APPENDIX L
Water Master Plan Report

Moffett Park Specific Plan
Sunnyvale, CA

Water Master Plan Report

October 2022

Prepared for:
City of Sunnyvale

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1.0 INTRODUCTION

The Moffett Park Specific Plan (MPSP) provides guidance on the development of the Moffett Park area with corporate headquarters, offices, and research and development facilities. The MPSP was adopted by City of Sunnyvale (City) in 2004, and last revised in 2013. The MPSP documents goals and objectives for future development, community and design guidelines, infrastructure improvements, and development standards. The MPSP is being updated because of recent changes to proposed land uses and anticipated development intensities.

The 2013 MPSP revision examined the existing water system and determined the minimum water system improvements that are required to support buildout conditions. Changes to the anticipated land use and development intensities may affect the proposed water system improvements. BKF Engineers (BKF) performed an analysis of the existing and proposed domestic water distribution system to evaluate impacts and determine required improvements to support the updated buildout conditions. The BKF effort included review of updated land uses and development intensity assumptions, estimation of domestic water demands, and evaluation of existing water system under peak demand scenarios. This Water Master Plan (WMP) has been prepared to document the analysis and provide recommended improvements to support the latest buildout condition.

2.0 LAND USE AND DEVELOPMENT INTENSITY

The MPSP provides a comprehensive, long-term plan that supports the development of the Moffett Park area. The plan includes a mix of land uses consistent with the City's goals and objectives for future development. The Moffett Park Specific Plan area is shown in **Figure 1** below.

Figure 1 – Moffett Park Specific Plan Area

The total MPSP area is approximately 1,157 acres. The majority of this area is expected to be re-developed as part of the buildout of Moffett Park, with some exceptions. Public land parcels that include right-of-way and public roads, the Lockheed Martin campus parcel, and institutional parcels including public schools and emergency services were all assumed to be fully developed in the existing condition. These parcels are not expected to be re-developed as part of buildout conditions. With these exceptions, the total Moffett Park area to be re-developed is approximately 783 acres.

The revised land use types include residential, office, research & development, and mixed-use land use. Each proposed land use has a corresponding minimum and maximum land use development intensity (**Appendix A**). These assumptions were expressed in terms of percent floor area ratio (FAR), which describes the allowable measurement of a building's floor area in relation to the size of the parcel that the building is on. These density assumptions were used as the basis for the water demand estimates described in the next section.

3.0 WATER DEMANDS

Domestic water system demands are estimated for the MPSP area under the latest full buildout condition. Existing domestic demands from the Moffett Park area are included, with the full buildout condition, as part of the model calibration process. This assumption is further explained in the calibration discussion in the model development section.

The buildout domestic demands are estimated using a water demand factor of 132 gallons per day per dwelling unit (gpd/du) for residential land use and 0.13 gallons per day per square foot (gpd/SF) for office and research & development land use[1]. These domestic demand factors include outdoor water use factors; however, there is an extensive recycled water system throughout the Moffett Park area. It is assumed that the already installed recycled water network will provide the entirety of outdoor water use once operational so the outdoor water factors are not included in this analysis. The existing recycled water system will also be used for toilet flushing which will further alleviate domestic demand. For the purposes of this analysis, this additional demand reduction is not included which is a conservative assumption. The indoor demand factors were applied to the maximum development intensity for each parcel based on the revised land use to calculate domestic demand.

Peaking factors are applied to an estimated average day demand (ADD) to estimate maximum day demand (MDD) and peak hour demand (PHD). MDD is typically used to evaluate water infrastructure in conjunction with the required fire flows. As noted above, the full buildout domestic demands are based on the maximum allowable development intensity. Therefore, the estimated ADD represents the most conservative development scenario for every redevelopment parcel within the Moffett Park area. Further, the estimated buildout demands are added to the existing domestic demands, captured through the calibration process. **Table 1** shows the domestic demands estimated using the minimum, average, and maximum development intensities. The maximum allowable development intensity ADD is 1.6 times greater than the average development intensity ADD. In other words, by using the maximum allowable redevelopment, there is already a peaking factor of 1.6 included. In comparison, the City's 2010 Water Utility Master Plan (WUMP) recommended an MDD peaking factor of 1.84, but noted that

[1] Demand factors consistent with City of Redwood City water demand factors (Appendix B)

East Palo Alto and CalWater used an MDD peaking factor of 1.4. Therefore, the assumption to use the maximum allowable development intensity already addresses the MDD peaking factor and so no additional peaking factor is included for the MDD water analysis. The buildout domestic demands estimated using this methodology are 12.5 million-gallons per day (MGD) for the 783 acres of redevelopment.

For PHD, the 2010 WUMP recommended a peaking factor of 3.04. The 3.04 peaking factor is applied to the domestic demands estimated from the average development intensity assumptions to assess the performance of the existing system under a peak hour demand scenario. The total peak hour demand is 23.2 MGD.

Per 2019 California Fire Code (CFC), the maximum fire flow demand for any building is 8,000 gallons per minute (gpm), while fire sprinklers can provide allowances for fire flow demand reductions of up to 75%. For this analysis, a reduction of 50% is applied to the maximum fire flow demand, and a fire flow demand of 4,000 gpm is established as the benchmark for evaluating the existing system. This is consistent with the maximum fire flow demand evaluated in the 2010 WUMP.

4.0 DESIGN CRITERIA

The following assumptions and design criteria are utilized in evaluating the City's water distribution system. The criteria is adapted from those used in the 2010 WUMP, and is established to ensure that the proposed distribution system will provide adequate water pressure and can accommodate peak demands without excessive wear or energy usage. The results of the existing system evaluation are evaluated against the recommended design criteria to identify system deficiencies and recommend improvements. The water system design criteria recommended for this hydraulic analysis are as follows:

Table 2 – Domestic Water System Design Criteria

Minimum Service Pressure during Non-Emergency Operations	40 psi
Minimum Residual Pressure during Maximum Day Demands + Fire Flow	20 psi
Maximum Service Pressure	150 psi
Minimum Pipe Size for New Construction with Fire Hydrant	6 inch
Maximum Pipeline Velocity during Non-Emergency Operations	7 fps
Maximum Pipeline Velocity during Maximum Day Demands + Fire Flow	15 fps
Maximum Headloss Gradient	0.015 ft/ft
Existing Pipeline Roughness Coefficient	Determined through model calibration
Proposed Pipeline Roughness Coefficient	C = 130

5.0 MODEL DEVELOPMENT

The domestic water system hydraulic model was developed for this study as a steady state model using Bentley WaterCAD modeling software. The modeled facilities were imported from the City's GIS records for the existing system, and include pipelines, junctions, and hydrants up to the point of connection of the Moffett Park area to the existing City of Sunnyvale system. BKF used information from GIS records, as-builts, and block maps to input the physical model parameters such as pipe size and materials. The extent of the modeled Moffett Park system and connection points to the existing system are shown in **Figure 2**.

BKF used 26 hydrant tests taken throughout the Moffett Park area to establish boundary conditions and calibrate the steady state hydraulic model. As hydrant tests are conducted in the field between the hours of 8AM to 5PM, test results reflect existing demand conditions within the focus area at the time of the test. The hydraulic grade line (HGL) at each hydrant was estimated based on measured test pressures and hydrant elevations, and the average HGL was used to establish model static pressures. Hydrant flows measured at each location were applied at the corresponding hydrant node in the model, as shown in **Figure 2**. The model was executed, and the calculated residual pressure was compared to the field measured residual pressure. The boundary conditions and the existing pipe roughness coefficients were adjusted iteratively until a best fit of residual pressures was achieved, while maintaining acceptable roughness coefficients based on the existing pipe material and pipe age.

Losses due to pipe friction were calculated by the modeling software using the Hazen-Williams Equation. Because the model does not individually account for minor losses associated with hydraulic singularities (such as bends, valves, and other appurtenances), modeled C-factors were conservatively reduced during calibration to account for these losses. The Hazen-Williams coefficients utilized in the calibrated model fell within the acceptable ranges per industry standards, and are summarized below:

Table 3 – Calibrated Hazen-Williams Coefficients

Pipe Material	Calibrated Hazen Williams Coefficient
Asbestos Cement	100
Concrete Cylindrical	100
Cast Iron	60
Ductile Iron	100
PVC	120
Steel	100

The calibrated model yielded a net zero difference when evaluating the modeled losses against the hydrant test losses. **Table 4** documents a comparison between hydrant test values and the calibrated model.

6.0 EXISTING SYSTEM EVALUATION

The existing water system was evaluated using the calibrated hydraulic model. Typically, water distribution systems are sensitive to fire flows. As a result, the most conservative demand conditions for evaluating the existing system are during either MDD plus fire flows, or during PHD. Steady-state scenarios modeling MDD, MDD plus fire flow, and PHD were developed to model the City's existing water system under buildout conditions.

The model indicates that the existing water system serving the Moffett Park area experiences residual pressures ranging from 56 psi to 65 psi under MDD conditions. In addition, no pipelines were determined to exceed a pipeline velocity of 7 fps or a headloss gradient of 0.015 ft/ft. Based on the established design criteria, the system performed adequately and all service junctions are expected to maintain service pressures within the allowable range under non-emergency conditions.

