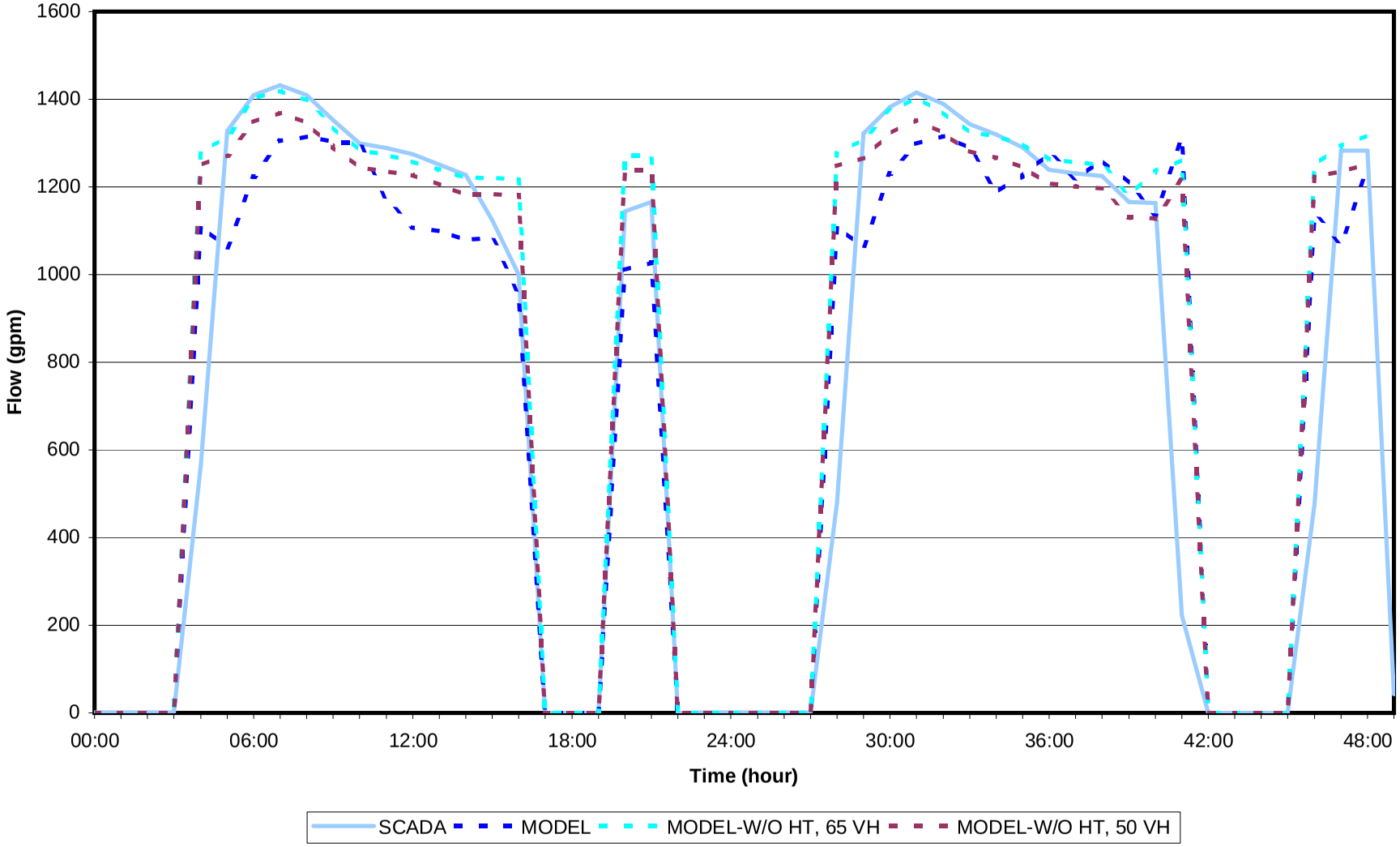



Public Version

West Yost Associates
o:\c\436\02063\E\4\diur\ZONE 475.xlsCH_ST66-1T
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 67 Flow
## Pressure Zone 475 - 07/12/06 to 07/13/06

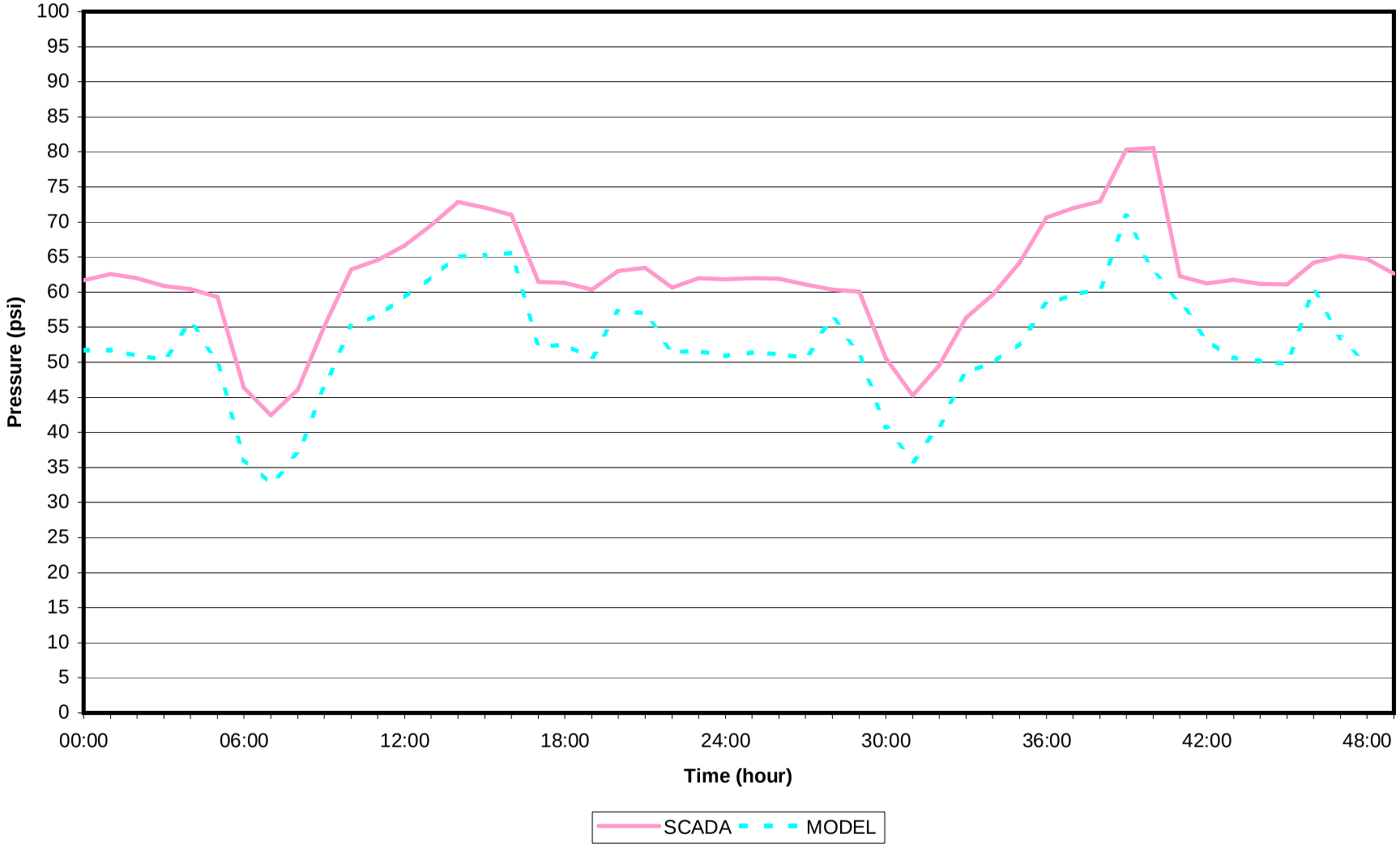



Public Version

West Yost Associates
o:\c\436\02063\E\4\diur\ZONE 475.xlsCH_ST67-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 67 Pressure
## Pressure Zone 475 - 07/12/06 to 07/13/06

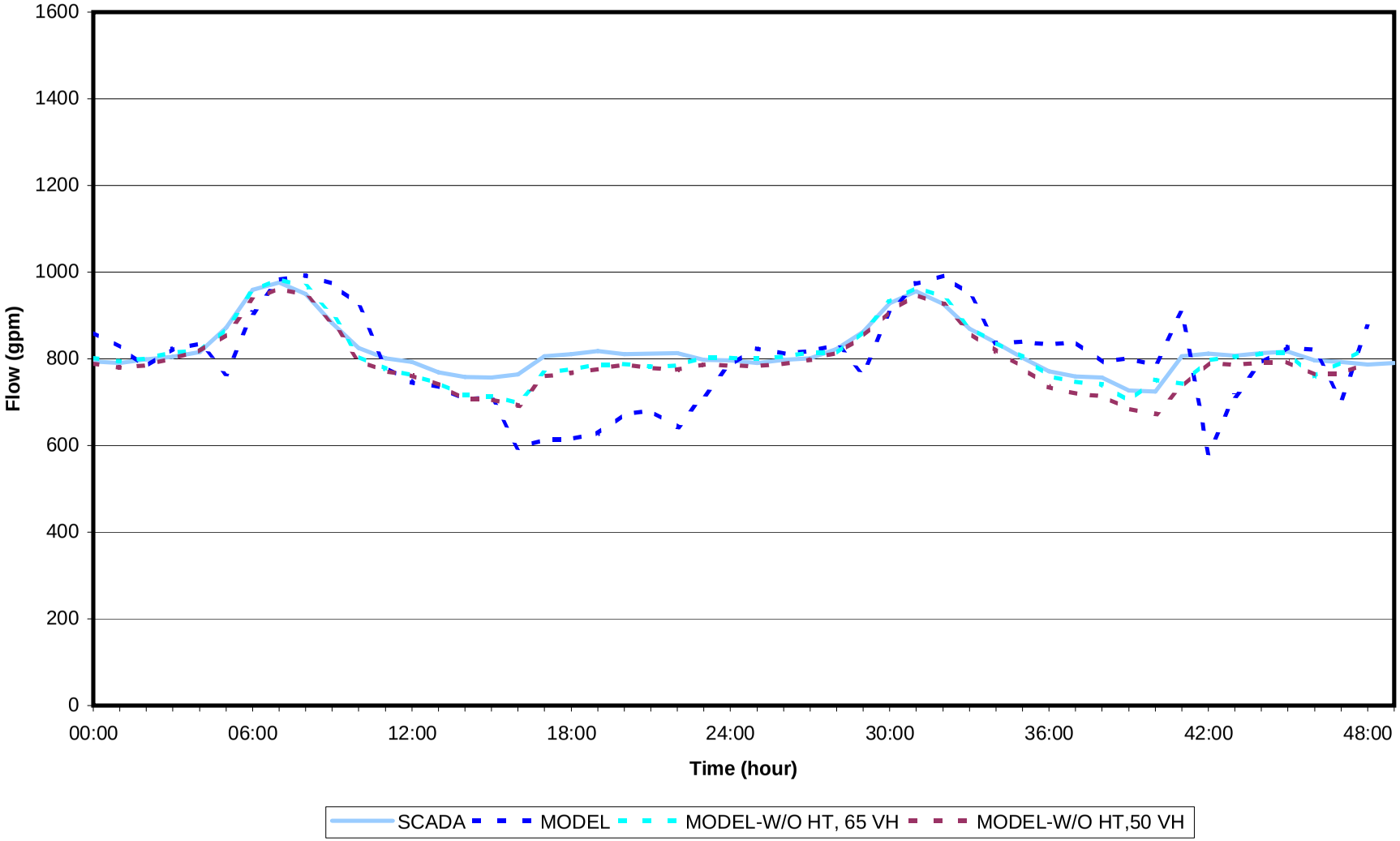



Public Version

West Yost Associates
o:\c\436\02063\E\4\diur\ZONE 475.xlsCH_ST67-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 70 Flow
## Pressure Zone 475 - 07/12/06 to 07/13/06

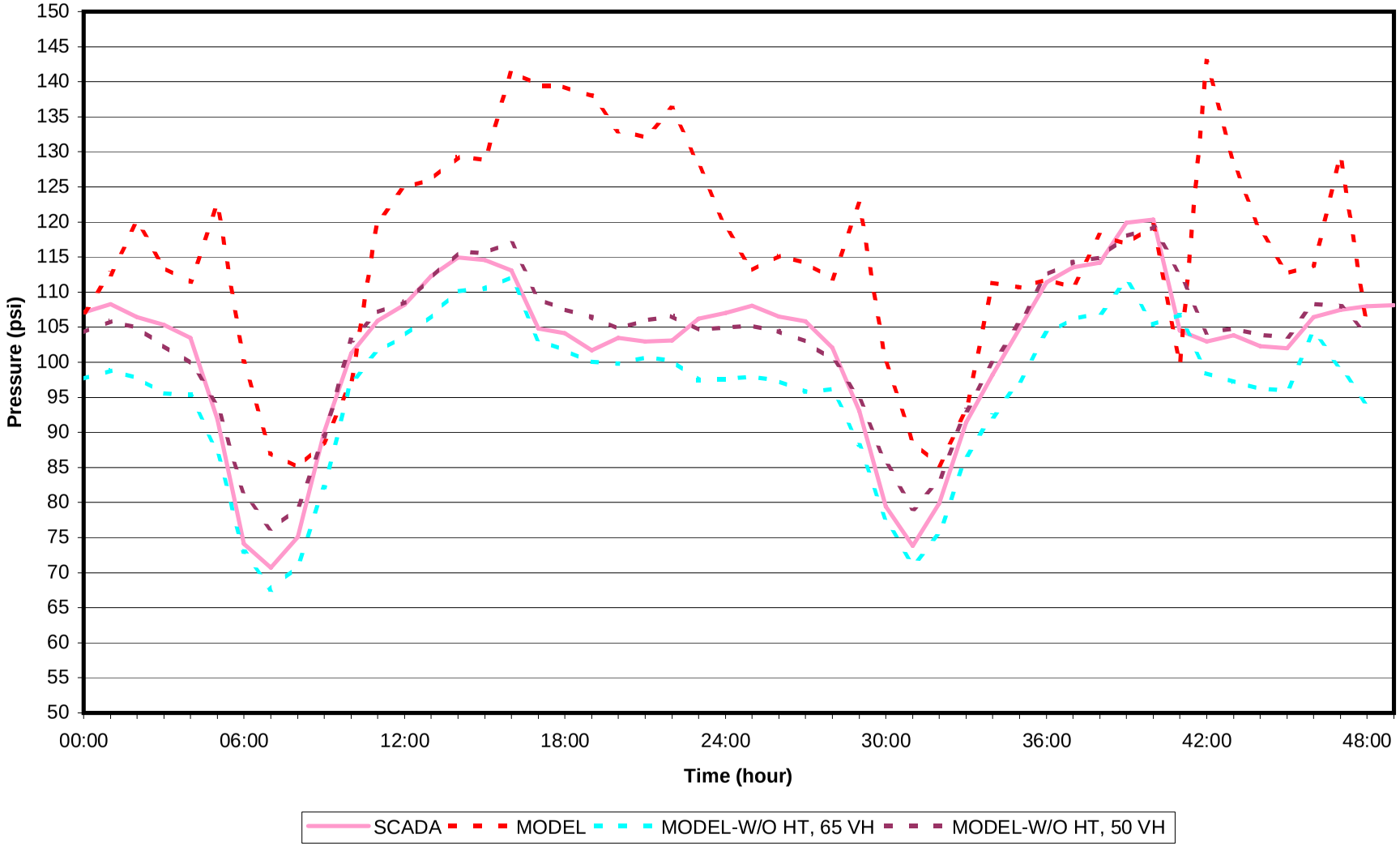



Public Version

West Yost Associates
o:\c\436\02063\E\4\diur\ZONE 475.xlsCH_ST70-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 70 Pressure
## Pressure Zone 475 - 07/12/06 to 07/13/06

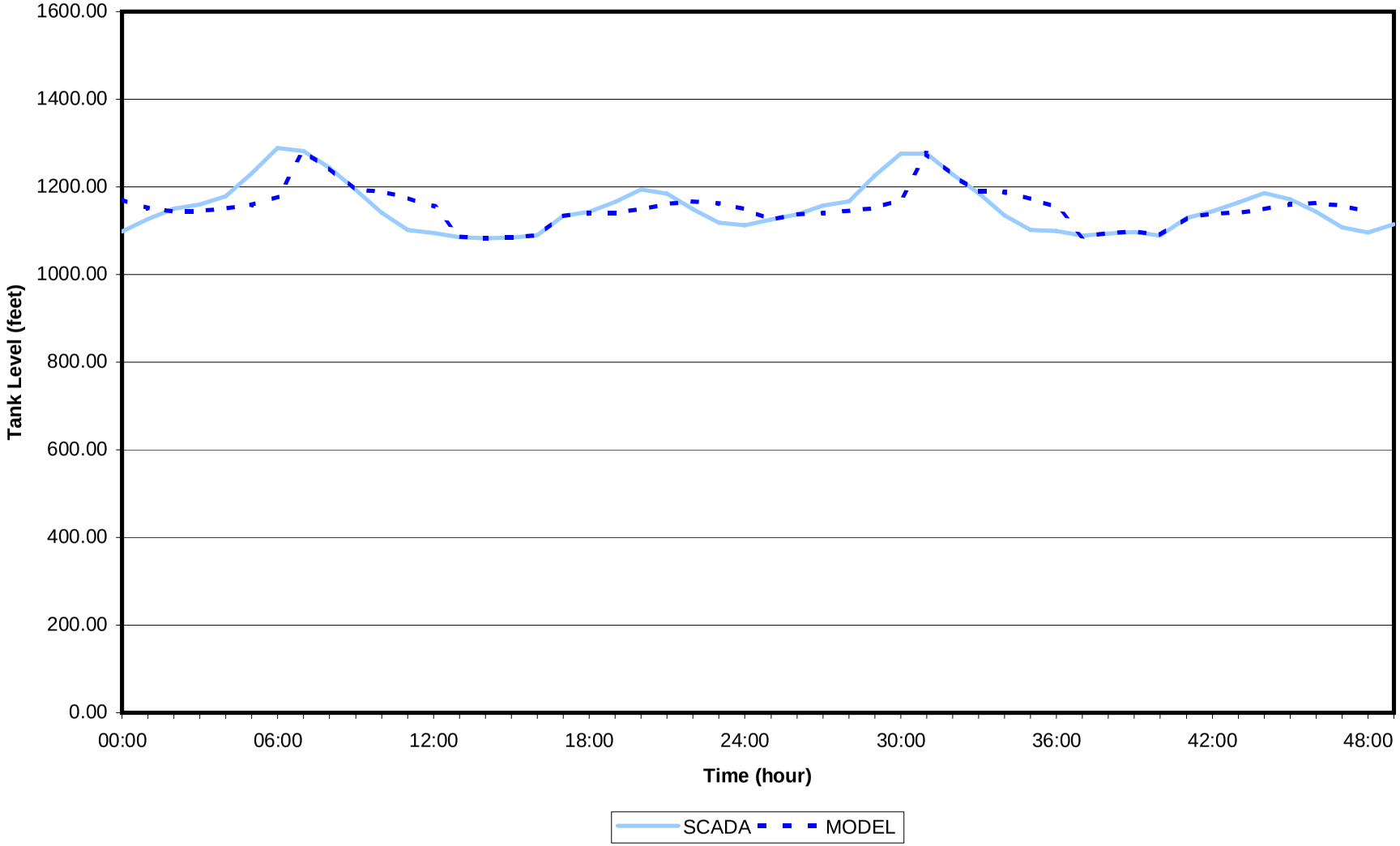



Public Version

West Yost Associates
o:\c\436\02063\E\4\diur\ZONE 475.xlsCH_ST70-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 72 Flow
## Pressure Zone 475 - 07/11/06 to 07/12/06

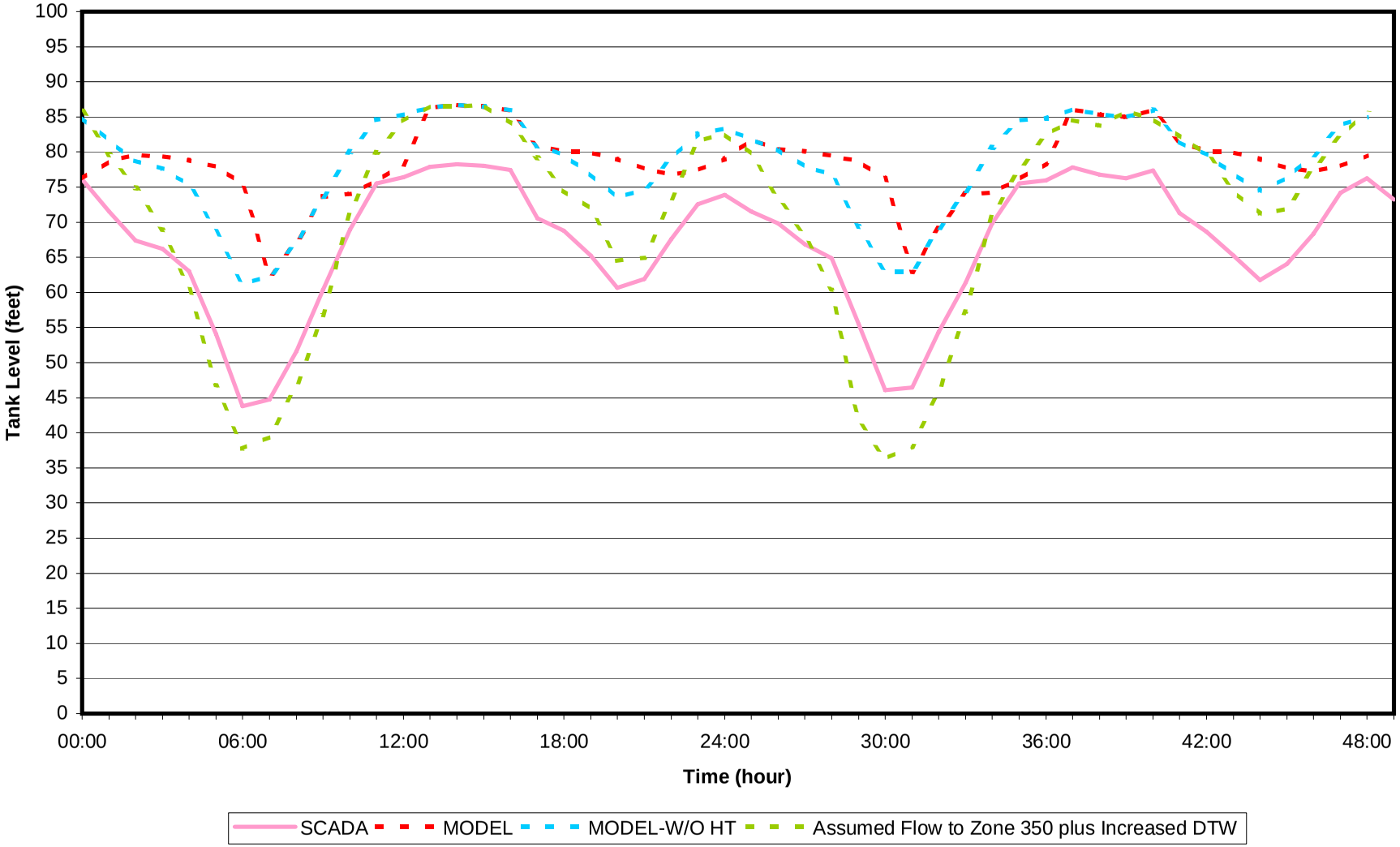



Public Version

West Yost Associates
o:\c\436\02063\E\4\diur\ZONE 475.xlsCH_ST72-1Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 72 Pressure
## Pressure Zone 475 - 07/11/06 to 07/12/06

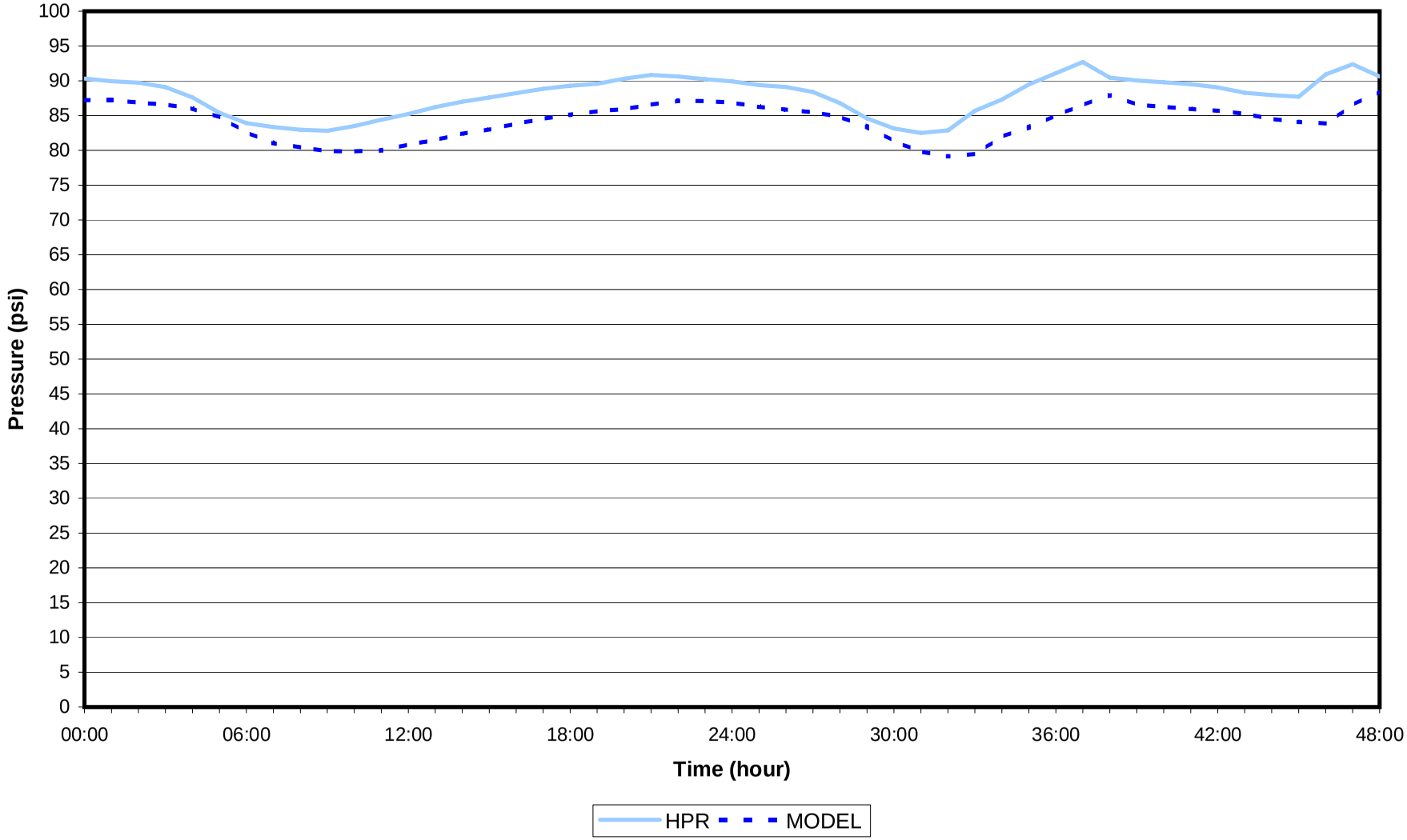



Public Version

West Yost Associates
o:\c\436\02063\E\4\diur\ZONE 475.xlsCH_ST72-1P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-11: Canyon Oaks Terrace
## Pressure Zone 635 - 07/12/06 to 7/13/06

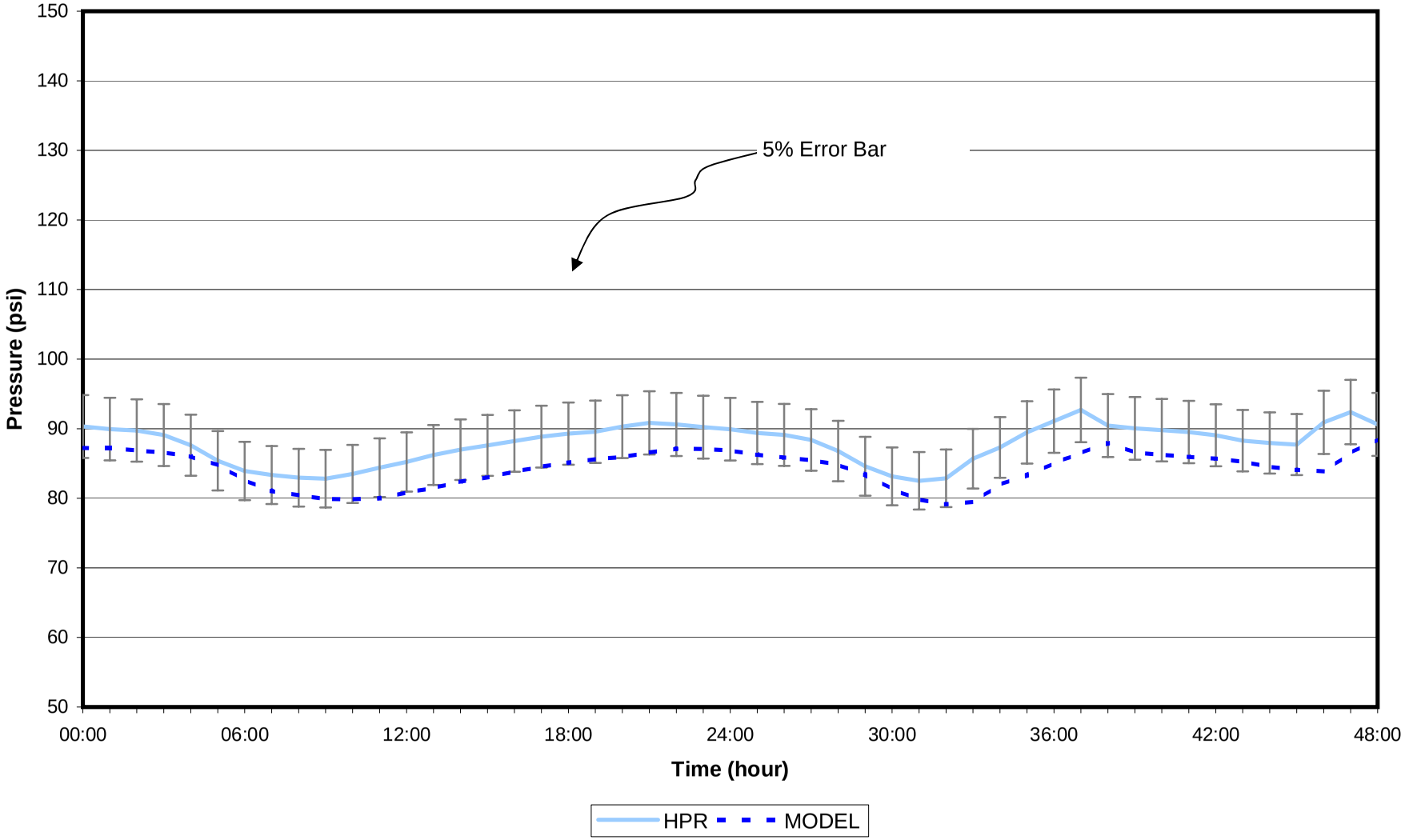



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071106-071806.xls\CH_B-11
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-11: Canyon Oaks Terrace
## Pressure Zone 635 - 07/12/06 to 7/13/06

