APPENDIX I

Water Study

CITY OF DIXON, CALIFORNIA

THE CAMPUS (Dixon 257)

M&P Project No. 20-0024-00 (v.3)

DRAFT WATER STUDY

February 2024

PREPARED BY:

mortonpitalo

600 Coolidge Drive, Suite 140
Folsom, CA 95630
Telephone: (916) 927-2400
Fax: (916) 357-7888

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1. BACKGROUND

This water study provides a preliminary water infrastructure plan and design standards for water facilities within the proposed Campus project. The project is located on approximately 259.7-acres within a portion of the City of Dixon in Solano County California (APNs 0111-040-010, -020, -030, -040, and 0111-080-050). The project is located within the City of Dixon's Northeast Quadrant and is part of the Northeast Quadrant Specific Plan (NQSP). The NQSP area is located south of I-80, north of Vaughn Road, east of N. First Street, and west of Pedrick Road. See **Figure 1** for the vicinity map.

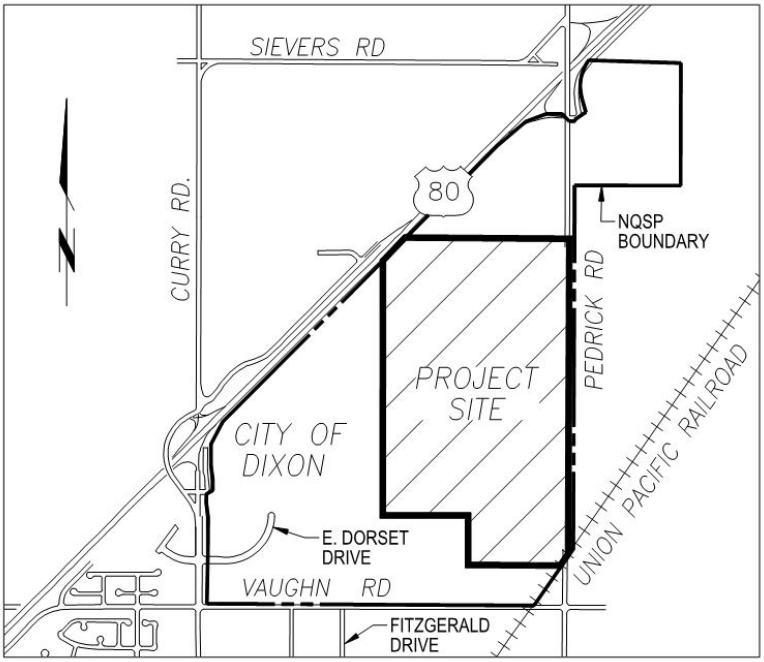


Figure 1 – Vicinity Map

2. PURPOSE

The main objective of this study is to determine the water demands of The Campus project. This study also seeks to determine the water infrastructure requirements based on the City of Dixon 2021 Water System Master Plan (WSMP) and to provide a preliminary water infrastructure plan that will meet the needs of the proposed site.

3. LAND USE

Historically, the Campus site has been used for farming. The majority of the site is presently under cultivation with field and row crops with a small portion of the site uncultivated due to the presence of old, concrete building foundations. The existing topography of the site is very flat and generally drains from the west to the east at one-third percent.

The project site is zoned as Corridor Mixed Use (CMU). The site area will be broken up into multiple proposed land uses. The majority of the site, totaling 128.2 acres, will be single-family residential (SFR). The northern portion of the site will contain 46.7 acres of light industrial area (LI), 9.7 acres of multi-family residential (MFR), 2.0 acres of neighborhood commercial (CC),

and a proposed well site on 1.6 acres. The proposed well will be discussed in the following section. See **Exhibit 1** for the Proposed Land Use Mix.

4. CITY OF DIXON WATER SYSTEM MASTER PLAN

4.1. EXISTING INFRASTRUCTURE

The City of Dixon 2021 Water System Master Plan (WSMP) by West Yost Associates determined the existing conditions of the Dixon water system and recommended water system improvements to meet the needs future development. The City of Dixon's existing water system is broken up into three zones, the North, South and Core Zones and the Zones are hydraulically connected to each other. The Campus site lies within the North Zone. The Dixon water system relies completely on groundwater wells. The city has three existing wells, one of which is a standby well (Industrial Well) for the city, and two storage tanks serving the Core and North Zone service areas. The total capacity of the two operational wells is 3,300 gallons per minute and the total usable volume of the tanks is 1.8 million gallons. Two existing booster pump stations serve the Core and North Zones. Existing 12" water pipelines exist south-west of the project site in East Dorset Drive and to the south of the project in Vaughn Road. **Figure 2** is taken from Figure 2-3 of the WSMP and shows the existing water system in the North Zone near the project site.