Under MDD plus fire flow, the model indicates that there are over 160 hydrants that are unable to achieve the required fire flow of 4,000 gpm at a minimum residual pressure of 20 psi, as shown in **Figure 3**. The pipelines in the Moffett Park area were likely not sized to meet demands resulting from the maximum development intensity assumption, and deficient pipes have been identified as capacity deficient and recommended for improvement in the next section. The model indicates that several pipelines have excessive velocities at the required fire flow. These pipelines are undersized and generate significant head loss at hydrants connected to these pipelines and were identified as capacity deficient. Improvements recommended to mitigate identified deficiencies will be discussed in the next section.

A summary of the pressure and velocity results from the existing system evaluation under MDD and MDD plus fire flow can be found in the **Table 5** below, while tables documenting the full output from the WaterCAD model can be found in **Appendix C**.

Table 5 – Existing System Evaluation Summary

Parameter	Requirement	Minimum	Maximum
Service Pressures during Non-Emergency Operations (psi)	40 min	56	65
Pipeline Velocities during Non-Emergency Operations (fps)	7 max	-	4.3
Residual Pressures during MDD plus Fire Flow (psi)	20 min	0	-
Pipeline Velocities during MDD plus Fire Flow (fps)	15 max	-	17.9
Available Fire Flow at Residual Pressure Criteria (gpm)	4,000 min	1,965	-

Under peak hour demands, the model indicates that the existing system is unable to maintain adequate service pressures. The entirety of the existing system serving the Moffett Park area experiences service pressures of 0 psi during peak hour demands. However, the majority of the pipelines were determined to be within a pipeline velocity of 7 fps or a headloss gradient of 0.015 ft/ft.

7.0 PROPOSED IMPROVEMENTS

As described in the previous section, the existing system is currently deficient under buildout conditions and is unable to meet the required fire flow during MDD conditions. In order to mitigate these deficiencies, several portions of the existing system are recommended for improvement. Key improvements are summarized below:

- The pipelines along Mathilda Avenue, Caribbean Drive, and Moffett Park Drive should be upsized to 18-inch domestic water main in order to provide a primary transmission loop through the Moffett Park area. This improvement will increase service pressures throughout the study area and provide reliability and redundancy under maximum day demands and emergency conditions.
- The pipelines along Bordeaux Drive and Java Drive should be upsized to 16-inch domestic water main in order to provide a secondary transmission loop through the Moffett Park area. In conjunction with the primary transmission loop, this improvement will mitigate the majority of the deficiencies in the system, allowing all but a few hydrants to achieve the required fire flow at a residual pressure of 20 psi under maximum day demand conditions.

While the above improvements address the majority of deficiencies, there are several additional targeted improvements that are recommended to allow any remaining hydrants to meet fire flow requirements. These improvements are primarily upsizing non-looped pipelines, where flow is constrained in a single unidirectional pipe. All of the recommended improvements are documented in **Figure 4**.

A summary of the pressure and velocity results with the proposed improvements can be found in the **Table 6** below, while tables documenting the full output from the WaterCAD model can be found in **Appendix C**.

Table 6 – Proposed Improvements Evaluation Summary

Parameter	Requirement	Minimum	Maximum
Service Pressures during Non-Emergency Operations (psi)	40 min	57	66
Pipeline Velocities during Non-Emergency Operations (fps)	7 max	-	3.7
Residual Pressures during MDD plus Fire Flow (psi)	20 min	20	-
Pipeline Velocities during MDD plus Fire Flow (fps)	15 max	-	15.0
Available Fire Flow at Residual Pressure Criteria (gpm)	4,000 min	4,015	-

Even with improvements made to the transmission lines within the Moffett Park area, the model indicated that the system was unable to support peak hour demands while maintaining adequate service pressures. With these improvements in place and under peak hour demand, the modeled system experiences an 8 psi drop across the distribution network. An additional 5 psi of losses are attributed to the existing piping across Highway 237 during peak hour demand. This suggests that these deficiencies cannot be mitigated by localized improvements, and would require that deficiencies caused by peak hour demands be addressed by improvements to supply provided by the City's water distribution system. However, evaluating the expansion of the City's water supply to serve buildout demands from the Moffett Park area is not within the scope of this plan, and it is recommended that the City initiate a planning effort to evaluate supply capacity for the Moffett Park area against the larger city-wide distribution system.

8.0 COST ESTIMATES

Preliminary cost estimates for the improvements described in the previous section are presented in **Table 8**. As shown, mitigating all existing deficiencies has an estimated total cost of $18.4 Million. These costs were estimated using pipeline unit costs as shown in **Table 7**. These costs were extracted from the 2010 WUMP, which were then escalated to reflect the most recent Engineering News Record Construction Cost Index (ENR CCI). The ENR CCI is an inflation index used to adjust prices from one time period to another. The cost estimates used in this report are based on the ENR CCI of 13,004 for May 2022. In addition, a factor of 30 percent has been factored into all unit costs for contingencies, such as engineering, legal, administration, and other construction contingencies. Estimates of improvement costs provided represent Class 4 Order of Magnitude level costs as established by the American Association of Cost Engineers and represent an accuracy of +50% to -30%, and new cost estimates should be obtained during pre-design for proposed improvements to confirm budget amounts.

9.0 CONCLUSIONS

Based on the evaluation described in the previous sections, the existing domestic water system serving the Moffett Park area is currently undersized for the maximum development assumptions designated by the updated MPSP. In order to mitigate deficiencies observed under maximum day demands plus fire flow, it is recommended that the following approximate lengths of new domestic water main be constructed:

- 0.4 miles of new 14-inch main
- 1.6 miles of new 16-inch main
- 4.5 miles of new 18-inch main

These improvements are estimated to have a total cost of $18.4 Million.

ATTACHMENTS

FIGURES

Figure 2: Existing Modeled System
Figure 3: Existing System Evaluation (MDD plus Fire Flow)
Figure 4: Proposed Improvements

TABLES

Table 1: Domestic Water Demands
Table 4: Hydrant Calibration
Table 7: Pipeline Unit Costs
Table 8: Proposed Improvement Costs

APPENDICES

Appendix A: Intensity and Density Standards by Land Use District

Appendix B: City of Redwood City Demand Factors

Appendix C: WaterCAD Model Output

FIGURES

LEGEND

EXISTING SYSTEM

8" EXISTING DIAMETER

TEST HYDRANT

GRAPHIC SCALE

(IN FEET)
1 inch = 500 ft.

FIGURE 2
EXISTING MODELED SYSTEM
MOFFETT PARK SPECIFIC PLAN
WATER MASTER PLAN
MAY 2022

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JOB NO. 20191089-10

2022_0518_Existing_System.dwg

LEGEND

EXISTING SYSTEM

8" EXISTING DIAMETER

HYDRANT W/ RESIDUAL PRESSURE ≥ 20 PSI

HYDRANT W/ RESIDUAL PRESSURE < 20 PSI

GRAPHIC SCALE

500 0 250 500 1000 2000

(IN FEET)
1 inch = 500 ft.

FIGURE 3
EXISTING SYSTEM EVALUATION
MOFFETT PARK SPECIFIC PLAN
WATER MASTER PLAN
MAY 2022

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2022_0518_Existing-Evaluation.dwg

LEGEND

EXISTING SYSTEM	8" EXISTING DIAMETER
PROPOSED IMPROVEMENT	8" PROPOSED DIAMETER
	(8") EXISTING DIAMETER TO BE REPLACED

GRAPHIC SCALE

(IN FEET)
1 inch = 500 ft.

FIGURE 4

PROPOSED IMPROVEMENTS

MOFFETT PARK SPECIFIC PLAN
WATER MASTER PLAN
MAY 2022

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JOB NO. 20191089-10

2022_0503_Proposed_Improvements.dwg

TABLES

Moffett Park Specific Plan - Water Master Plan
Table 1 - Domestic Water Demands

Land Use Type	Area	Office+R&D Floor Area		Residential Units		Water Demands											
		Minimum	Maximum	Minimum	Maximum	Minimum Development Intensity			Average Development Intensity			Maximum Development Intensity			Peak Hour Demands		
	(ac)	(SF)	(SF)	(units)	(units)	(MGD)	(gpd)	(gpm)	(MGD)	(gpd)	(gpm)	(MGD)	(gpd)	(gpm)	(MGD)	(gpd)	(gpm)
MP-AC	82	1,251,332	3,575,235	3,112	14,056	0.6	573,457	398	1.4	1,446,815	1,005	2.3	2,320,173	1,611	4.4	4,398,317	3,054
MP-R	133	0	0	8,571	21,028	1.1	1,131,372	786	2.0	1,953,534	1,357	2.8	2,775,696	1,928	5.9	5,938,743	4,124
MP-MU	147	2,239,977	3,199,967	0	21,552	0.3	291,197	202	1.8	1,776,028	1,233	3.3	3,260,860	2,264	5.4	5,399,126	3,749
MP-O1	231	3,517,933	15,076,856	0	0	0.5	457,331	318	1.2	1,208,661	839	2.0	1,959,991	1,361	3.7	3,674,330	2,552
MP-O2	187	2,848,371	16,276,404	0	0	0.4	370,288	257	1.2	1,243,110	863	2.1	2,115,933	1,469	3.8	3,779,055	2,624
MP-E4	5	77,246	220,703	0	0	0.0	10,042	7	0.0	19,367	13	0.03	28,691	20	0.06	58,875	41
MP-P	27																
MP-I	16																
TOTAL	**1,157**	**9,934,859**	**38,349,164**	**11,683**	**56,636**	**2.8**	**2,833,688**	**1,968**	**7.6**	**7,647,515**	**5,311**	**12.5**	**12,461,343**	**8,654**	**23.2**	**23,248,447**	**16,145**