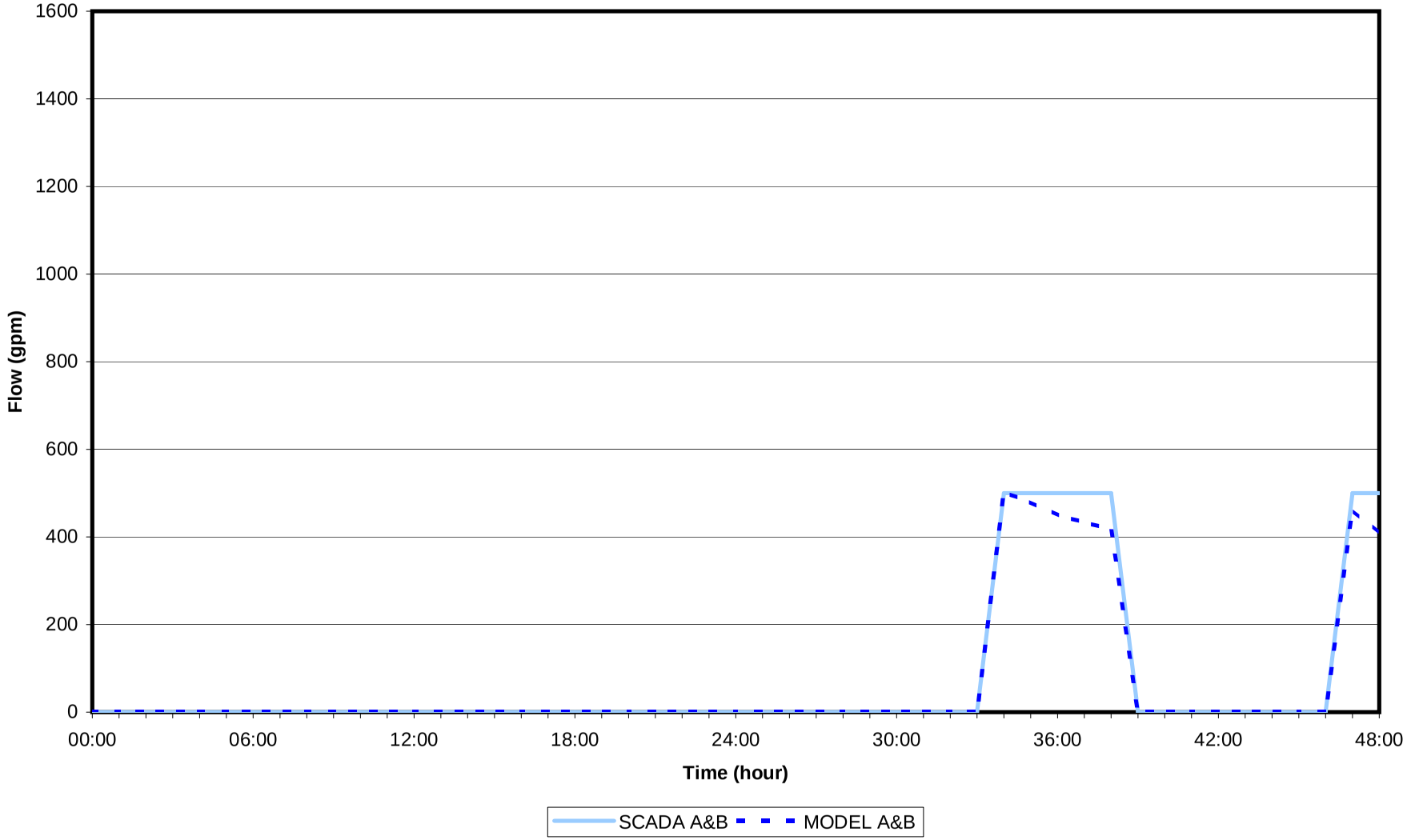



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071106-071806.xls\CH_B-11 (2)
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 66 A & B Flow
## Pressure Zone 635 - 07/12/06 to 07/13/06

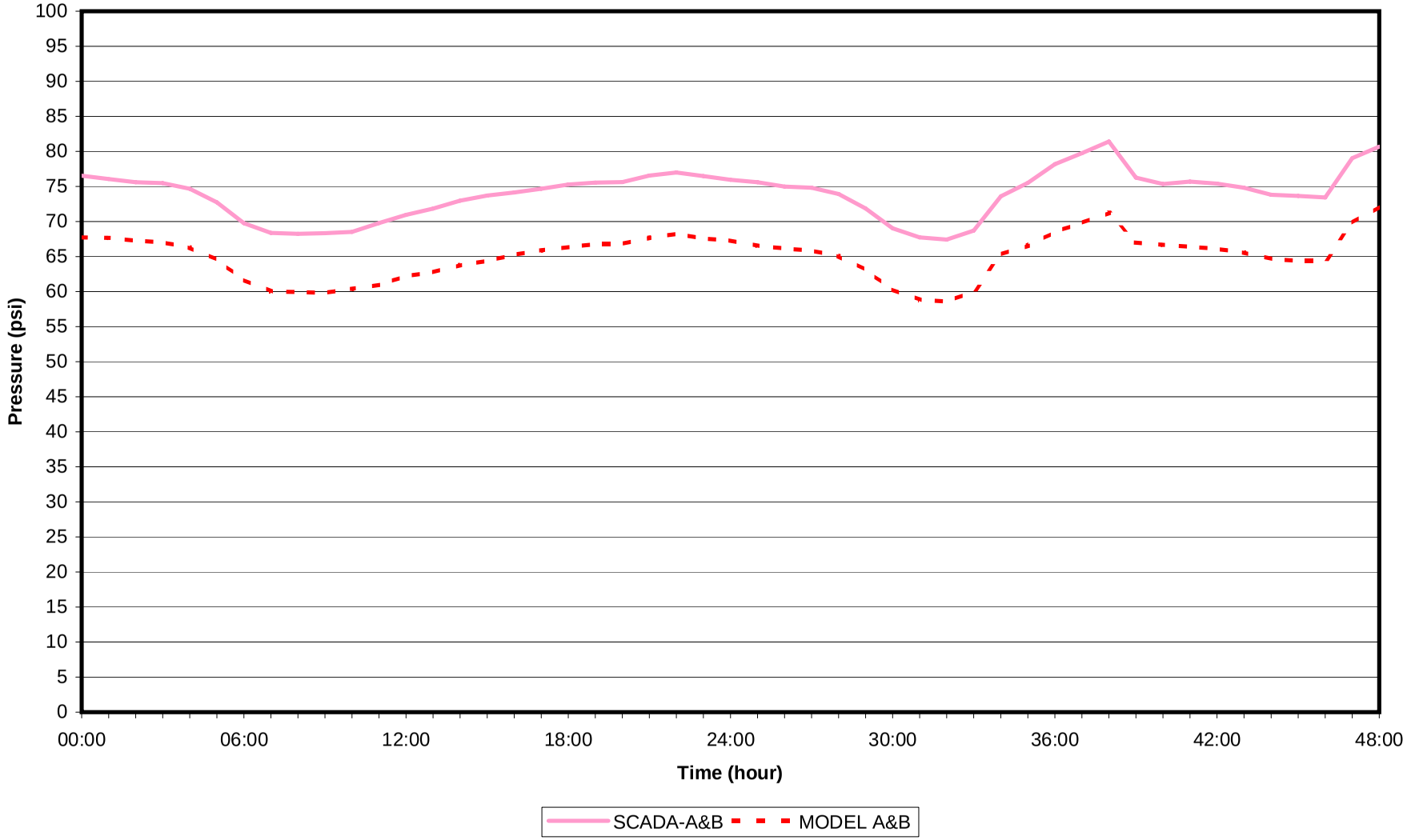



Public Version

West Yost Associates
o:\c\436\02063\E\4\diur\ZONE 635.xlsCH_ST66A&B-1Q
Last Revised: 06/16/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 66 A & B Pressure
## Pressure Zone 635 - 07/12/06 to 07/13/06

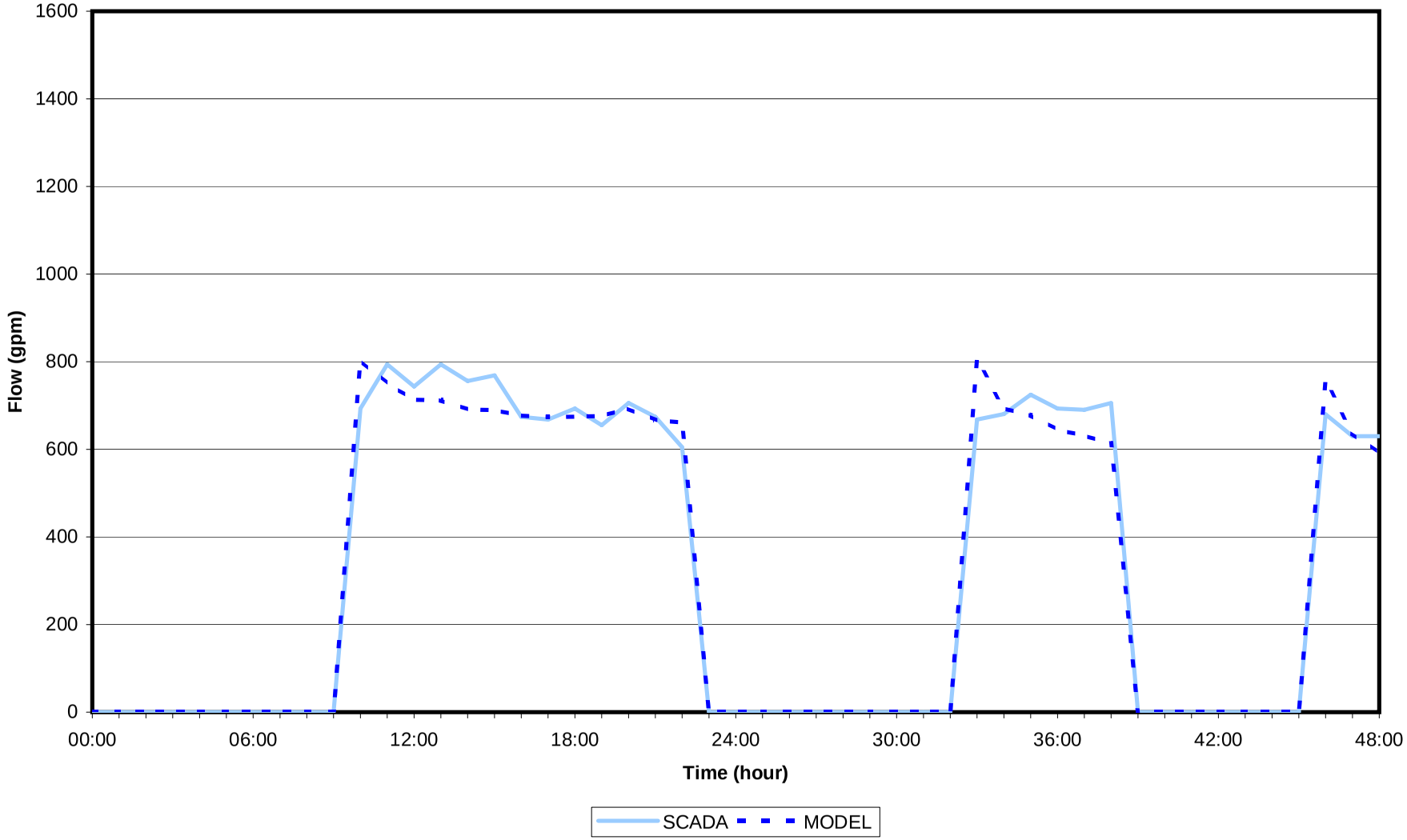



Public Version

West Yost Associates
o:\c\436\02063\E\4\diur\ZONE 635.xlsCH_ST66A&B-1P
Last Revised: 06/16/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 73 Flow
## Pressure Zone 635 - 07/12/06 to 07/13/06

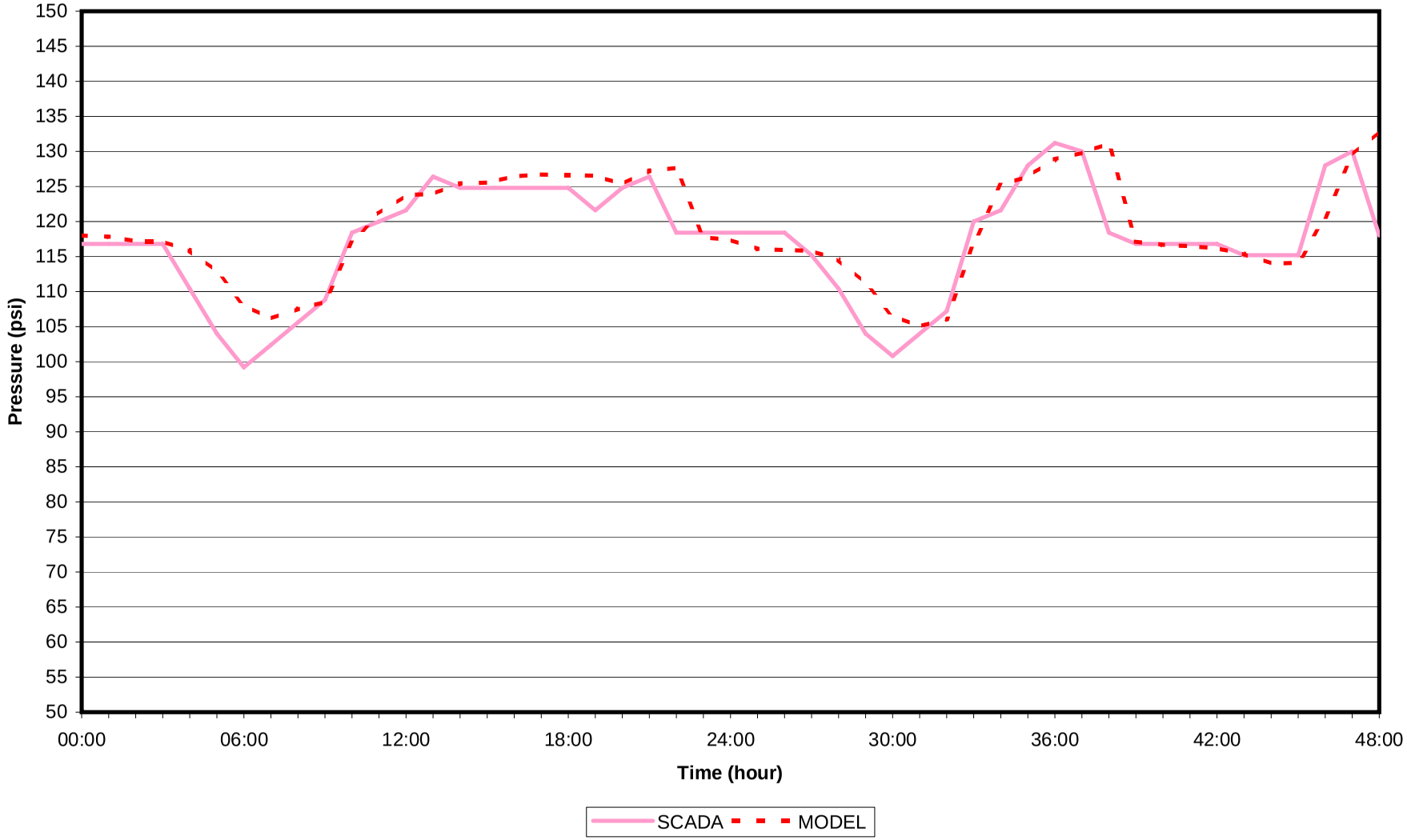



Public Version

West Yost Associates
o:\c\436\02063\E\4\diur\ZONE 635.xlsCH_ST73-1Q
Last Revised: 06/16/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 73 Pressure
## Pressure Zone 635 - 07/12/06 to 07/13/06

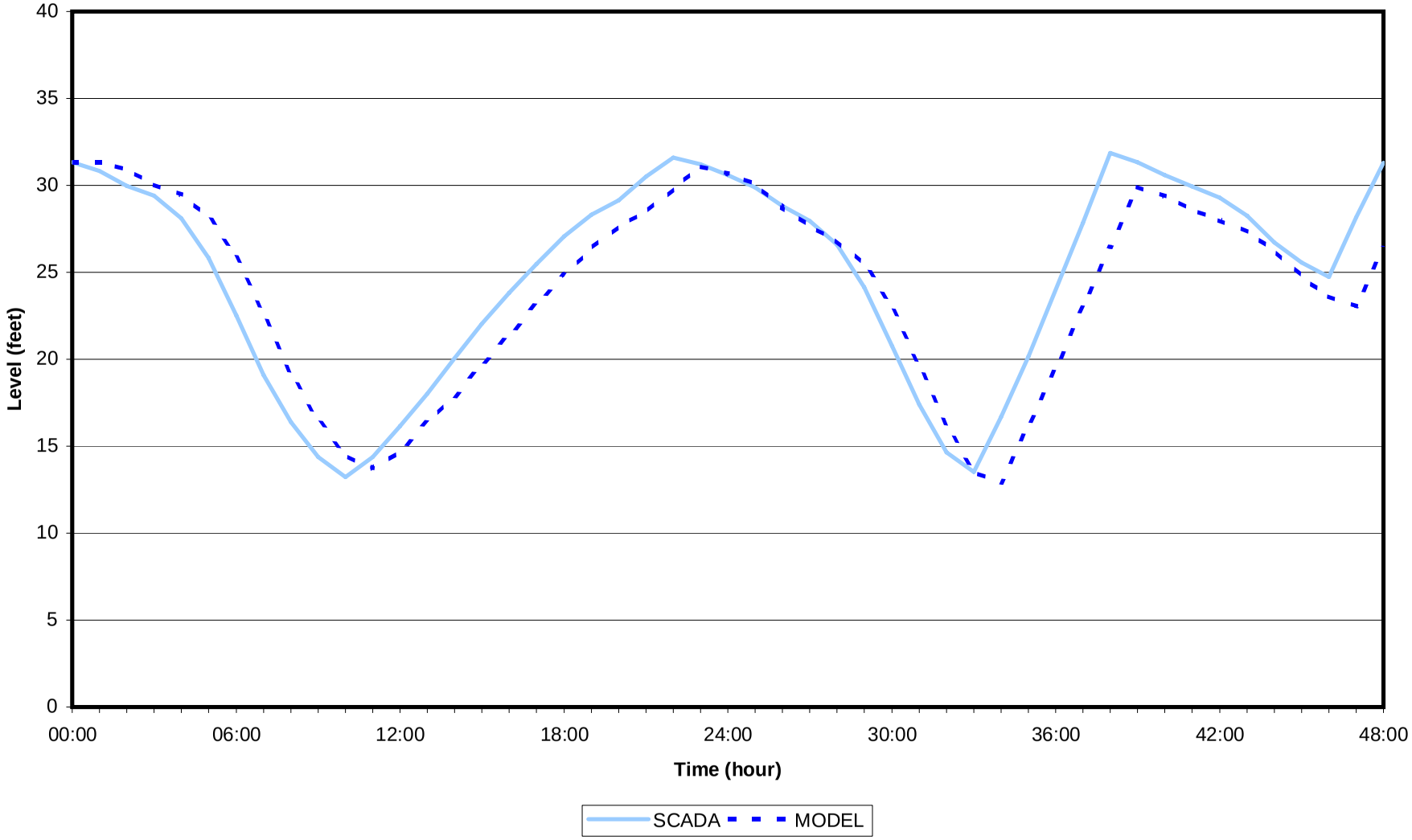



Public Version

West Yost Associates
o:\c\436\02063\E\4\diur\ZONE 635.xlsCH_ST73-1P
Last Revised: 06/16/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 74 Tank Level
## Pressure Zone 635 - 07/12/06 to 07/13/06

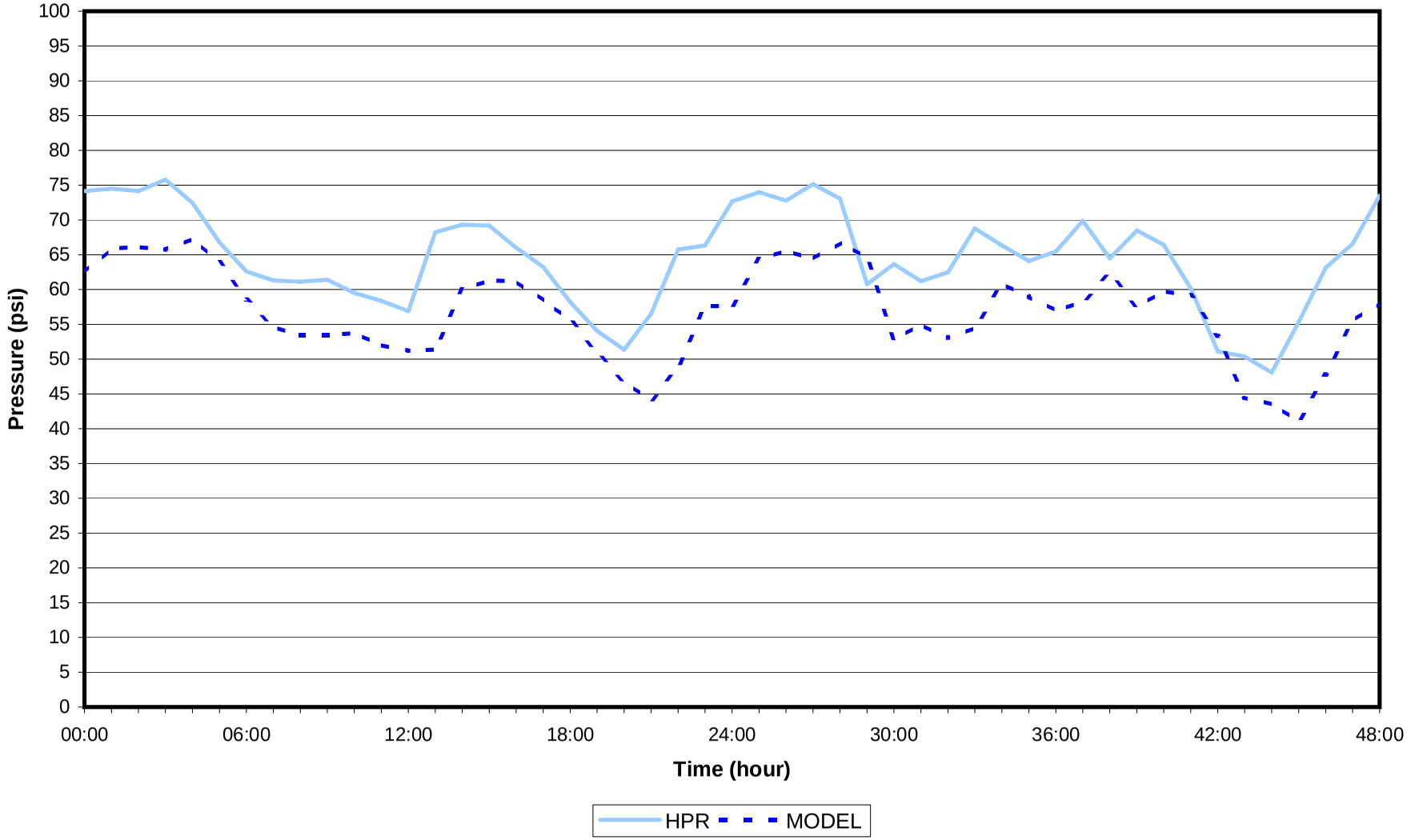



Public Version

West Yost Associates
o:\c\436\02063\E\4\diur\ZONE 635.xlsCH_ST74-1T
Last Revised: 06/16/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-15: Second Street
## Hamilton City - 07/12/06 to 7/13/06

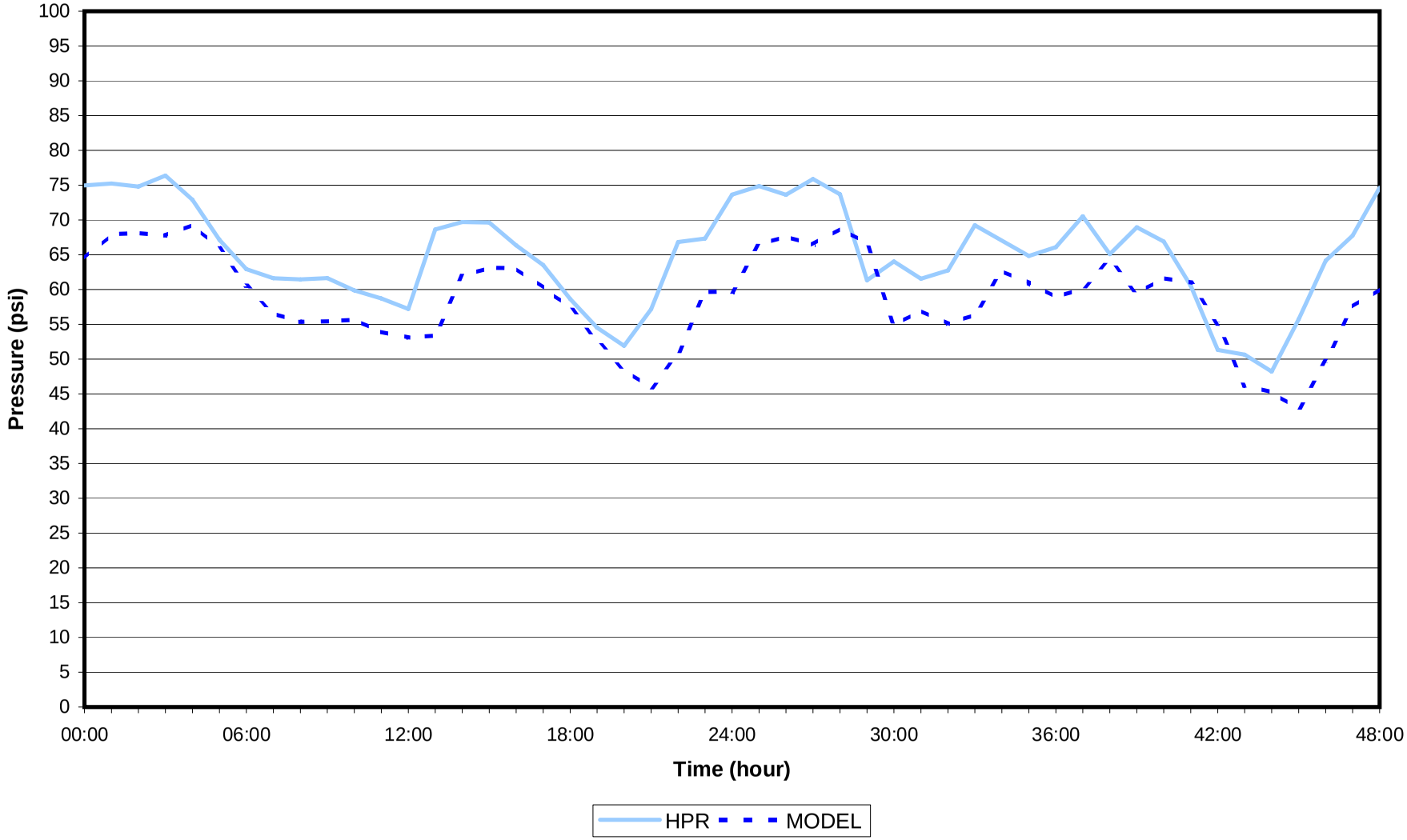



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071106-071806.xls\CH_B-15
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-16: Between Sierra Avenue and Sacramento Avenue, northwest of Third Street
## Hamilton City - 07/12/06 to 7/13/06

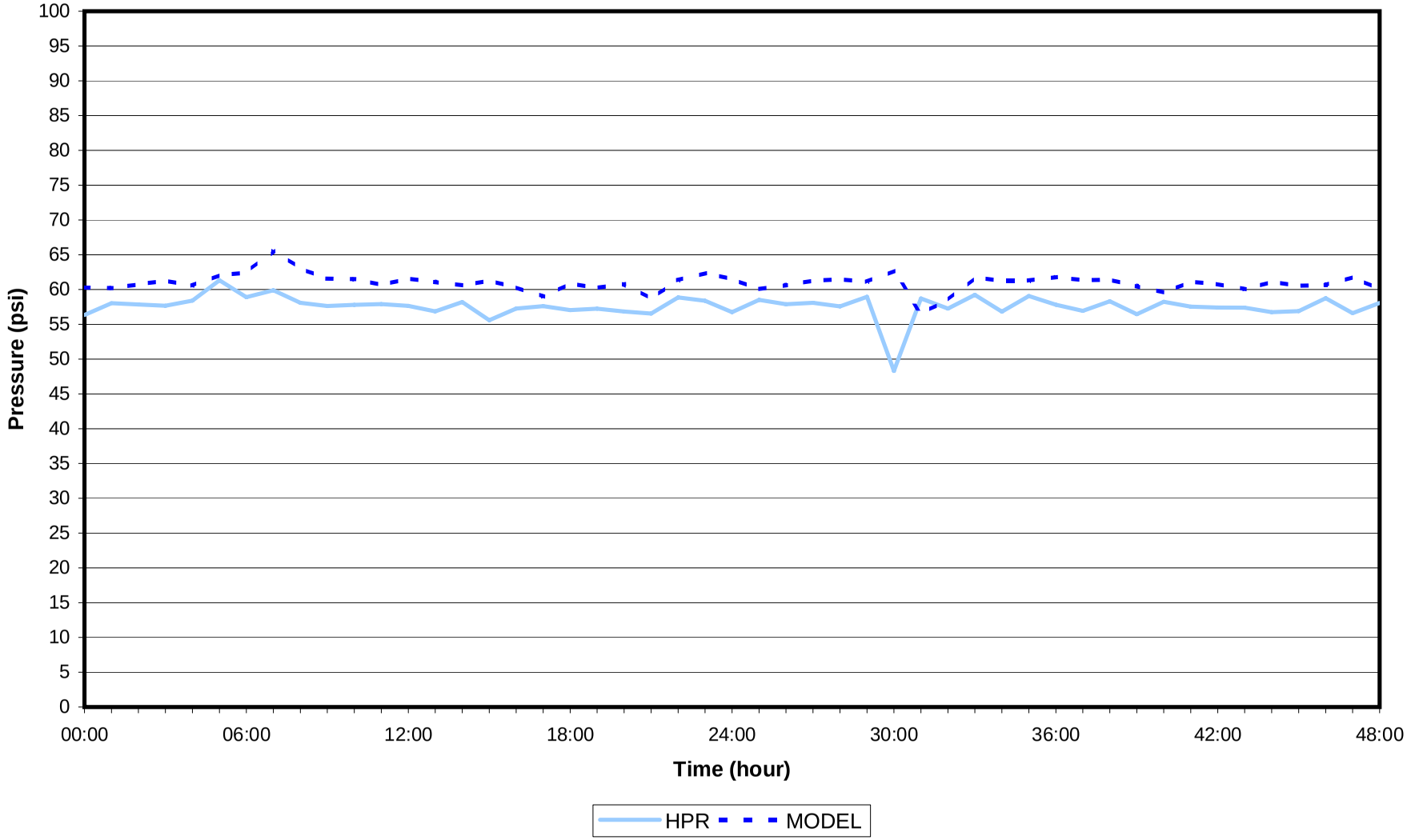



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071106-071806.xls\CH_B-16
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## HPR B-12: Whispering Winds Lane
## Pressure Zone 795 - 07/12/06 to 7/13/06

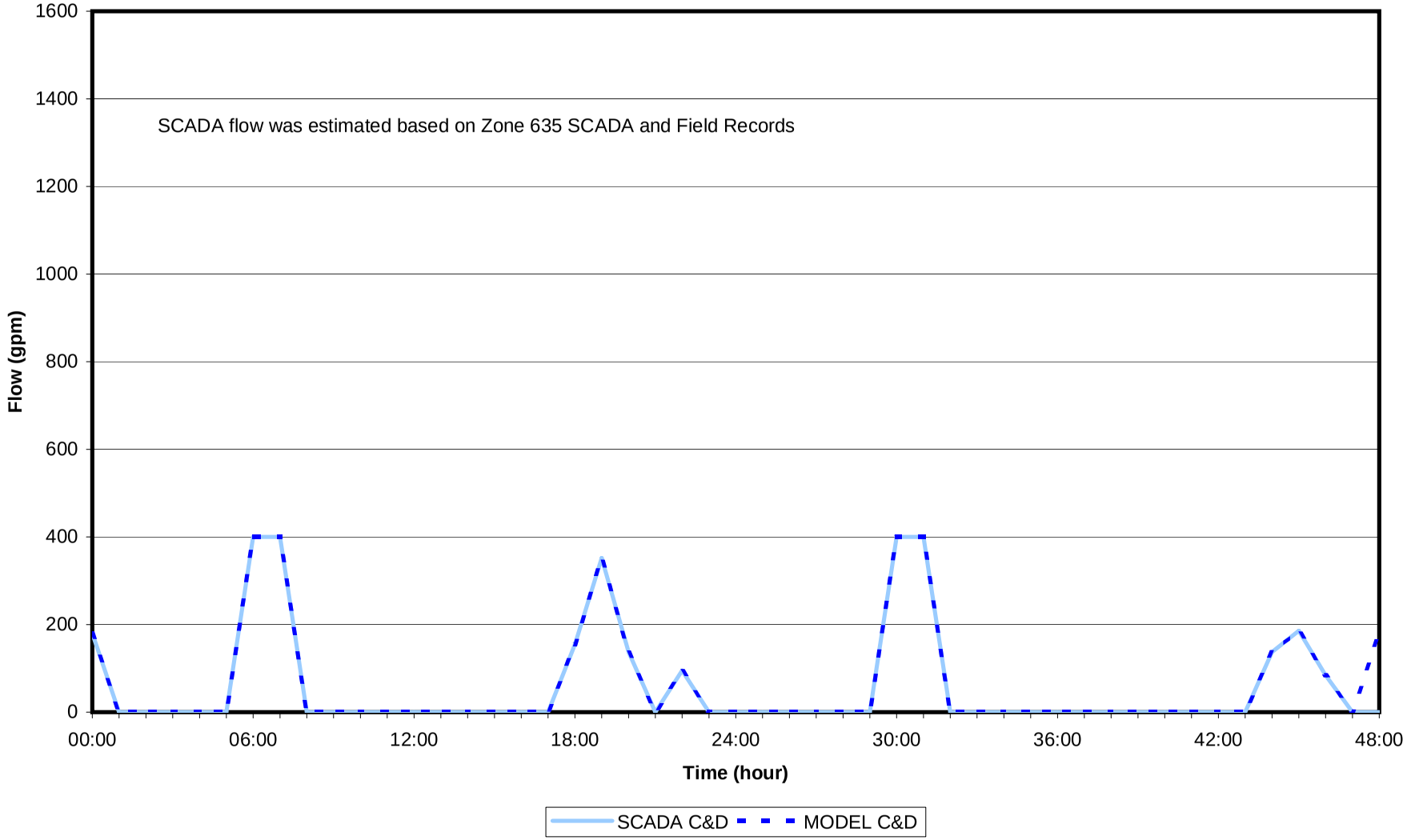



Public Version

West Yost Associates
o:\e\436\02-06-03\E\4\Verf\HPR_071106-071806.xls\CH_B-12
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 66 C & D Flow
## Pressure Zone 795 - 07/12/06 to 07/13/06