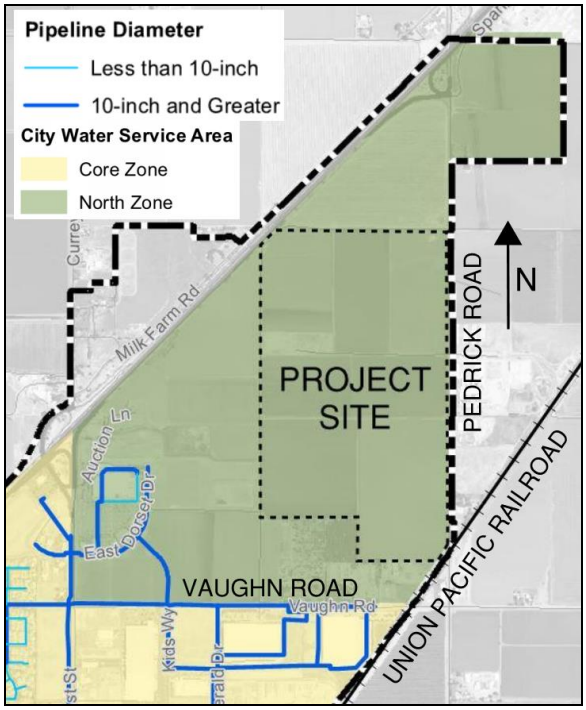


Figure 2 – Existing Water Infrastructure from WSMP

4.2. PROPOSED INFRASTRUCTURE

Figure 3 is taken from Figure 8-1 of the WSMP and shows proposed future water facilities in the North Zone. The WSMP proposes construction of a new 1,500 gallon per minute well in the Northeast Quadrant (North Zone) by 2030. In future buildout conditions, an additional well and 0.40 MG of useable storage are proposed within the Northeast Quadrant (North Zone). The

usable storage calculation does not take into consideration requirements for dead storage or overflow requirements. Construction of a new 1,500 gpm well is proposed as part of the Campus project and will be located in the northwest portion of the site. The proposed well site can accommodate a future storage tank and an additional well will be constructed within the Northeast Quadrant in future build-out conditions when deemed necessary by the City of Dixon. The future second well site will tentatively be located at the northeast edge of the specific plan. In addition to the proposed well, **Figure 3** shows proposed 12" water mains serving the site and the parcels north with two connections in East Dorset Drive and two connections in Vaughn Road.