Table 4 - Hydrant Calibration

Hydrant ID	Hydrant Tests			Calibrated Model			Hydrant Tests vs. Calibrated Model	Percent Change		
	Static Pressure (psi)	Residual Pressure @ 1,500 gpm [1] (psi)	Pressure Loss (psi)	Static Pressure (psi)	Residual Pressure @ 1,500 gpm [1] (psi)	Pressure Loss (psi)	(psi)	Static Pressure (%)	Residual Pressure (%)	Pressure Loss (%)
554-106-75	95	92	3	90	84	6	-3	-5%	-9%	107%
593-A-75	100	97	3	93	89	4	-1	-7%	-9%	54%
W551H750101	86	83	3	90	88	2	1	5%	6%	-31%
W552H750101	95	90	6	89	87	2	4	-6%	-3%	-64%
W552H751024	95	93	2	87	84	3	-1	-8%	-10%	50%
W573H750101	94	90	4	93	91	2	2	-1%	1%	-52%
W573H750105	94	90	4	93	91	2	2	-1%	1%	-52%
W575H750103	94	88	6	96	93	3	3	2%	6%	-49%
W589H750102	102	100	2	95	92	3	-1	-7%	-8%	50%
W589H750103	98	96	2	95	92	3	-1	-3%	-4%	50%
W589H750108	100	98	2	95	92	3	-1	-5%	-6%	50%
W589H750109	100	98	2	95	92	3	-1	-5%	-6%	50%
W589H750110	88	86	2	96	93	3	-1	9%	8%	50%
W589H750111	100	98	2	95	92	3	-1	-5%	-6%	50%
W590H750101	90	88	2	95	92	3	-1	6%	5%	50%
W610H750108	86	84	2	95	92	3	-1	10%	10%	50%
W610H750109	98	94	4	94	91	3	1	-4%	-3%	-23%
W610H750110	84	82	2	95	92	3	-1	13%	12%	50%
W611H750105	92	88	4	96	94	2	2	4%	7%	-50%
W613H750101	92	88	4	97	95	2	2	5%	8%	-49%
W613H750103	98	95	3	97	94	3	0	-1%	-1%	3%
W615H750101	90	88	2	96	93	3	-1	7%	6%	50%
W629H750101	92	90	2	97	94	3	-1	5%	4%	50%
W629H750103	92	90	2	97	95	2	0	5%	6%	0%
W629H750104	100	98	2	96	93	3	-1	-4%	-5%	30%
W631H750104	94	90	4	95	92	3	1	1%	2%	-23%
Average	**94**	**91**	**3**	**94**	**91**	**3**	**0**	**0%**	**0%**	**0%**

Notes:

1. Hydrant test flows ranged from 1,210 gpm to 1,590 gpm. Hazen-Williams equation was used to determine headloss in relation to measured test flow. This relation was applied to a fire flow of 1,500 gpm to provide equivalent residual pressures across the modeled system in order to allow for a direct comparsion of test results. These adjusted residual pressures are reported in this table.

Moffett Park Specific Plan - Water Master Plan

Table 7 - Pipeline Unit Costs

Pipe Diameter (in)	Unit Cost ($/LF)
6	$191
8	$250
10	$316
12	$382
14	$441
16	$507
18	$565
20	$631
24	$756
27	$844
30	$939
36	$1,130

Notes:

1. Unit Costs include a 30% cost contingency factor to account for Engineering, Legal, Administration, and other Construction Cost Contingencies.

2. Unit Costs shown are based on ENR-CCI cost index of 13,004 for May 2022.

Moffett Park Specific Plan - Water Master Plan

Table 8 - Proposed Improvement Costs

Project Number	Description	Length (LF)	Existing Diameter (in)	Proposed Diameter (in)	Unit Cost ($/LF)	Total Cost ($)
1	Primary Transmission Loop	21,550	12	18	565	$12,176,000
2	Secondary Transmission Loop	7,749	12	16	507	$3,929,000
3	Targetted Fire Flow Improvement	1,061	12	14	441	$468,000
4	Targetted Fire Flow Improvement	506	12	16	507	$257,000
5	Targetted Fire Flow Improvement	488	10	14	441	$216,000
6	Targetted Fire Flow Improvement	388	8	14	441	$172,000
7	Targetted Fire Flow Improvement	2,113	12	18	565	$1,194,000
	Sub-total - New 14-inch Main	1,937				$856,000
	Sub-total - New 16-inch Main	8,255				$4,186,000
	Sub-total - New 18-inch Main	23,663				$13,370,000
	Total	33,855				$18,412,000

Notes:

1. Recommended improvement lengths shown above represent improvements required to meet criteria assuming full flow at each hydrant, where flows are applied to the hydrant connection to the distribution main. Splitting fire flow would allow for less length of recommended improvements, as described below:
    - Project Number 5 - Instead of 488 LF of 14-inch, only 241 LF would be required to meet criteria. This would result in a total project cost of $107,000.

APPENDIX A

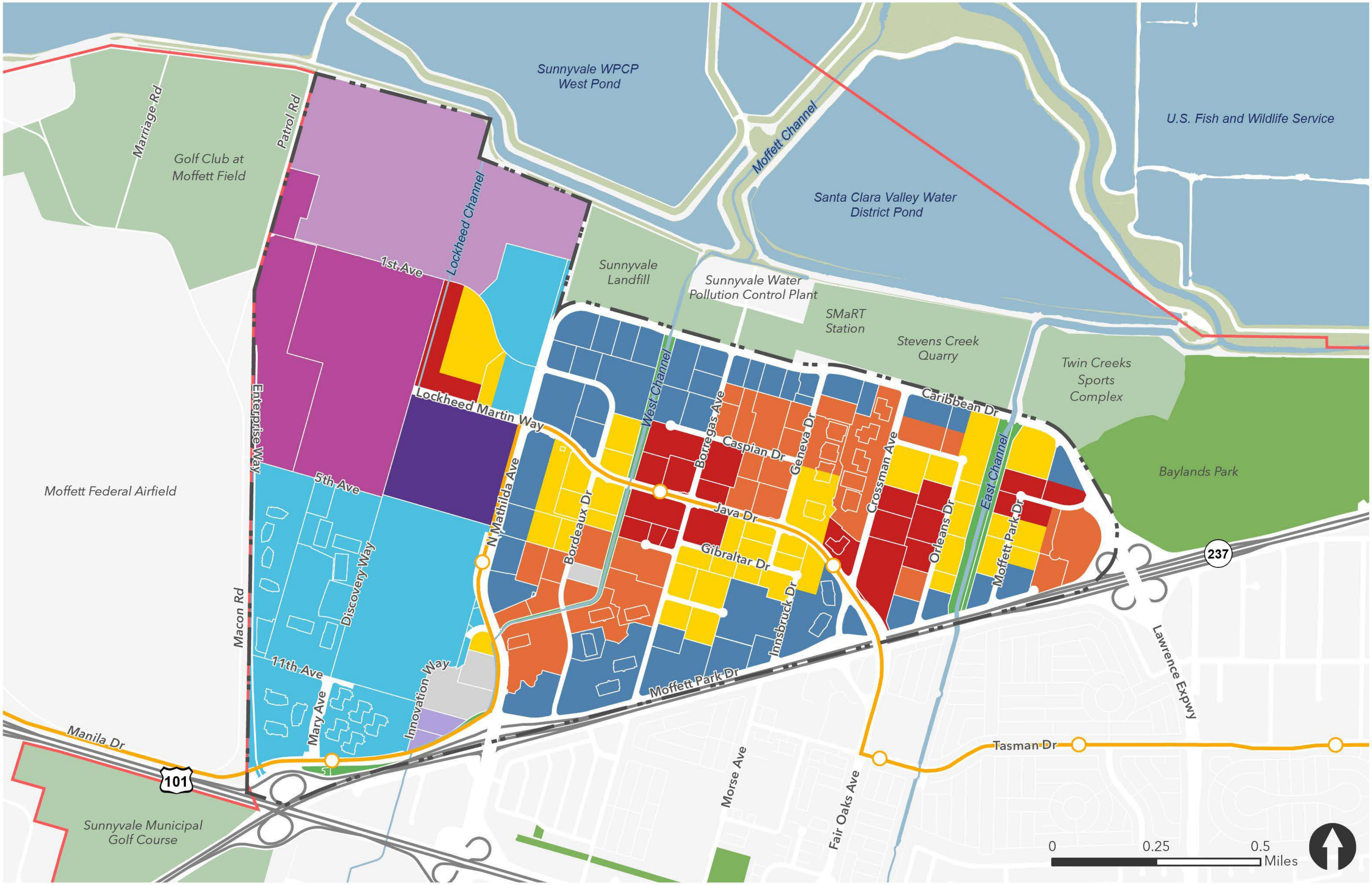
Intensity and Density Standards by Land Use District