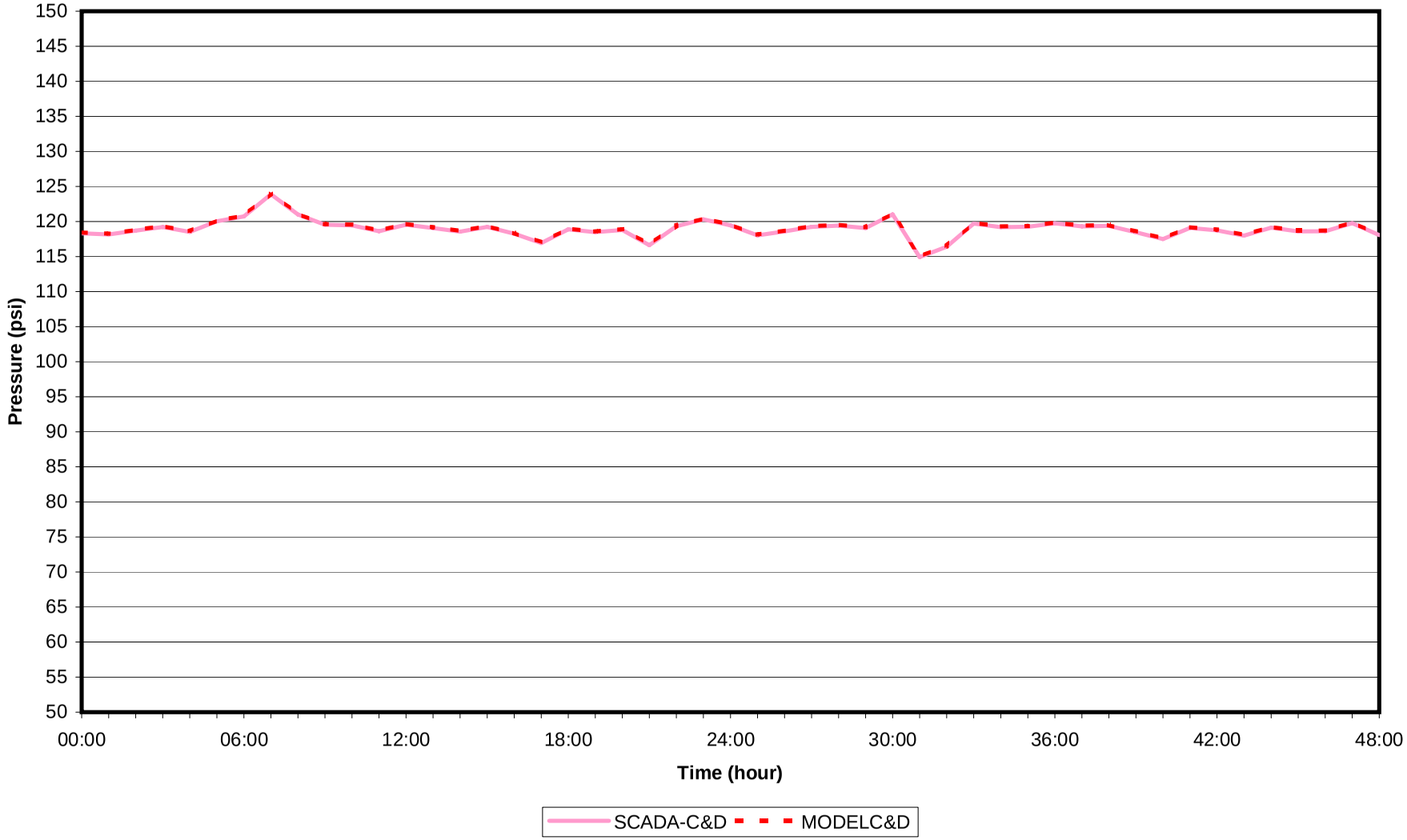



Public Version

West Yost Associates
o:\c\436\02063\E\4\diur\ZONE 635.xlsCH_ST66C&D-1Q
Last Revised: 06/16/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 66 C & D Pressure
## Pressure Zone 795 - 07/12/06 to 07/13/06

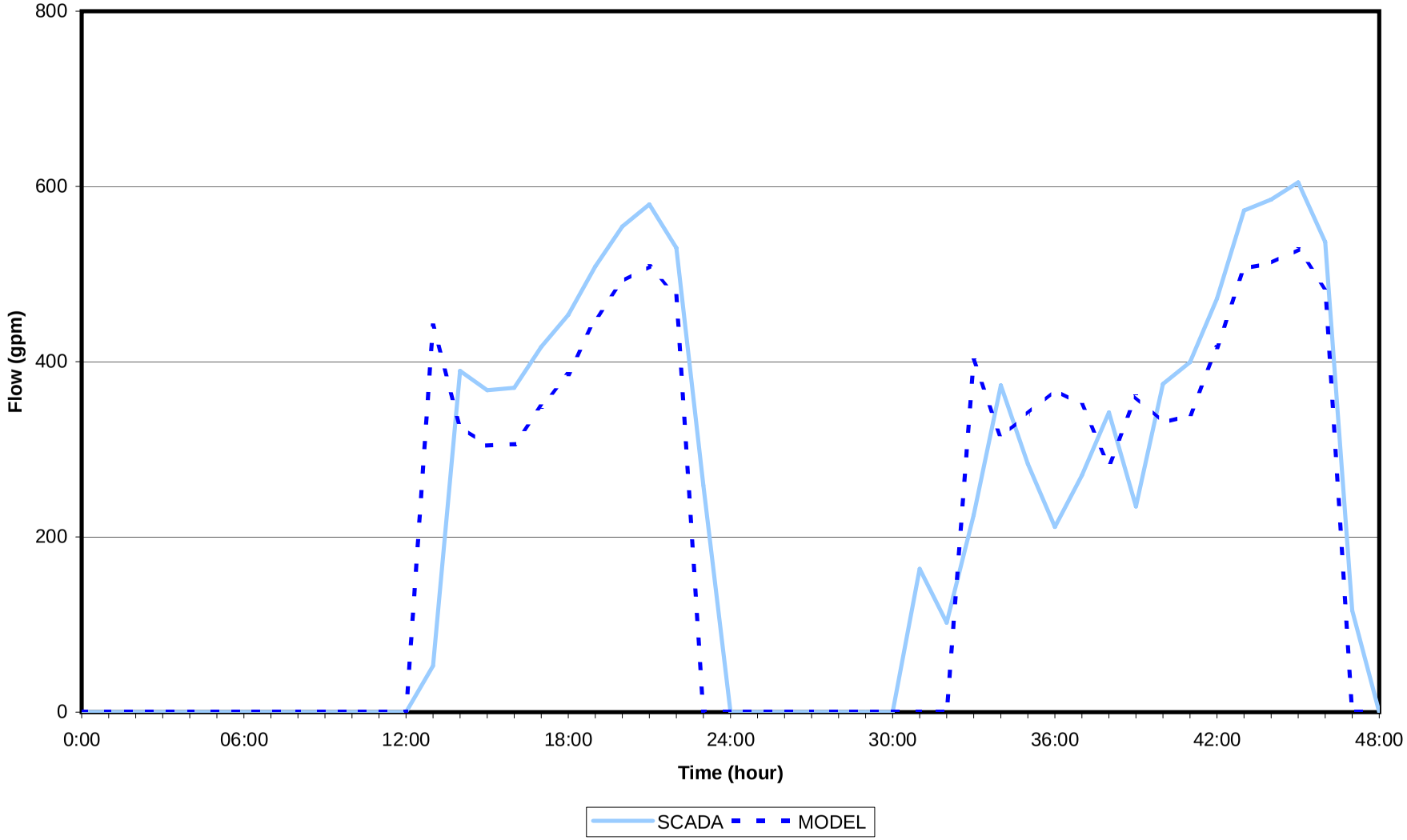



Public Version

West Yost Associates
o:\c\436\02063\E\4\diur\ZONE 635.xlsCH_ST66C&D-1P
Last Revised: 06/16/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 1-01 Flow
## Hamilton City - 07/12/06 to 07/13/06

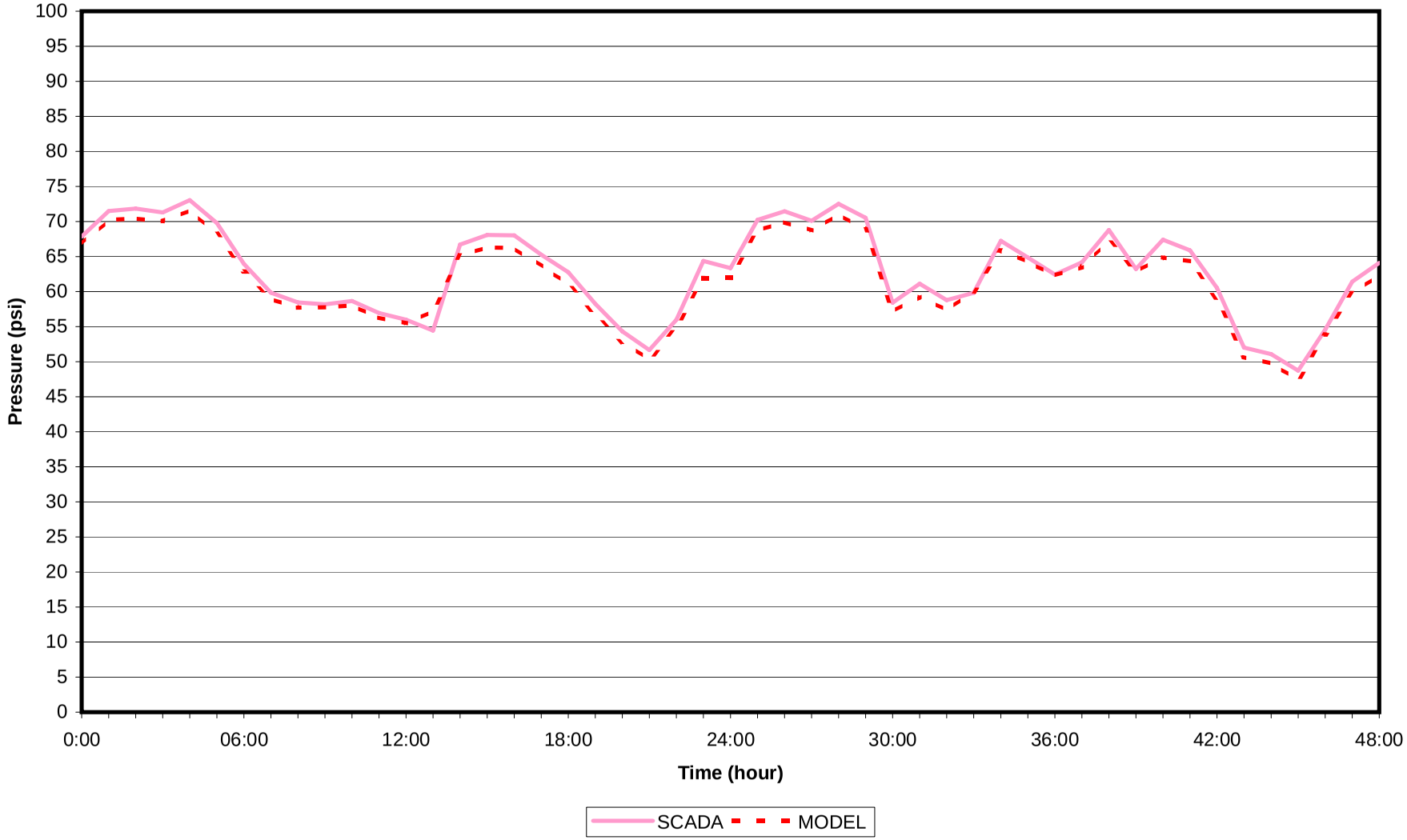



Public Version

West Yost Associates
o:\c\436\02-06-03\E\T4\diurnal\HAM.xlsST101Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 1-01 Pressure
## Hamilton City - 07/12/06 to 07/13/06

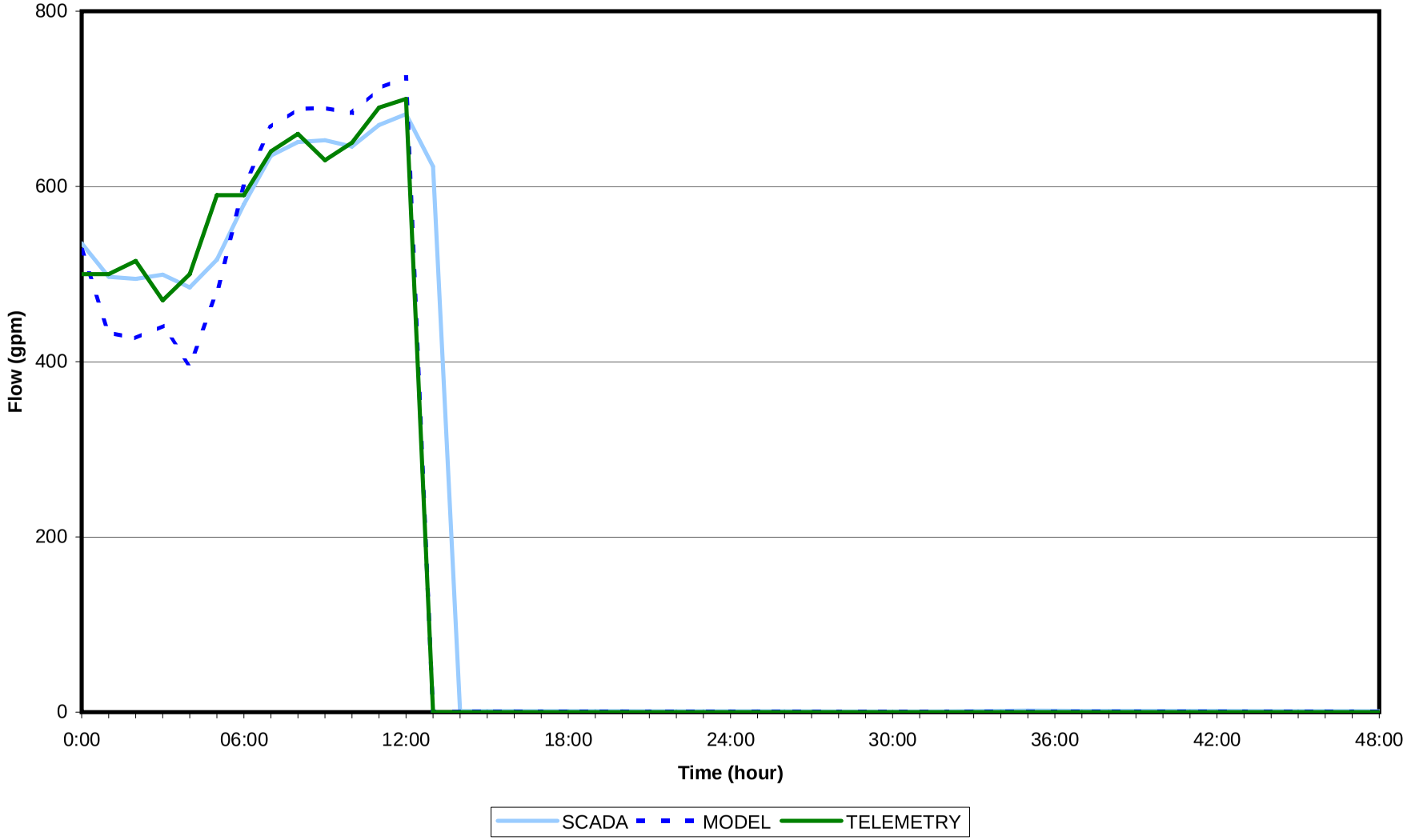



Public Version

West Yost Associates
o:\c\436\02-06-03\E\T4\diurnal\HAM.xlsST101P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 2-01 Flow
## Hamilton City - 07/12/06 to 07/13/06

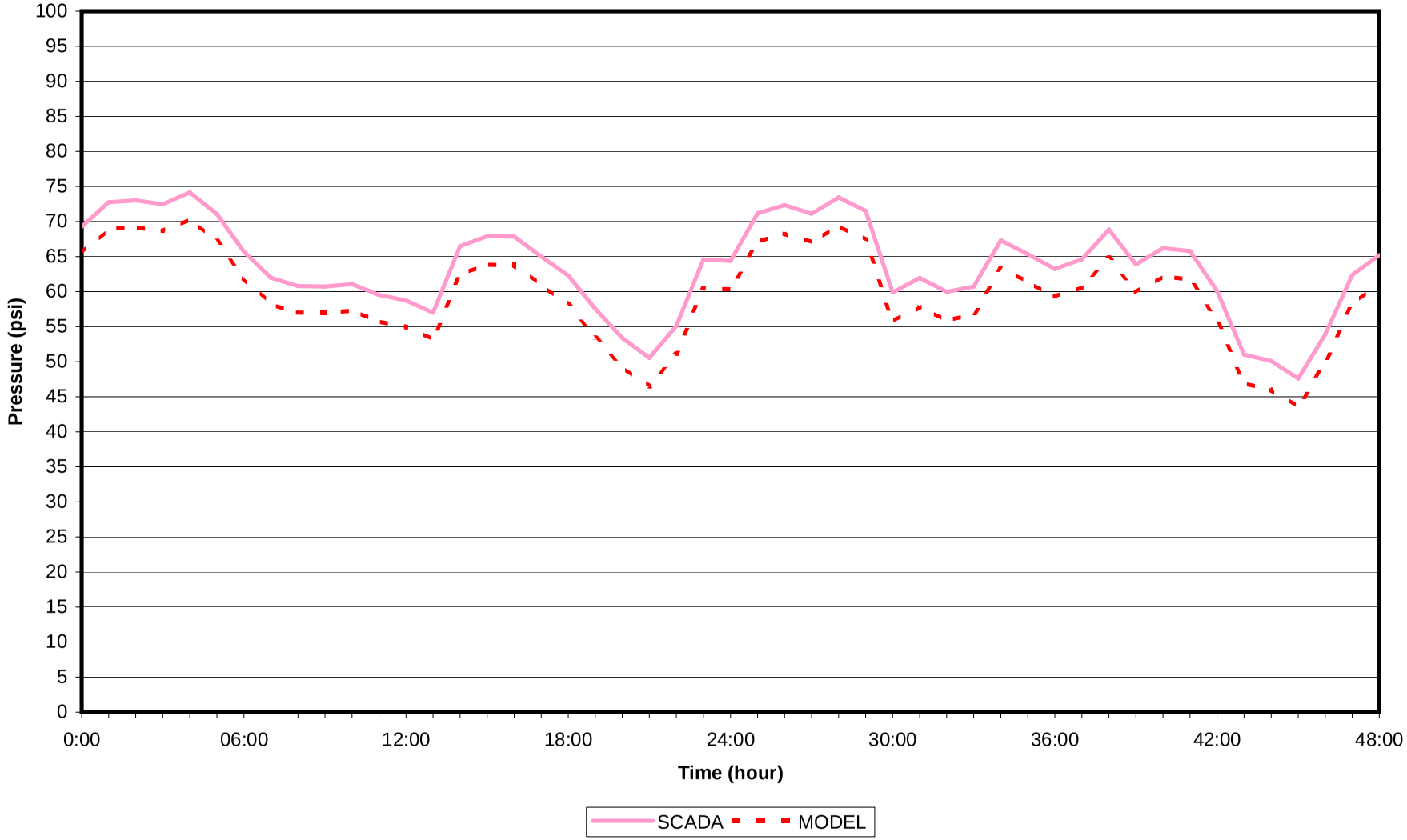



Public Version

West Yost Associates
o:\c\436\02-06-03\E\T4\diurnal\HAM.xlsST201Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 2-01 Pressure
## Hamilton City - 07/12/06 to 07/13/06

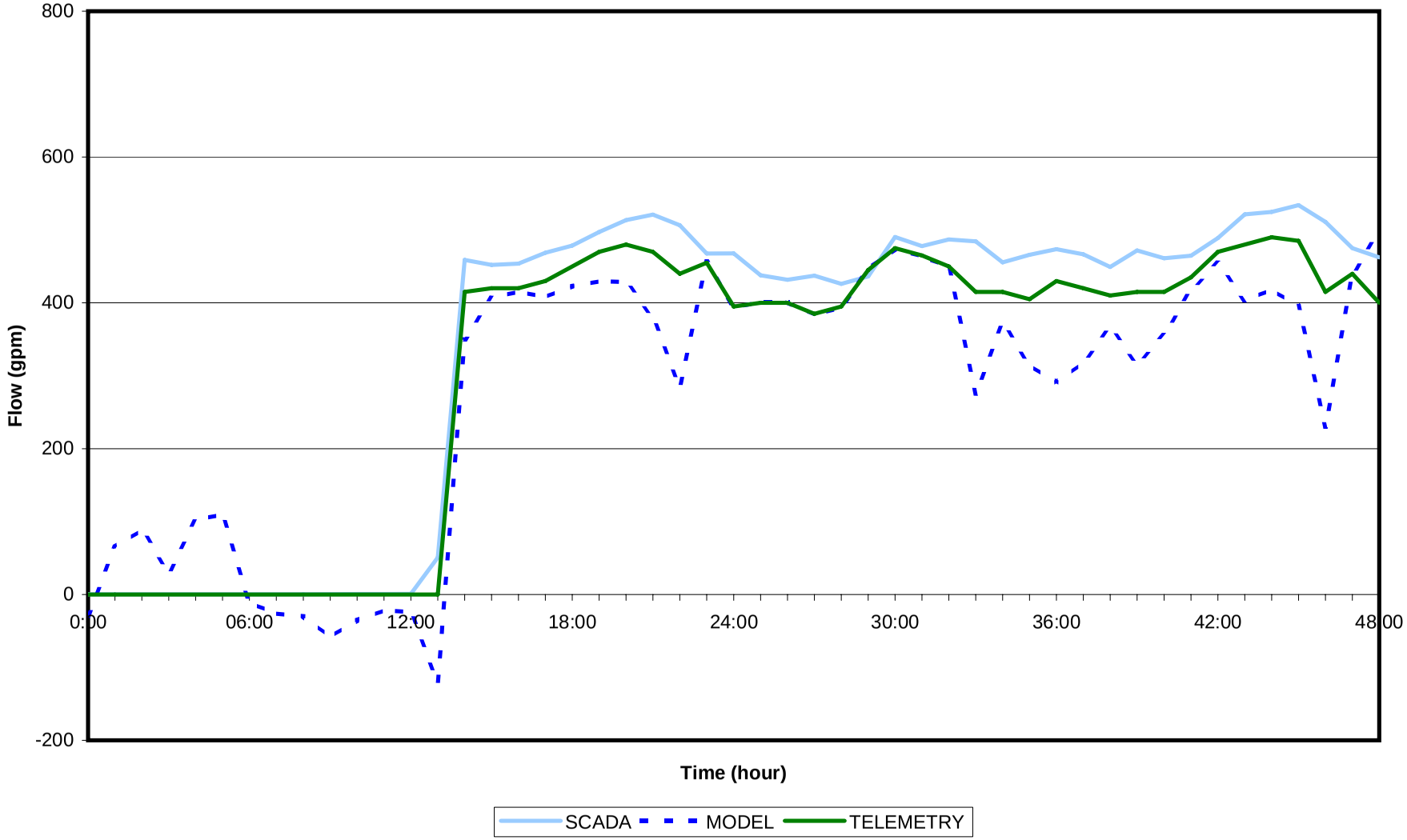



Public Version

West Yost Associates
o:\c\436\02-06-03\E\T4\diurnal\HAM.xlsST201P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 2-02 Flow
## Hamilton City - 07/12/06 to 07/13/06

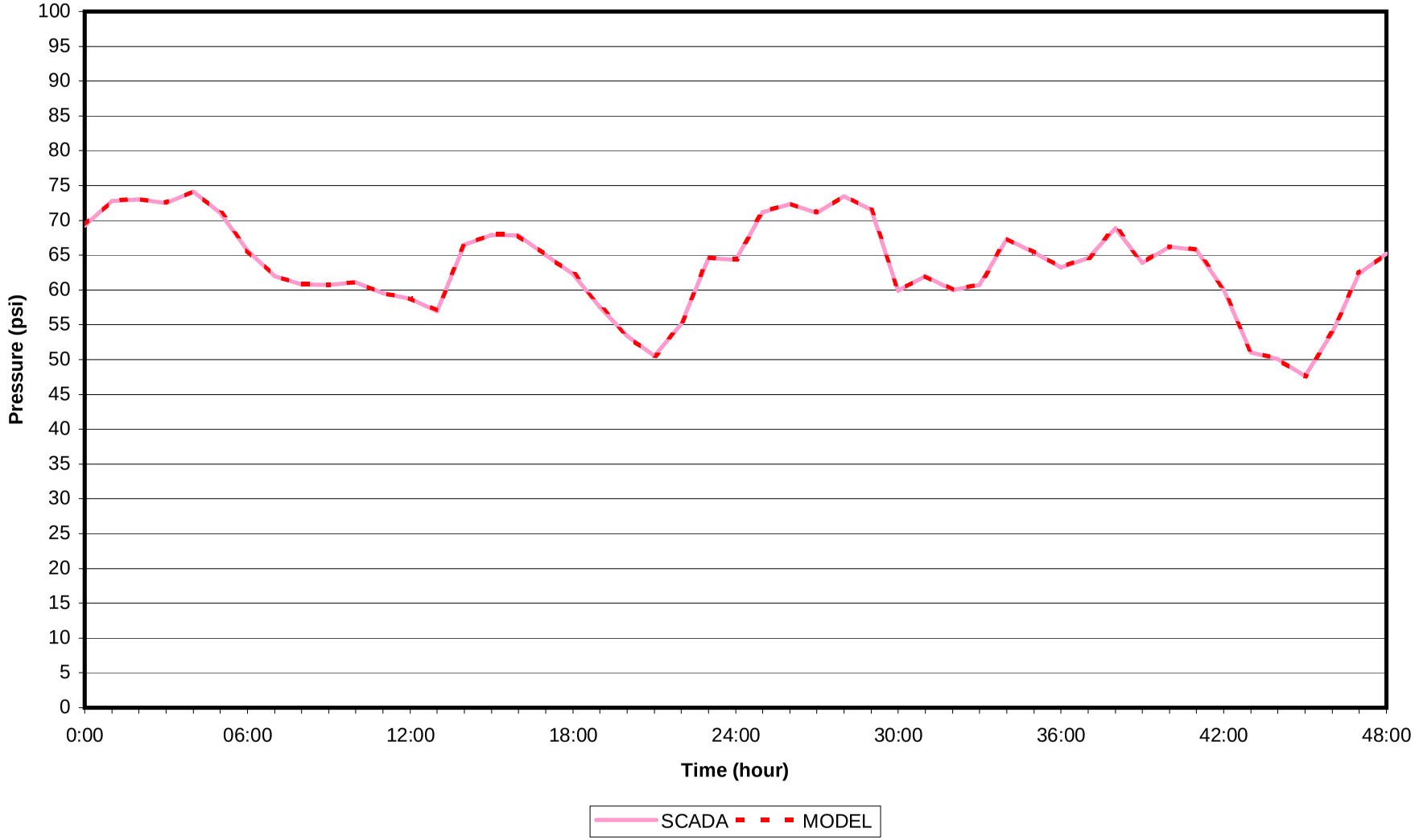



Public Version

West Yost Associates
o:\c\436\02-06-03\E\T4\diurnal\HAM.xlsST202Q
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

## Station 2-02 Pressure
## Hamilton City - 07/12/06 to 07/13/06




Public Version

West Yost Associates
o:\c\436\02-06-03\E\T4\diurnal\HAM.xlsST202P
Last Revised: 09/12/07

California Water Service Company
Chico-Hamilton City District
Water Supply and Facilities Master Plan

Public Version

# APPENDIX N

**Table 1. Recommended Renewal and Replacement (R&R) of System Facilities**

**Table 2. Asset Inventory Summary of District Facilities**

**Table 3. Summary of the Recommendations**

Public Version

**Table 1. Chico - Hamilton City District Recommended Renewal and Replacement (R&R) of System Facilities**

| District | Station | Asset | 2006-2010 | 2011-2015 | 2016-2020 | 2021-2025 | 2026-2030 |
|---|---|---|---|---|---|---|---|
| CHICO | STA. 001-04 | Well | R&R | | | | |
| CHICO | STA. 001-04 | Well Pump | R&R | | | | |
| CHICO | STA. 001-04 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 001-T1 | Tank | R&R | | | | |
| CHICO | STA. 001-T2 | Tank | R&R | | | | |
| CHICO | STA. 001-04 | SCADA | | | R&R | | R&R |
| CHICO | STA. 003-03 | Well | R&R | | | | |
| CHICO | STA. 003-03 | Well Pump | | | | R&R | |
| CHICO | STA. 003-03 | Well Pump Motor | | | | R&R | |
| CHICO | STA. 003-03 | Building | R&R | | | | |
| CHICO | STA. 003-T4 | Tank | R&R | | | | |
| CHICO | STA. 003-03 | SCADA | | | R&R | | R&R |
| CHICO | STA. 004-02 | Well | R&R | | | | |
| CHICO | STA. 004-02 | Well Pump | R&R | | | | |
| CHICO | STA. 004-02 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 004-02 | SCADA | | | R&R | | R&R |
| CHICO | STA. 005-02 | Well | | | R&R | | |
| CHICO | STA. 005-02 | Well Pump | R&R | | | | |
| CHICO | STA. 005-02 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 005-02 | Building | | | | R&R | |
| CHICO | STA. 005-02 | SCADA | | | R&R | | R&R |
| CHICO | STA. 007-04 | Well | R&R | | | | |
| CHICO | STA. 007-04 | Well Pump | | | | R&R | |
| CHICO | STA. 007-04 | Well Pump Motor | | | | R&R | |
| CHICO | STA. 007-04 | Building | R&R | | | | |
| CHICO | STA. 007-04 | SCADA | | | R&R | | R&R |
| CHICO | STA. 008-01 | Well | R&R | | | | |
| CHICO | STA. 008-01 | Well Pump | R&R | | | | |
| CHICO | STA. 008-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 008-01 | Building | R&R | | | | |
| CHICO | STA. 008-T3 | Tank | R&R | | | | |
| CHICO | STA. 008-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 009-02 | Well | R&R | | | | |
| CHICO | STA. 009-02 | Well Pump | | | | R&R | |
| CHICO | STA. 009-02 | Well Pump Motor | | | | R&R | |
| CHICO | STA. 009-02 | Building | R&R | | | | |
| CHICO | STA. 009-02 | SCADA | | | R&R | | R&R |
| CHICO | STA. 011-01 | Well | R&R | | | | |
| CHICO | STA. 011-01 | Well Pump | R&R | | | | |
| CHICO | STA. 011-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 011-01 | Building | R&R | | | | |
| CHICO | STA. 011-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 012-01 | Well | R&R | | | | |
| CHICO | STA. 012-01 | Well Pump | | | | R&R | |
| CHICO | STA. 012-01 | Well Pump Motor | | | | R&R | |
| CHICO | STA. 012-01 | Building | R&R | | | | |
| CHICO | STA. 012-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 013-01 | Well | R&R | | | | |
| CHICO | STA. 013-01 | Well Pump | | | | | |
| CHICO | STA. 013-01 | Well Pump Motor | | | | | |
| CHICO | STA. 013-01 | Building | | | | | |
| CHICO | STA. 013-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 014-01 | Well | R&R | | | | |
| CHICO | STA. 014-01 | Well Pump | | | R&R | | |
| CHICO | STA. 014-01 | Well Pump Motor | | R&R | | | |
| CHICO | STA. 014-01 | Building | R&R | | | | |
| CHICO | STA. 014-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 015-01 | Well | R&R | | | | |
| CHICO | STA. 015-01 | Well Pump | | | | R&R | |
| CHICO | STA. 015-01 | Well Pump Motor | | | | R&R | |
| CHICO | STA. 015-01 | Building | R&R | | | | |
| CHICO | STA. 015-01 | SCADA | | | R&R | | R&R |