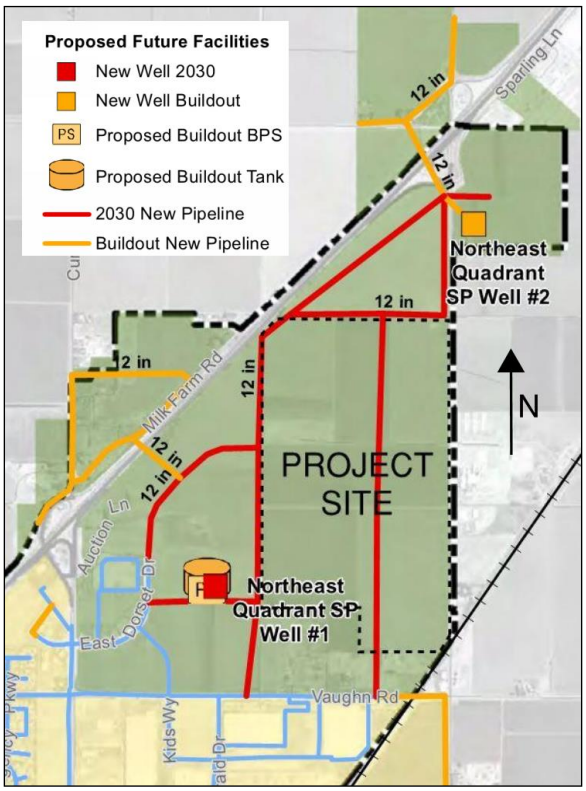


Figure 3 – Proposed Water Infrastructure per the WSMP

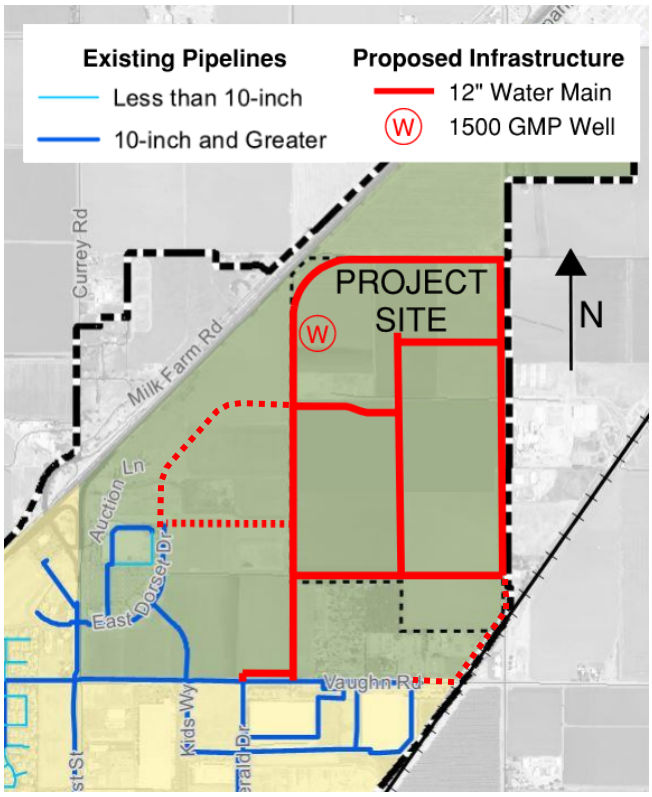


Figure 4 – Proposed Water Infrastructure for the The Campus Project

Figure 4 shows the water infrastructure proposed as part of the Campus project. Note that the proposed water main alignments and well location differ from **Figure 3**. The Campus project will follow the intention of the WSMP by providing a new well within the North Zone and extending the water distribution system up to the northern boundary of parcel. However, the water main alignments will differ from the WSMP slightly. One connection will be provided to Vaughn Road. A second connection will also be provided. Three options for the second connection are shown on Figure 4 (dashed red lines). To limit the impacts on the City's existing water system during construction, the new 1,500 gpm well and water pipelines included in The Campus project will be constructed and in operation prior to beginning construction of other buildings withing the project. Infrastructure that is not susceptible to fire (like roads and underground utilities) can be constructed prior to the well and water pipelines being fully

constructed and connected to the City's existing water system. In addition, construction water trucks will be limited to filling between the hours of 9 AM and 4 PM, which do not correspond to the other peak demands on the water system.

Exhibit 2 is the Water Plan and Shed Map. It shows the water infrastructure proposed as part of the Campus project in more detail than **Figure 4**, as well as the water supply sheds which will be discussed in Section 6. The proposed well will be based on Detail DF-6 from the Dixon Engineering Design Standards. This detail is provided as **Exhibit 3.**

5. DISTRIBUTION AND FIRE FLOW REQUIREMENTS

Exhibit 4 is a summary of water system performance and operational criteria taken directly from the WSMP. The WSMP provides requirements for fire flow, water supply capacity, water distribution system capacity, pumping facility capacity and water storage capacity. It also has requirements for system pressure, pipe diameter, pipe material and flow velocity. Pipelines serving multi-family residential, commercial, and industrial developments shall be a minimum of 12 inches in size. **Table 1** provides minimum and maximum distribution system pressures.

Distribution System Pressures	
Minimum Pressure – Normal Operating Conditions	50 psi
Minimum Pressure – Peak Hour Conditions	45 psi
Minimum Pressure – Fire Flow Conditions	20 psi
Maximum Pressure	80 psi

Table 1 – Distribution System Pressures

Table 2 provides the fire flow requirements that pertain to the Campus project, based on Table 5-4 from the WSMP. The project lies within the Northeast Quadrant (NEQ) which has larger fire flow requirements than other areas within the city. For planning purposes, fire flows are assumed to be met concurrently with a Maximum Day Demand condition, while maintaining a residual system pressure of 20 psi throughout the City of Dixon's service area. Calculation of Maximum Day Demand is discussed in Section 6.

Fire Flow Requirements for New Developments within the NEQ		
Land Use	**Flow, gpm**	**Duration, hours**
Single-Family Residential	1,000	3
Multi-Family Residential	2,500	3
Commercial in the Northeast Quadrant (NEQ)	4,000	3
Industrial in the NEQ and Future Areas East of Railroad Tracks	4,000	3
Note 1: Unique projects or projects with alternate materials may require higher fire flow and should be reviewed by the Fire Marshal on a case-by-case basis. Note 2: Fire flows are to be supplied at a minimum residual pressure of 20 psi.		