Table XX: Intensity and Density Standards by Land Use District

District	Office/R+D Base FAR	Office/R+D Bonus FAR Maximum	Residential Density Minimum	Residential Density Maximum	Total FAR Maximum**
MP-AC	35%	75%	40 du/a (100%)	180 du/a (350%)	450%* 150% Office
MP-R	-	-	70 du/a (175%)	150 du/a (350%)	400%*
MP-MU	35%	100%	-	150 du/a (350%)	400% 200% Office
MP-O1	35%	100%	-	-	150%
MP-O2	35%	135%	-	-	200%
MP-E1(Navy)	35%	75%	(Maker Space Minimum: 35% FAR)		150%
MP-E2 (LHM Core)	35%	50%	-	-	100%
MP-E3 (North LHM)	35%	-	(Maker Space Minimum: 5% of floor area)		35%
MP-E4	35%	50%	-	-	100%
MP-P	-	-	-	-	-
MP-I	-	-	-	-	-

- Note: Maximum residential densities not inclusive of Assembly Bill 2345 density bonus.
- ***East Orleans** may exceed the Residential FAR Maximum and Maximum FAR by up to 1.0 FAR because of the increased height limits in the East Orleans neighborhood, MP-AC and MP-R projects only.
- ****Maximum FAR**. Maximum FAR is allowed non-res FAR, residential FAR, and Transfer of Development Rights

March 2022



Specific Plan Boundary
City of Sunnyvale Limit
VTA Light Rail
Freeway
Water/Channel
MP-O1: Office 1
MP-O2: Office 2
MP-E1: Mixed Employment 1
MP-E2: Mixed Employment 2
MP-E3: Employment 3
MP-E4: Mixed Employment 4
MP-AC: Activity Center 1
MP-MU: Mixed Use 1
MP-R: Residential 1
MP-P: Public 1
MP-I: Institutional 1

Data Sources: City of Sunnyvale (2020); County of Santa Clara (2021); ESRI (2020); California Department of Fish and Wildlife (2021)

APPENDIX B

City of Redwood City Demand Factors

ATTACHMENT Q (1 of 3)

WATER DEMAND PROJECTION WORKSHEET

JOB TITLE ____________________ CAL. BY ____________

JOB NUMBER ________________ CHKD. BY __________

JOB LOCATION ________________ DATE ____________

INDOOR WATER DEMAND PROJECTION

A. RESIDENTIAL

1. Multi - Family
   _______ Units X 2.2 Persons = ________ Persons

2. Single Family
   _______ Units X 3.4 Persons = ________ Persons

_____________ Persons X 60*GPD = ____________ **GPD Projected**

B. OFFICE/COMMERCIAL

_________ sqft X 0.13 gpd/sqft = _________ **GPD Projected**

C. HOTEL

_________ rooms X 195 gpd/room = _________ **GPD Projected**

D. RESTAURANTS

_________ seats X 30 gpd/seat = _________ **GPD Projected**

E. ALL OTHERS SEE PAGE 3: = _________ **GPD Projected**

LANDSCAPING WATER DEMAND PROJECTION

A. RESIDENTIAL

17 gpd X _________ persons = _________ **GPD Projected**

B. COMMERCIAL

__________ sqft X 3.5 cuft of water /sqft of landscape per year = ____________ **CUFT/YR**

To convert to GPD:

_________ cuft/yr X 7.48 gal/cuft X 1 yr/365 days = ____________ **GPD Projected**

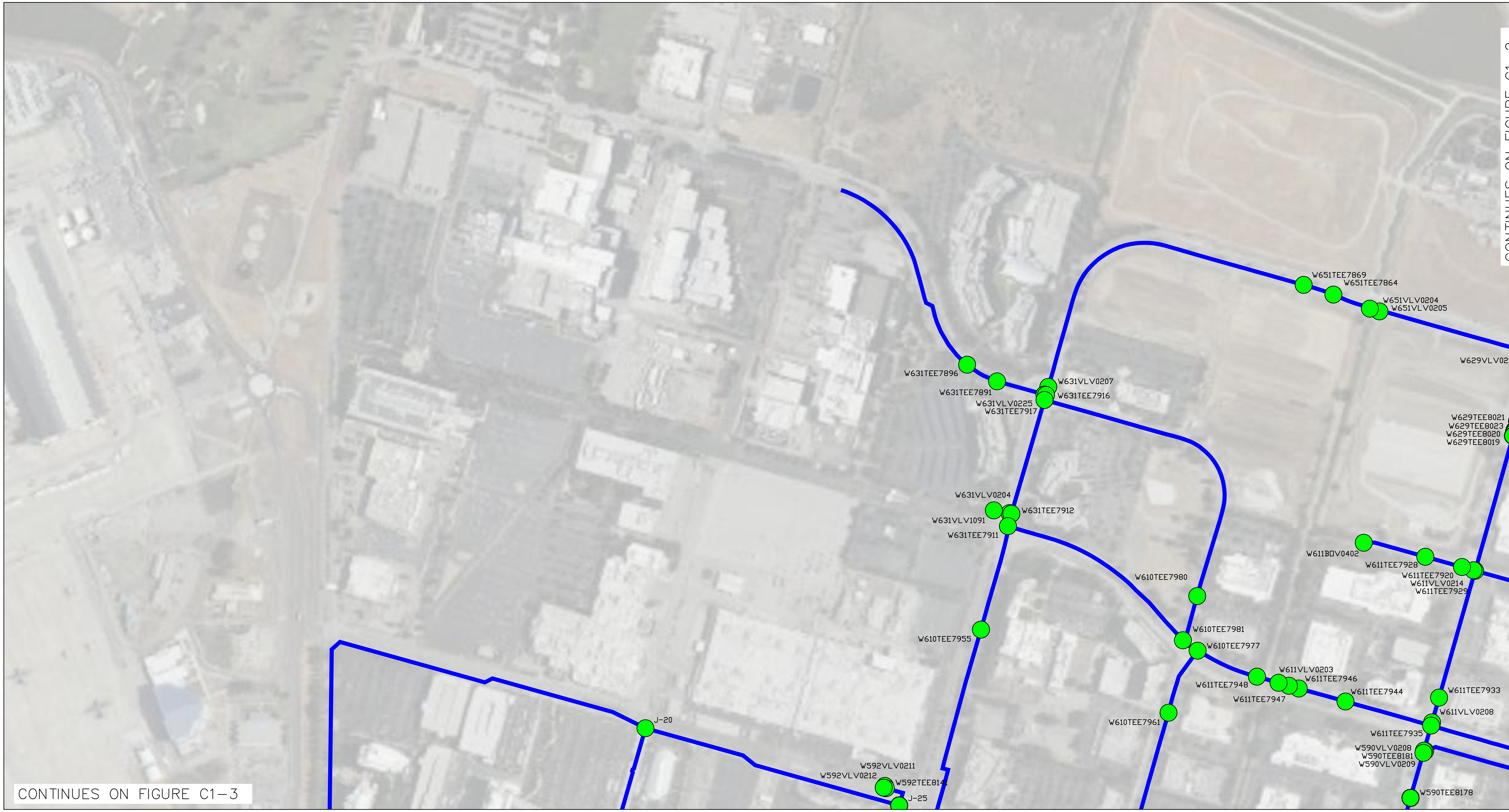
TOTAL DOMESTIC WATER DEMAND PROJECTION

INDOOR + LANDSCAPING PROJECTION = _______________ **GPD Projected**

* From SFPUC Demand Study by URS, " Projected Water Usage for BAWSCA Agencies " , Tech Memo of August 2006.

APPENDIX C

WaterCAD Model Output



LEGEND

MODELED PIPELINES

MODELED JUNCTION NODES

GRAPHIC SCALE

250 0 125 250 500 1000

(IN FEET)
1 inch = 250 ft.

FIGURE C1-1
MODELED JUNCTIONS
MOFFETT PARK SPECIFIC PLAN
WATER MASTER PLAN
OCTOBER 2022

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LEGEND

MODELED PIPELINES

MODELED JUNCTION NODES

GRAPHIC SCALE

250 0 125 250 500 1000

(IN FEET)
1 inch = 250 ft.