Public Version

**Table 1. Chico - Hamilton City District Recommended Renewal and Replacement (R&R) of System Facilities**

| District | Station | Asset | 2006-2010 | 2011-2015 | 2016-2020 | 2021-2025 | 2026-2030 |
|---|---|---|---|---|---|---|---|
| CHICO | STA. 016-01 | Well | R&R | | | | |
| CHICO | STA. 016-01 | Well Pump | R&R | | | | |
| CHICO | STA. 016-01 | Well Pump Motor | | | | | R&R |
| CHICO | STA. 016-01 | Building | R&R | | | | |
| CHICO | STA. 016-A | Booster Pump | | | | R&R | |
| CHICO | STA. 016-A | Booster Pump Motor | R&R | | | | |
| CHICO | STA. 016-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 017-01 | Well | R&R | | | | |
| CHICO | STA. 017-01 | Well Pump | | | | R&R | |
| CHICO | STA. 017-01 | Well Pump Motor | | | | R&R | |
| CHICO | STA. 016-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 018-01 | Well | R&R | | | | |
| CHICO | STA. 018-01 | Well Pump | | | | R&R | |
| CHICO | STA. 018-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 018-01 | Building | R&R | | | | |
| CHICO | STA. 018-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 019-01 | Well | R&R | | | | |
| CHICO | STA. 019-01 | Well Pump | | | | R&R | |
| CHICO | STA. 019-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 019-01 | Building | R&R | | | | |
| CHICO | STA. 019-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 020-01 | Well | R&R | | | | |
| CHICO | STA. 020-01 | Well Pump | | | | R&R | |
| CHICO | STA. 020-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 020-01 | Building | R&R | | | | |
| CHICO | STA. 020-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 021-01 | Well | R&R | | | | |
| CHICO | STA. 021-01 | Well Pump | R&R | | | | |
| CHICO | STA. 021-01 | Well Pump Motor | | | R&R | | |
| CHICO | STA. 021-01 | Building | R&R | | | | |
| CHICO | STA. 021-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 022-01 | Well | R&R | | | | |
| CHICO | STA. 022-01 | Well Pump | R&R | | | | |
| CHICO | STA. 022-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 022-01 | Building | R&R | | | | |
| CHICO | STA. 022-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 023-01 | Well | R&R | | | | |
| CHICO | STA. 023-01 | Well Pump | R&R | | | | |
| CHICO | STA. 023-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 023-01 | Building | R&R | | | | |
| CHICO | STA. 023-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 024-01 | Well | R&R | | | | |
| CHICO | STA. 024-01 | Well Pump | | | R&R | | |
| CHICO | STA. 024-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 024-01 | Building | R&R | | | | |
| CHICO | STA. 024-01 | SCADA | R&R | | | R&R | |
| CHICO | STA. 025-01 | Well | R&R | | | | |
| CHICO | STA. 025-01 | Well Pump | R&R | | | | |
| CHICO | STA. 025-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 025-01 | Building | R&R | | | | |
| CHICO | STA. 025-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 026-01 | Well | R&R | | | | |
| CHICO | STA. 026-01 | Well Pump | | R&R | | | |
| CHICO | STA. 026-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 026-01 | Building | R&R | | | | |
| CHICO | STA. 026-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 027-01 | Well | R&R | | | | |
| CHICO | STA. 027-01 | Well Pump | R&R | | | | |
| CHICO | STA. 027-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 027-01 | Building | R&R | | | | |
| CHICO | STA. 027-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 028-01 | Well | R&R | | | | |
| CHICO | STA. 028-01 | Well Pump | | | | R&R | |
| CHICO | STA. 028-01 | Well Pump Motor | | | | R&R | |
| CHICO | STA. 028-01 | Building | R&R | | | | |
| CHICO | STA. 028-01 | SCADA | | | R&R | | R&R |

Public Version

**Table 1. Chico - Hamilton City District Recommended Renewal and Replacement (R&R) of System Facilities**

| District | Station | Asset | 2006-2010 | 2011-2015 | 2016-2020 | 2021-2025 | 2026-2030 |
|---|---|---|---|---|---|---|---|
| CHICO | STA. 029-01 | Well | R&R | | | | |
| CHICO | STA. 029-01 | Well Pump | R&R | | | | |
| CHICO | STA. 029-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 029-01 | Building | R&R | | | | |
| CHICO | STA. 029-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 030-01 | Well | R&R | | | | |
| CHICO | STA. 030-01 | Well Pump | R&R | | | | |
| CHICO | STA. 030-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 030-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 031-01 | Well | R&R | | | | |
| CHICO | STA. 031-01 | Well Pump | | | | R&R | |
| CHICO | STA. 031-01 | Well Pump Motor | | | | R&R | |
| CHICO | STA. 031-01 | Building | R&R | | | | |
| CHICO | STA. 031-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 032-01 | Well | R&R | | | | |
| CHICO | STA. 032-01 | Well Pump | | | | R&R | |
| CHICO | STA. 032-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 032-01 | Building | | R&R | | | |
| CHICO | STA. 032-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 033-01 | Well | R&R | | | | |
| CHICO | STA. 033-01 | Well Pump | R&R | | | | |
| CHICO | STA. 033-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 033-01 | Building | | R&R | | | |
| CHICO | STA. 033-01 | SCADA | R&R | | | R&R | |
| CHICO | STA. 034-01 | Well | R&R | | | | |
| CHICO | STA. 034-01 | Well Pump | | | | R&R | |
| CHICO | STA. 034-01 | Well Pump Motor | | | | R&R | |
| CHICO | STA. 034-01 | Building | | R&R | | | |
| CHICO | STA. 034-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 035-01 | Well | R&R | | | | |
| CHICO | STA. 035-01 | Well Pump | R&R | | | | |
| CHICO | STA. 035-01 | Well Pump Motor | | | | R&R | |
| CHICO | STA. 035-01 | Building | | R&R | | | |
| CHICO | STA. 035-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 037-01 | Well | | | | | |
| CHICO | STA. 037-01 | Well Pump | | | | | R&R |
| CHICO | STA. 037-01 | Well Pump Motor | | | | | R&R |
| CHICO | STA. 037-01 | Building | | | | | |
| CHICO | STA. 037-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 038-01 | Well | | R&R | | | |
| CHICO | STA. 038-01 | Well Pump | | | | R&R | |
| CHICO | STA. 038-01 | Well Pump Motor | | | | R&R | |
| CHICO | STA. 038-01 | Building | | | R&R | | |
| CHICO | STA. 038-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 039-01 | Well | | R&R | | | |
| CHICO | STA. 039-01 | Well Pump | | | R&R | | |
| CHICO | STA. 039-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 039-01 | Building | | | R&R | | |
| CHICO | STA. 039-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 040-01 | Well | | R&R | | | |
| CHICO | STA. 040-01 | Well Pump | R&R | | | | |
| CHICO | STA. 040-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 040-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 041-01 | Well | | R&R | | | |
| CHICO | STA. 041-01 | Well Pump | | R&R | | | |
| CHICO | STA. 041-01 | Well Pump Motor | | R&R | | | |
| CHICO | STA. 041-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 042-01 | Well | | R&R | | | |
| CHICO | STA. 042-01 | Well Pump | R&R | | | | |
| CHICO | STA. 042-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 042-01 | Building | | | R&R | | |
| CHICO | STA. 042-01 | SCADA | | | R&R | | R&R |

Public Version

**Table 1. Chico - Hamilton City District Recommended Renewal and Replacement (R&R) of System Facilities**

| District | Station | Asset | 2006-2010 | 2011-2015 | 2016-2020 | 2021-2025 | 2026-2030 |
|---|---|---|---|---|---|---|---|
| CHICO | STA. 044-01 | Well | R&R | | | | |
| CHICO | STA. 044-01 | Well Pump | | | | | R&R |
| CHICO | STA. 044-01 | Well Pump Motor | | | | R&R | |
| CHICO | STA. 044-01 | Building | R&R | | | | |
| CHICO | STA. 044-01 | SCADA | R&R | | | R&R | |
| CHICO | STA. 044-P1 | HP Tank | R&R | | | | |
| CHICO | STA. 045-01 | Well | | | | | |
| CHICO | STA. 045-01 | Well Pump | | | | | |
| CHICO | STA. 045-01 | Well Pump Motor | | | | | |
| CHICO | STA. 045-01 | Building | | | | | |
| CHICO | STA. 045-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 046-01 | Well | | | R&R | | |
| CHICO | STA. 046-01 | Well Pump | | | R&R | | |
| CHICO | STA. 046-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 046-01 | Building | | | | R&R | |
| CHICO | STA. 046-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 047-01 | Well | | | R&R | | |
| CHICO | STA. 047-01 | Well Pump | R&R | | | | |
| CHICO | STA. 047-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 047-01 | Building | | | | R&R | |
| CHICO | STA. 047-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 048-01 | Well | | | R&R | | |
| CHICO | STA. 048-01 | Well Pump | | | | R&R | |
| CHICO | STA. 048-01 | Well Pump Motor | | | | R&R | |
| CHICO | STA. 048-01 | Building | | | | R&R | |
| CHICO | STA. 048-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 049-01 | Well | | | R&R | | |
| CHICO | STA. 049-01 | Well Pump | | | | | R&R |
| CHICO | STA. 049-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 049-01 | Building | | | | R&R | |
| CHICO | STA. 049-01 | SCADA | R&R | | | R&R | |
| CHICO | STA. 050-01 | Well | | | R&R | | |
| CHICO | STA. 050-01 | Well Pump | R&R | | | | |
| CHICO | STA. 050-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 050-01 | Building | | | | R&R | |
| CHICO | STA. 050-A | Booster Pump | R&R | | | | |
| CHICO | STA. 050-A | Booster Pump Motor | R&R | | | | |
| CHICO | STA. 050-P1 | HP Tank | | | | | R&R |
| CHICO | STA. 050-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 051-01 | Well | | | | R&R | |
| CHICO | STA. 051-01 | Well Pump | R&R | | | | |
| CHICO | STA. 051-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 051-01 | Building | | | | | R&R |
| CHICO | STA. 051-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 052-01 | Well | | | | R&R | |
| CHICO | STA. 052-01 | Well Pump | R&R | | | | |
| CHICO | STA. 052-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 052-01 | Building | | | | | R&R |
| CHICO | STA. 052-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 053-01 | Well | | | | R&R | |
| CHICO | STA. 053-01 | Well Pump | R&R | | | | |
| CHICO | STA. 053-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 053-01 | Building | | | | | R&R |
| CHICO | STA. 053-01 | SCADA | R&R | | | R&R | |
| CHICO | STA. 054-01 | Well | | | | R&R | |
| CHICO | STA. 054-01 | Well Pump | R&R | | | | |
| CHICO | STA. 054-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 054-01 | Building | | | | | R&R |
| CHICO | STA. 054-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 055-01 | Well | | | | R&R | |
| CHICO | STA. 055-01 | Well Pump | | | | | R&R |
| CHICO | STA. 055-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 055-01 | Building | | | | | R&R |
| CHICO | STA. 055-01 | SCADA | | | R&R | | R&R |

Public Version

**Table 1. Chico - Hamilton City District Recommended Renewal and Replacement (R&R) of System Facilities**

| District | Station | Asset | 2006-2010 | 2011-2015 | 2016-2020 | 2021-2025 | 2026-2030 |
|---|---|---|---|---|---|---|---|
| CHICO | STA. 056-01 | Well | | | | R&R | |
| CHICO | STA. 056-01 | Well Pump | R&R | | | | |
| CHICO | STA. 056-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 056-01 | Building | | | | | R&R |
| CHICO | STA. 056-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 057-01 | Well | | | | | |
| CHICO | STA. 057-01 | Well Pump | | | | | R&R |
| CHICO | STA. 057-01 | Well Pump Motor | | | | | R&R |
| CHICO | STA. 057-01 | Building | | | | | |
| CHICO | STA. 057-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 058-01 | Well | | | | | R&R |
| CHICO | STA. 058-01 | Well Pump | R&R | | | | |
| CHICO | STA. 058-01 | Well Pump Motor | R&R | | | | |
| CHICO | STA. 058-01 | Building | | | | | |
| CHICO | STA. 058-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 059-01 | Well | | | | | R&R |
| CHICO | STA. 059-01 | Well Pump | | | | R&R | |
| CHICO | STA. 059-01 | Well Pump Motor | | | | R&R | |
| CHICO | STA. 059-01 | Building | | | | | |
| CHICO | STA. 059-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 061-01 | Well | | | | | |
| CHICO | STA. 061-01 | Well Pump | | R&R | | | |
| CHICO | STA. 061-01 | Well Pump Motor | | R&R | | | |
| CHICO | STA. 061-01 | Building | | | | | |
| CHICO | STA. 061-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 062-01 | Well | | | | | |
| CHICO | STA. 062-01 | Well Pump | | R&R | | | |
| CHICO | STA. 062-01 | Well Pump Motor | | R&R | | | |
| CHICO | STA. 062-01 | Building | | | | | |
| CHICO | STA. 062-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 063-01 | Well | | | | | |
| CHICO | STA. 063-01 | Well Pump | | R&R | | | |
| CHICO | STA. 063-01 | Well Pump Motor | | R&R | | | |
| CHICO | STA. 063-01 | Building | | | | | |
| CHICO | STA. 063-01 | SCADA | | | R&R | | R&R |
| CHICO | STA. 064-01 | Well | | | | | |
| CHICO | STA. 064-01 | Well Pump | | R&R | | | |
| CHICO | STA. 064-01 | Well Pump Motor | | R&R | | | |
| CHICO | STA. 064-01 | Building | | | | | |
| CHICO | STA. 064-P1 | HP Tank | | | | | |
| CHICO | STA. 064-01 | SCADA | R&R | | | R&R | |
| CHICO | STA. 065-01 | Well | | | | | |
| CHICO | STA. 065-01 | Well Pump | | R&R | | | |
| CHICO | STA. 065-01 | Well Pump Motor | | R&R | | | |
| CHICO | STA. 065-01 | Building | | | | | |
| CHICO | STA. 065-P1 | HP Tank | | | | | |
| CHICO | STA. 065-01 | SCADA | R&R | | | R&R | |
| CHICO | STA. 066-A | Booster Pump | | R&R | | | |
| CHICO | STA. 066-A | Booster Pump Motor | | R&R | | | |
| CHICO | STA. 066-B | Booster Pump | | R&R | | | |
| CHICO | STA. 066-B | Booster Pump Motor | | R&R | | | |
| CHICO | STA. 066-B | Building | | | | | |
| CHICO | STA. 066-C | Booster Pump | | | | | R&R |
| CHICO | STA. 066-C | Booster Pump Motor | | | | | R&R |
| CHICO | STA. 066-D | Booster Pump | | | | | R&R |
| CHICO | STA. 066-D | Booster Pump Motor | | | | | R&R |
| CHICO | STA. 066-D | Building | | | | | |
| CHICO | STA. 066-T1 | Tank | | | | | |
| CHICO | STA. 066-T2 | Tank | | | | | |
| CHICO | STA. 066-P1 | HP Tank | | | | R&R | |
| CHICO | STA. 066-P2 | HP Tank | | | | | |
| CHICO | STA. 066-D | SCADA | R&R | | | R&R | |
| CHICO | STA. 067-01 | Well | | | | | |
| CHICO | STA. 067-01 | Well Pump | | | R&R | | |
| CHICO | STA. 067-01 | Well Pump Motor | | | R&R | | |
| CHICO | STA. 067-01 | Building | | | | | |
| CHICO | STA. 067-01 | SCADA | R&R | | | R&R | |

Public Version

**Table 1. Chico - Hamilton City District Recommended Renewal and Replacement (R&R) of System Facilities**

| District | Station | Asset | 2006-2010 | 2011-2015 | 2016-2020 | 2021-2025 | 2026-2030 |
|---|---|---|---|---|---|---|---|
| CHICO | STA. 068-01 | Well | | | | | |
| CHICO | STA. 068-01 | Well Pump | | | | R&R | |
| CHICO | STA. 068-01 | Well Pump Motor | | | | R&R | |
| CHICO | STA. 068-01 | Building | | | | | |
| CHICO | STA. 068-01 | SCADA | R&R | | | R&R | |
| CHICO | STA. 069-01 | Well | | | | | |
| CHICO | STA. 069-01 | Well Pump | | | | R&R | |
| CHICO | STA. 069-01 | Well Pump Motor | | | | R&R | |
| CHICO | STA. 069-01 | Building | | | | | |
| CHICO | STA. 069-01 | SCADA | R&R | | | R&R | |
| CHICO | STA. 070-01 | Well | | | | | |
| CHICO | STA. 070-01 | Well Pump | | | | | R&R |
| CHICO | STA. 070-01 | Well Pump Motor | | | | | R&R |
| CHICO | STA. 070-01 | Building | | | | | |
| CHICO | STA. 070-P1 | HP Tank | | | | | |
| CHICO | STA. 070-01 | SCADA | R&R | | | R&R | |
| CHICO | STA. 071-01 | Well | | | | | |
| CHICO | STA. 071-01 | Well Pump | | | | | R&R |
| CHICO | STA. 071-01 | Well Pump Motor | | | | | R&R |
| CHICO | STA. 071-01 | Building | | | | | |
| CHICO | STA. 071-01 | SCADA | R&R | | | R&R | |
| CHICO | STA. 072-01 | Well | | | | | |
| CHICO | STA. 072-01 | Well Pump | | | | | R&R |
| CHICO | STA. 072-01 | Well Pump Motor | | | | | R&R |
| CHICO | STA. 072-01 | Building | | | | | |
| CHICO | STA. 072-P1 | HP Tank | | | | | |
| CHICO | STA. 072-01 | SCADA | R&R | | | R&R | |
| CHICO | STA. 073-A | Booster Pump | | | | | R&R |
| CHICO | STA. 073-A | Booster Pump Motor | | | | | R&R |
| CHICO | STA. 073-B | Booster Pump | | | | | R&R |
| CHICO | STA. 073-B | Booster Pump Motor | | | | | R&R |
| CHICO | STA. 073-B | Building | | | | | |
| CHICO | STA. 073-A | SCADA | | R&R | | R&R | |
| CHICO | STA. 074-T1 | Tank | | | | | |
| HC | STA. 001-01 | Well | R&R | | | | |
| HC | STA. 001-01 | Well Pump | | | R&R | | |
| HC | STA. 001-01 | Well Pump Motor | | | R&R | | |
| HC | STA. 001-01 | Building | R&R | | | | |
| HC | STA. 001-P1 | HP Tank | | | | | |
| HC | STA. 001-01 | SCADA | R&R | | | R&R | |
| HC | STA. 002-01 | Well | | R&R | | | |
| HC | STA. 002-01 | Well Pump | | | R&R | | |
| HC | STA. 002-01 | Well Pump Motor | | | R&R | | |
| HC | STA. 002-01 | Building | | | R&R | | |
| HC | STA. 002-P1 | HP Tank | | | | | |
| HC | STA. 002-01 | SCADA | R&R | | | R&R | |
| HC | STA. 002-02 | Well | | | | | |
| HC | STA. 002-02 | Well Pump | | | | R&R | |
| HC | STA. 002-02 | Well Pump Motor | | | | R&R | |
| HC | STA. 002-02 | Building | | | | | |
| HC | STA. 002-P2 | HP Tank | | | | | |
| HC | STA. 002-02 | SCADA | R&R | | | R&R | |

Public Version

**Table 2. Asset Inventory Summary for District Facilities**

| Cal Water Chico – Hamilton City District | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| City | Station | Well | Well Pump | Well Pump Motor | Booster Pump | Booster Pump Motor | Storage Tank | Hydro-pneumatic Tank | RTU |
| Chico | 001 | 1 | 1 | 1 | - | - | 2 | - | 1 |
| Chico | 003 | 1 | 1 | 1 | - | - | 1 | - | - |
| Chico | 004[a] | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 005 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 007 | 1 | 1 | 1 | - | - | - | - | 1 |
| Chico | 008 | 1 | 1 | 1 | - | - | 1 | - | - |
| Chico | 009[a] | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 011 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 012 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 013[a] | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 014 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 015[a] | 1 | 1 | 1 | - | - | - | - | 1 |
| Chico | 016 | 1 | 1 | 1 | 1 | 1 | - | - | 1 |
| Chico | 017 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 018 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 019 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 020 | 1 | 1 | 1 | - | - | - | - | 1 |
| Chico | 021 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 022 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 023 | 1 | 1 | 1 | - | - | - | - | 1 |
| Chico | 024 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 025 | 1 | 1 | 1 | - | - | - | - | 1 |
| Chico | 026 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 027 | 1 | 1 | 1 | - | - | - | - | 1 |
| Chico | 028 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 029 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 030 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 031 | 1 | 1 | 1 | - | - | - | - | 1 |
| Chico | 032 | 1 | 1 | 1 | - | - | - | - | 1 |
| Chico | 033[a] | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 034 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 035 | 1 | 1 | 1 | - | - | - | - | 1 |
| Chico | 037 | 1 | 1 | 1 | - | - | - | - | 1 |
| Chico | 038 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 039 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 040[a] | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 041 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 042 | 1 | 1 | 1 | - | - | - | - | 1 |
| Chico | 044 | 1 | 1 | 1 | - | - | - | 1 | - |
| Chico | 045[b] | 1 | 1 | 1 | - | - | - | - | 1 |
| Chico | 046 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 047 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 048 | 1 | 1 | 1 | - | - | - | - | 1 |
| Chico | 049 | 1 | 1 | 1 | - | - | - | - | 1 |
| Chico | 050 | 1 | 1 | 1 | 1 | 1 | - | 1 | - |
| Chico | 051 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 052 | 1 | 1 | 1 | - | - | - | - | 1 |
| Chico | 053 | 1 | 1 | 1 | - | - | - | - | 1 |
| Chico | 054 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 055[a] | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 056 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 057 | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 058[a] | 1 | 1 | 1 | - | - | - | - | - |
| Chico | 059 | 1 | 1 | 1 | - | - | - | - | 1 |
| Chico | 061 | 1 | 1 | 1 | - | - | - | - | 1 |
| Chico | 062 | 1 | 1 | 1 | - | - | - | - | - |

Public Version

| Cal Water Chico – Hamilton City District | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| City | Station | Well | Well Pump | Well Pump Motor | Booster Pump | Booster Pump Motor | Storage Tank | Hydro-pneumatic Tank | RTU |
| Chico | 063 | 1 | 1 | 1 | - | - | - | - | 1 |
| Chico | 064 | 1 | 1 | 1 | - | - | - | 1 | 1 |
| Chico | 065 | 1 | 1 | 1 | - | - | - | 1 | 1 |
| Chico | 066 | - | - | - | 4 | 4 | 2 | 2 | 1 |
| Chico | 067 | 1 | 1 | 1 | - | - | - | - | 1 |
| Chico | 068 | 1 | 1 | 1 | - | - | - | - | 1 |
| Chico | 069 | 1 | 1 | 1 | - | - | - | - | 1 |
| Chico | 070 | 1 | 1 | 1 | - | - | - | 1 | 1 |
| Chico | 071 | 1 | 1 | 1 | - | - | - | - | 1 |
| Chico | 072 | 1 | 1 | 1 | - | - | - | 1 | 1 |
| Chico | 073 | - | - | - | 2 | 2 | - | - | 1 |
| Chico | 074 | - | - | - | - | - | 1 | - | 1 |
| Hamilton | 001 | 1 | 1 | 1 | - | - | 1 | 1 | 1 |
| Hamilton | 002-1 | 1 | 1 | 1 | - | - | - | 1 | 1 |
| Hamilton | 002-2 | 1 | 1 | 1 | - | - | - | 1 | - |
| Total | | 68 | 68 | 68 | 8 | 8 | 8 | 11 | 34 |

(a) Inactive
(b) Abandoned

**Table 3. Summary of the Recommendations**

| Stations | Recommendations |
|---|---|
| Chico-001 | Repaint Tank 2 and erect fence along the perimeter of the tank site as planned, investigate the noise from the upper bearing of the motor, complete the interior painting currently in progress at Tank 2, replace cathodic protection anodes in 2007, and evaluate the integrity of the well casing. Evaluate the benefit of the two elevated tanks with a new booster pump installed downstream. |
| Chico-004 | Provide the scheduled minimum maintenance. |
| Chico-013 | Provide the scheduled minimum maintenance. |
| Chico-016 | Trim branches of tall trees nearby. Move the disinfection supply and equipment out of the pump building and store them in a separate shed equipped with secondary containment. Examine the conditions of the well and booster pump motor as they have lasted beyond the typical design life. |
| Chico-021 | Paint the exterior of the building and the GAC tower. Examine the conditions of the well and well pump as they have lasted beyond the typical design life. |
| Chico-024 | Evaluate the conditions of the well and well pump motor as they lasted beyond the typical design life. |
| Chico-026 | Paint the exterior of the pump building. |
| Chico-031 | Paint the exterior of the building. Verify the existence of the auxiliary power supply. |
| Chico-033 | Paint the building, and evaluate the conditions of the well and well pump as they have lasted beyond the typical design life. |
| Chico-040 | Provide the minimum scheduled maintenance. |
| Chico-042 | Repair or replace the pump motor. |
| Chico-044 | Secure the electrical panel, paint the exterior of the building trims and the hydropneumatic tank, and evaluate the conditions of the well and well pump as they have lasted beyond the typical design life. Install the variable frequency drive and adjust the pressure set point at the hydropneumatic tank. |
| Chico-046 | Remove the rust and repaint the electrical panel and evaluate the conditions of the well pump motor as it exceeded the typical design life. |
| Chico-053 | Repair the bent pane at the electrical panel and evaluate the conditions of the well pump as it has exceeded the typical design life. |
| Chico-056 | The loose engine exhaust seal should be corrected, furnish the missing “Eye Wash” sign, remove the rust and repaint the electrical panel, repair or replace building trim and repaint the fuel tank convault, and evaluate the conditions of the well pump and well pump motor as they exceeded the typical design life. |
| Chico-058 | Consider installing the tie-in with the drainage pipeline, rehabilitating the well and reactivating the station. |
| Chico-059 | Move the hypochlorite bins outside in a separate shed. |
| Chico-061 | Inspect structure for increased deterioration or defects. Repair the disinfectant generator (in process). |
| Chico-064 | Move the hypochlorite supply bins to a separate shed with a secondary containment. Paint the building trims and the hydropneumatic tank. |
| Chico-066 | Repaint Tank 2 exterior as scheduled. |
| Chico-068 | Provide a ramp to the secondary containment. |
| Chico-071 | Service the pump to minimize the leak and repaint the well head if damaged. |

# APPENDIX O

## Technical Memo for CWS SCADA System

Public Version

A T.E.E.M ELECTRICAL ENGINEERING Inc.
INDUSTRIAL & COMMERCIAL DESIGN

3123 BROADWAY
SACRAMENTO, CA 95817
TEL: (916) 457-8144
FAX: (916) 457-7876

June 26, 2006

Tony Park, P.E.
West Yost and Associates
7041 Koll Center Parkway Ste 100
Pleasanton, CA 94566
E-Mail: tpark@westyost.com

Description: Technical Memo for CWS SCADA System
Location: Chico and Livermore

It is the intent of this document to provide the California Water Service Company with an outline of future construction and maintenance considerations for the Supervisory Control and Data Acquisition (SCADA) System which it operates.

1. Construction Considerations:

   a. SCADAPack Remote Telemetry Units (RTU) should be used to replace existing RTUs, and installed in locations where there are no existing RTU.

   b. At a minimum, flow, pressure, and pump status should be monitored at each location. At build out, each RTU site should be controlled from a central location, and networked to other RTUs. Power meters should be installed to interface with the RTU to monitor the well efficiencies at each site. On-line chemical testing (total chlorine and nitrates) should be installed and monitored by SCADA.

   c. Security alarms and cameras should be installed at high risk locations. Digital video recorders can be located at each site, and video transferred on demand to a central viewing location.

   d. Chico will be adding at least 15 new RTU sites over the next year; Livermore will be adding at least 13 new RTU sites. Existing sites should be retrofitted to meet or exceed the current installation standard.

2. Maintenance:

   a. A maintenance program and schedule should be initiated to track all equipment installation dates, regular maintenance and calibrations. The following is a minimal list of what should be considered for maintenance of the SCADA system.

      1. CWS currently maintains FCC licensed radio pairs for SCADA communications. These licenses must be maintained to ensure the integrity of the SCADA system.

      2. Computers should be replaced every three to five years to reduce the chance of computer failure. CWS should have spare computer, preload with SCADA software, on hand to quickly replace any failed computer.

3. SCADA graphics programming should be maintained constantly to meet the needs of operations and management throughout the CWS system.

4. SCADA software should be maintained to meet version upgrade needs. Upgrade expenses of $5,000 per unit can be expected at least every five years. It is foreseeable that at some time in the future the current software will no longer be supported. At that time, CWS should investigate other software packages that will meet the needs of the system. New programming software may cost more than $10,000 per unit.

5. Each district should have several RTUs on hand for emergency repair needs, and at least one of each type of instrumentation equipment. This will shorten down time for any one RTU site.

6. It should be expected that at least four RTUs will need to be replaced every year for each district. This will allow for rotating out all RTUs every ten years.

7. Radios, antennas, and communications hardware will need to be replaced about as often as RTUs. As a RTU is replaced for normal maintenance, the radio equipment and monitoring equipment should be replaced.

Please call if you have any questions or require further information.