Table 2 – Fire Flow Requirements for New Development within the NEQ

6. WATER DEMANDS

According to the WSMP, the City of Dixon's peak water supply capacity is sized to meet Maximum Day Demand for each of its zones. It must also be able to meet four hours of Peak Hour Demand with source capacity, storage capacity, and/or emergency source connections. To determine how the Campus project will affect the City of Dixon's ability to meet these demand requirements, it is necessary to estimate the Maximum Day Demand and Peak Hour Demand for the site.

Maximum Day Demand and Peak Hour Demand have been calculated based on the design criteria from Chapter 5 of the WSMP. Per Section 5.1.1 of the WSMP, Average Day Demand is calculated by multiplying area by the Unit Demand Factor, which is dependent on land use. Per

Section 5.1.2, Maximum Day Demand is 2.2 times Average Day Demand and Peak Hour Demand is 3.3 times Average Day Demand. **Table 3** shows the unit water demand factors used as part of this study. The table is based on Table 5-3 from Section 5.1.1 of the WSMP.

Water Unit Demand Factors	
Land Use	**Unit Demand Factor, af/ac/yr**
Single-Family	2.7
Multi-Family	3.9
Commercial/Public	1.3
Industrial	1.5
Landscape	3.0
Maximum Day Demand Factor: 2.2 times Average Day Demand Peak Hour Demand Factor: 3.3 times Average Day Demand	

Table 3 – Water Unit Demand Factors from the WSMP

Water demands were calculated based on the land uses shown on the **Exhibit 1** Proposed Land Use Mix and the **Table 3** Unit Demand Factors. The total on-site water supply shed area is 259.6 acres. The proposed well site was assumed to have water demands similar to that of an industrial site. Roadway areas were assumed to have no water demand. **Exhibit 2** shows the water supply sheds as well as proposed water infrastructure. **Exhibit 5** provides the full water demand calculation. **Table 4** summarizes the results of the water demand calculation.

Project Water Demands				
Project Area (ac.)	Average Water Demand (af/yr)	Average Day Demand (mgd)	Maximum Day Demand (mgd)	Peak Hour Demand (mgd)
259.6	562.7	0.502	1.105	1.658

Table 4 – Project Water Demands

7. CONCLUSIONS

The Campus project will extend the City of Dixon's water system northeastward with connections in East Dorset Drive and Vaughn Road. The project will also provide a 1500 gallon per minute well in the northwest corner of the project. Using the methodology from the WSMP, this study estimated average annual water demand for the project to be 562.7 acre-feet. Maximum Day Demand and Peak Hour Demand were estimated to be 1.105 and 1.658 million gallons per day respectively. In the future, an additional well and 0.26 MG of storage will be constructed within Dixon's North Zone. The well site being proposed can accommodate a future tank. The future second well site will tentatively be located at the northeast edge of the specific plan.