FIGURE C1-2
MODELED JUNCTIONS
MOFFETT PARK SPECIFIC PLAN
WATER MASTER PLAN
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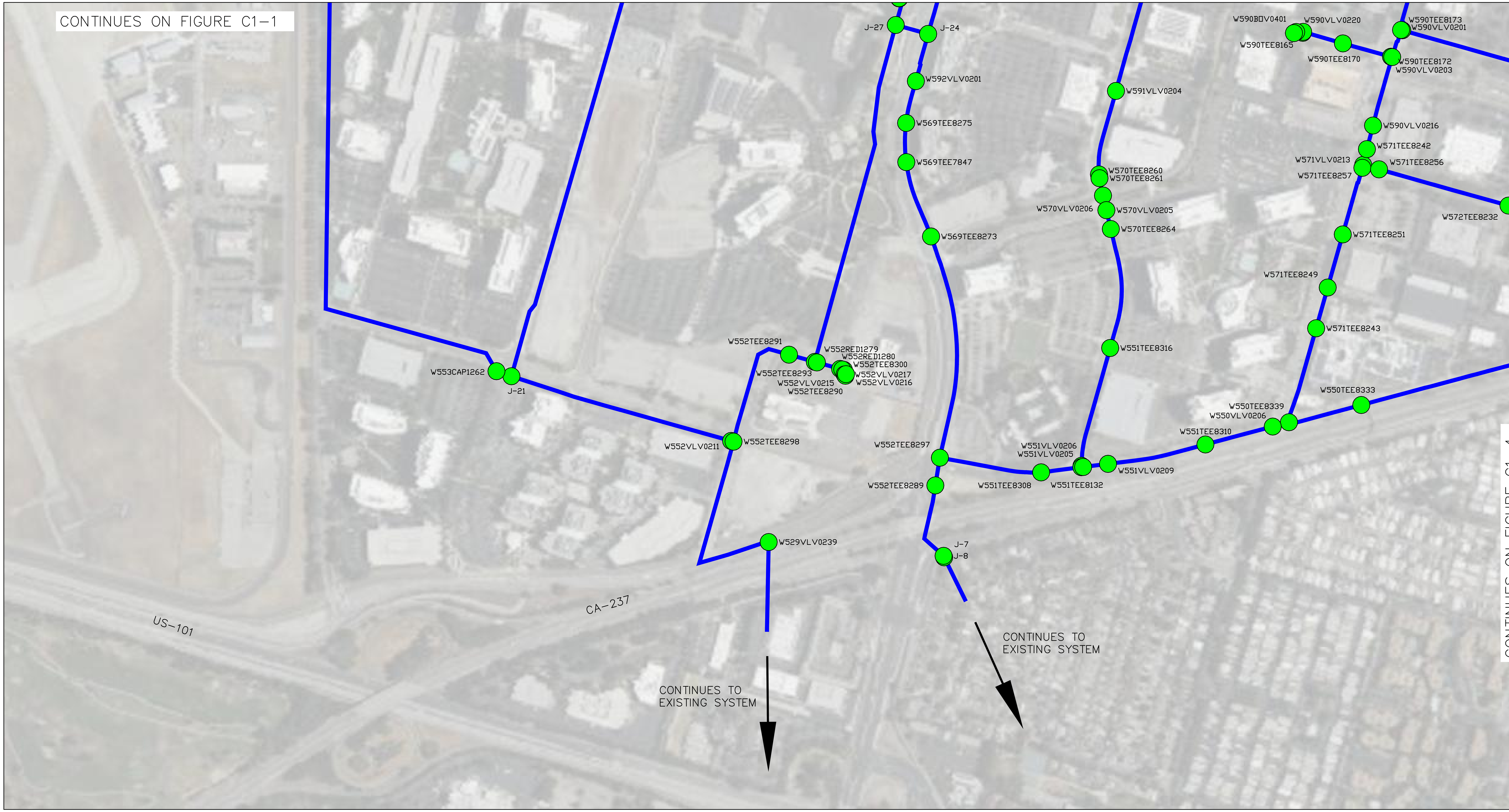

LEGEND

MODELED PIPELINES

MODELED JUNCTION NODES

GRAPHIC SCALE

(IN FEET)
1 inch = 250 ft.

FIGURE C1-3
MODELED JUNCTIONS
MOFFETT PARK SPECIFIC PLAN
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LEGEND

MODELED PIPELINES

MODELED JUNCTION NODES

GRAPHIC SCALE

(IN FEET)
1 inch = 250 ft.

FIGURE C1-4
MODELED JUNCTIONS
MOFFETT PARK SPECIFIC PLAN
WATER MASTER PLAN
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Moffett Park Specific Plan - Water Master Plan
Table C1 - Allocated Demands under Maximum Development Intensity Assumptions

Model Node ID	Demand (gpm)
W529VLV0239	6.8
W550TEE8333	39.5
W550TEE8339	75.0
W550VLV0206	0.0
W551TEE8132	0.0
W551TEE8308	51.6
W551TEE8310	140.1
W551TEE8316	26.7
W551VLV0205	0.0
W551VLV0206	0.0
W551VLV0209	0.0
W552RED1279	0.0
W552RED1280	0.0
W552TEE8289	0.0
W552TEE8290	0.0
W552TEE8291	0.0
W552TEE8293	30.8
W552TEE8297	0.0
W552TEE8298	13.1
W552TEE8300	0.0
W552VLV0211	0.0
W552VLV0215	0.0
W552VLV0216	0.0
W552VLV0217	0.0
W553CAP1262	155.5
W569TEE7847	39.6
W569TEE8273	243.4
W569TEE8275	0.0
W570TEE8260	85.8
W570TEE8261	0.0
W570TEE8264	99.6
W570VLV0205	0.0
W570VLV0206	0.0
W571TEE8242	0.0
W571TEE8243	0.0
W571TEE8249	19.7
W571TEE8251	42.4

Moffett Park Specific Plan - Water Master Plan
Table C1 - Allocated Demands under Maximum Development Intensity Assumptions

Model Node ID	Demand (gpm)
W571TEE8256	0.0
W571TEE8257	172.1
W571VLV0213	0.0
W572TEE8223	45.3
W572TEE8224	0.0
W572TEE8227	17.6
W572TEE8232	213.7
W572TEE8238	0.0
W572VLV0210	0.0
W573ARV0601	15.2
W573RED1296	0.0
W573TEE8644	0.0
W573TEE8645	298.5
W573TEE8649	145.8
W573VLV0208	0.0
W573VLV0209	0.0
W573VLV0222	23.7
W574TEE8632	67.4
W574TEE8633	0.0
W574VLV0202	0.0
W574VLV0203	19.2
W586RED1287	0.0
W586TEE8516	56.6
W586VLV0201	150.7
W586VLV0202	0.0
W586VLV0204	0.0
W587VLV0217	191.6
W588TEE8485	172.5
W588TEE8495	168.2
W589TEE8187	101.6
W589TEE8206	115.1
W589TEE8208	18.6
W589TEE8218	0.0
W589TEE8219	0.0
W589VLV0210	102.6
W589VLV0217	0.0
W589VLV0218	0.0

Moffett Park Specific Plan - Water Master Plan
Table C1 - Allocated Demands under Maximum Development Intensity Assumptions

Model Node ID	Demand (gpm)
W589VLV0221	0.0
W590BOV0401	0.0
W590TEE8165	156.7
W590TEE8170	42.5
W590TEE8172	36.5
W590TEE8173	0.0
W590TEE8178	228.6
W590TEE8181	0.0
W590VLV0201	0.0
W590VLV0203	0.0
W590VLV0206	0.0
W590VLV0208	0.0
W590VLV0209	0.0
W590VLV0216	0.0
W590VLV0220	0.0
W591VLV0204	142.0
W592TEE8141	0.0
W592VLV0201	0.0
W592VLV0211	0.0
W592VLV0212	0.0
W610TEE7955	146.9
W610TEE7961	174.3
W610TEE7977	38.3
W610TEE7980	188.5
W610TEE7981	0.0
W611BOV0402	150.1
W611TEE7920	0.0
W611TEE7928	28.7
W611TEE7929	198.2
W611TEE7933	0.0
W611TEE7935	46.7
W611TEE7944	75.4
W611TEE7946	62.1
W611TEE7947	0.0
W611TEE7948	0.0
W611VLV0203	0.0
W611VLV0208	0.0

Moffett Park Specific Plan - Water Master Plan
Table C1 - Allocated Demands under Maximum Development Intensity Assumptions

Model Node ID	Demand (gpm)
W611VLV0214	0.0
W612TEE7842	52.6
W612TEE8114	372.6
W613TEE8098	240.9
W613TEE8101	97.4
W613VLV0206	126.2
W615CAP1255	0.0
W615TEE8057	0.0
W615TEE8060	0.0
W615TEE8062	0.0
W615TEE8063	0.0
W615TEE8065	111.0
W615TEE8077	104.0
W615VLV0201	0.0
W615VLV0204	0.0
W615VLV0207	0.0
W615VLV0215	0.0
W615VLV0220	80.4
W615VLV0226	0.0
W615VLV0227	0.0
W615VLV0228	0.0
W626TEE8049	0.0
W627ARV0601	0.0
W627TEE8039	0.0
W627TEE8047	0.0
W627VLV0202	0.0
W628ARV0601	0.0
W628TEE8030	15.0
W628TEE8035	220.8
W628VLV0202	0.0
W628VLV0205	0.0
W628VLV0211	0.0
W629TEE8013	52.2
W629TEE8016	101.8
W629TEE8019	41.9
W629TEE8020	0.0
W629TEE8021	0.0

Moffett Park Specific Plan - Water Master Plan
Table C1 - Allocated Demands under Maximum Development Intensity Assumptions

Model Node ID	Demand (gpm)
W629TEE8023	14.8
W629TEE8026	32.6
W629TEE8038	15.3
W629VLV0201	0.0
W629VLV0202	22.0
W629VLV0204	0.0
W631TEE7891	0.0
W631TEE7896	549.4
W631TEE7911	0.0
W631TEE7912	0.0
W631TEE7916	83.8
W631TEE7917	20.1
W631VLV0204	0.0
W631VLV0207	36.2
W631VLV0225	0.0
W631VLV1091	89.7
W651TEE7864	27.3
W651TEE7869	44.4
W651VLV0204	0.0
W651VLV0205	36.4
J-2	0.0
J-3	0.0
J-4	0.0
J-7	0.0
J-8	0.0
J-9	0.0
J-10	0.0
J-11	0.0
J-16	0.0
J-20	277.6
J-21	284.7
J-24	458.8
J-25	0.0
J-27	162.4
Total	7,470

LEGEND

MODELED PIPELINES

MODELED HYDRANT NODES

GRAPHIC SCALE

250 0 125 250 500 1000

(IN FEET)
1 inch = 250 ft.