Sincerely,

Erik E. Burns, P.E.
A T.E.E.M. Electrical Engineering

Public Version

| Item | | 2006 | 2011 | 2016 | 2021 | 2026 | 2031 |
|---|---|---|---|---|---|---|---|
| **SCADAPack RTU** | | $7,000 | $7,000 | $7,000 | $7,000 | $7,000 | $7,000 |
| **Backup Power** | | $1,000 | $1,000 | $1,000 | $1,000 | $1,000 | $1,000 |
| **Antenna** | | $1,000 | $1,000 | $1,000 | $1,000 | $1,000 | $1,000 |
| **Installation** | | $15,000 | $15,000 | $15,000 | $15,000 | $15,000 | $15,000 |
| **Programming** | | $10,000 | $10,000 | $10,000 | $10,000 | $10,000 | $10,000 |
| **Misc.** | | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 |
| **Radio** | | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 | $5,000 |
| **Computer** | | $6,000 | $6,000 | $6,000 | $6,000 | $6,000 | $6,000 |
| **Software** | | $5,000 | $5,000 | $15,000 | $5,000 | $5,000 | $15,000 |
| **Process Equipment** | | $20,000 | $20,000 | $20,000 | $20,000 | $20,000 | $20,000 |
| **Network Hardware** | | $10,000 | $10,000 | $10,000 | $10,000 | $10,000 | $10,000 |
| | 0 | 85000 | 85000 | 95000 | 85000 | 85000 | 95000 |
| | | $5 | $5 | $5 | $5 | $5 | $5 |
| | | $17,000 | $17,000 | $19,000 | $17,000 | $17,000 | $19,000 |

Public Version

# APPENDIX P

## Condition Assessment Forms

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

## BUILDING, PUMP, MOTOR, DISINFECTION, AUXILIARY POWER, ELECTRICAL PANEL, and SCADA

Station: STA. 001

Location: [redacted]
Date:
Name:

**Building**
- [ ] Wood
- [ ] Sheet metal
- [ ] CMU
- [ ] Fiberglass
- [x] None — E. Panel w/ roof

E | A | P | n/a ✓

Year Constructed: _____

Dimension
- Length _____ ft
- Width _____ ft
- Height _____ ft

**Roof**
- [x] Sheet metal (corrugated)
- [ ] Tar coating
- [ ] Wood shingle
- [ ] Asphalt shingle
- [ ] Fiberglass

E | A ✓ | P | n/a

**Floor**
- [ ] Cracks
- [ ] Wet
- [ ] Workable space
- [ ] Clean

E | A | P | n/a ✓

**Illumination**
- [ ] Site — E | A | P | n/a ✓
- [x] Indoor — E | A ✓ | P | n/a

**Paint**
- Exterior — E | A | P | n/a ✓
- Interior — E | A | P | n/a ✓

**Security**
- [x] Gate with Padlock — E | A ✓ | P | n/a
- [x] Entry door with Lock (Panel) — E | A | P | n/a ✓
- [ ] Secured window

**HVAC**
- Heating
- Ventilation
- [ ] Space heater
- [ ] Louvers
- [ ] Roof fan

E | A | P | n/a ✓

**Fire Protection**
- [ ] Automatic fire sprinkler
- [ ] Portable fire extinguisher

None

**Well Pump**
- Manufacturer: BYRON JACKSO
- Model
- Design Flow: 500 gpm
- TDH: 214 ft

E | A | P | n/a

Year Installed: 12/30/1952 ★

**Status**
- [x] Active
  - [ ] Pumping at the time of inspection
  - [x] Off at the time of inspection — rarely used
  - [ ] Water quality
  - [ ] Yield
  - [ ] Other ( )
- [ ] Inactive
- [ ] Abandoned

**Packing**
- [ ] Leakage
- [ ] Mech. Seal
- [ ] Water Lube

oil lube

E | A ✓ | P | n/a

**Operation**
- [x] Excessive Noise (motor, per DHS)
- [ ] Excessive Vibration

E | A | P ✓ | n/a

**Paint**
- [ ] Fresh
- [x] Wear and Tear — Condition OK.

E | A | P ✓ | n/a

**Pump Motor**
- Manufacturer: U.S.
- Model
- Rating: 35 hp

Year Installed: 12/30/1952 ★

- [ ] Direct Drive backup
- [ ] Oil Level

E | A | P | n/a

**Disinfection**
- [ ] Calcium Hypochlorite
- [ ] Sodium Hypochlorite
- [ ] Generates the disinfectant

Plastic shed only

E | A | P | n/a ✓

**Metering Pump**
- Manufacturer
- Model

X

**Sampling**
- [ ] Analyzer
- [ ] Sampling Station

**Storage Bin**
- [ ] Volume 15 50 gallons
- [ ] In the pump building
- [ ] Weight on top of container
- [x] In a separate shed
- [ ] Secondary containment

X

E | A | P | n/a ✓

**Panel**
- Enclosure
  - [ ] Indoor
  - [x] Outdoor
  - [ ] Explosion-proof
- [ ] Board-mounted
- [x] Tip-over restraints
- [ ] On a concrete pad

E | A ✓ | P | n/a

Year Installed: _____

Integrity
- [x] Rusted ( Top Bottom <5 %) — minor
- [ ] Other

E | A | P ✓ | n/a

**Auxiliary Power**
- [ ] Equipped
- [x] Not equipped

E | A | P | n/a ✓

Type
- [ ] Generator
- [ ] Direct drive

X

Fuel
- [ ] Gasoline
- [ ] Diesel
- [ ] Natural Gas

X

**SCADA**
- RTU
  - [ ] MonoCon
  - [x] SCADAPack
  - [ ] Other
- [ ] Relay Antenna/Repeater

E ✓ | A | P | n/a

Year Installed: 2005 – 2006

- Manufacturer
- Model

Parameters
- [ ] Influent Pressure — E | A | P | n/a
- [x] Effluent Pressure — E | A | P | n/a
- [x] Flow Rate — E | A | P | n/a
- [ ] Tank Level — E | A | P | n/a
- [ ] Water Quality — E | A | P | n/a
  - [ ] Bacteria — E | A | P | n/a
  - [ ] Nitrate — E | A | P | n/a
  - [ ] VOC — E | A | P | n/a
  - [ ] Other

**Other Observations**

Tank
- Site to be fenced in next year
- Source of liability (people climbing the elevated tanks)
- Well const. in 1909.

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

## STORAGE TANK

Station: STA. 001

Location
Date
Name: [redacted]

Tank No.: STA. 001-T1

Capacity: 74,000 gallons

Installed Year: 1905 *

Material:
- [ ] Redwood
- [ ] Concrete
- [x] Steel Elevated

Dimension:
- Diameter: 22 ft
- Height: 26 ft

Tank Filled by:
- [ ] Booster
- [x] Well
- [x] Zone pressure

Fill stopped by:
- [ ] Altitude valve
- [ ] Level sensor pump shut off

Tank Drawn by:
- [ ] Booster
- [x] Zone pressure

Roof Type:
- [ ] Wood Frame
- [x] Steel
- [ ] Sheet metal
- [ ] Tar coating
- [ ] Wood shingle
- [ ] Umbrella
- [ ] Knuckle
- [x] Cone

E | A | P | n/a

Coating:
- Exterior
  - [x] Paint — E | A | P | n/a — Date
  - [ ] Epoxy
  - [ ] Other ( )
- Interior
  - [ ] Fiberglass — E | A | P | n/a — Date
  - [ ] Epoxy
  - [ ] Other ( )

Corrosion:
- [x] Current Cathodic Protection (Serviced by District
- [ ] Other ( )

Rust, Rust Stain, Pitting, Peeling, Blisters: Not visible % of tank surface

Hazard:
- [x] Overgrown Tree nearby Not threat
- [ ] Storage pile nearby
- [ ] Other ( )

Cracks:
- [ ] Concrete Wall
- [ ] Ring Foundation N/A
- [ ] Footing

Leaks:
- [ ] Weep
- [ ] Seep None witnessed

Mixing:
- [x] Single inlet/outlet rarely cycles
- [ ] Separate inlet/outlet
- [ ] Motorized mixing

Air Vents:
- [ ] Roof — [ ] Screened — E | A | P | n/a
- [ ] Overflow pipe — [ ] Screened — E | A | P | n/a
- [ ] Other ( ) — [ ] Screened — E | A | P | n/a

Foundation: E | A | P | n/a
- [ ] Compacted soil
- [ ] Oiled sand pad
- [ ] Asphalt pad
- [x] Concrete footing (10' x 10')
- [ ] Concrete ring
- [ ] Berm

Seismic: E | A | P | n/a
- [ ] Anchor bolts None
- [ ] Flexible Connection
- [ ] Bellow (Dia. inch)
- [ ] EBBA fitting

Access to Roof:
- [x] Ladder
- [ ] Other ( )

Security:
- [ ] Chain Link Fence with Lock — E | A | P | n/a
- [ ] Wood Fence with Lock — E | A | P | n/a
- [ ] Hatch Open Alarm
- [x] Covered Ladder

Site:
- [ ] Erosion around tank
- [ ] Blend well with surroundings
- Max vehicle access width: 24 ft

Notes and Other Observations

- Elev. tanks are not cycling due to low HGL compared to the main pressure zone HGL.
- Staff drains monthly to avoid prolonged stagnation of stored water.

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

**STORAGE TANK**

Station: STA. 001

Location / Date / Name: [redacted]

Tank No.: STA. 001-T2

Capacity: 126,000 gallons

Installed Year: 1913 ✗

Material:
- [ ] Redwood
- [ ] Concrete
- [x] Steel Elevated

Dimension: Diameter 27 ft; Height 29.5 ft

Tank Filled by:
- [ ] Booster
- [x] Well
- [x] Zone pressure

Fill stopped by:
- [ ] Altitude valve
- [ ] Level sensor pump shut off

Tank Drawn by:
- [ ] Booster
- [x] Zone pressure

Roof Type:
- [ ] Wood Frame
- [x] Steel

Sheet metal / Tar coating / Wood shingle / Umbrella / Knuckle / [x] Cone — E A P n/a

Coating:
- Exterior: [x] Paint — E A P n/a; Epoxy; Other ( ); Date
- Interior: Fiberglass — E A P n/a; Epoxy; Other ( ); Date

Corrosion:
- [x] Current Cathodic Protection (Serviced by District)
- [ ] Other ( )

Rust, Rust Stain, Pitting, Peeling, Blisters: Not visible % of tank surface

Hazard:
- [ ] Overgrown Tree nearby
- [ ] Storage pile nearby
- [ ] Other ( )

Cracks:
- [ ] Concrete Wall
- [ ] Ring Foundation
- [ ] Footing

N/A

Leaks:
- [ ] Weep
- [ ] Seep

None witnessed

Mixing:
- [x] Single inlet/outlet
- [ ] Separate inlet/outlet
- [ ] Motorized mixing

Air Vents:
- [ ] Roof — [ ] Screened — E A P n/a
- [ ] Overflow pipe — [ ] Screened — E A P n/a
- [ ] Other ( ) — [ ] Screened — E A P n/a

Foundation: E A P n/a
- [ ] Compacted soil
- [ ] Oiled sand pad
- [ ] Asphalt pad
- [x] Concrete footing (10' X 10')
- [ ] Concrete ring
- [ ] Berm

Seismic: E A P n/a
- [ ] Anchor bolts — None
- [ ] Flexible Connection — [ ] Bellow (Dia. inch); [ ] EBBA fitting

Access to Roof:
- [x] Ladder
- [ ] Other ( )

Security:
- [ ] Chain Link Fence with Lock — E A P n/a
- [ ] Wood Fence with Lock — E A P n/a
- [ ] Hatch Open Alarm
- [x] Covered Ladder

Site:
- [ ] Erosion around tank
- [ ] Blend well with surroundings
- Max vehicle access width: 24 ft

Notes and Other Observations

The exterior to be painted in summer 2006 (or 2007).

See T1 comments.

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

## BUILDING, PUMP, MOTOR, DISINFECTION, AUXILIARY POWER, ELECTRICAL PANEL, and SCADA

Station: STA. 004

Location: [redacted]
Date: [redacted]
Name: [redacted]

**Building** — E | A | P | n/a ✓
- [ ] Wood
- [ ] Sheet metal
- [ ] CMU
- [ ] Fiberglass
- [✓] None — E. Panel w/ roof

Year Constructed: _____

Dimension
- Length _____ ft
- Width _____ ft
- Height _____ ft

Roof — E | A | P | n/a ✓
- [✓] Sheet metal — Corrugated
- [ ] Tar coating
- [ ] Wood shingle
- [ ] Asphalt shingle
- [ ] Fiberglass

Floor — E | A | P | n/a ✓
- [ ] Cracks
- [ ] Wet
- [ ] Workable space
- [ ] Clean

Illumination
- [ ] Site — E | A | P | n/a
- [ ] Indoor — E | A | P | n/a

Paint
- Exterior — E | A | P | n/a
- Interior — E | A | P | n/a

Security — E | A | P | n/a ✓
- [ ] Gate with Padlock — NO (6' fence)
- [✓] Entry door with Lock — (Panel)
- [ ] Secured window

HVAC — E | A | P | n/a
- Heating
- Ventilation
- [ ] Space heater
- [ ] Louvers
- [ ] Roof fan

Fire Protection
- [ ] Automatic fire sprinkler
- [ ] Portable fire extinguisher

**Well Pump** — E | A | P | n/a
- Manufacturer: BYRON JACKSO
- Model: 122CKMH
- Design Flow: 1000 gpm
- TDH: 217 ft

Submersible

Year Installed: 5/9/1960 ✗

Status
- [ ] Active
- [✓] Inactive
- [ ] Abandoned
- [ ] Pumping at the time of inspection
- [✓] Off at the time of inspection
- [ ] Water quality
- [ ] Yield
- [ ] Other ( )

Packing — E | A | P | n/a ✓
- [ ] Leakage
- [ ] Mech. Seal
- [ ] Water Lube

Operation — E | A | P | n/a ✓
- [ ] Excessive Noise
- [ ] Excessive Vibration

Paint — E | A | P | n/a ✓
- [ ] Fresh
- [✓] Wear and Tear

**Pump Motor**
- Manufacturer: BYRON JACKSON
- Model: TYPE H
- Rating: 75 hp

Submersible

Year Installed: 11/9/1976 ✗

- [ ] Direct Drive backup
- [ ] Oil Level — E | A | P | n/a ✓

**Disinfection** — E | A | P | n/a
- [ ] Calcium Hypochlorite
- [ ] Sodium Hypochlorite
- [ ] Generates the disinfectant

Plastic shed only

Metering Pump
- Manufacturer
- Model

X

Sampling
- [ ] Analyzer
- [ ] Sampling Station

X

Storage Bin
- [ ] Volume 15 50 gallons
- [ ] In the pump building
- [ ] Weight on top of container
- [✓] In a separate shed — E | A | P | n/a
- [ ] Secondary containment

**Panel**
- Enclosure
  - [ ] Indoor
  - [✓] Outdoor
  - [ ] Explosion-proof — E | A | P | n/a
- [ ] Board-mounted
- [ ] Tip-over restraints
- [✓] On 3" concrete pad

Year Installed: _____

Integrity — E | A | P | n/a ✓
- [ ] Rusted ( Top Bottom %)
- [ ] Other

**Auxiliary Power** — E | A | P | n/a
- [ ] Equipped
- [✓] Not equipped

Type
- [ ] Generator
- [ ] Direct drive

Fuel
- [ ] Gasoline
- [ ] Diesel
- [ ] Natural Gas

**SCADA** — E | A | P | n/a ✓
- RTU
  - [ ] MonoCon
  - [ ] SCADAPack
  - [ ] Other
- [ ] Relay Antenna/Repeater

Year Installed: _____

- Manufacturer
- Model

X

Parameters — E | A | P | n/a
- [ ] Influent Pressure
- [ ] Effluent Pressure
- [ ] Flow Rate
- [ ] Tank Level
- [ ] Water Quality
- [ ] Bacteria
- [ ] Nitrate
- [ ] VOC
- [ ] Other

**Other Observations**

Station inactive due to:
- low yield (200 gpm)
- Heavy Sand
- well const. in 1960.

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

## BUILDING, PUMP, MOTOR, DISINFECTION, AUXILIARY POWER, ELECTRICAL PANEL, and SCADA

Station: STA. 013

Location
Date
Name

**Building**
- [ ] Wood
- [x] Sheet metal
- [ ] CMU
- [ ] Fiberglass
- [ ] None

E | A | [x] | n/a

Year Constructed: _____

Dimension
- Length _____ ft
- Width _____ ft
- Height _____ ft

Roof
- [x] Sheet metal
- [ ] Tar coating
- [ ] Wood shingle
- [ ] Asphalt shingle
- [ ] Fiberglass

E | [x] | [ ] | n/a

Floor
- [x] Cracks
- [ ] Wet
- [ ] Workable space
- [ ] Clean

E | [x] | P | n/a

Illumination
- [ ] Site — E | A | P | n/a
- [x] Indoor — E | A | P | n/a

Paint
- Exterior — E | [x] | [ ] | n/a
- Interior — E | [x] | [ ] | n/a

Security
- [x] Gate with Padlock — E | [x] | P | n/a
- [x] Entry door with Lock — E | [x] | P | n/a
- [ ] Secured window

HVAC
- Heating / Ventilation
- [ ] Space heater
- [x] Louvers
- [ ] Roof fan

E | A | [x] | n/a

Fire Protection
- [ ] Automatic fire sprinkler
- [ ] Portable fire extinguisher

**Well Pump**
- Manufacturer NULL
- Model NULL
- Design Flow NULL gpm
- TDH NULL ft

E | A | P | n/a

Year Installed: NULL

Status
- [ ] Active
- [x] Inactive
- [ ] Abandoned
- [ ] Pumping at the time of inspection
- [x] Off at the time of inspection
- [x] Water quality
- [ ] Yield
- [ ] Other ( )

Packing
- [ ] Leakage
- [ ] Mech. Seal
- [ ] Water Lube

oil lube

E | A | P | n/a

Operation
- [ ] Excessive Noise
- [ ] Excessive Vibration

E | A | P | n/a

Paint
- [ ] Fresh
- [ ] Wear and Tear

E | [x] | P | n/a

**Pump Motor**
- Manufacturer NULL
- Model NULL
- Rating NULL hp

Year Installed: NULL

- [ ] Direct Drive backup
- [ ] Oil Level

E | A | P | n/a

**Disinfection**
- [ ] Calcium Hypochlorite
- [ ] Sodium Hypochlorite
- [ ] Generates the disinfectant

E | A | P | [x]

Metering Pump
- Manufacturer
- Model

X

Sampling
- [ ] Analyzer
- [ ] Sampling Station

Storage Bin
- [ ] Volume 15 50 gallons
- [ ] In the pump building
- [ ] Weight on top of container
- [ ] In a separate shed
- [ ] Secondary containment

E | A | P | n/a

**Panel**
- Enclosure
- [x] Indoor
- [ ] Outdoor
- [ ] Explosion-proof
- [x] Board-mounted
- [ ] Tip-over restraints
- [ ] On 3" concrete pad

E | A | [x] | n/a

Year Installed: _____

Integrity
- [ ] Rusted ( Top Bottom %)
- [ ] Other

E | [x] | P | n/a

**Auxiliary Power**
- [ ] Equipped
- [x] Not equipped

E | A | P | n/a

Type
- [ ] Generator
- [ ] Direct drive

Fuel
- [ ] Gasoline
- [ ] Diesel
- [ ] Natural Gas

**SCADA**
- RTU
- [ ] Relay Antenna/Repeater
- [ ] MonoCon
- [ ] SCADAPack
- [ ] Other

E | A | P | [x]

Year Installed: _____

- Manufacturer
- Model

X

Parameters
- [ ] Influent Pressure — E | A | P | n/a
- [ ] Effluent Pressure — E | A | P | n/a
- [ ] Flow Rate — E | A | P | n/a
- [ ] Tank Level — E | A | P | n/a
- [ ] Water Quality — E | A | P | n/a
- [ ] Bacteria — E | A | P | n/a
- [ ] Nitrate — E | A | P | n/a
- [ ] VOC — E | A | P | n/a
- [ ] Other

**Other Observations**

- WQ per DHS : Taste & Odor
- Sand trap
- Ext. pipe to be repainted.
- well const. in 1948.
- No immediate plans for reactivation.

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

**BUILDING, PUMP, MOTOR, DISINFECTION, AUXILIARY POWER, ELECTRICAL PANEL, and SCADA**

Station: STA. 016

Location: [redacted]
Date: [redacted]
Name: [redacted]

**Building**
- [ ] Wood
- [x] Sheet metal
- [ ] CMU
- [ ] Fiberglass
- [ ] None

E | A | P | n/a

Year Constructed: _____

Dimension: Length 12 ft; Width 12 ft; Height _____ ft

**Roof**
- [x] Sheet metal
- [ ] Tar coating
- [ ] Wood shingle
- [ ] Asphalt shingle
- [ ] Fiberglass

E | A | P | n/a

Paint peeling

**Floor**
- [ ] Cracks
- [ ] Wet
- [x] Workable space
- [x] Clean NOT

E | A | P | n/a

Non-skid coating peeling

**Illumination**
- [ ] Site — E | A | P | n/a
- [x] Indoor — E | A | P | n/a

**Paint**
- Exterior — E | A | P | n/a
- Interior — E | A | P | n/a

peeling

**Security**
- [x] Gate with Padlock — E | A | P | n/a
- [x] Entry door with Lock — E | A | P | n/a
- [x] Secured window — Boarded up

**HVAC**
- Heating / Ventilation
- [ ] Space heater
- [x] Louvers
- [ ] Roof fan

E | A | P | n/a

**Fire Protection**
- [ ] Automatic fire sprinkler
- [ ] Portable fire extinguisher

**Well Pump**
- Manufacturer: PEERLESS
- Model: 10 HXB
- Design Flow: 900 gpm
- TDH: 110 ft

E | A | P | n/a

Year Installed: 9/4/1985

**Status**
- [x] Active
  - [x] Pumping at the time of inspection
  - [ ] Off at the time of inspection
  - [ ] Water quality
  - [ ] Yield
  - [ ] Other ( )
- [ ] Inactive
- [ ] Abandoned

**Packing**
- [ ] Leakage
- [ ] Mech. Seal
- [ ] Water Lube

E | A | P | n/a

**Operation**
- [ ] Excessive Noise
- [ ] Excessive Vibration

normal op.

E | A | P | n/a

**Paint**
- [ ] Fresh
- [x] Wear and Tear

E | A | P | n/a

**Pump Motor**
- Manufacturer: 0
- Model: 0
- Rating: 0 hp

Year Installed: 4/29/2002

- [ ] Direct Drive backup
- [ ] Oil Level

E | A | P | n/a

**Disinfection**
- [ ] Calcium Hypochlorite
- [x] Sodium Hypochlorite
- [ ] Generates the disinfectant

E | A | P | n/a

Metering Pump
- Manufacturer
- Model: Alldos 208

**Sampling**
- [ ] Analyzer
- [x] Sampling Station PCE

**Storage Bin**
- [ ] Volume: 15 (50) gallons ×2
- [x] In the pump building
- [x] Weight on top of container
- [ ] In a separate shed
- [ ] Secondary containment (missing)

E | A | P | n/a

**Panel**
- Enclosure
  - [x] Indoor
  - [ ] Outdoor
  - [ ] Explosion-proof
- [x] Board-mounted
- [ ] Tip-over restraints
- [ ] On 3" concrete pad

E | A | P | n/a

Year Installed: _____

Integrity
- [ ] Rusted ( Top Bottom %)
- [ ] Other

E | A | P | n/a

**Auxiliary Power**
- [ ] Equipped
- [x] Not equipped

E | A | P | n/a

Type
- [ ] Generator
- [ ] Direct drive

Fuel
- [ ] Gasoline
- [ ] Diesel
- [ ] Natural Gas

**SCADA**
- RTU
  - [ ] MonoCon
  - [x] SCADAPack
  - [ ] Other
- [ ] Relay Antenna/Repeater

E | A | P | n/a

Year Installed: 2005-2006

- Manufacturer
- Model

Parameters
- [ ] Influent Pressure — E | A | P | n/a
- [x] Effluent Pressure — E | A | P | n/a
- [x] Flow Rate — E | A | P | n/a
- [ ] Tank Level — E | A | P | n/a
- [ ] Water Quality — E | A | P | n/a
  - [ ] Bacteria — E | A | P | n/a
  - [ ] Nitrate — E | A | P | n/a
  - [ ] VOC — E | A | P | n/a
  - [ ] Other

**Other Observations**

- Air Stipper for PCE removal
- Booster from wet well.
- Tree branches too close to air stripper
- Cl2 supply to move out of building

- well const. in 1949.
- Duck taped air ducks.

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

**BUILDING, PUMP, MOTOR, DISINFECTION, AUXILIARY POWER, ELECTRICAL PANEL, and SCADA**

Station: STA. 021

Location
Date
Name

**Building**
- [x] Wood
- [ ] Sheet metal
- [ ] CMU
- [ ] Fiberglass
- [ ] None

E [x] A [ ] n/a

Year Constructed: _____

Dimension
- Length: 12 ft
- Width: 12 ft
- Height: _____ ft

Roof
- [ ] Sheet metal
- [ ] Tar coating
- [ ] Wood shingle
- [x] Asphalt shingle
- [ ] Fiberglass

E [x] A [ ] n/a

Floor
- [x] Cracks minor
- [ ] Wet
- [ ] Workable space
- [ ] Clean

E [x] A P n/a

Illumination
- [ ] Site — E A P n/a
- [x] Indoor — E A P n/a

Paint
- Exterior — E [x] A [x] n/a
- Interior — E [x] A P n/a

Security
- [x] Gate with Padlock — E [x] A P n/a
- [x] Entry door with Lock — E [x] A P n/a
- [x] Secured window (screen)

HVAC
- Heating / Ventilation
- [ ] Space heater
- [x] Louvers
- [ ] Roof fan

E [x] A P n/a

Fire Protection
- [ ] Automatic fire sprinkler
- [ ] Portable fire extinguisher

none

**Well Pump**
- Manufacturer: L&B
- Model
- Design Flow: 850 gpm
- TDH: 0 ft

E A P n/a

Year Installed: 1/1/1953 ★

Status
- [x] Active
- [ ] Inactive
- [ ] Abandoned

- [x] Pumping at the time of inspection
- [ ] Off at the time of inspection
- [ ] Water quality
- [ ] Yield
- [ ] Other ( )

Packing
- [ ] Leakage
- [ ] Mech. Seal
- [ ] Water Lube

E A P n/a

Operation
- [ ] Excessive Noise
- [ ] Excessive Vibration

normal op.

E A P n/a

Paint
- [ ] Fresh
- [ ] Wear and Tear

E A P n/a

**Pump Motor**
- Manufacturer: G.E.
- Model: 5KS364 DT6005D2
- Rating: 60 hp

Year Installed: 3/24/1995

- [ ] Direct Drive backup
- [ ] Oil Level

E A P n/a

**Disinfection**
- [ ] Calcium Hypochlorite
- [x] Sodium Hypochlorite
- [ ] Generates the disinfectant

E [x] A P n/a

Metering Pump
- Manufacturer
- Model: Alldos 208

Sampling
- [ ] Analyzer
- [x] Sampling Station

Storage Bin
- [ ] Volume: 15 50 gallons (x2)
- [ ] In the pump building
- [ ] Weight on top of container
- [x] In a separate shed
- [x] Secondary containment

E [x] A P n/a

**Panel**
- Enclosure
- [x] Indoor
- [ ] Outdoor
- [ ] Explosion-proof

E [x] A [ ] n/a

- [ ] Board-mounted
- [ ] Tip-over restraints
- [ ] On 3" concrete pad

on floor

Year Installed: _____

Integrity
- [ ] Rusted ( Top Bottom %)
- [ ] Other

E A P n/a

**Auxiliary Power**
- [ ] Equipped
- [x] Not equipped

E A P n/a

Type
- [ ] Generator
- [ ] Direct drive

Fuel
- [ ] Gasoline
- [ ] Diesel
- [ ] Natural Gas

**SCADA**
- RTU
- [ ] MonoCon
- [x] SCADAPack
- [ ] Other
- [ ] Relay Antenna/Repeater

E [x] A P n/a

Year Installed: 2005-2006

- Manufacturer
- Model

Parameters
- [ ] Influent Pressure — E A P n/a
- [x] Effluent Pressure — E A P n/a
- [x] Flow Rate — E A P n/a
- [ ] Tank Level — E A P n/a
- [ ] Water Quality — E A P n/a
  - [ ] Bacteria — E A P n/a
  - [ ] Nitrate — E A P n/a
  - [ ] VOC — E A P n/a
  - [ ] Other

**Other Observations**

- GAC Tower dirty (moved from STA 15)
- Media replacement period = 18 mo.
- " " last week.
- Pressure loss = 4 psi w/ new media.

- well const. in 1953.
- Ext. piping paint peeling
- GAC tower placed in 1993.

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

**BUILDING, PUMP, MOTOR, DISINFECTION, AUXILIARY POWER, ELECTRICAL PANEL, and SCADA**

Station: STA. 024

Location
Date
Name

[redacted]

**Building**
- [x] Wood
- [ ] Sheet metal
- [ ] CMU
- [ ] Fiberglass
- [ ] None

E [ ] A [x] P [ ] n/a

Year Constructed: _____

Dimension
- Length _____ ft
- Width _____ ft
- Height _____ ft

Roof
- [ ] Sheet metal
- [ ] Tar coating
- [ ] Wood shingle
- [x] Asphalt shingle
- [ ] Fiberglass

E [ ] A [x] P [ ] n/a

Floor
- [ ] Cracks
- [ ] Wet
- [ ] Workable space
- [ ] Clean

E [ ] A [ ] P [ ] n/a

Illumination
- [ ] Site — E [ ] A [ ] P [ ] n/a
- [x] Indoor — E [ ] A [ ] P [ ] n/a

Paint
- Exterior — E [ ] A [x] P [ ] n/a
- Interior — E [ ] A [x] P [ ] n/a

Security
- [x] Gate with Padlock — E [ ] A [x] P [ ] n/a
- [x] Entry door with Lock — E [ ] A [x] P [ ] n/a
- [ ] Secured window

HVAC
- Heating / Ventilation
- [ ] Space heater
- [x] Louvers
- [ ] Roof fan

E [ ] A [ ] P [ ] n/a

Fire Protection
- [ ] Automatic fire sprinkler
- [ ] Portable fire extinguisher

none

**Well Pump**
- Manufacturer: BYRON JACKSO
- Model
- Design Flow: 750 gpm
- TDH: 255 ft

E [ ] A [ ] P [ ] n/a

Year Installed: 10/26/1994

Status
- [x] Active
- [ ] Inactive
- [ ] Abandoned

550 gpm @ 2:50pm

- [x] Pumping at the time of inspection
- [ ] Off at the time of inspection
- [ ] Water quality
- [ ] Yield
- [ ] Other ( )

Packing
- [ ] Leakage
- [ ] Mech. Seal
- [ ] Water Lube

E [ ] A [ ] P [ ] n/a

Normal op.

Operation
- [ ] Excessive Noise
- [ ] Excessive Vibration

E [ ] A [ ] P [ ] n/a

Paint
- [ ] Fresh
- [ ] Wear and Tear

E [ ] A [ ] P [ ] n/a

**Pump Motor**
- Manufacturer: G.E.
- Model: 5KS364DT6005
- Rating: 60 hp

Year Installed: 3/1/1955 ★

- [ ] Direct Drive backup
- [ ] Oil Level

E [ ] A [ ] P [ ] n/a

**Disinfection**
- [ ] Calcium Hypochlorite
- [x] Sodium Hypochlorite
- [ ] Generates the disinfectant

E [ ] A [ ] P [ ] n/a

Metering Pump
- Manufacturer
- Model: Alldos 208

Sampling
- [x] Analyzer: Cl2
- [ ] Sampling Station

Storage Bin
- [ ] Volume: 15 / 50 (x2) gallons
- [ ] In the pump building
- [ ] Weight on top of container
- [x] In a separate shed
- [x] Secondary containment

E [x] A [ ] P [ ] n/a

**Panel**
- Enclosure
- [x] Indoor
- [ ] Outdoor
- [ ] Explosion-proof

E [ ] A [ ] P [x] n/a

- [ ] Board-mounted
- [ ] Tip-over restraints
- [ ] On 3" concrete pad

On floor

Year Installed: _____

Integrity
- [x] Rusted ( Top / Bottom %)
- [ ] Other

E [ ] A [x] P [ ] n/a

**Auxiliary Power**
- [ ] Equipped
- [x] Not equipped

E [ ] A [ ] P [ ] n/a

Type
- [ ] Generator
- [ ] Direct drive

Fuel
- [ ] Gasoline
- [ ] Diesel
- [ ] Natural Gas

**SCADA**
- RTU
- [x] MonoCon
- [ ] SCADAPack
- [ ] Other
- [ ] Relay Antenna/Repeater

E [ ] A [ ] P [ ] n/a

Year Installed: pre 2005

- Manufacturer
- Model

Parameters
- [ ] Influent Pressure — E [ ] A [ ] P [ ] n/a
- [x] Effluent Pressure — E [ ] A [ ] P [ ] n/a
- [x] Flow Rate — E [ ] A [ ] P [ ] n/a
- [ ] Tank Level — E [ ] A [ ] P [ ] n/a
- [x] Water Quality — E [ ] A [ ] P [ ] n/a
  - [ ] Bacteria — E [ ] A [ ] P [ ] n/a
  - [ ] Nitrate — E [ ] A [ ] P [ ] n/a
  - [ ] VOC — E [ ] A [ ] P [ ] n/a
  - [x] Other Cl2

**Other Observations**

- Well was rehabbed ~2 yrs ago
- Bacti in raw water.
- Well const in 1955.