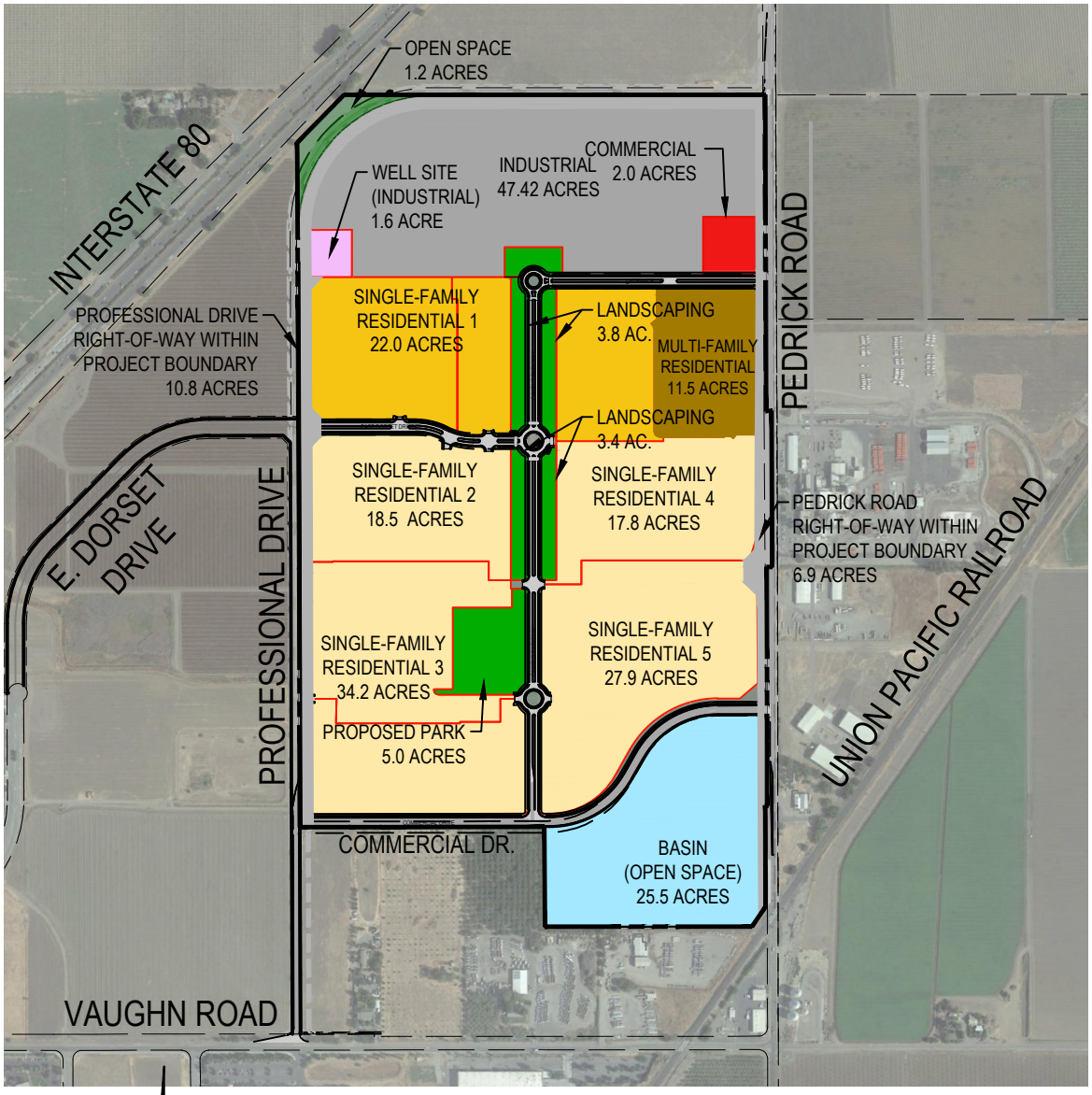
This is a preliminary study of proposed water infrastructure. Further analysis must be conducted to confirm that proposed water infrastructure improvements will meet the performance and operational criteria of the City of Dixon's Water System Master Plan. This includes modeling the proposed system to ensure that minimum system pressure is maintained during fire flow conditions.

8. REFERENCES

1. City of Dixon Engineering Design Standards, 2022

2. City Dixon – 2021 Water System Master Plan Update (Addendum to 2016 WSMP)

3. City of Dixon 2016 Water System Master Plan and Strategic Asset Management Plan, West Yost, 2016



LEGEND

EXISTING ROADWAYS

FUTURE ROADWAYS

PROJECT BOUNDARY

GRAPHIC SCALE

1000 500 0 1000

Scale

LAND USE TABLE

LAND USE	ACRES
SINGLE-FAMILY RESIDENTIAL	120.1
MULTI-FAMILY RESIDENTIAL	11.5
INDUSTRIAL	47.4
NEIGHBORHOOD COMMERCIAL	2.0
WELL SITE	1.6
ROADS, OPEN SPACE AND BASIN	63.6
PARK AND LANDSCAPING	13.4
TOTAL SITE AREA	**259.6**

MORTON & PITALO, INC.
CIVIL ENGINEERING • LAND PLANNING • LAND SURVEYING
Folsom * Fresno
600 Coolidge Drive, Suite #140
Folsom, CA 95630
phone: (916) 984-7621
web: www.mpengr.com