FIGURE C2-1
MODELED HYDRANTS
MOFFETT PARK SPECIFIC PLAN
WATER MASTER PLAN
OCTOBER 2022

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LEGEND

MODELED PIPELINES

MODELED HYDRANT NODES

GRAPHIC SCALE

(IN FEET)
1 inch = 250 ft.

FIGURE C2-2
MODELED HYDRANTS
MOFFETT PARK SPECIFIC PLAN
WATER MASTER PLAN
OCTOBER 2022

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LEGEND

MODELED PIPELINES

MODELED HYDRANT NODES

GRAPHIC SCALE

(IN FEET)
1 inch = 250 ft.

FIGURE C2-3
MODELED HYDRANTS
MOFFETT PARK SPECIFIC PLAN
WATER MASTER PLAN
OCTOBER 2022

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LEGEND

MODELED PIPELINES

MODELED HYDRANT NODES

GRAPHIC SCALE

(IN FEET)
1 inch = 250 ft.

FIGURE C2-4
MODELED HYDRANTS
MOFFETT PARK SPECIFIC PLAN
WATER MASTER PLAN
OCTOBER 2022

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Moffett Park Specific Plan - Water Master Plan
Appendix C - WaterCAD Model Output
Table C2 - Existing System Fire Flow Results (during MDD)

Hydrant ID	Hydrant Elevation (ft)	Required Fire Flow (gpm)	Static Pressure (psi)	Residual Pressure (psi)	Available Fire Flow (gpm)	Velocity of Maximum Pipe (gpm)
W631H750104	7.5	4,000	60	13	3,490	9.5
W631H760108	8.5	4,000	60	11	3,416	9.4
W631H750106	8.6	4,000	60	10	3,368	9.4
W631H750107	7.9	4,000	60	11	3,403	9.4
W631H750103	8.7	4,000	60	11	3,429	9.4
W610H750109	9.7	4,000	59	13	3,484	9.5
W553H751025	26.3	4,000	57	5	3,076	8.8
W553H751026	25.9	4,000	57	9	3,262	8.9
W552H751024	26.8	4,000	58	15	3,624	10.7
W551H750101	21.9	4,000	58	19	3,890	9.6
W551H750102	20.3	4,000	57	17	3,752	9.6
W551H750105	20.0	4,000	57	14	3,528	9.5
W551H750106	19.8	4,000	57	11	3,377	9.4
W570H750101	18.5	4,000	57	9	3,284	9.3
W570H750102	17.1	4,000	57	8	3,234	9.3
W570H750103	15.6	4,000	56	6	3,113	9.2
W591H750101	17.8	4,000	58	7	3,193	9.2
W591H750102	14.2	4,000	59	9	3,291	9.3
W591H750103	11.0	4,000	58	9	3,298	9.3
W610H750107	11.9	4,000	58	12	3,461	9.5
W610H750108	11.4	4,000	59	16	3,704	9.7
W610H750110	9.4	4,000	59	14	3,590	9.6
W610H750106	9.4	4,000	59	14	3,545	9.5
W610H750111	10.0	4,000	59	13	3,524	9.5
W610H750105	10.3	4,000	59	14	3,538	9.5
W631H750101	10.2	4,000	59	15	3,629	9.6
W610H910104	9.5	4,000	59	15	3,652	9.6
W610H910103	10.5	4,000	60	15	3,655	9.5
W610H910102	11.3	4,000	60	16	3,698	9.5
W610H910101	11.9	4,000	60	17	3,753	9.5
W592H910103	12.5	4,000	61	18	3,846	9.5
W592H750101	12.8	4,000	61	19	3,960	9.5
W569H750103	12.3	4,000	60	17	3,786	9.4
W569H750102	13.3	4,000	60	16	3,702	9.3
W569H750101	15.8	4,000	60	15	3,662	9.3

Table C2 - Existing System Fire Flow Results (during MDD)

Hydrant ID	Hydrant Elevation (ft)	Required Fire Flow (gpm)	Static Pressure (psi)	Residual Pressure (psi)	Available Fire Flow (gpm)	Velocity of Maximum Pipe (gpm)
W552H750103	16.7	4,000	59	16	3,723	9.3
W552H750102	17.8	4,000	59	18	3,813	9.4
W551H750103	18.5	4,000	56	15	3,555	9.5
W551H750104	20.2	4,000	56	13	3,488	9.5
W550H750102	20.9	4,000	57	14	3,506	9.5
W550H750106	19.8	4,000	57	13	3,484	9.6
W571H750105	18.3	4,000	58	13	3,487	9.6
W571H750103	17.4	4,000	58	13	3,484	9.6
W571H750102	14.9	4,000	59	14	3,586	9.7
W571H750104	14.0	4,000	58	12	3,455	9.6
W572H750101	11.4	4,000	58	12	3,447	9.6
W572H750102	13.5	4,000	59	14	3,598	9.7
W550H750103	12.4	4,000	57	14	3,524	9.6
W550H750104	10.5	4,000	58	13	3,481	9.6
W550H750105	17.2	4,000	58	13	3,474	9.6
W550H750109	15.5	4,000	58	12	3,433	9.5
W549H750111	14.5	4,000	59	14	3,566	9.7
W549H750110	15.9	4,000	58	15	3,600	9.7
W572H750106	12.8	4,000	59	18	3,809	9.9
W572H750105	14.6	4,000	59	16	3,725	9.8
W572H750104	12.4	4,000	59	16	3,671	9.7
W572H750103	12.5	4,000	59	15	3,655	9.7
W589H750113	12.1	4,000	60	16	3,728	9.8
W589H750112	10.7	4,000	60	17	3,789	9.8
W589H750114	8.6	4,000	59	15	3,630	9.7
W589H750115	9.2	4,000	59	15	3,599	9.7
W590H750106	10.5	4,000	59	16	3,703	9.8
W589H750109	10.5	4,000	59	19	3,880	9.9
W589H750108	9.2	4,000	60	13	3,514	9.6
W589H750107	9.4	4,000	60	11	3,394	9.5
W589H750106	8.7	4,000	59	12	3,432	9.5
W590H750105	8.5	4,000	60	18	3,836	12.7
W611H750101	9.6	4,000	60	18	3,868	9.9
W589H750105	7.3	4,000	60	16	3,709	9.8
W589H750104	8.2	4,000	60	16	3,707	9.8

Table C2 - Existing System Fire Flow Results (during MDD)

Hydrant ID	Hydrant Elevation (ft)	Required Fire Flow (gpm)	Static Pressure (psi)	Residual Pressure (psi)	Available Fire Flow (gpm)	Velocity of Maximum Pipe (gpm)
W589H750103	8.9	4,000	60	17	3,771	9.8
W589H750110	8.2	4,000	61	18	3,847	9.9
W612H750106	8.9	4,000	61	17	3,768	9.8
W589H750102	6.5	4,000	60	18	3,841	9.9
W589H750101	5.4	4,000	59	16	3,711	9.8
W589H750111	9.2	4,000	60	12	3,489	9.6
W588H750104	9.6	4,000	60	16	3,714	9.8
W588H750106	8.7	4,000	60	12	3,457	9.6
W591H750104	9.2	4,000	59	11	3,387	9.4
W572H750107	10.0	4,000	60	20	3,962	10.1
W573H750105	10.9	4,000	60	19	3,917	10.1
W573H750106	11.1	4,000	60	17	3,776	12.5
W588H750103	12.2	4,000	60	17	3,751	9.9
W588H750107	10.3	4,000	60	17	3,791	9.9
W588H750102	9.9	4,000	60	15	3,657	9.8
W588H750101	8.9	4,000	61	15	3,634	9.8
W588H750108	8.8	4,000	61	15	3,630	9.8
W613H750104	6.5	4,000	62	15	3,650	9.8
W613H750103	5.6	4,000	62	16	3,757	9.9
W611H750104	5.3	4,000	59	15	3,609	9.6
W611H940108	3.2	4,000	58	14	3,525	9.5
W610H750114	10.1	4,000	59	15	3,663	9.6
W590H750104	13.0	4,000	60	18	3,811	9.8
W590H750101	9.4	4,000	60	17	3,749	9.8
W590H750102	7.8	4,000	59	0	1,965	13.8
W590H750103	8.8	4,000	59	16	3,681	9.7
W571H750101	10.6	4,000	59	16	3,689	9.8
W611H750102	9.5	4,000	61	17	3,795	9.8
W611H750107	10.0	4,000	60	0	2,580	11.3
W611H750106	12.1	4,000	61	2	3,052	13.2
W611H750105	5.5	4,000	61	16	3,716	9.8
W629H750102	8.0	4,000	61	15	3,619	9.7
W629H750101	5.4	4,000	61	15	3,662	9.7
W651H940105	5.9	4,000	61	13	3,516	9.6
W651H940104	5.2	4,000	60	10	3,377	9.5
W651H940103	4.1	4,000	59	7	3,204	9.3
W651H940102	4.9	4,000	62	9	3,332	9.4
W651H940101	6.2	4,000	61	8	3,313	9.4
W650H940104	9.7	4,000	61	8	3,285	9.4
W650H940103	3.8	4,000	60	8	3,281	9.4
W650H940102	4.1	4,000	61	10	3,349	9.4