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

## BUILDING, PUMP, MOTOR, DISINFECTION, AUXILIARY POWER, ELECTRICAL PANEL, and SCADA

Station: STA. 026

Location
Date
Name

**Building**
- [x] Wood
- [ ] Sheet metal
- [ ] CMU
- [ ] Fiberglass
- [ ] None

E [ ] A [x] P [ ] n/a

Year Constructed: _____

Dimension
- Length _____ ft
- Width _____ ft
- Height _____ ft

Roof
- [ ] Sheet metal
- [ ] Tar coating
- [ ] Wood shingle
- [x] Asphalt shingle
- [ ] Fiberglass

E [ ] A [x] P [ ] n/a

Floor
- [x] Cracks minor
- [ ] Wet
- [ ] Workable space
- [x] Clean NOT

E [ ] A [ ] P [x] n/a

Illumination
- [ ] Site — E [ ] A [ ] P [ ] n/a
- [x] Indoor — E [ ] A [ ] P [ ] n/a

Paint
- Exterior — E [ ] A [x] P [ ] n/a
- Interior — E [ ] A [x] P [ ] n/a

Need some painting

Security
- [x] Gate with Padlock — E [ ] A [ ] P [ ] n/a
- [x] Entry door with Lock — E [ ] A [ ] P [ ] n/a
- [x] Secured window (screened)

HVAC
- Heating
- Ventilation
- [ ] Space heater
- [ ] Louvers
- [ ] Roof fan

E [ ] A [ ] P [ ] n/a

Fire Protection
- [ ] Automatic fire sprinkler
- [ ] Portable fire extinguisher

**Well Pump**
- Manufacturer: LAYNE & BOWLE
- Model: 12RXL
- Design Flow: 850 gpm
- TDH: 270 ft

E [ ] A [ ] P [ ] n/a

Year Installed: 3/1/1990

Status
- [x] Active
- [ ] Inactive
- [ ] Abandoned
- [ ] Pumping at the time of inspection
- [ ] Off at the time of inspection
- [ ] Water quality
- [ ] Yield
- [ ] Other ( )

Packing
- [ ] Leakage
- [ ] Mech. Seal
- [ ] Water Lube

Oil lube

E [ ] A [ ] P [ ] n/a

Operation
- [ ] Excessive Noise
- [ ] Excessive Vibration

E [ ] A [ ] P [ ] n/a

Paint
- [ ] Fresh
- [x] Wear and Tear

E [ ] A [ ] P [ ] n/a

**Pump Motor**
- Manufacturer: G.E.
- Model: 5KS6268XH1A
- Rating: 75 hp

Year Installed: 1/1/1984

- [ ] Direct Drive backup
- [ ] Oil Level

E [ ] A [ ] P [ ] n/a

8'x8' FG Shed

**Disinfection**
- [ ] Calcium Hypochlorite
- [x] Sodium Hypochlorite
- [ ] Generates the disinfectant

E [ ] A [ ] P [ ] n/a

Metering Pump
- Manufacturer
- Model

Sampling
- [ ] Analyzer
- [ ] Sampling Station

Storage Bin
- [ ] Volume 15 (50) x2 gallons
- [ ] In the pump building
- [ ] Weight on top of container
- [x] In a separate shed
- [x] Secondary containment

E [x] A [ ] P [ ] n/a

**Panel**
- Enclosure
  - [x] Indoor
  - [ ] Outdoor
  - [ ] Explosion-proof
- [ ] Board-mounted
- [ ] Tip-over restraints
- [ ] On 3" concrete pad on floor

E [ ] A [x] P [ ] n/a

Year Installed: _____

Integrity
- [x] Rusted ( Top (Bottom) 10 %)
- [ ] Other

Needs corrosion protection

E [ ] A [x] P [ ] n/a

**Auxiliary Power**
- [ ] Equipped
- [x] Not equipped

E [ ] A [ ] P [ ] n/a

Type
- [ ] Generator
- [ ] Direct drive

Fuel
- [ ] Gasoline
- [ ] Diesel
- [ ] Natural Gas

**SCADA**
- RTU
  - [ ] MonoCon
  - [x] SCADAPack
  - [ ] Other
- [ ] Relay Antenna/Repeater

E [x] A [ ] P [ ] n/a

Year Installed: 2005 - 2006

- Manufacturer
- Model

Parameters
- [ ] Influent Pressure — E [ ] A [ ] P [ ] n/a
- [x] Effluent Pressure — E [ ] A [ ] P [ ] n/a
- [x] Flow Rate — E [ ] A [ ] P [ ] n/a
- [ ] Tank Level — E [ ] A [ ] P [ ] n/a
- [ ] Water Quality — E [ ] A [ ] P [ ] n/a
  - [ ] Bacteria — E [ ] A [ ] P [ ] n/a
  - [ ] Nitrate — E [ ] A [ ] P [ ] n/a
  - [ ] VOC — E [ ] A [ ] P [ ] n/a
  - [ ] Other

**Other Observations**

- Station drawings show a 500-gal fuel tank in the yard.
- Correct the drawing per existing condition.
- Well const. in 1959.

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

## BUILDING, PUMP, MOTOR, DISINFECTION, AUXILIARY POWER, ELECTRICAL PANEL, and SCADA

Station: STA. 031

Location: [redacted]
Date: [redacted]
Name: [redacted]

**Building**
- [x] Wood — E [ ] A [x] P n/a
- [ ] Sheet metal
- [ ] CMU
- [ ] Fiberglass
- [ ] None

Year Constructed: _____

Dimension
- Length _____ ft
- Width _____ ft
- Height _____ ft

Roof
- [ ] Sheet metal — E [ ] A [x] P n/a
- [ ] Tar coating
- [ ] Wood shingle
- [x] Asphalt shingle
- [ ] Fiberglass

Floor
- [x] Cracks minor — E [ ] A [x] P n/a
- [ ] Wet
- [ ] Workable space
- [ ] Clean

Illumination
- [ ] Site — E A P n/a
- [ ] Indoor — E A P n/a

Paint
- Exterior — E A [x] P n/a
- Interior — E [x] A P n/a

Security
- [x] Gate with Padlock — E [x] A P n/a
- [x] Entry door with Lock — E [x] A P n/a
- [ ] Secured window

HVAC
- Heating / Ventilation — E [x] A P n/a
- [ ] Space heater
- [x] Louvers
- [ ] Roof fan

Fire Protection
- [ ] Automatic fire sprinkler
- [ ] Portable fire extinguisher

**Well Pump**
- Manufacturer: LAYNE & BOWLE — E A P n/a
- Model: 12RL
- Design Flow: 950 gpm
- TDH: 240 ft

Year Installed: 4/17/1996

Status
- [x] Active
- [ ] Inactive
- [ ] Abandoned
- [x] Pumping at the time of inspection — 700gpm @ 70psi
- [ ] Off at the time of inspection
- [ ] Water quality
- [ ] Yield
- [ ] Other ( )

Packing
- [ ] Leakage — E A P n/a
- [ ] Mech. Seal
- [ ] Water Lube

Operation
- [x] Excessive Noise — E A P n/a
- [ ] Excessive Vibration

Paint
- [ ] Fresh — E A P n/a
- [x] Wear and Tear

**Pump Motor**
- Manufacturer: U.S.
- Model: RZ03-Z0870231GT
- Rating: 75 hp

Year Installed: 3/19/1996

- [ ] Direct Drive backup
- [x] Oil Level OK — E A P n/a

**Disinfection** — 8'x8' FG shed
- [ ] Calcium Hypochlorite — E A P n/a
- [x] Sodium Hypochlorite
- [ ] Generates the disinfectant

Metering Pump
- Manufacturer / Model: Alldos 208

Sampling
- [ ] Analyzer
- [ ] Sampling Station

Storage Bin
- [ ] Volume: 15 / 50 (x2) gallons
- [ ] In the pump building
- [ ] Weight on top of container
- [x] In a separate shed — [x] E A P n/a
- [x] Secondary containment

**Panel**
- Enclosure — E [x] A [x] P n/a
- [x] Indoor
- [ ] Outdoor
- [ ] Explosion-proof
- [ ] Board-mounted
- [ ] Tip-over restraints
- [ ] On 3" concrete pad — on floor

Year Installed: _____

Integrity
- [x] Rusted ( Top / Bottom ) 10 %) — E [x] A P n/a
- [ ] Other

**Auxiliary Power**
- [ ] Equipped — E A P n/a
- [x] Not equipped

Type
- [ ] Generator
- [ ] Direct drive

Fuel
- [ ] Gasoline
- [ ] Diesel
- [ ] Natural Gas

**SCADA**
- RTU — chart recorder only — E A P [x] n/a
- [ ] MonoCon
- [ ] SCADAPack
- [ ] Other
- [ ] Relay Antenna/Repeater

Year Installed: _____

Manufacturer
Model

Parameters
- [ ] Influent Pressure — E A P n/a
- [ ] Effluent Pressure — E A P n/a
- [ ] Flow Rate — E A P n/a
- [ ] Tank Level — E A P n/a
- [ ] Water Quality — E A P n/a
  - [ ] Bacteria — E A P n/a
  - [ ] Nitrate — E A P n/a
  - [ ] VOC — E A P n/a
  - [ ] Other

**Other Observations**

- This station operates 24/7 during summer months.
- Greenish water at startup per DHS.
- well const. in 1960.

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

**BUILDING, PUMP, MOTOR, DISINFECTION, AUXILIARY POWER, ELECTRICAL PANEL, and SCADA**

Station: STA. 033

Location: [redacted]
Date:
Name:

**Building**
- [x] Wood
- [ ] Sheet metal
- [ ] CMU
- [ ] Fiberglass
- [ ] None

E | A | P | n/a

Year Constructed: _____

Dimension
- Length: 12 ft
- Width: 12 ft
- Height: _____ ft

Roof
- [ ] Sheet metal
- [ ] Tar coating
- [ ] Wood shingle
- [x] Asphalt shingle
- [ ] Fiberglass

E | A | P | n/a

Floor
- [x] Cracks minor
- [ ] Wet
- [ ] Workable space
- [ ] Clean

E | A | P | n/a

Illumination
- [ ] Site — E | A | P | n/a
- [x] Indoor — E | A | P | n/a

Paint
- Exterior — E | A | P | n/a
- Interior — E | A | P | n/a

Security
- [x] Gate with Padlock — E | A | P | n/a
- [x] Entry door with Lock — E | A | P | n/a
- [x] Secured window (screened)

HVAC
- Heating / Ventilation
- [ ] Space heater
- [x] Louvers
- [ ] Roof fan

E | A | P | n/a

Fire Protection
- [ ] Automatic fire sprinkler
- [x] Portable fire extinguisher

**Well Pump**
- Manufacturer: ~~LAYNE & BOWLE~~ BJ
- Model: ~~12GL~~ 10 MCL
- Design Flow: ~~600~~ ~~100~~ gpm
- TDH: 392 ~~210~~ ft

E | A | P | n/a

Year Installed: 4/11/1961 ★

Status
- [x] Active Since 1-2000.
- [x] Inactive
- [ ] Abandoned
- [ ] Pumping at the time of inspection
- [x] Off at the time of inspection (repair)
- [x] Water quality (High iron)
- [ ] Yield
- [x] Other (electrical

Packing
- [ ] Leakage
- [ ] Mech. Seal
- [ ] Water Lube

Oil lube

E | A | P | n/a

Operation
- [ ] Excessive Noise
- [ ] Excessive Vibration

E | A | P | n/a

Paint
- [ ] Fresh
- [ ] Wear and Tear

E | A | P | n/a

**Pump Motor**
- Manufacturer: ~~GE~~ Johnson Clear + MFG
- Model: ~~5KS6268XHA~~ 38118-HD75EL
- Rating: 75 hp

Year Installed: 1/1/1984

- [ ] Direct Drive backup
- [ ] Oil Level

E | A | P | n/a

8'x8' FG shed

**Disinfection**
- [ ] Calcium Hypochlorite
- [x] Sodium Hypochlorite
- [ ] Generates the disinfectant

E | A | P | n/a

Metering Pump
- Manufacturer
- Model

Sampling
- [x] Analyzer Cl2
- [ ] Sampling Station

Storage Bin
- [ ] Volume: 15 (50) gallons ×1
- [ ] In the pump building
- [ ] Weight on top of container
- [x] In a separate shed
- [x] Secondary containment

E | A | P | n/a

**Panel**
- Enclosure
- [x] Indoor
- [ ] Outdoor
- [ ] Explosion-proof
- [ ] Board-mounted
- [ ] Tip-over restraints
- [ ] On 3" concrete pad

on floor

E | A | P | n/a

Year Installed: _____

Integrity
- [ ] Rusted ( Top Bottom %)
- [ ] Other

E | A | P | n/a

**Auxiliary Power**
- [x] Equipped
- [ ] Not equipped

E | A | P | n/a

Type
- [ ] Generator
- [x] Direct drive

Fuel
- [x] Gasoline
- [ ] Diesel
- [ ] Natural Gas

**SCADA**
- RTU
- [x] MonoCon
- [ ] SCADAPack
- [ ] Other
- [ ] Relay Antenna/Repeater

E | A | P | n/a

Year Installed: _____

- Manufacturer
- Model

Parameters
- [ ] Influent Pressure — E | A | P | n/a
- [x] Effluent Pressure — E | A | P | n/a
- [x] Flow Rate — E | A | P | n/a
- [ ] Tank Level — E | A | P | n/a
- [x] Water Quality — E | A | P | n/a
  - [ ] Bacteria — E | A | P | n/a
  - [ ] Nitrate — E | A | P | n/a
  - [ ] VOC — E | A | P | n/a
  - [x] Other Cl2

**Other Observations**

- Impacted by iron bacteria.
- New flushing capability (DI drain pipeline construction)
- Horiz. sand trap.
- well const. in 1961
- Very close to reactivation

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

**BUILDING, PUMP, MOTOR, DISINFECTION, AUXILIARY POWER, ELECTRICAL PANEL, and SCADA**

Station: STA. 040

Location: [redacted]
Date:
Name:

**Building**
- [ ] Wood
- [ ] Sheet metal
- [ ] CMU
- [ ] Fiberglass
- [x] None

E.Panel w/ roof

E | A | P | n/a ✓

Year Constructed: _____

Dimension
- Length _____ ft
- Width _____ ft
- Height _____ ft

Roof
- [ ] Sheet metal
- [ ] Tar coating
- [ ] Wood shingle
- [ ] Asphalt shingle
- [x] Fiberglass PVC

holes & cracks

E | A | P | n/a ✓

Floor
- [x] Cracks major
- [ ] Wet
- [ ] Workable space
- [ ] Clean

E | A | P | n/a ✓

Illumination
- [ ] Site — E | A | P | n/a
- [ ] Indoor — E | A | P | n/a

Paint
- Exterior — E | A | P | n/a
- Interior — E | A | P | n/a

Security
- [x] Gate with Padlock — E | A ✓ | P | n/a
- [x] Entry door with Lock (Panel) — E | A | P | n/a
- [ ] Secured window

HVAC
- Heating
- Ventilation
- [ ] Space heater
- [ ] Louvers
- [ ] Roof fan

E | A | P | n/a ✓

Fire Protection
- [ ] Automatic fire sprinkler
- [ ] Portable fire extinguisher

**Well Pump**
- Manufacturer: LAYNE & BOWLE
- Model: 10 RH
- Design Flow: 825 gpm
- TDH: 225 ft

E | A | P | n/a

Year Installed: 4/1/1968 ✗

Status
- [ ] Active
- [x] Inactive
- [ ] Abandoned
- [ ] Pumping at the time of inspection
- [ ] Off at the time of inspection
- [x] Water quality
- [ ] Yield
- [ ] Other ( )

Packing
- [ ] Leakage
- [ ] Mech. Seal
- [ ] Water Lube

E | A | P | n/a

Operation
- [ ] Excessive Noise
- [ ] Excessive Vibration

E | A | P | n/a

Paint
- [ ] Fresh
- [ ] Wear and Tear

E | A | P | n/a

**Pump Motor**
- Manufacturer: G.E.
- Model: 5K6257XH5A
- Rating: 60 hp

Year Installed: 4/1/1968 ✗

- [ ] Direct Drive backup
- [ ] Oil Level

E | A | P | n/a

Plastic shed only.

**Disinfection**
- [ ] Calcium Hypochlorite ?
- [ ] Sodium Hypochlorite ?
- [ ] Generates the disinfectant

E | A | P | n/a

Metering Pump
- Manufacturer
- Model

Sampling
- [ ] Analyzer
- [ ] Sampling Station

Storage Bin
- [ ] Volume 15 50 gallons
- [ ] In the pump building
- [ ] Weight on top of container
- [ ] In a separate shed
- [ ] Secondary containment

E | A | P | n/a

**Panel**
Enclosure
- [ ] Indoor
- [x] Outdoor
- [ ] Explosion-proof

E | A | P ✓ | n/a

- [ ] Board-mounted
- [ ] Tip-over restraints
- [ ] On 3" concrete pad

Year Installed: _____

Integrity
- [ ] Rusted ( Top Bottom %)
- [ ] Other

E | A | P ✓ | n/a

**Auxiliary Power**
- [ ] Equipped
- [x] Not equipped

E | A | P | n/a

Type
- [ ] Generator
- [ ] Direct drive

Fuel
- [ ] Gasoline
- [ ] Diesel
- [ ] Natural Gas

**SCADA**
RTU — chart recorder only
- [ ] MonoCon
- [ ] SCADAPack
- [ ] Other
- [ ] Relay Antenna/Repeater

E | A | P | n/a

Year Installed: _____

- Manufacturer
- Model

Parameters
- [ ] Influent Pressure — E | A | P | n/a
- [ ] Effluent Pressure — E | A | P | n/a
- [ ] Flow Rate — E | A | P | n/a
- [ ] Tank Level — E | A | P | n/a
- [ ] Water Quality — E | A | P | n/a
  - [ ] Bacteria — E | A | P | n/a
  - [ ] Nitrate — E | A | P | n/a
  - [ ] VOC — E | A | P | n/a
  - [ ] Other

**Other Observations**

- GW impacted by cis 1,2-dichloroethylene
- Behind an apartment complex.
- Well Const. in 1968.
- GAC in 2007. Oil → Wtr lube pump

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

**BUILDING, PUMP, MOTOR, DISINFECTION, AUXILIARY POWER, ELECTRICAL PANEL, and SCADA**

Station: STA. 042

Location: [redacted]
Date:
Name:

**Building**
- [ ] Wood
- [ ] Sheet metal
- [x] CMU
- [ ] Fiberglass
- [ ] None

E [ ] A [x] P [ ] n/a

Year Constructed: _____

Dimension
- Length: 18 ft
- Width: 24 ft
- Height: _____ ft

**Roof**
- [ ] Sheet metal
- [ ] Tar coating
- [ ] Wood shingle
- [x] Asphalt shingle ? sliding roof
- [ ] Fiberglass

E [ ] A [x] P [ ] n/a

**Floor**
- [x] Cracks minor
- [ ] Wet
- [ ] Workable space
- [ ] Clean

E [ ] A [x] P [ ] n/a

**Illumination**
- [ ] Site — E [ ] A [ ] P [ ] n/a
- [x] Indoor — E [ ] A [x] P [ ] n/a

**Paint**
- Exterior Trim — E [ ] A [x] P [ ] n/a
- Interior — E [ ] A [ ] P [ ] n/a

**Security**
- [x] Gate with Padlock — E [ ] A [ ] P [ ] n/a
- [x] Entry door with Lock — E [ ] A [ ] P [ ] n/a
- [ ] Secured window

**HVAC**
- Heating
- Ventilation
- [ ] Space heater
- [x] Louvers
- [ ] Roof fan

E [ ] A [ ] P [ ] n/a

**Fire Protection**
- [ ] Automatic fire sprinkler
- [x] Portable fire extinguisher

**Well Pump**
- Manufacturer: LAYNE & BOWLE
- Model: 12RM
- Design Flow: 850 gpm
- TDH: 218 ft

E [ ] A [ ] P [ ] n/a

Year Installed: 5/1/1970 ★

**Status**
- [x] Active
- [ ] Inactive
- [ ] Abandoned
- [ ] Pumping at the time of inspection
- [x] Off at the time of inspection
- [ ] Water quality
- [ ] Yield
- [ ] Other ( )

**Packing**
- [ ] Leakage
- [ ] Mech. Seal
- [ ] Water Lube

E [ ] A [ ] P [ ] n/a

**Operation**
- [ ] Excessive Noise
- [ ] Excessive Vibration

E [ ] A [ ] P [ ] n/a

**Paint**
- [ ] Fresh
- [ ] Wear and Tear

E [ ] A [ ] P [ ] n/a

**Pump Motor**
- Manufacturer: G.E.
- Model: 5K445XC4A
- Rating: 75 hp

Year Installed: 5/1/1970 ★

- [ ] Direct Drive backup
- [ ] Oil Level

E [ ] A [ ] P [ ] n/a

**Disinfection**
- [ ] Calcium Hypochlorite
- [x] Sodium Hypochlorite
- [ ] Generates the disinfectant

E [ ] A [ ] P [ ] n/a

Metering Pump
- Manufacturer
- Model: Aldos 208

Sampling
- [ ] Analyzer
- [ ] Sampling Station

**Storage Bin**
- [ ] Volume: 15 (50) gallons ×2
- [x] In the pump building
- [x] Weight on top of container
- [ ] In a separate shed
- [ ] Secondary containment

E [ ] A [x] P [ ] n/a

**Panel**
- Enclosure
  - [x] Indoor
  - [ ] Outdoor
  - [ ] Explosion-proof
- [ ] Board-mounted
- [ ] Tip-over restraints
- [ ] On 3" concrete pad on floor

E [ ] A [x] P [ ] n/a

Year Installed: _____

Integrity
- [ ] Rusted ( Top Bottom %)
- [ ] Other

E [ ] A [x] P [ ] n/a

**Auxiliary Power**
- [x] Equipped
- [ ] Not equipped

E [ ] A [ ] P [ ] n/a

Type
- [ ] Generator
- [x] Direct drive

Fuel
- [x] Gasoline
- [ ] Diesel
- [ ] Natural Gas

**SCADA**
- RTU chart recorder only
  - [ ] MonoCon
  - [ ] SCADAPack
  - [ ] Other
- [ ] Relay Antenna/Repeater

E [ ] A [ ] P [ ] n/a

Year Installed: _____

Manufacturer
Model

Parameters
- [ ] Influent Pressure — E [ ] A [ ] P [ ] n/a
- [x] Effluent Pressure — E [ ] A [ ] P [ ] n/a
- [x] Flow Rate — E [ ] A [ ] P [ ] n/a
- [ ] Tank Level — E [ ] A [ ] P [ ] n/a
- [ ] Water Quality — E [ ] A [ ] P [ ] n/a
  - [ ] Bacteria — E [ ] A [ ] P [ ] n/a
  - [ ] Nitrate — E [ ] A [ ] P [ ] n/a
  - [ ] VOC — E [ ] A [ ] P [ ] n/a
  - [ ] Other

**Other Observations**

- Summer operation.
- Off due to "bad motor."
- Basin dug around the site to store purged water.

- well cont. in 1970.

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

**BUILDING, PUMP, MOTOR, DISINFECTION, AUXILIARY POWER, ELECTRICAL PANEL, and SCADA**

Station: STA. 044

Location
Date
Name

**Building**
- [ ] Wood
- [x] Sheet metal — corrugated
- [ ] CMU
- [ ] Fiberglass
- [ ] None

E | A | [x] | n/a

Year Constructed: _____

Dimension
- Length _____ ft
- Width _____ ft
- Height _____ ft

**Roof**
- [x] Sheet metal — corrugated
- [ ] Tar coating
- [ ] Wood shingle
- [ ] Asphalt shingle
- [ ] Fiberglass

E | A | [x] | n/a

**Floor**
- [x] Cracks — minor
- [ ] Wet
- [x] Workable space — good
- [ ] Clean

E | [x] | P | n/a

**Illumination**
- [ ] Site — E | A | P | n/a
- [x] Indoor — E | [x] | P | n/a

**Paint**
- Exterior — E | A | [x] | n/a
- Interior — E | A | [x] | n/a

**Security**
- [x] Gate with Padlock — E | [x] | P | n/a
- [x] Entry door with Lock — E | [x] | P | n/a
- [ ] Secured window

**HVAC**
- Heating / Ventilation
- [ ] Space heater
- [x] Louvers
- [ ] Roof fan

E | A | [x] | n/a

**Fire Protection**
- [ ] Automatic fire sprinkler
- [x] Portable fire extinguisher

**Well Pump**
- Manufacturer: ~~BYRON JACKSON~~ Goulds
- Model: ~~2KHC5~~
- Design Flow: 700 gpm
- TDH: ~~754~~ ~380' ft

E | A | P | n/a

Year Installed: ~~3/1/1973~~ 5/2005 *

**Status**
- [x] Active
- [ ] Inactive
- [ ] Abandoned

- [ ] Pumping at the time of inspection
- [x] Off at the time of inspection
- [ ] Water quality
- [ ] Yield
- [ ] Other ( )

**Packing**
- [ ] Leakage
- [x] Mech. Seal
- [ ] Water Lube

E | A | P | n/a

**Operation**
- [ ] Excessive Noise
- [ ] Excessive Vibration

E | A | P | n/a

**Paint**
- [ ] Fresh
- [ ] Wear and Tear

E | A | P | n/a

**Pump Motor**
- Manufacturer: ~~WESTINGHOUSE~~ US elec. Motor
- Model: Style: ~~1077225~~
- Rating: 75 hp

Year Installed: 10/19/2000

- [ ] Direct Drive backup
- [ ] Oil Level

E | A | P | n/a

**Disinfection**
- [ ] Calcium Hypochlorite
- [x] Sodium Hypochlorite
- [ ] Generates the disinfectant

E | A | P | n/a

Metering Pump
- Manufacturer
- Model: Alldos 808

Sampling
- [ ] Analyzer
- [ ] Sampling Station

Storage Bin
- [ ] Volume: (15) 50 gallons — x3
- [ ] In the pump building
- [ ] Weight on top of container
- [x] In a separate ~~shed~~ room
- [x] Secondary containment

E | [x] | P | n/a

**Panel**
- Enclosure
- [x] Indoor
- [ ] Outdoor
- [ ] Explosion-proof

E | [x] | P | n/a

- [ ] Board-mounted
- [ ] Tip-over restraints
- [x] On 3" concrete pad

Year Installed: _____

Integrity
- [ ] Rusted ( Top Bottom %)
- [ ] Other

E | [x] | P | n/a

**Auxiliary Power**
- [x] Equipped
- [ ] Not equipped

E | A | P | n/a

Type
- [x] Generator
- [ ] Direct drive

Fuel
- [ ] Gasoline
- [x] Diesel
- [ ] Natural Gas

**SCADA**
- RTU
- [x] MonoCon
- [ ] SCADAPack
- [ ] Other
- [ ] Relay Antenna/Repeater

E | [x] | P | n/a

Year Installed: _____

- Manufacturer
- Model

Parameters
- [ ] Influent Pressure — E | A | P | n/a
- [x] Effluent Pressure — E | A | P | n/a
- [x] Flow Rate — E | A | P | n/a
- [ ] Tank Level — E | A | P | n/a
- [ ] Water Quality — E | A | P | n/a
  - [ ] Bacteria — E | A | P | n/a
  - [ ] Nitrate — E | A | P | n/a
  - [ ] VOC — E | A | P | n/a
  - [ ] Other

**Other Observations**

- No ramp to sec. containment.
- Muffler on roof.
- New chain link fence.
- 10,000 gal HP tank.

VFD to be installed

- Chart storage area.
- well const. in 1942.
- HP tank need paint.
- Exterior piping need paint.

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

**BUILDING, PUMP, MOTOR, DISINFECTION, AUXILIARY POWER, ELECTRICAL PANEL, and SCADA**

Station: STA. 046

Location: [redacted]
Date:
Name:

8'x8' FG shed

**Building**
- [ ] Wood
- [ ] Sheet metal
- [x] CMU
- [ ] Fiberglass
- [ ] None

E [x] P n/a

Year Constructed: _____

Dimension: Length 18 ft; Width 18 ft; Height _____ ft

**Roof**
- [ ] Sheet metal
- [ ] Tar coating
- [ ] Wood shingle
- [ ] Asphalt shingle
- [x] Fiberglass

E [x] P n/a

**Floor**
- [x] Cracks minor
- [ ] Wet
- [ ] Workable space
- [ ] Clean

E A [x] P n/a

**Illumination**
- [x] Site — E [x] P n/a
- [x] Indoor — E [x] P n/a

**Paint**
- Exterior Trim — E [x] P n/a
- Interior — E A P n/a

**Security**
- [x] Gate with Padlock — E [x] P n/a
- [x] Entry door with Lock — E [x] P n/a
- [ ] Secured window

**HVAC**
- Heating / Ventilation
- [ ] Space heater
- [x] Louvers
- [ ] Roof fan

E A P n/a

**Fire Protection**
- [ ] Automatic fire sprinkler
- [ ] Portable fire extinguisher

**Well Pump**
- Manufacturer: L&B - PEERLESS
- Model: ~~10MA~~ 12 RL
- Design Flow: 500 gpm
- TDH: 295 ft

E A P n/a

Year Installed: 3/4/1994

**Status**
- [x] Active
- [ ] Inactive
- [ ] Abandoned

- [ ] Pumping at the time of inspection
- [x] Off at the time of inspection
- [ ] Water quality
- [ ] Yield
- [ ] Other ( )

**Packing**
- [ ] Leakage
- [ ] Mech. Seal
- [ ] Water Lube

E A P n/a

**Operation**
- [ ] Excessive Noise
- [ ] Excessive Vibration

E A P n/a

**Paint**
- [ ] Fresh
- [x] Wear and Tear

E A [x] n/a

**Pump Motor**
- Manufacturer: U.S.
- Model: ~~R 2848-02-171-D~~ D38058
- Rating: 75 hp

Year Installed: 7/1/1972

- [ ] Direct Drive backup
- [x] Oil Level

E A P n/a

**Disinfection**
- [ ] Calcium Hypochlorite
- [x] Sodium Hypochlorite
- [ ] Generates the disinfectant

E A P n/a

**Metering Pump**
- Manufacturer
- Model: Alldos 208

**Sampling**
- [ ] Analyzer
- [x] Sampling Station

**Storage Bin**
- [ ] Volume: 15 50 gallons x2
- [ ] In the pump building
- [ ] Weight on top of container
- [x] In a separate shed
- [x] Secondary containment

[x] A P n/a

**Panel**
- Enclosure
- [x] Indoor
- [ ] Outdoor
- [ ] Explosion-proof

E A [x] n/a

- [ ] Board-mounted
- [ ] Tip-over restraints
- [ ] On 3" concrete pad on floor

Year Installed: _____

**Integrity**
- [x] Rusted ( Top Bottom 10%)
- [ ] Other

E [x] P n/a

**Auxiliary Power**
- [ ] Equipped
- [x] Not equipped

E A P n/a

**Type**
- [ ] Generator
- [ ] Direct drive

**Fuel**
- [ ] Gasoline
- [ ] Diesel
- [ ] Natural Gas

**SCADA**
- RTU
- [ ] MonoCon
- [x] SCADAPack
- [ ] Other
- [ ] Relay Antenna/Repeater

[x] A P n/a

Year Installed: 2005 - 2006

- Manufacturer
- Model

**Parameters**
- [ ] Influent Pressure — E A P n/a
- [x] Effluent Pressure — E A P n/a
- [x] Flow Rate — E A P n/a
- [ ] Tank Level — E A P n/a
- [ ] Water Quality — E A P n/a
  - [ ] Bacteria — E A P n/a
  - [ ] Nitrate — E A P n/a
  - [ ] VOC — E A P n/a
  - [ ] Other

**Other Observations**

- GAC tower for PCE removed.
- 24/7 operation but is waiting for lab result to restart after media change (7/25/06).
- well const. in 1972.
- GAC tower & ext. piping need attention.

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

**BUILDING, PUMP, MOTOR, DISINFECTION, AUXILIARY POWER, ELECTRICAL PANEL, and SCADA**

Station: STA. 053

Location: [redacted]
Date:
Name:

**Building**
- [ ] Wood
- [ ] Sheet metal
- [x] CMU
- [ ] Fiberglass
- [ ] None

E [ ] A [x] P [ ] n/a

Year Constructed: _____

Dimension
- Length: 24 ft
- Width: 12 ft
- Height: _____ ft

**Roof**
- [x] Sheet metal Corrugated
- [ ] Tar coating
- [ ] Wood shingle
- [ ] Asphalt shingle
- [ ] Fiberglass

E [ ] A [x] P [ ] n/a

**Floor**
- [x] Cracks minor
- [ ] Wet
- [ ] Workable space
- [ ] Clean

E [ ] A [x] P [ ] n/a

**Illumination**
- Site: E [ ] A [ ] P [ ] n/a
- Indoor: E [ ] A [x] P [ ] n/a

**Paint**
- Exterior: E [ ] A [ ] P [ ] n/a
- Interior: E [ ] A [ ] P [ ] n/a

**Security**
- [x] Gate with Padlock: E [ ] A [x] P [ ] n/a
- [x] Entry door with Lock: E [ ] A [x] P [ ] n/a
- [ ] Secured window

**HVAC**
- Heating / Ventilation
- [ ] Space heater
- [x] Louvers
- [ ] Roof fan

E [ ] A [x] P [ ] n/a

**Fire Protection**
- [ ] Automatic fire sprinkler
- [x] Portable fire extinguisher

**Well Pump**
- Manufacturer: AURORA
- Model: 12RC
- Design Flow: 1100 gpm
- TDH: ~~0~~ 228 ft

E [ ] A [ ] P [ ] n/a

Year Installed: 7/1/1977 *

**Status**
- [x] Active
- [ ] Inactive
- [ ] Abandoned

- [x] Pumping at the time of inspection
- [ ] Off at the time of inspection
- [ ] Water quality
- [ ] Yield
- [ ] Other ( )

**Packing**
- [ ] Leakage
- [ ] Mech. Seal
- [ ] Water Lube

E [ ] A [ ] P [ ] n/a

**Operation**
- [ ] Excessive Noise
- [ ] Excessive Vibration

E [ ] A [ ] P [ ] n/a

**Paint**
- [ ] Fresh
- [ ] Wear and Tear

E [ ] A [ ] P [ ] n/a

**Pump Motor**
- Manufacturer: G.E.
- Model: 5KS6268XH4A
- Rating: 100 hp

Year Installed: 1/1/1984

- [ ] Direct Drive backup
- [ ] Oil Level

E [ ] A [ ] P [ ] n/a

**Disinfection**
- [ ] Calcium Hypochlorite
- [x] Sodium Hypochlorite
- [ ] Generates the disinfectant

E [ ] A [ ] P [ ] n/a

Metering Pump
- Manufacturer
- Model: Alldos 208

Sampling
- [ ] Analyzer
- [ ] Sampling Station

x 3

**Storage Bin**
- [ ] Volume: 15 (50) gallons
- [ ] In the pump building
- [ ] Weight on top of container
- [x] In a separate shed
- [x] Secondary containment

E [x] A [ ] P [ ] n/a

**Panel**
- Enclosure
- [x] Indoor
- [ ] Outdoor
- [ ] Explosion-proof

E [ ] A [x] P [ ] n/a

- [ ] Board-mounted
- [ ] Tip-over restraints
- [x] On 3" concrete pad

Year Installed: _____

Integrity
- [x] Rusted ( Top (Bottom) <5 %)
- [ ] Other

E [ ] A [x] P [ ] n/a

**Auxiliary Power**
- [x] Equipped
- [ ] Not equipped

E [ ] A [ ] P [ ] n/a

Type
- [ ] Generator
- [x] Direct drive

Fuel
- [ ] Gasoline
- [x] Diesel
- [ ] Natural Gas

**SCADA**
- RTU
- [x] MonoCon
- [ ] SCADAPack
- [ ] Other
- [ ] Relay Antenna/Repeater

E [ ] A [x] P [ ] n/a

Year Installed: pre 2005

- Manufacturer
- Model

Parameters
- [ ] Influent Pressure: E [ ] A [ ] P [ ] n/a
- [x] Effluent Pressure: E [ ] A [ ] P [ ] n/a
- [x] Flow Rate: E [ ] A [ ] P [ ] n/a
- [ ] Tank Level: E [ ] A [ ] P [ ] n/a
- [ ] Water Quality: E [ ] A [ ] P [ ] n/a
  - [ ] Bacteria: E [ ] A [ ] P [ ] n/a
  - [ ] Nitrate: E [ ] A [ ] P [ ] n/a
  - [ ] VOC: E [ ] A [ ] P [ ] n/a
  - [ ] Other

**Other Observations**

- 1 of the Electrical panel panes is bent + rusted.
- well const. in 1953.