DRAWN:	DF	JOB NO:	20-0024-00
CHECKED:	GB	DATE:	JULY 2023
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EXHIBIT 1

DIXON 257 WATER STUDY

PROPOSED LAND USE MIX

DIXON, CALIFORNIA

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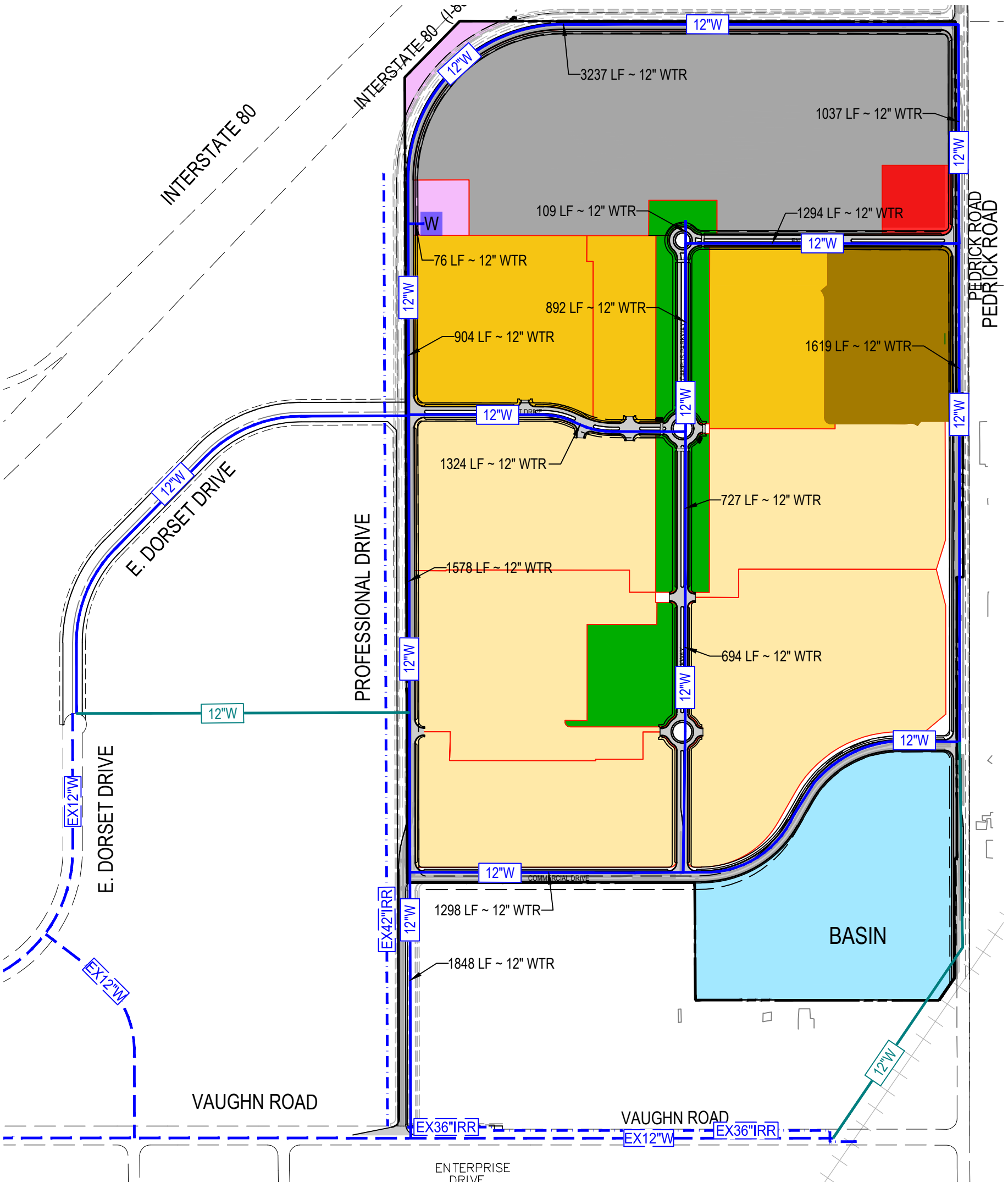
GRAPHIC SCALE

500 250 0 500

1 in = 500 ft

LEGEND

- SINGLE- FAMILY (SFR) LAND USE
- MULTI-FAMILY (MFR) LAND USE
- LIGHT INDUSTRIAL (LI) LAND USE
- COMMERCIAL (CC) LAND USE
- LANDSCAPING AND OPEN SPACE
- ROADWAYS
- EXISTING ROADWAYS
- FUTURE ROADWAYS
- PROJECT BOUNDARY
- WATER SUPPLY SHED BOUNDARY
- W — PROPOSED WELL SITE
- 12"W — PROPOSED WATER MAIN
- EX12"W — EXISTING WATER MAIN
- EX42"IRR — EXISTING IRRIGATION MAIN
- 12"W — ALTERNATIVE WATER MAIN



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MORTON & PITALO, INC.
CIVIL ENGINEERING • LAND PLANNING • LAND SURVEYING
Folsom ∗ Fresno
600 Coolidge Drive, Suite #140
Folsom, CA 95630
phone: (916) 984-7621
web: www.mpengr.com