Table C2 - Existing System Fire Flow Results (during MDD)

Hydrant ID	Hydrant Elevation (ft)	Required Fire Flow (gpm)	Static Pressure (psi)	Residual Pressure (psi)	Available Fire Flow (gpm)	Velocity of Maximum Pipe (gpm)
W650H940101	5.5	4,000	61	12	3,455	9.5
W631H940102	6.4	4,000	60	14	3,592	9.6
W631H750105	6.0	4,000	59	10	3,333	9.4
W611H750103	5.0	4,000	59	16	3,665	9.7
W629H940108	7.5	4,000	62	15	3,658	9.7
W629H940107	10.2	4,000	61	14	3,609	9.7
W629H750104	10.0	4,000	61	16	3,721	9.8
W629H750105	3.6	4,000	61	15	3,671	9.7
W629H750106	5.1	4,000	62	15	3,677	9.7
W612H750105	5.7	4,000	61	16	3,689	9.7
W612H750104	4.7	4,000	61	17	3,781	9.8
W612H750103	3.6	4,000	61	15	3,675	9.7
W612H750102	4.3	4,000	61	15	3,653	9.7
W612H750101	4.6	4,000	61	16	3,693	9.7
W573H750107	4.8	4,000	62	19	3,916	10.0
W574H750104	4.6	4,000	62	17	3,782	9.9
W587H750103	4.6	4,000	62	15	3,689	9.8
W587H750102	8.3	4,000	62	13	3,566	9.7
W587H750101	6.7	4,000	63	13	3,578	9.7
W614H750104	6.4	4,000	62	12	3,511	9.7
W614H750103	7.5	4,000	62	13	3,543	9.7
W614H750102	5.2	4,000	63	13	3,587	9.7
W614H750101	6.5	4,000	62	14	3,617	9.7
W613H750101	5.1	4,000	63	18	3,863	9.9
W613H750102	4.0	4,000	62	16	3,701	9.8
W629H750103	4.3	4,000	63	18	3,883	9.9
W628H750101	3.1	4,000	63	19	3,917	10.0
W627H940105	4.0	4,000	62	17	3,803	9.9
W627H940104	2.8	4,000	62	16	3,727	9.8
W627H940103	3.0	4,000	63	16	3,713	9.8
W627H940102	4.6	4,000	61	13	3,563	9.6
W627H940101	4.8	4,000	60	12	3,507	9.6
W626H940101	3.9	4,000	63	16	3,719	9.8
W615H940104	8.8	4,000	63	17	3,789	9.8
W615H750105	11.3	4,000	64	14	3,632	9.7
W615H750106	5.4	4,000	64	14	3,624	9.7
W615H940103	5.2	4,000	64	17	3,807	9.8
W615H750101	3.0	4,000	63	17	3,803	9.8
W615H750102	3.9	4,000	64	18	3,871	9.9
W615H750107	4.3	4,000	64	18	3,860	9.8
W614H750105	6.4	4,000	65	18	3,858	9.9

Table C2 - Existing System Fire Flow Results (during MDD)

Hydrant ID	Hydrant Elevation (ft)	Required Fire Flow (gpm)	Static Pressure (psi)	Residual Pressure (psi)	Available Fire Flow (gpm)	Velocity of Maximum Pipe (gpm)
W587H750107	4.8	4,000	64	16	3,765	9.8
W587H750106	4.6	4,000	64	17	3,801	9.8
W587H750105	3.0	4,000	63	17	3,772	9.8
W587H750104	5.2	4,000	64	19	3,898	9.9
W574H750106	3.9	4,000	60	17	3,795	9.8
W574H750107	6.3	4,000	59	16	3,733	9.8
W649H001007	5.5	4,000	60	0	2,355	8.6
W649H001006	5.2	4,000	59	0	2,566	8.8
W649H001009	6.7	4,000	58	0	2,667	9.1
W631H001008	13.2	4,000	59	0	2,831	9.6
W628H750102	14.6	4,000	63	18	3,843	10.9
593-A-75	7.0	4,000	62	8	3,324	9.0
554-106-75	8.0	4,000	59	0	2,835	8.6
W552H750101	10.8	4,000	58	20	4,005	9.6
W592H910102	9.6	4,000	62	21	4,005	9.5
W573H750101	2.8	4,000	60	22	4,005	10.2
W574H750105	12.8	4,000	64	21	4,005	10.0
W575H750103	20.6	4,000	64	21	4,005	9.9

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Appendix C - WaterCAD Model Output
Table C3 - Fire Flow Results with Proposed Improvements (during MDD)

Hydrant ID	Hydrant Elevation (ft)	Required Fire Flow (gpm)	Static Pressure (psi)	Residual Pressure (psi)	Available Fire Flow (gpm)	Velocity of Maximum Pipe (gpm)
W631H750104	7.5	4,000	64	28	4,737	10.6
W631H760108	8.5	4,000	63	26	4,518	10.0
W631H750106	8.6	4,000	63	24	4,288	9.8
W631H750107	7.9	4,000	63	24	4,301	9.8
W631H750103	8.7	4,000	63	24	4,324	9.9
W610H750109	9.7	4,000	63	25	4,414	9.9
W553H751025	26.3	4,000	57	21	4,128	9.5
W553H751026	25.9	4,000	58	22	4,201	9.6
W552H751024	26.8	4,000	57	22	4,234	9.6
W551H750101	20.3	4,000	59	26	4,606	10.0
W551H750102	20.0	4,000	59	26	4,599	10.1
W551H750105	19.8	4,000	59	25	4,546	10.0
W551H750106	18.5	4,000	59	25	4,538	10.0
W570H750101	17.1	4,000	60	26	4,547	10.0
W570H750102	15.6	4,000	60	26	4,570	10.0
W570H750103	17.8	4,000	59	25	4,452	10.0
W591H750101	14.2	4,000	61	26	4,581	10.1
W591H750102	11.0	4,000	62	28	4,706	10.1
W591H750103	11.9	4,000	62	27	4,673	10.1
W610H750107	11.4	4,000	62	28	4,727	10.2
W610H750108	9.4	4,000	63	29	4,820	10.2
W610H750110	9.4	4,000	63	26	4,566	10.0
W610H750106	10.0	4,000	62	26	4,503	10.0
W610H750111	10.3	4,000	62	26	4,484	10.0
W610H750105	10.2	4,000	62	26	4,515	10.0
W631H750101	9.5	4,000	63	28	4,718	10.1
W610H910104	10.5	4,000	62	29	4,863	10.2
W610H910103	11.3	4,000	62	29	4,847	10.2
W610H910102	11.9	4,000	62	28	4,841	10.2
W610H910101	12.5	4,000	62	28	4,833	10.2
W592H910103	12.8	4,000	62	28	4,843	10.2
W592H750101	13.3	4,000	62	29	4,858	10.2
W569H750103	15.8	4,000	60	27	4,747	10.1
W569H750102	16.7	4,000	60	27	4,707	10.1
W569H750101	17.8	4,000	60	27	4,664	10.1

Moffett Park Specific Plan - Water Master Plan
Appendix C - WaterCAD Model Output
Table C3 - Fire Flow Results with Proposed Improvements (during MDD)