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

**BUILDING, PUMP, MOTOR, DISINFECTION, AUXILIARY POWER, ELECTRICAL PANEL, and SCADA**

Station: STA. 056

Location
Date
Name

[redacted]

8'x8' FG shed

**Building**
- [ ] Wood
- [ ] Sheet metal
- [x] CMU
- [ ] Fiberglass
- [ ] None

E [ ] A [x] P [ ] n/a

Year Constructed: _____

Dimension
- Length _____ ft
- Width _____ ft
- Height _____ ft

Roof
- [ ] Sheet metal
- [ ] Tar coating
- [ ] Wood shingle
- [ ] Asphalt shingle
- [x] Fiberglass

E [ ] A [x] P [ ] n/a

Floor
- [ ] Cracks
- [ ] Wet
- [ ] Workable space
- [ ] Clean

E [ ] A [x] P [ ] n/a

Illumination
- [ ] Site — E [ ] A [ ] P [ ] n/a
- [x] Indoor — E [ ] A [x] P [ ] n/a

Paint
- Exterior — E [ ] A [x] P [ ] n/a
- Interior — E [ ] A [ ] P [x] n/a

Security
- [x] Gate with Padlock — E [ ] A [x] P [ ] n/a
- [x] Entry door with Lock — E [ ] A [ ] P [x] n/a
- [ ] Secured window

HVAC
- Heating
- Ventilation
- [ ] Space heater
- [x] Louvers
- [ ] Roof fan

E [ ] A [x] P [ ] n/a

Fire Protection
- [ ] Automatic fire sprinkler
- [x] Portable fire extinguisher

**Well Pump**
- Manufacturer: AURORA/L&B
- Model: 12RXL
- Design Flow: 900 gpm
- TDH: 275 ft

E [ ] A [ ] P [ ] n/a

Year Installed: 11/1/1978

Status
- [x] Active
- [ ] Inactive
- [ ] Abandoned
- [ ] Pumping at the time of inspection
- [x] Off at the time of inspection
- [ ] Water quality
- [ ] Yield
- [ ] Other ( )

Packing
- [ ] Leakage
- [ ] Mech. Seal
- [ ] Water Lube

E [ ] A [ ] P [ ] n/a

Operation
- [ ] Excessive Noise
- [ ] Excessive Vibration

E [ ] A [ ] P [ ] n/a

Paint
- [ ] Fresh
- [ ] Wear and Tear

E [ ] A [ ] P [ ] n/a

**Pump Motor**
- Manufacturer: NEWMAN
- Model
- Rating: 75 hp

Year Installed: 11/1/1978

- [ ] Direct Drive backup
- [ ] Oil Level

E [ ] A [ ] P [ ] n/a

**Disinfection**
- [ ] Calcium Hypochlorite
- [x] Sodium Hypochlorite
- [ ] Generates the disinfectant

E [ ] A [ ] P [ ] n/a

Metering Pump
- Manufacturer
- Model

Sampling
- [ ] Analyzer
- [ ] Sampling Station

Storage Bin
- [ ] Volume — 15 (50) gallons — x2
- [ ] In the pump building
- [ ] Weight on top of container
- [x] In a separate shed
- [x] Secondary containment

E [x] A [ ] P [ ] n/a

**Panel**
- Enclosure
- [x] Indoor
- [ ] Outdoor
- [ ] Explosion-proof
- [ ] Board-mounted
- [x] Tip-over restraints
- [x] On 3" concrete pad

E [ ] A [x] P [ ] n/a

Year Installed: _____

Integrity
- [x] Rusted ( Top (Bottom) 50%)
- [ ] Other

E [ ] A [x] P [ ] n/a

**Auxiliary Power**
- [x] Equipped
- [ ] Not equipped

E [ ] A [ ] P [ ] n/a

Type
- [ ] Generator
- [x] Direct drive

Fuel
- [ ] Gasoline
- [x] Diesel
- [ ] Natural Gas

**SCADA**
- RTU — chart recorder only
- [ ] Relay Antenna/Repeater
- [ ] MonoCon
- [ ] SCADAPack
- [ ] Other

E [ ] A [ ] P [ ] n/a

Year Installed: _____

- Manufacturer
- Model

Parameters
- [ ] Influent Pressure — E [ ] A [ ] P [ ] n/a
- [x] Effluent Pressure — E [ ] A [ ] P [ ] n/a
- [x] Flow Rate — E [ ] A [ ] P [ ] n/a
- [ ] Tank Level — E [ ] A [ ] P [ ] n/a
- [ ] Water Quality — E [ ] A [ ] P [ ] n/a
- [ ] Bacteria — E [ ] A [ ] P [ ] n/a
- [ ] Nitrate — E [ ] A [ ] P [ ] n/a
- [ ] VOC — E [ ] A [ ] P [ ] n/a
- [ ] Other

**Other Observations**

- Operates only for the peak hours of the AM. (5-6 hrs)
- Needs "eye wash" sign.
- Heavy rust on E. panel
- Exhaust pipe seal needs repair.
- well const. in 1978.

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

**BUILDING, PUMP, MOTOR, DISINFECTION, AUXILIARY POWER, ELECTRICAL PANEL, and SCADA**

Station: STA. 058

Location: [redacted]
Date:
Name:

**Building** — E ✓ P n/a
- [ ] Wood
- [ ] Sheet metal
- [x] CMU
- [ ] Fiberglass
- [ ] None

Year Constructed: _____

Dimension
- Length _____ ft
- Width _____ ft
- Height _____ ft

Roof — E A ✓ P n/a
- [ ] Sheet metal
- [ ] Tar coating
- [ ] Wood shingle
- [x] Asphalt shingle
- [ ] Fiberglass

Dry rot need to be repaired

Floor — E ✓ P n/a
- [x] Cracks minor
- [ ] Wet
- [ ] Workable space
- [ ] Clean

Illumination
- [x] Site — E A ✓ P n/a
- [x] Indoor — E ✓ P n/a

Paint
- Exterior trim — E A ✓ P n/a
- Interior — E ✓ P n/a

Security
- [x] Gate with Padlock — E ✓ P n/a
- [x] Entry door with Lock — E ✓ P n/a
- [ ] Secured window

HVAC — E ✓ P n/a
- Heating
- Ventilation
  - [ ] Space heater
  - [x] Louvers
  - [ ] Roof fan

Fire Protection
- [ ] Automatic fire sprinkler
- [ ] Portable fire extinguisher

**Well Pump** — E A P n/a
- Manufacturer: AURORA/L&B
- Model: 12R1
- Design Flow: 1000 gpm
- TDH: 246 ft

Year Installed: 1/1/1981 *

Status
- [ ] Active
- [x] Inactive
- [ ] Abandoned
- [ ] Pumping at the time of inspection
- [ ] Off at the time of inspection
- [x] Water quality Color/odor
- [ ] Yield
- [ ] Other ( )

Packing — E A P n/a
- [ ] Leakage
- [ ] Mech. Seal
- [ ] Water Lube

Operation — E A P n/a
- [ ] Excessive Noise
- [ ] Excessive Vibration

Paint — ✓ A P n/a
- [x] Fresh
- [ ] Wear and Tear

**Pump Motor**
- Manufacturer: G.E.
- Model: 5K6255XM533A
- Rating: 75 hp

Year Installed: 1/1/1981 *

- [ ] Direct Drive backup
- [ ] Oil Level — E A P n/a

**Disinfection** — E A P n/a
- [ ] Calcium Hypochlorite None
- [ ] Sodium Hypochlorite
- [ ] Generates the disinfectant

Metering Pump
- Manufacturer
- Model

X

Sampling
- [ ] Analyzer
- [ ] Sampling Station

X

Storage Bin
- [ ] Volume 15 50 gallons
- [ ] In the pump building
- [ ] Weight on top of container
- [ ] In a separate shed — E A P n/a
- [ ] Secondary containment

**Panel**
- Enclosure — E ✓ P n/a
  - [x] Indoor
  - [ ] Outdoor
  - [ ] Explosion-proof
- [ ] Board-mounted
- [ ] Tip-over restraints
- [ ] On 3" concrete pad on floor

Year Installed: _____

Integrity — E ✓ P n/a
- [ ] Rusted ( Top Bottom %)
- [ ] Other

**Auxiliary Power** — E A P n/a
- [ ] Equipped
- [x] Not equipped

Type
- [ ] Generator
- [ ] Direct drive

Fuel
- [ ] Gasoline
- [ ] Diesel
- [ ] Natural Gas

**SCADA** — E A P n/a
- RTU chart recorder only
  - [ ] MonoCon
  - [ ] SCADAPack
  - [ ] Other
- [ ] Relay Antenna/Repeater

Year Installed: _____

- Manufacturer
- Model

Parameters — E A P n/a
- [ ] Influent Pressure
- [x] Effluent Pressure
- [x] Flow Rate
- [ ] Tank Level
- [ ] Water Quality
  - [ ] Bacteria
  - [ ] Nitrate
  - [ ] VOC
  - [ ] Other

**Other Observations**

- NE side roof rot
- District considering rehabbing in the future.
- Well const. in 1981.
- Reactivation planned after rehab.

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

**BUILDING, PUMP, MOTOR, DISINFECTION, AUXILIARY POWER, ELECTRICAL PANEL, and SCADA**

Station: STA. 059

Location: [redacted]
Date:
Name:

**Building**
- [ ] Wood
- [ ] Sheet metal
- [x] CMU
- [ ] Fiberglass
- [ ] None

E [ ] A [✓] P [ ] n/a

Year Constructed: _____

Dimension
- Length: 18 ft
- Width: 24 ft
- Height: _____ ft

Roof
- [ ] Sheet metal
- [ ] Tar coating
- [ ] Wood shingle
- [x] Asphalt shingle
- [ ] Fiberglass

E [ ] A [✓] P [ ] n/a

Floor
- [x] Cracks minor
- [ ] Wet
- [ ] Workable space
- [ ] Clean

E [ ] A [✓] P [ ] n/a

Illumination
- [ ] Site — E [ ] A [ ] P [ ] n/a
- [x] Indoor — E [ ] A [✓] P [ ] n/a

Paint
- Exterior Trim — E [✓] A [ ] P [ ] n/a
- Interior — E [ ] A [ ] P [ ] n/a

Security
- [x] Gate with Padlock — E [ ] A [✓] P [ ] n/a
- [x] Entry door with Lock — E [ ] A [✓] P [ ] n/a
- [ ] Secured window

HVAC
- Heating / Ventilation
- [ ] Space heater
- [x] Louvers
- [ ] Roof fan

E [ ] A [✓] P [ ] n/a

Fire Protection
- [ ] Automatic fire sprinkler
- [x] Portable fire extinguisher

**Well Pump**
- Manufacturer: L&B
- Model: 11MQH
- Design Flow: 1100 gpm
- TDH: ~210 ft

E [ ] A [ ] P [ ] n/a

Year Installed: 10/16/2000

Status
- [x] Active
- [ ] Inactive
- [ ] Abandoned

- [x] Pumping at the time of inspection @ 827 gpm
- [ ] Off at the time of inspection
- [ ] Water quality
- [ ] Yield
- [ ] Other ( )

Packing
- [ ] Leakage
- [ ] Mech. Seal
- [ ] Water Lube

E [ ] A [ ] P [ ] n/a

Operation
- [ ] Excessive Noise
- [ ] Excessive Vibration

E [ ] A [ ] P [ ] n/a

Paint
- [ ] Fresh
- [x] Wear and Tear

E [ ] A [✓] P [ ] n/a

**Pump Motor**
- Manufacturer: G.E.
- Model: 5K6255XM673A
- Rating: 75 hp

Year Installed: 10/16/2000

- [ ] Direct Drive backup
- [ ] Oil Level

E [ ] A [ ] P [ ] n/a

**Disinfection**
- [ ] Calcium Hypochlorite
- [x] Sodium Hypochlorite
- [ ] Generates the disinfectant

E [ ] A [ ] P [ ] n/a

Metering Pump
- Manufacturer
- Model: Milton 208

Sampling
- [ ] Analyzer
- [ ] Sampling Station

Storage Bin
- [ ] Volume: 15 (50) gallons ×2
- [x] In the pump building
- [x] Weight on top of container
- [ ] In a separate shed
- [ ] Secondary containment

E [ ] A [✓] n/a

**Panel**
- Enclosure
  - [ ] Indoor
  - [ ] Outdoor
  - [ ] Explosion-proof
- [ ] Board-mounted
- [ ] Tip-over restraints
- [x] On 3" concrete pad

E [ ] A [✓] P [ ] n/a

Year Installed: _____

Integrity
- [ ] Rusted ( Top Bottom 65 %)
- [ ] Other

E [ ] A [✓] P [ ] n/a

**Auxiliary Power**
- [x] Equipped
- [ ] Not equipped

E [ ] A [ ] P [ ] n/a

Type
- [x] Generator
- [ ] Direct drive

Fuel
- [ ] Gasoline
- [x] Diesel
- [ ] Natural Gas

**SCADA**
- RTU — chart recorder only
  - [ ] MonoCon
  - [ ] SCADAPack
  - [ ] Other
- [ ] Relay Antenna/Repeater

E [ ] A [ ] P [ ] n/a

Year Installed: _____

Manufacturer
Model

Parameters
- [ ] Influent Pressure — E [ ] A [ ] P [ ] n/a
- [x] Effluent Pressure — E [ ] A [ ] P [ ] n/a
- [x] Flow Rate — E [ ] A [ ] P [ ] n/a
- [ ] Tank Level — E [ ] A [ ] P [ ] n/a
- [ ] Water Quality — E [ ] A [ ] P [ ] n/a
  - [ ] Bacteria — E [ ] A [ ] P [ ] n/a
  - [ ] Nitrate — E [ ] A [ ] P [ ] n/a
  - [ ] VOC — E [ ] A [ ] P [ ] n/a
  - [ ] Other

**Other Observations**

- E. Panel noisy.
- Cl2 tanks need to move out to a shed.
- Well const. in 1981.

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

**BUILDING, PUMP, MOTOR, DISINFECTION, AUXILIARY POWER, ELECTRICAL PANEL, and SCADA**

Station: STA. 061

Location: [redacted]
Date:
Name:

**Building**
- [ ] Wood
- [ ] Sheet metal
- [x] CMU
- [ ] Fiberglass
- [ ] None

E | A ✓ | P | n/a

Year Constructed: _____

Dimension
- Length: 24 ft
- Width: 18 ft
- Height: _____ ft

Roof
- [ ] Sheet metal
- [ ] Tar coating
- [ ] Wood shingle
- [x] Asphalt shingle
- [ ] Fiberglass

E | A ✓ | P | n/a

Floor
- [x] Cracks minor
- [ ] Wet
- [ ] Workable space
- [ ] Clean

E | A ✓ | P | n/a

Illumination
- [ ] Site — E | A | P | n/a
- [x] Indoor — E | A ✓ | P | n/a

Paint
- Exterior trim — E | A ✓ | P | n/a
- Interior — E | A | P | n/a

Security
- [x] Gate with Padlock — E | A ✓ | P | n/a
- [x] Entry door with Lock — E | A ✓ | P | n/a
- [ ] Secured window

HVAC
- Heating
- Ventilation
- [ ] Space heater
- [x] Louvers
- [ ] Roof fan

E | A ✓ | P | n/a

Fire Protection
- [ ] Automatic fire sprinkler
- [ ] Portable fire extinguisher

**Well Pump**
- Manufacturer: L&B VERTI-LINE
- Model: 12RM
- Design Flow: 1100 gpm
- TDH: 245 ft

E | A | P | n/a

Year Installed: 11/1/1989

Status
- [x] Active
- [ ] Inactive
- [ ] Abandoned

- [x] Pumping at the time of inspection @ 730gpm
- [ ] Off at the time of inspection
- [ ] Water quality
- [ ] Yield
- [ ] Other ( )

Packing
- [ ] Leakage
- [ ] Mech. Seal
- [ ] Water Lube

E | A | P | n/a

Operation
- [ ] Excessive Noise
- [ ] Excessive Vibration

E | A | P | n/a

Paint
- [ ] Fresh
- [ ] Wear and Tear

E | A | P | n/a

**Pump Motor**
- Manufacturer: G.E.
- Model: 5KS404DP6005
- Rating: 100 hp

Year Installed: 11/1/1989

- [ ] Direct Drive backup
- [ ] Oil Level

E | A | P | n/a

Wooden shed (8'x8')

**Disinfection**
- [ ] Calcium Hypochlorite
- [ ] Sodium Hypochlorite
- [x] Generates the disinfectant under repair

E | A | P | n/a ✓

Metering Pump
- Manufacturer
- Model

Sampling
- [ ] Analyzer
- [ ] Sampling Station

w/ 150gal day tank

Storage Bin
- [ ] Volume 15 50 gallons
- [ ] In the pump building
- [ ] Weight on top of container
- [x] In a separate shed — E | A | P | n/a
- [ ] Secondary containment

**Panel**
- Enclosure
  - [x] Indoor — E | A ✓ | P | n/a
  - [ ] Outdoor
  - [ ] Explosion-proof
- [ ] Board-mounted
- [ ] Tip-over restraints
- [x] On 3" concrete pad

Year Installed: _____

Integrity
- [ ] Rusted ( Top Bottom %) — E | A ✓ | P | n/a
- [ ] Other

**Auxiliary Power**
- [ ] Equipped
- [x] Not equipped

E | A | P | n/a

Type
- [ ] Generator
- [ ] Direct drive

Fuel
- [ ] Gasoline
- [ ] Diesel
- [ ] Natural Gas

**SCADA**
- RTU
  - [ ] MonoCon — E ✓ | A | P | n/a
  - [x] SCADAPack
  - [ ] Other
- [ ] Relay Antenna/Repeater

Year Installed: 2005-2006

- Manufacturer
- Model

Parameters
- [ ] Influent Pressure — E | A | P | n/a
- [ ] Effluent Pressure — E | A | P | n/a
- [ ] Flow Rate — E | A | P | n/a
- [ ] Tank Level — E | A | P | n/a
- [ ] Water Quality — E | A | P | n/a
  - [ ] Bacteria — E | A | P | n/a
  - [ ] Nitrate — E | A | P | n/a
  - [ ] VOC — E | A | P | n/a
  - [ ] Other

**Other Observations**

- Pump building temporarily stores salt & bleach bottles.
- Vertical crack on wall near door (ceiling to floor)
- well const. in 1989

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

## BUILDING, PUMP, MOTOR, DISINFECTION, AUXILIARY POWER, ELECTRICAL PANEL, and SCADA

Station: STA. 064

Location
Date
Name

**Building**
- [ ] Wood
- [ ] Sheet metal
- [x] CMU
- [ ] Fiberglass
- [ ] None

E [ ] A [x] P [ ] n/a

Year Constructed: _____

Dimension
- Length _____ ft
- Width _____ ft
- Height _____ ft

**Roof**
- [ ] Sheet metal
- [ ] Tar coating
- [ ] Wood shingle
- [x] Asphalt shingle
- [ ] Fiberglass

E [ ] A [x] P [ ] n/a

**Floor**
- [x] Cracks minor
- [ ] Wet
- [ ] Workable space
- [ ] Clean

E [ ] A [x] P [ ] n/a

**Illumination**
- [ ] Site — E [ ] A [ ] P [ ] n/a
- [x] Indoor — E [ ] A [x] P [ ] n/a

**Paint**
- Exterior — E [ ] A [x] P [ ] n/a
- Interior — E [ ] A [x] P [ ] n/a

Trim to be repainted

**Security**
- [x] Gate with Padlock — E [ ] A [x] P [ ] n/a
- [x] Entry door with Lock — E [ ] A [x] P [ ] n/a
- [ ] Secured window

**HVAC**
- Heating
- Ventilation
- [ ] Space heater
- [x] Louvers
- [ ] Roof fan

E [ ] A [x] P [ ] n/a

**Fire Protection**
- [ ] Automatic fire sprinkler
- [ ] Portable fire extinguisher

None

**Well Pump**
- Manufacturer: BYRON JACKSO
- Model: 11MQH
- Design Flow: 850 gpm
- TDH: 270 ft

E [ ] A [ ] P [ ] n/a

Year Installed: 4/1/1988

**Status**
- [x] Active
  - [ ] Pumping at the time of inspection
  - [x] Off at the time of inspection
  - [ ] Water quality
  - [ ] Yield
  - [ ] Other ( )
- [ ] Inactive
- [ ] Abandoned

**Packing**
- [ ] Leakage
- [ ] Mech. Seal
- [ ] Water Lube

E [ ] A [ ] P [ ] n/a

**Operation**
- [ ] Excessive Noise
- [ ] Excessive Vibration

E [ ] A [ ] P [ ] n/a

**Paint**
- [ ] Fresh
- [x] Wear and Tear

E [ ] A [ ] P [ ] n/a

**Pump Motor**
- Manufacturer: G.E.
- Model: 5KS365DP6005A
- Rating: 75 hp

Year Installed: 4/1/1988

- [ ] Direct Drive backup
- [x] Oil Level

E [ ] A [ ] P [ ] n/a

**Disinfection**
- [ ] Calcium Hypochlorite
- [x] Sodium Hypochlorite
- [ ] Generates the disinfectant

E [ ] A [ ] P [ ] n/a

Metering Pump
- Manufacturer
- Model: Alldos 508

**Sampling**
- [ ] Analyzer
- [ ] Sampling Station

**Storage Bin**
- [ ] Volume: 15 50 gallons (x2)
- [x] In the pump building
- [x] Weight on top of container
- [ ] In a separate shed
- [ ] Secondary containment

to be moved out

E [ ] A [x] P [ ] n/a

**Panel**
- Enclosure
  - [x] Indoor
  - [ ] Outdoor
  - [ ] Explosion-proof
- [ ] Board-mounted
- [x] Tip-over restraints
- [x] On 3" concrete pad

E [ ] A [x] P [ ] n/a

Year Installed: _____

**Integrity**
- [x] Rusted ( Top Bottom 5 %)
- [ ] Other

E [ ] A [x] P [ ] n/a

**Auxiliary Power**
- [x] Equipped
- [ ] Not equipped

E [ ] A [ ] P [ ] n/a

**Type**
- [ ] Generator
- [ ] Direct drive

(Feed from STA.044.)

**Fuel**
- [ ] Gasoline
- [ ] Diesel
- [ ] Natural Gas

**SCADA**
- RTU
  - [x] MonoCon
  - [ ] SCADAPack
  - [ ] Other
- [ ] Relay Antenna/Repeater

E [ ] A [x] P [ ] n/a

Year Installed: pre-2005

- Manufacturer
- Model

**Parameters**
- [ ] Influent Pressure — E [ ] A [ ] P [ ] n/a
- [ ] Effluent Pressure — E [ ] A [ ] P [ ] n/a
- [ ] Flow Rate — E [ ] A [ ] P [ ] n/a
- [ ] Tank Level — E [ ] A [ ] P [ ] n/a
- [ ] Water Quality — E [ ] A [ ] P [ ] n/a
  - [ ] Bacteria — E [ ] A [ ] P [ ] n/a
  - [ ] Nitrate — E [ ] A [ ] P [ ] n/a
  - [ ] VOC — E [ ] A [ ] P [ ] n/a
  - [ ] Other

**Other Observations**

- Generator @ STA 44 also supports this station.
- 5000 gal HP tank (1988)
- Paint building trims.
- Well const. in 1988.

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

**BUILDING, PUMP, MOTOR, DISINFECTION, AUXILIARY POWER, ELECTRICAL PANEL, and SCADA**

Station: STA. 066 — Boosters A & B

Location: [redacted]
Date:
Name:

**Building** — E ✓ A P n/a
- [ ] Wood
- [ ] Sheet metal
- [x] CMU
- [ ] Fiberglass
- [ ] None

Year Constructed: _____

Dimension: Length 24 ft; Width 36 ft; Height _____ ft

**Roof** — E ✓ A P n/a
- [ ] Sheet metal
- [ ] Tar coating
- [ ] Wood shingle
- [x] Asphalt shingle
- [ ] Fiberglass

**Floor** — E ✓ P n/a
- [ ] Cracks
- [ ] Wet
- [x] Workable space good
- [x] Clean

**Illumination**
- [ ] Site — E A P n/a
- [x] Indoor — E ✓ P n/a

**Paint**
- Exterior trim — E ✓ P n/a
- Interior — E ✓ P n/a

**Security**
- [x] Gate with Padlock — E ✓ P n/a
- [x] Entry door with Lock — E ✓ P n/a
- [ ] Secured window

**HVAC** — E ✓ A P n/a
- Heating
- Ventilation
- [ ] Space heater
- [x] Louvers
- [x] Roof fan

**Fire Protection**
- [ ] Automatic fire sprinkler
- [x] Portable fire extinguisher

**Well Pump** — E A P n/a
- Manufacturer (A = B) L & B
- Model 10RL
- Design Flow 500 gpm
- TDH 180 ft

Year Installed: 6/1/1990

Status
- [x] Active
- [ ] Inactive
- [ ] Abandoned

- [x] Pumping at the time of inspection @ 300 gpm
- [ ] Off at the time of inspection
- [ ] Water quality
- [ ] Yield
- [ ] Other ( )

**Packing** — E A P n/a
- [ ] Leakage
- [ ] Mech. Seal
- [ ] Water Lube

**Operation** — E A P n/a
- [ ] Excessive Noise
- [ ] Excessive Vibration

**Paint** — E A P n/a
- [ ] Fresh
- [ ] Wear and Tear

**Pump Motor**
- Manufacturer (A = B) U.S.
- Model T08/T1800396/GT
- Rating 30 hp

Year Installed

- [ ] Direct Drive backup
- [ ] Oil Level — E A P n/a

**Disinfection** — E A P ✓ n/a
- [ ] Calcium Hypochlorite
- [ ] Sodium Hypochlorite
- [ ] Generates the disinfectant

Metering Pump
- Manufacturer
- Model

Sampling
- [ ] Analyzer
- [ ] Sampling Station

Storage Bin
- [ ] Volume 15 50 gallons
- [ ] In the pump building
- [ ] Weight on top of container
- [ ] In a separate shed
- [ ] Secondary containment

E A P n/a

**Panel**
- Enclosure
- [x] Indoor — E ✓ P n/a
- [ ] Outdoor
- [ ] Explosion-proof
- [ ] Board-mounted
- [ ] Tip-over restraints
- [x] On 3" concrete pad

Year Installed: _____

Integrity
- [ ] Rusted ( Top Bottom %) — E ✓ P n/a
- [ ] Other

**Auxiliary Power** — E A P n/a
- [x] Equipped
- [ ] Not equipped

Type
- [x] Generator
- [ ] Direct drive

Fuel
- [ ] Gasoline
- [x] Diesel
- [ ] Natural Gas

**SCADA**
- RTU
- [x] MonoCon — E ✓ P n/a
- [ ] SCADAPack
- [ ] Other
- [x] Relay Antenna/Repeater

Year Installed: _____

Manufacturer
Model

Parameters
- [ ] Influent Pressure — E A P n/a
- [ ] Effluent Pressure — E A P n/a
- [ ] Flow Rate — E A P n/a
- [ ] Tank Level — E A P n/a
- [ ] Water Quality — E A P n/a
  - [ ] Bacteria — E A P n/a
  - [ ] Nitrate — E A P n/a
  - [ ] VOC — E A P n/a
  - [ ] Other

**Other Observations**

- Repeater Antenna next to Bldg.
- Gen set in the Pump building.
- Booster A & B pressurizes 10,000 gal HP tank.

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

**BUILDING, PUMP, MOTOR, DISINFECTION, AUXILIARY POWER, ELECTRICAL PANEL, and SCADA**

Station STA. 066 Boosters C & D

Location [redacted]
Date
Name

**Building**
- [ ] Wood
- [ ] Sheet metal
- [x] CMU
- [ ] Fiberglass
- [ ] None

E A P n/a

Year Constructed _____

Dimension
- Length 24 ft
- Width 36 ft
- Height _____ ft

**Roof**
- [ ] Sheet metal
- [ ] Tar coating
- [ ] Wood shingle
- [x] Asphalt shingle
- [ ] Fiberglass

E A P n/a

**Floor**
- [ ] Cracks
- [ ] Wet
- [x] Workable space good
- [x] Clean

E A P n/a

**Illumination**
- [ ] Site — E A P n/a
- [x] Indoor — E A P n/a

**Paint**
- Exterior trim — E A P n/a
- Interior — E A P n/a

**Security**
- [x] Gate with Padlock — E A P n/a
- [x] Entry door with Lock — E A P n/a
- [ ] Secured window

**HVAC**
- Heating
- Ventilation
- [ ] Space heater
- [x] Louvers
- [ ] Roof fan

E A P n/a

**Fire Protection**
- [ ] Automatic fire sprinkler
- [ ] Portable fire extinguisher

**Well Pump** (C=D)
- Manufacturer GOULDS
- Model 9RCLC-DWT
- Design Flow 400 gpm
- TDH 332 ft

E A P n/a

Year Installed 7/11/2001

**Status**
- [x] Active
- [ ] Inactive
- [ ] Abandoned
- [ ] Pumping at the time of inspection
- [x] Off at the time of inspection
- [ ] Water quality
- [ ] Yield
- [ ] Other ( )

**Packing**
- [ ] Leakage
- [ ] Mech. Seal
- [ ] Water Lube

E A P n/a

**Operation**
- [ ] Excessive Noise
- [ ] Excessive Vibration

E A P n/a

**Paint**
- [ ] Fresh
- [ ] Wear and Tear

E A P n/a

**Pump Motor** (C=D)
- Manufacturer U.S.
- Model VHS PREMIUM EFF.
- Rating 60 hp

Year Installed 10/1/2001

- [ ] Direct Drive backup
- [ ] Oil Level

E A P n/a

**Disinfection**
- [ ] Calcium Hypochlorite
- [ ] Sodium Hypochlorite
- [ ] Generates the disinfectant

E A P n/a

Metering Pump
- Manufacturer
- Model X

Sampling
- [ ] Analyzer
- [ ] Sampling Station

Storage Bin
- [ ] Volume 15 50 gallons N/A
- [ ] In the pump building
- [ ] Weight on top of container
- [ ] In a separate shed
- [ ] Secondary containment

E A P n/a

**Panel**
- Enclosure
  - [x] Indoor
  - [ ] Outdoor
  - [ ] Explosion-proof
- [ ] Board-mounted
- [ ] Tip-over restraints
- [ ] On 3" concrete pad on floor

E A P n/a

Year Installed _____

Integrity
- [ ] Rusted ( Top Bottom %)
- [ ] Other

E A P n/a

**Auxiliary Power**
- [x] Equipped outside
- [ ] Not equipped

E A P n/a

Type
- [x] Generator
- [ ] Direct drive

Fuel
- [ ] Gasoline
- [x] Diesel
- [ ] Natural Gas

**SCADA** w/ Boosters A&B
- RTU
  - [x] MonoCon
  - [ ] SCADAPack
  - [ ] Other
- [ ] Relay Antenna/Repeater

E A P n/a

Year Installed _____

Manufacturer
Model

Parameters
- [ ] Influent Pressure — E A P n/a
- [ ] Effluent Pressure — E A P n/a
- [ ] Flow Rate — E A P n/a
- [ ] Tank Level — E A P n/a
- [ ] Water Quality — E A P n/a
  - [ ] Bacteria — E A P n/a
  - [ ] Nitrate — E A P n/a
  - [ ] VOC — E A P n/a
  - [ ] Other

**Other Observations**

Gen set out side the building.