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CHECKED:		DATE:	JAN 2024
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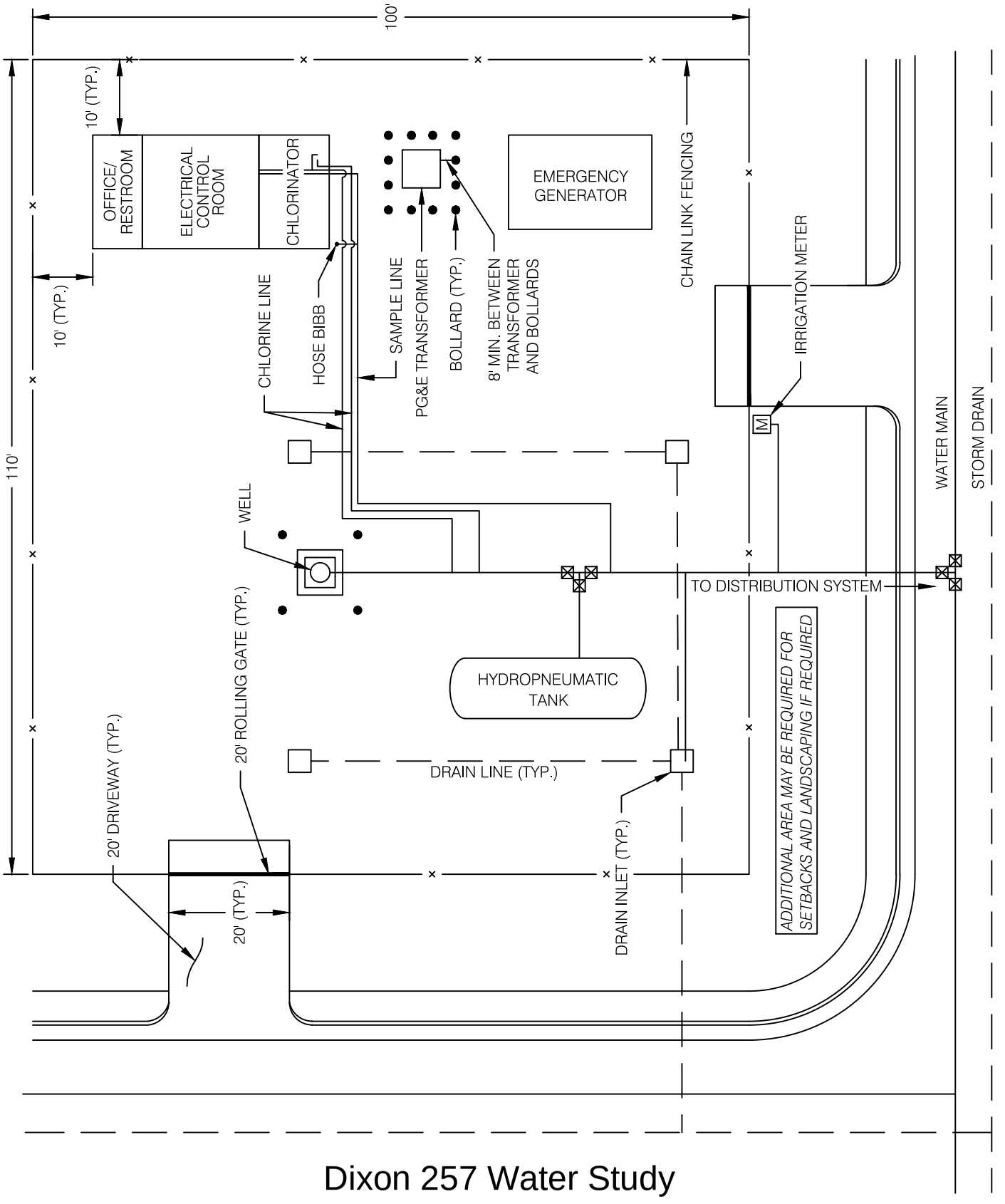
EXHIBIT FOR

DIXON 257 WATER STUDY

EXHIBIT 2
WATER PLAN

DIXON, CA



Dixon 257 Water Study
Exhibit 3 - Proposed Well Detail

DF-6	TYPICAL DIRECT FEED WELL FACILITY	APPROVED: MARCH 2022	CITY OF DIXON ENGINEERING STANDARD DETAIL

Table 3. Summary of Recommended Potable Water System Performance and Operational Criteria