Hydrant ID	Hydrant Elevation (ft)	Required Fire Flow (gpm)	Static Pressure (psi)	Residual Pressure (psi)	Available Fire Flow (gpm)	Velocity of Maximum Pipe (gpm)
W552H750103	18.5	4,000	59	26	4,647	10.1
W552H750102	20.2	4,000	59	26	4,598	10.0
W551H750103	20.9	4,000	58	25	4,536	10.0
W551H750104	19.8	4,000	59	26	4,565	10.0
W550H750102	18.3	4,000	59	26	4,618	10.1
W550H750106	17.4	4,000	60	24	4,383	9.9
W571H750105	14.9	4,000	61	23	4,248	9.8
W571H750103	14.0	4,000	61	22	4,186	9.8
W571H750102	11.4	4,000	62	23	4,279	9.8
W571H750104	13.5	4,000	61	21	4,102	9.7
W572H750101	12.4	4,000	61	21	4,076	9.7
W572H750102	10.5	4,000	62	23	4,268	9.8
W550H750103	17.2	4,000	60	27	4,656	10.1
W550H750104	15.5	4,000	60	27	4,717	10.2
W550H750105	14.5	4,000	61	28	4,758	10.2
W550H750109	15.9	4,000	60	27	4,703	10.2
W549H750111	12.8	4,000	62	28	4,839	10.3
W549H750110	14.6	4,000	61	28	4,777	10.2
W572H750106	12.4	4,000	62	28	4,738	10.8
W572H750105	12.5	4,000	62	26	4,505	10.0
W572H750104	12.1	4,000	62	25	4,397	9.9
W572H750103	10.7	4,000	62	24	4,355	9.9
W589H750113	8.6	4,000	63	25	4,442	10.0
W589H750112	9.2	4,000	63	26	4,561	10.1
W589H750114	10.5	4,000	62	24	4,341	9.9
W589H750115	10.5	4,000	62	24	4,296	9.9
W590H750106	9.2	4,000	63	25	4,439	10.0
W589H750109	9.4	4,000	63	28	4,769	10.2
W589H750108	8.7	4,000	63	23	4,191	11.4
W589H750107	8.5	4,000	63	20	4,015	9.6
W589H750106	9.6	4,000	63	21	4,088	10.4
W590H750105	7.3	4,000	64	28	4,448	15.0
W611H750101	8.2	4,000	63	29	4,912	10.3
W589H750105	8.9	4,000	63	29	4,860	10.3
W589H750104	8.2	4,000	63	29	4,887	10.3

Table C3 - Fire Flow Results with Proposed Improvements (during MDD)

Hydrant ID	Hydrant Elevation (ft)	Required Fire Flow (gpm)	Static Pressure (psi)	Residual Pressure (psi)	Available Fire Flow (gpm)	Velocity of Maximum Pipe (gpm)
W589H750103	8.9	4,000	63	29	4,881	10.3
W589H750110	6.5	4,000	64	28	4,717	10.2
W612H750106	5.4	4,000	64	27	4,592	10.1
W589H750102	9.2	4,000	63	29	4,890	10.3
W589H750101	9.6	4,000	63	29	4,861	10.3
W589H750111	8.7	4,000	63	21	4,104	10.5
W588H750104	9.2	4,000	63	29	4,881	10.3
W588H750106	10.0	4,000	63	21	4,080	10.6
W591H750104	10.9	4,000	62	28	4,726	10.2
W572H750107	11.1	4,000	62	30	4,975	10.4
W573H750105	12.2	4,000	62	29	4,881	10.3
W573H750106	10.3	4,000	63	27	4,405	15.0
W588H750103	9.9	4,000	63	29	4,873	10.3
W588H750107	8.9	4,000	63	28	4,763	11.6
W588H750102	8.8	4,000	63	25	4,459	10.0
W588H750101	6.5	4,000	64	24	4,340	9.9
W588H750108	5.6	4,000	64	24	4,291	9.9
W613H750104	5.3	4,000	65	24	4,300	9.9
W613H750103	3.2	4,000	65	26	4,428	10.0
W611H750104	10.1	4,000	62	28	4,801	10.2
W611H940108	13.0	4,000	61	27	4,688	10.1
W610H750114	9.4	4,000	63	29	4,839	10.3
W590H750104	7.8	4,000	63	27	4,612	10.1
W590H750101	8.8	4,000	63	26	4,496	10.0
W590H750102	10.6	4,000	62	22	4,152	9.7
W590H750103	9.5	4,000	63	25	4,391	9.9
W571H750101	10.0	4,000	62	25	4,404	9.9
W611H750102	5.5	4,000	64	28	4,647	10.1
W611H750107 [1]	8.0	4,000	63	23	4,199	9.8
W611H750106	5.4	4,000	64	26	4,447	10.0
W611H750105	5.9	4,000	64	27	4,585	10.1
W629H750102	5.2	4,000	64	26	4,506	10.0
W629H750101	4.1	4,000	65	29	4,855	10.7
W651H940105	4.9	4,000	65	30	4,979	10.4
W651H940104	6.2	4,000	64	30	4,917	10.3
W651H940103	9.7	4,000	63	28	4,773	10.2
W651H940102	3.8	4,000	65	31	5,006	10.4
W651H940101	4.1	4,000	65	31	4,997	10.4
W650H940104	5.5	4,000	64	30	4,947	10.3
W650H940103	6.4	4,000	64	30	4,916	

Moffett Park Specific Plan - Water Master Plan
Appendix C - WaterCAD Model Output
Table C3 - Fire Flow Results with Proposed Improvements (during MDD)

Hydrant ID	Hydrant Elevation (ft)	Required Fire Flow (gpm)	Static Pressure (psi)	Residual Pressure (psi)	Available Fire Flow (gpm)	Velocity of Maximum Pipe (gpm)
W650H940102	6.0	4,000	64	30	4,945	10.3
W650H940101	5.0	4,000	65	31	5,004	10.4
W631H940102	7.5	4,000	64	30	4,950	10.3
W631H750105	10.2	4,000	62	24	4,323	9.9
W611H750103	10.0	4,000	62	28	4,815	10.2
W629H940108	3.6	4,000	65	31	5,040	10.4
W629H940107	5.1	4,000	65	30	4,986	10.4
W629H750104	5.7	4,000	64	29	4,839	11.1
W629H750105	4.7	4,000	65	27	4,606	10.1
W629H750106	3.6	4,000	65	27	4,539	10.0
W612H750105	4.3	4,000	65	26	4,523	10.0
W612H750104	4.6	4,000	65	27	4,634	10.1
W612H750103	4.8	4,000	65	26	4,472	10.0
W612H750102	4.6	4,000	65	25	4,436	10.0
W612H750101	4.6	4,000	65	26	4,505	10.0
W573H750107	8.3	4,000	64	29	4,837	12.0
W574H750104	6.7	4,000	64	26	4,490	10.0
W587H750103	6.4	4,000	64	24	4,311	9.9
W587H750102	7.5	4,000	64	22	4,123	9.7
W587H750101	5.2	4,000	65	22	4,107	9.7
W614H750104	6.5	4,000	64	20	4,023	9.7
W614H750103	5.1	4,000	65	21	4,058	9.7
W614H750102	4.0	4,000	65	22	4,117	9.7
W614H750101	4.3	4,000	65	22	4,174	9.8
W613H750101	3.1	4,000	65	27	4,586	10.1
W613H750102	4.0	4,000	65	24	4,316	9.9
W629H750103	2.8	4,000	66	28	4,700	10.2
W628H750101	3.0	4,000	66	30	4,930	10.6
W627H940105	4.6	4,000	65	31	5,036	10.4
W627H940104	4.8	4,000	65	31	5,028	10.4
W627H940103	3.9	4,000	65	31	5,062	10.4
W627H940102	8.8	4,000	63	29	4,873	10.3
W627H940101	11.3	4,000	62	28	4,777	10.2
W626H940101	5.4	4,000	65	31	5,026	10.4
W615H940104	5.2	4,000	65	31	5,043	10.4
W615H750105	3.0	4,000	66	26	4,418	11.5
W615H750106	3.9	4,000	65	25	4,337	10.2
W615H940103	4.3	4,000	65	31	5,092	10.5
W615H750101	6.4	4,000	64	31	5,030	10.4
W615H750102	4.8	4,000	65	29	4,809	[illegible]
W615H750107	4.6	4,000	65	28	4,693	[illegible]

Table C3 - Fire Flow Results with Proposed Improvements (during MDD)

Hydrant ID	Hydrant Elevation (ft)	Required Fire Flow (gpm)	Static Pressure (psi)	Residual Pressure (psi)	Available Fire Flow (gpm)	Velocity of Maximum Pipe (gpm)
W614H750105	3.0	4,000	66	27	4,583	10.1
W587H750107	5.2	4,000	65	25	4,423	9.9
W587H750106	3.9	4,000	65	26	4,447	10.0
W587H750105	6.3	4,000	64	25	4,428	10.0
W587H750104	5.5	4,000	65	28	4,639	10.1
W574H750106	13.2	4,000	62	28	4,834	10.3
W574H750107	14.6	4,000	61	28	4,783	10.2
W649H001007	7.0	4,000	64	20	4,031	9.6
W649H001006	8.0	4,000	63	24	4,289	9.8
W649H001009	10.8	4,000	62	25	4,382	9.9
W631H001008	9.6	4,000	63	26	4,577	10.0
W628H750102	2.8	4,000	66	30	4,892	13.9
593-A-75	12.8	4,000	62	20	4,025	9.5
554-106-75	20.6	4,000	60	22	4,176	9.6
W552H750101	21.9	4,000	58	25	4,562	10.0
W592H910102	12.3	4,000	62	29	4,901	10.2
W573H750101	12.1	4,000	62	29	4,966	10.4
W574H750105	5.2	4,000	65	31	5,032	12.5
W575H750103	6.7	4,000	64	31	5,112	10.5

Notes:

1. Recommended improvements represent improvements required to meet criteria assuming full fire flow at each hydrant, where flows are applied to the hydrant connection to the distribution main. Splitting fire flow would allow for less length of recommended improvement to pipelines serving hydrant W611H750107. The decrease in improvement length would result in a residual pressure at 2,000 gpm of 22 psi and an available fire flow of 2,114 gpm.