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

**STORAGE TANK**

Station: STA. 066

Location / Date / Name: [redacted]

Tank No.: STA. 066-T1

Capacity: 573,000 gallons

Installed Year: 1974

Material:
- [ ] Redwood
- [ ] Concrete
- [x] Steel

Dimension:
- Diameter: 57 ft
- Height: 30 ft

Tank Filled by:
- [x] Booster @ STA 73
- [ ] Well
- [ ] Zone pressure

Fill stopped by:
- [x] Altitude valve
- [ ] Level sensor pump shut off

Tank Drawn by:
- [x] Booster A+B @ STA 66
- [ ] Zone pressure

Roof Type:
- [ ] Wood Frame
- [x] Steel
- [ ] Sheet metal
- [ ] Tar coating
- [ ] Wood shingle
- [ ] Umbrella
- [x] Knuckle
- [ ] Cone

E | A | P | n/a

Coating:
- Exterior: [x] Paint; [ ] Epoxy; [ ] Other ( ) — E | A | P | n/a — Date
- Interior: [ ] Fiberglass; [ ] Epoxy; [ ] Other ( ) — E | A | P | n/a — Date

Corrosion:
- [x] Current Cathodic Protection (Serviced by District
- [ ] Other ( )

Rust, Rust Stain, Pitting, Peeling, Blisters: <5 % of tank surface

Hazard:
- [ ] Overgrown Tree nearby
- [ ] Storage pile nearby
- [ ] Other ( )

Cracks:
- [ ] Concrete Wall
- [ ] Ring Foundation
- [ ] Footing

Leaks:
- [ ] Weep
- [ ] Seep

Mixing:
- [x] Single inlet/outlet
- [ ] Separate inlet/outlet
- [ ] Motorized mixing

Air Vents:
- [ ] Roof — [ ] Screened — E | A | P | n/a
- [x] Overflow pipe — [x] Screened — E | A | P | n/a
- [ ] Other ( ) — [ ] Screened — E | A | P | n/a

Foundation:
- [ ] Compacted soil — E | A | P | n/a
- [ ] Oiled sand pad
- [ ] Asphalt pad
- [ ] Concrete footing ( X )
- [x] Concrete ring
- [ ] Berm

Seismic:
- [ ] Anchor bolts — E | A | P | n/a
- [x] Flexible Connection — [ ] Bellow (Dia. inch) — [ ] EBBA fitting

Access to Roof:
- [x] Ladder
- [ ] Other ( )

Security:
- [ ] Chain Link Fence with Lock — E | A | P | n/a
- [ ] Wood Fence with Lock — E | A | P | n/a
- [ ] Hatch Open Alarm
- [x] Covered Ladder

Site:
- [ ] Erosion around tank
- [ ] Blend well with surroundings
- Max vehicle access width: 24 ft

Notes and Other Observations

- Paint crusty + easily chipped.
- District to paint w/ Epoxy next week. (?)

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

**STORAGE TANK**

Station: STA. 066

Location
Date
Name: [redacted]

Tank No.: STA. 066-T2

Capacity: 515,000 gallons

Installed Year: 2003

Material
- [ ] Redwood
- [ ] Concrete
- [x] Steel

Dimension
- Diameter: 57 ft
- Height: 27 ft

Tank Filled by
- [x] Booster STA 73
- [ ] Well
- [ ] Zone pressure

Fill stopped by
- [x] Altitude valve
- [ ] Level sensor pump shut off

Tank Drawn by
- [x] Booster C & D @ STA 66
- [ ] Zone pressure

Roof Type
- [ ] Wood Frame
- [x] Steel
- [ ] Sheet metal — E A P n/a
- [ ] Tar coating
- [ ] Wood shingle
- [ ] Umbrella
- [x] Knuckle
- [ ] Cone

Coating
- Exterior
  - [ ] Paint — E A P n/a
  - [ ] Epoxy — Date
  - [x] Other (Urethane, 10 mils)
- Interior
  - [ ] Fiberglass — E A P n/a
  - [x] Epoxy 15 mils — Date
  - [ ] Other ( )

Corrosion
- [x] Current Cathodic Protection (Serviced by District)
- [ ] Other ( )

Rust, Rust Stain, Pitting, Peeling, Blisters: Ø % of tank surface

Hazard
- [ ] Overgrown Tree nearby
- [ ] Storage pile nearby
- [ ] Other ( )

Cracks
- [ ] Concrete Wall
- [x] Ring Foundation (minor)
- [ ] Footing

Leaks
- [ ] Weep
- [ ] Seep

Mixing
- [ ] Single inlet/outlet
- [ ] Separate inlet/outlet
- [ ] Motorized mixing

Air Vents
- [ ] Roof — [ ] Screened — E A P n/a
- [x] Overflow pipe — [x] Screened — E A P n/a
- [ ] Other ( ) — [ ] Screened — E A P n/a

Foundation
- [ ] Compacted soil — E A P n/a
- [ ] Oiled sand pad
- [ ] Asphalt pad
- [ ] Concrete footing ( X )
- [x] Concrete ring
- [ ] Berm

Seismic
- [x] Anchor bolts — E A P n/a
- [x] Flexible Connection
  - [ ] Bellow (Dia. inch)
  - [x] EBBA fitting

Access to Roof
- [x] Ladder
- [ ] Other ( )

Security
- [ ] Chain Link Fence with Lock — E A P n/a
- [ ] Wood Fence with Lock — E A P n/a
- [ ] Hatch Open Alarm
- [x] Covered Ladder

Site
- [ ] Erosion around tank
- [ ] Blend well with surroundings
- Max vehicle access width: 24 ft

Notes and Other Observations

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

## BUILDING, PUMP, MOTOR, DISINFECTION, AUXILIARY POWER, ELECTRICAL PANEL, and SCADA

Station: STA. 068

Location
Date
Name

[redacted]

**Building** — E ✓ P n/a
- [ ] Wood
- [ ] Sheet metal
- [x] CMU
- [ ] Fiberglass
- [ ] None

Year Constructed: _____

Dimension
- Length: 24 ft
- Width: 36 ft
- Height: _____ ft

Roof — E ✓ P n/a
- [ ] Sheet metal
- [ ] Tar coating
- [ ] Wood shingle
- [x] Asphalt shingle
- [ ] Fiberglass

Floor — E ✓ P n/a
- [ ] Cracks
- [x] Wet from Condensation
- [x] Workable space good
- [x] Clean

Illumination
- Site: E A P n/a
- Indoor: E ✓ P n/a

Paint
- Exterior trim: E ✓ P n/a
- Interior: E ✓ P n/a

Security
- [x] Gate with Padlock: E ✓ P n/a
- [x] Entry door with Lock: E ✓ P n/a
- [ ] Secured window

HVAC — E ✓ P n/a
- Heating / Ventilation
- [ ] Space heater
- [x] Louvers
- [ ] Roof fan

Fire Protection
- [ ] Automatic fire sprinkler
- [ ] Portable fire extinguisher

**Well Pump** — E A P n/a
- Manufacturer: GOULDS
- Model: 12DHLC
- Design Flow: 1200 gpm
- TDH: 210 ft

Year Installed: 12/28/1998

Status
- [x] Active
- [ ] Inactive
- [ ] Abandoned

- [x] Pumping at the time of inspection @ 1100 gpm
- [ ] Off at the time of inspection
- [ ] Water quality
- [ ] Yield
- [ ] Other ( )

Packing — E A P n/a
- [ ] Leakage
- [ ] Mech. Seal
- [x] Water Lube Normal op.

Operation — E A P n/a
- [ ] Excessive Noise
- [ ] Excessive Vibration

Paint — E A P n/a
- [ ] Fresh
- [ ] Wear and Tear

**Pump Motor**
- Manufacturer: U.S.
- Model: R485A-804-4286M
- Rating: 100 hp

Year Installed: 12/28/1998

- [ ] Direct Drive backup
- [ ] Oil Level — E A P n/a

**Disinfection** — E A P n/a
- [ ] Calcium Hypochlorite
- [x] Sodium Hypochlorite
- [ ] Generates the disinfectant

Metering Pump
- Manufacturer / Model: Alldos 208

Sampling
- [ ] Analyzer
- [ ] Sampling Station

Storage Bin
- [ ] Volume: 15 ~~50~~ x2 gallons
- [ ] In the pump building
- [ ] Weight on top of container
- [x] In a separate ~~shed~~ room — E ✓ P n/a
- [x] Secondary containment need ramp.

**Panel** — E ✓ P n/a
- Enclosure
- [x] Indoor
- [ ] Outdoor
- [ ] Explosion-proof

- [ ] Board-mounted
- [ ] Tip-over restraints
- [x] On 3" concrete pad

Year Installed: _____

Integrity — E ✓ P n/a
- [ ] Rusted ( Top Bottom %)
- [ ] Other

**Auxiliary Power** — E A P n/a
- [ ] Equipped
- [x] Not equipped

Type
- [ ] Generator
- [ ] Direct drive

Fuel
- [ ] Gasoline
- [ ] Diesel
- [ ] Natural Gas

**SCADA** — E A P n/a
- RTU
- [x] MonoCon
- [ ] SCADAPack
- [ ] Other
- [ ] Relay Antenna/Repeater

Year Installed: _____

Manufacturer
Model

Parameters
- [ ] Influent Pressure — E A P n/a
- [x] Effluent Pressure — E A P n/a
- [x] Flow Rate — E A P n/a
- [ ] Tank Level — E A P n/a
- [ ] Water Quality — E A P n/a
  - [ ] Bacteria — E A P n/a
  - [ ] Nitrate — E A P n/a
  - [ ] VOC — E A P n/a
  - [ ] Other

**Other Observations**

- No ramps to the 2ndary Containment.
- Well const. in 1998.

***

Public Version

**Conditions Assessment Form**
Cal Water, Chico-Hamilton City District

**BUILDING, PUMP, MOTOR, DISINFECTION, AUXILIARY POWER, ELECTRICAL PANEL, and SCADA**

Station: STA. 071

Location: [redacted]
Date: [redacted]
Name: [redacted]

**Building** — E ✓ A P n/a
- [ ] Wood
- [ ] Sheet metal
- [x] CMU
- [ ] Fiberglass
- [ ] None

Year Constructed: _____

Dimension
- Length _____ ft
- Width _____ ft
- Height _____ ft

Roof — E ✓ A P n/a
- [ ] Sheet metal
- [ ] Tar coating
- [ ] Wood shingle
- [x] Asphalt shingle
- [ ] Fiberglass

Floor — E ✓ P n/a
- [x] Cracks minor
- [x] Wet pumphead
- [x] Workable space good
- [x] Clean

Illumination
- [ ] Site — E A P n/a
- [x] Indoor — E ✓ P n/a

Paint
- Exterior trim — ✓ A P n/a
- Interior — ✓ A P n/a

Security
- [x] Gate with Padlock — E A P n/a
- [x] Entry door with Lock — E A P n/a
- [ ] Secured window

HVAC — E ✓ P n/a
- Heating / Ventilation
- [ ] Space heater
- [x] Louvers
- [ ] Roof fan

Fire Protection
- [ ] Automatic fire sprinkler
- [ ] Portable fire extinguisher

**Well Pump** — E A P n/a
- Manufacturer: GOULDS
- Model: 12 DHLC
- Design Flow: 1500 gpm
- TDH: 277 ft

Year Installed: 4/1/2001

Status
- [x] Active
- [ ] Inactive
- [ ] Abandoned

@1385 gpm
- [x] Pumping at the time of inspection
- [ ] Off at the time of inspection
- [ ] Water quality
- [ ] Yield
- [ ] Other ( )

Packing — E A P n/a
- [ ] Leakage
- [ ] Mech. Seal
- [ ] Water Lube

Operation — E A P n/a
- [ ] Excessive Noise
- [ ] Excessive Vibration

Paint — E A ✓ n/a
- [ ] Fresh
- [x] Wear and Tear (salt)

**Pump Motor**
- Manufacturer: U.S.
- Model: 0
- Rating: 150 hp

Year Installed: 4/1/2001

- [ ] Direct Drive backup
- [ ] Oil Level — E A P n/a

**Disinfection** — E A P n/a
- [ ] Calcium Hypochlorite
- [x] Sodium Hypochlorite
- [ ] Generates the disinfectant

Metering Pump
- Manufacturer / Model: Alldos 208

Sampling
- [ ] Analyzer
- [ ] Sampling Station

Storage Bin
- [ ] Volume 15 50 gallons ×2
- [ ] In the pump building
- [ ] Weight on top of container
- [x] In a separate ~~shed~~ room — E ✓ A P n/a
- [x] Secondary containment

**Panel**
- Enclosure: New. — [x] Indoor, [ ] Outdoor, [ ] Explosion-proof — E ✓ A P n/a
- [ ] Board-mounted
- [ ] Tip-over restraints
- [x] On 3" concrete pad

Year Installed: _____

Integrity — E ✓ A P n/a
- [ ] Rusted ( Top Bottom %)
- [ ] Other

**Auxiliary Power** — E A P n/a
- [ ] Equipped
- [x] Not equipped

Type
- [ ] Generator
- [ ] Direct drive

Fuel
- [ ] Gasoline
- [ ] Diesel
- [ ] Natural Gas

**SCADA** — E A P n/a
- RTU
- [x] MonoCon
- [ ] SCADAPack
- [ ] Other
- [ ] Relay Antenna/Repeater

Year Installed: pre 2005

Manufacturer
Model

Parameters
- [ ] Influent Pressure — E A P n/a
- [x] Effluent Pressure — E A P n/a
- [x] Flow Rate — E A P n/a
- [ ] Tank Level — E A P n/a
- [ ] Water Quality — E A P n/a
  - [ ] Bacteria — E A P n/a
  - [ ] Nitrate — E A P n/a
  - [ ] VOC — E A P n/a
  - [ ] Other

**Other Observations**

- Chronic failure of packing. (Needs freq. adjusting)
- Well const. in 2001.

# APPENDIX Q

## Station Facility Photos from Site Visits

# STATION 001

Public Version

# STATION 004

Public Version

# STATION 013

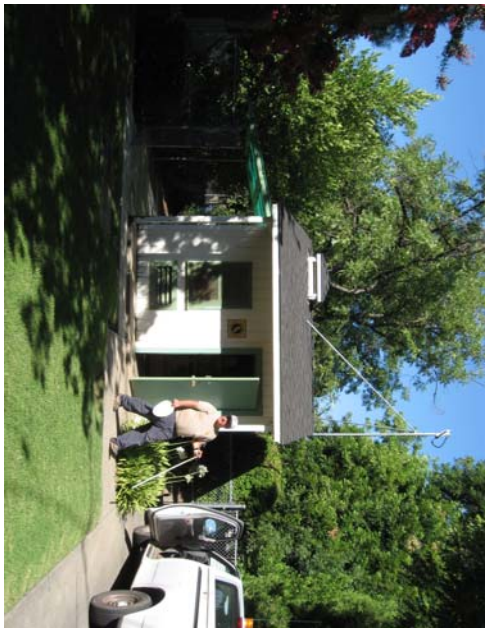
Public Version

# STATION 016

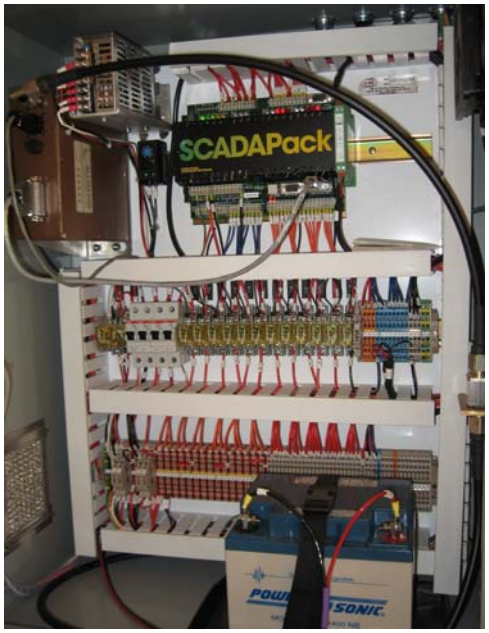
Public Version

# STATION 021

Public Version



Public Version



Public Version

# STATION 024

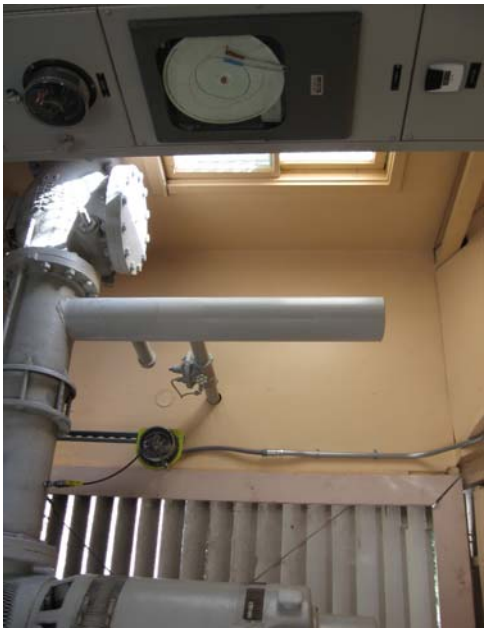
Public Version

***

Public Version

# STATION 026

Public Version



Public Version

# STATION 031

Public Version

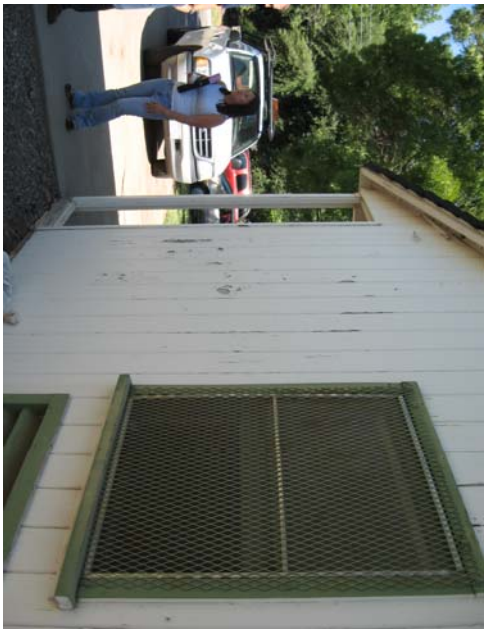
***

Public Version

# STATION 033

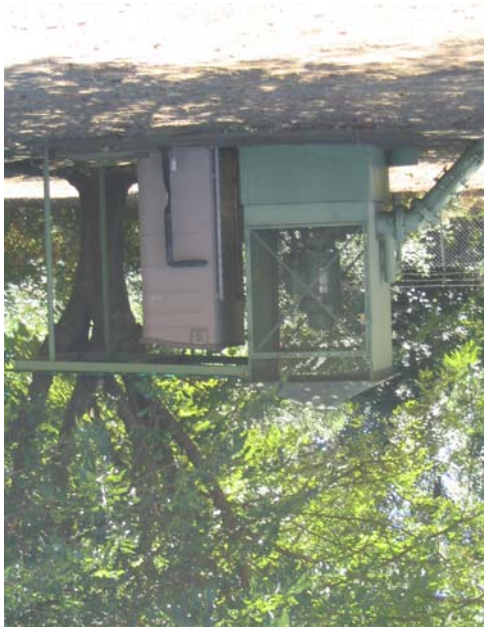
Public Version

Public Version



# STATION 040

Public Version



# STATION 042

Public Version

Public Version

# STATION 044

Public Version

Public Version

Public Version

# STATION 046

Public Version

Public Version

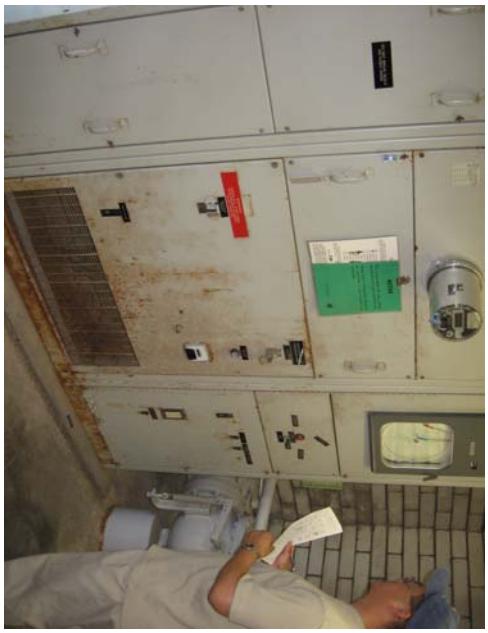
# STATION 053

Public Version

Public Version

# STATION 056

Public Version



Public Version

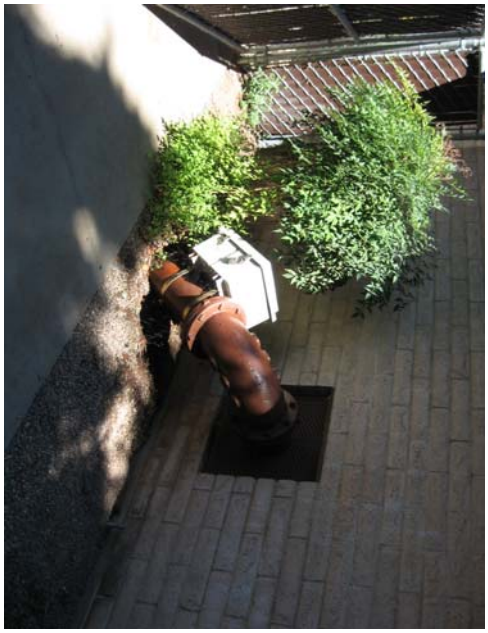
# STATION 058

Public Version

Public Version

# STATION 059

Public Version



DANGER
THIS EQUIPMENT
STARTS AND STOPS
AUTOMATICALLY

***

Public Version

# STATION 061

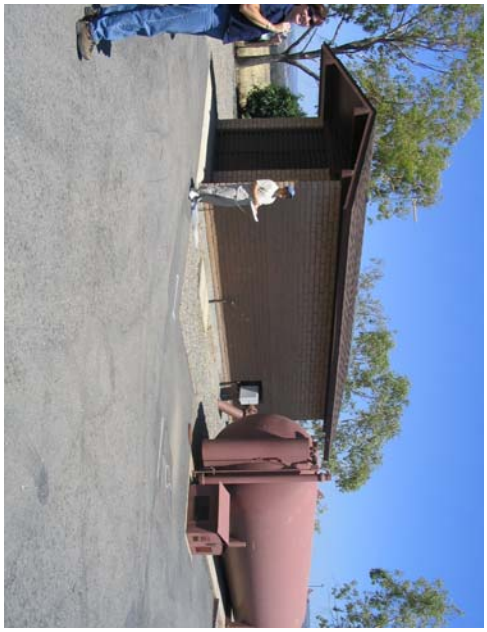
Public Version

Public Version

# STATION 064

Public Version

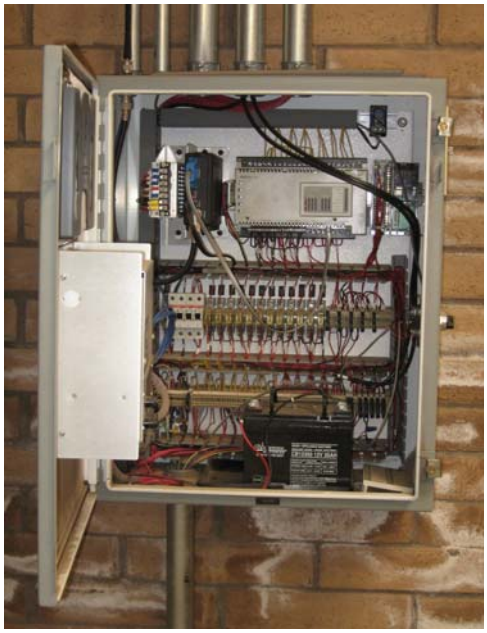
Public Version



# STATION 066

Public Version

Public Version



Public Version

Public Version

Public Version

# APPENDIX R

## Cost Estimating Assumptions

# APPENDIX R. COST ESTIMATING ASSUMPTIONS

This appendix provides the assumptions used by WYA to estimate the construction costs for planning and design of future water system facilities for the California Water Service Company Livermore District. The costs were developed based on data supplied by manufacturers, published industry standard cost data and curves, construction costs for similar facilities built by Cal Water and/or other public agencies, and construction costs previously estimated by WYA for similar facilities with similar construction cost indexes. All construction costs have been adjusted to reflect September 2007 costs at an Engineering News Record (ENR) Construction Cost Index (CCI) of 8050 (20 Cities Average). These costs are to be used for conceptual cost estimates only, and should be updated regularly.

Additionally, these costs are for construction only and do not include estimating uncertainties or unexpected construction costs (e.g., variations in final quantities) or cost estimates for land acquisition, engineering, legal costs, environmental review, inspections and/or contract administration. These additional cost items are referred to as contingency costs and project allowances and are further described in the last section of this Appendix.

Construction cost data presented in this appendix are not intended to represent the lowest prices in the industry for each type of construction; rather they are representative of average or typical construction costs. The planning level cost estimates have been prepared for guidance in evaluating various options, and are intended for budgetary purposes only, within the context of this master planning effort.

## FACILITY COSTS

### Pipelines

Unit construction costs for water pipelines 6 through 36 inches in diameter are provided in Table R-1. These costs are to be used for typical pipeline construction in developed areas (developed) and construction across open fields or areas that are not yet developed (undeveloped). These costs generally include pipeline materials, trenching, placing and jointing pipe, valves, fittings, hydrants, service connections, placing imported pipe bedding, native backfill material, and asphalt pavement replacement, if required. The costs presented in Table R-1 do not include the cost of boring and jacking pipe. The costs shown in Table R-2 should be added where required for this purpose.

**Table R-1. Unit Construction Costs for Pipelines[a]**

| Pipe Diameter, inches | Unit Construction Cost, $/linear foot | |
|---|---|---|
| | Developed Areas | Undeveloped Areas |
| 6 | 100 | 90 |
| 8 | 130 | 110 |
| 10 | 150 | 130 |
| 12 | 180 | 150 |
| 14 | 210 | 170 |
| 16 | 230 | 190 |
| 18 | 260 | 220 |
| 20 | 280 | 240 |
| 24 | 330 | 270 |
| 30 | 400 | 340 |
| 36 | 460 | 390 |

[a] Based on the September 2007 ENR index of 8050.

**Table R-2. Unit Construction Costs for Jack & Boring[a]**

| Size | Unit Construction Cost, $/linear foot[b] |
|---|---|
| 8-inch pipe (16-inch casing) | 370 |
| 12-inch pipe (21-inch casing) | 420 |
| 16-inch pipe (24-inch casing) | 480 |
| 20-inch pipe (30-inch casing) | 600 |
| 54-inch pipe (66-inch casing) | 1,200 |
| Tunnel | 2,500 |

[a] Based on the September 2007 ENR index of 8050.
[b] Conductor pipe not included in cost.

### Treated Water Storage Tanks

Table R-3 lists the estimated total construction costs for water storage tanks in the size ranges of 1.0 to 6.0 MG. As previously stated, these costs are representative of construction conducted under normal excavation and foundation conditions, and would be significantly higher for special or difficult foundation requirements.

**Table R-3. Construction Costs for Treated Water Storage Reservoirs[(a)]**

| Capacity, MG | Estimated Construction Cost Pre-Stressed Concrete Storage Reservoir, million dollars | Estimated Construction Cost Steel Storage Reservoir, million dollars |
|---|---|---|
| 1.0 | 1.33 | 1.12 |
| 2.0 | 2.55 | 1.74 |
| 3.0 | 3.47 | 2.25 |
| 4.0 | 4.59 | 2.86 |
| 5.0 | 5.72 | 3.47 |
| 6.0 | 6.84 | 4.08 |

(a) Based on the September 2007 ENR index of 8050.

### Treated Water Booster Pump Stations

Distribution pumping station costs vary considerably, depending on such factors as architectural design, pumping head, and station capacity. Estimated average construction costs for distribution pumping stations, as shown in Table R-4 are based on enclosed stations with architectural and landscaping treatment suitable for residential areas. Pump station cost estimates include backup/standby generators and SCADA, and are based on the typical Cal Water configuration, which includes 1 to 3 pumps at 1 to 2 mgd.

**Table R-4. Construction Costs for Booster Pump Stations[(a)]**

| Capacity, mgd | Estimated Construction Cost, million dollars |
|---|---|
| 0.5 | 0.31 |
| 1 | 0.41 |
| 2 | 0.61 |
| 3 | 0.92 |
| 5 | 1.33 |
| 10 | 2.45 |

(a) Based on the September 2007 ENR index of 8050.

### Groundwater Production Wells

Well construction consists of pilot hole drilling, water quality/soil sampling, pilot hole reaming, well construction, well development and providing the necessary housing, pump, motor, automatic control equipment, discharge piping, SCADA, and disinfection equipment. Costs are estimated to be approximately $1,500,000 per well, for a 1,500 to 2,000-gpm well, approximately 400 to 500 feet deep. The estimated cost for wellhead treatment (iron and manganese) for a 1,500 gpm well is approximately $1,900,000. These costs are representative of construction conducted under normal drilling conditions, and would be significantly higher for special or difficult

locations. The estimated cost for existing well Renewal and Replacement in Chapter 7 is approximately $1,000,000.

## CONTINGENCIES AND OTHER PROJECT COSTS

Contingency costs must be reviewed on a case-by-case basis because they will vary considerably with each project. However, to assist Cal Water in budgeting for these future construction projects, contingency costs have been added to the planning budget as percentages of the estimated construction cost, divided into two categories: Construction Contingency Costs and Other Project Cost Allowances.

### Construction Contingency Costs

The construction costs presented above are representative of the construction of water system facilities under normal construction conditions and schedules; consequently, it is appropriate to allow for estimating and construction uncertainties unavoidably associated with the conceptual planning of projects. Such factors as unexpected construction conditions, the need for unforeseen mechanical items, and variations in final quantities are a few of the items that can increase project costs for which it is wise to make allowances in preliminary estimates. An allowance of 20 percent of the base construction cost will be included to cover such project related construction contingencies.

### Other Project Cost Allowances

Other project cost allowances are divided into three subcategories, totaling 28 percent:

- Design services associated with new facilities include preliminary investigations and reports, right-of-way acquisition, foundation explorations, preparation of drawings and specifications for construction, surveying and staking, sampling of testing material, and start-up services. For this study, engineering costs are assumed to be 10 percent of the construction cost estimates after construction contingencies have been applied.
- Construction management covers such items as contract management and inspection during construction. The cost of these items can also vary, but for the purpose of this study, it is assumed that construction management charges will equal approximately 10 percent of the construction costs after construction contingencies have been applied.
- Administration costs cover such items as legal fees, environmental/CEQA compliance requirements, financing expenses, and interest during construction. The cost of these items can also vary, but for the purpose of this study, it is assumed that program implementation costs will equal approximately 8 percent of the construction costs after construction contingencies have been applied.

An example application of these items to a project with an assumed construction cost of $1.0 million is shown in Table R-5. As shown, the total cost of all project construction contingencies (construction, design services, construction management, and administration costs) is approximately 54 percent of the base construction costs for each project.

**Table R-5. Example Application of Construction Contingency Costs and Other Project Cost Allowances**

| Cost Component | Percent | Cost | Total Cost |
|---|---|---|---|
| Estimated Base Construction Cost before Contingencies | | $1,000,000[a] | |
| Construction Contingency Costs | 20% | 200,000 | |
| Estimated Construction Cost with Contingencies | | | $1,200,000 |
| Other Project Cost Allowances: | | | |
| Design | 10% | $120,000 | |
| Construction Management | 10% | 120,000 | |
| Administration | 8% | 96,000 | |
| Total Project Cost Allowances | | | $336,000 |
| Estimated Project Cost[b] | | | $1,536,000 |

(a) Assumed cost of example project.

(b) Revenue requirement rate of 13% is not included in estimated project cost. This rate will be included when developing the annual project costs.