Component	Criteria	Remarks / Issues
Fire Flow Requirements (flow [gpm] @ duration [hours])[a]		
Single Family Residential	1,000 gpm @ 3 hours	
Multi Family Residential	2,500 gpm @ 3 hours	
Commercial and Industrial	3,500 gpm @ 3 hours	Includes schools
Commercial and Industrial in Northeast Quadrant	4,000 gpm @ 3 hours	
Water Supply Capacity[b]		
Supply / Pumping Capacity	Provide firm supply capacity equal to maximum day demand	Firm groundwater supply capacity is defined as the largest facility out of service for maintenance
Water Distribution System Capacity[b]		
Maximum Day Demand plus Fire Flow	Provide firm capacity equal to maximum day demand plus fire flow	
Peak Hour Demand	Provide firm capacity equal to peak hour demand	
Pumping Facility Capacity[b]		
Pumping Capacity	Provide the greater of maximum day concurrent with fire flow or peak hour demand	Assumes firm pumping capacity. Firm pumping capacity is defined as the total booster pump station capacity with the largest pump out of service
Backup Power	Provide backup power at all wells and pump stations	
Water Storage Capacity[c]		
Operational	20 percent of maximum day demand	
Fire	Largest fire flow for each zone	North/Core Zone: 4000 gpm x 3 hrs = 0.72 million gallons (MG) South Zone: 3500 gpm x 3 hrs = 0.63 MG
Emergency	1 x average day demand (minimum)	Provided by the City's backup power at all pumping facilities
Total Water Storage Capacity	Operational + Fire + Emergency	
Distribution System Pressures[d]		
Minimum Pressure - Normal Operating Conditions	50 psi	
Minimum Pressure - Peak Hour Conditions	45 psi	
Maximum Pressure	80 psi	
Minimum Pressure - Fire Flow Conditions	20 psi	At all customer service connections
Water Transmission and Distribution Pipelines[a]		
Minimum Pipeline Diameter	6-inch; 12-inch for multi-family residential, commercial, and industrial developments with more than two units	Locate new distribution pipelines within designated utility corridors wherever possible
Maximum Velocity - Normal Operating Conditions	6 ft/s	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
Maximum Velocity - Fire Flow Conditions	12 ft/s	
Hazen Williams "C" Factor	130	For consistency in hydraulic modeling
Pipeline Material	Polyvinyl chloride (PVC)	For consistency in hydraulic modeling

(a) Criteria based on the City's Engineering Design Standards, August 2014 Section 5.

(b) Criteria included in the City's 2000 Master Plan

(c) Water storage capacity fire component criteria updated to provide redundancy in the North/Core and South Zones

(d) Criteria based on SCADA data and actual system operation pressures.

Morton & Pitalo, Inc

Project: Dixon 257 Water Study
Job No. 20-0024-00
Date: 1/4/2023

References: *City of Dixon Engineering Design Standards (Mar. 2022),*
City of Dixon 2016 Water System Master Plan and Strategic Asset Management Plan

Assumptions:

1. Proposed well site is assumed to be part of the Industrial land use

Table 3-6. Recommended Unit Water Demand Factors	
Water Use Type	**Unit Demand Factor, af/ac/yr**
Single Family Residential (SFR)	2.7
Multi-Family Residential (MFR)	3.9
Commercial	1.3
Industrial	1.5
Landscape	3.0

*Table from page 3-12 of 2016 Water System Master Plan

Table 3-8 Peaking Factors	
Maximum Day Demand Factor	2.2 times average day demand
Peak Hour Demand Factor	3.3 times average day demand

*Table from page 3-13 of 2016 Water System Master Plan

Design Flows

Name of Proposed Land Use	Area (Ac.)	Unit Water Demand Factor (af/ac/yr)	Average Water Demand (af/yr)	Average Day Demand (mgd)	Maximum Day Demand (mgd)	Peak Hour Demand (mgd)
Industrial	**46.7**	1.5	70.1	0.063	0.138	0.206
Well Site	**0.3**	1.5	0.5	0.000	0.001	0.001
Commercial	**2.0**	1.3	2.6	0.002	0.005	0.008
SFR 1	**20.0**	2.7	54.0	0.048	0.106	0.159
SFR 2	**20.2**	2.7	54.5	0.049	0.107	0.161
SFR 3	**30.9**	2.7	83.4	0.074	0.164	0.246
SFR 4	**28.3**	2.7	76.4	0.068	0.150	0.225
SFR 5	**28.8**	2.7	77.8	0.069	0.153	0.229
MFR	**9.7**	3.9	37.8	0.034	0.074	0.111
Park	**5.5**	3.0	16.5	0.015	0.032	0.049
Landscaping	**9.0**	3.0	27.0	0.024	0.053	0.080
Basin & O. Space	**20.7**	3.0	62.1	0.055	0.122	0.183
Roadways	**37.5**	0	0	0	0	0
Totals:	**259.6**		**562.7**	**0.502**	**1.105**	**1.658**