

Elk Grove Multi-Sport Complex & Grant Line Industrial Annexation Area

FINAL Water Study

October 1, 2020

Prepared for:



and

Sacramento County Water Agency



Prepared by:



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TABLE OF CONTENTS

1.0	Introduction	1
1.1	Multi-Sport Complex and Grant Line Industrial Annexation Area.....	1
1.2	Existing & Future Water Studies.....	2
2.0	Project Water Demands	5
3.0	Service Description and System Criteria	7
3.1	Service Description.....	7
3.2	System Criteria	7
4.0	Hydraulic Model Analysis and Results.....	10
5.0	Phasing	11
6.0	Cost Estimate	13
7.0	Conclusion.....	14

TABLES

Table 1-1: Proposed Project Land Use – Ultimate Buildout of Plan Area	2
Table 2-1: Water Demand Factors and Average Annual Water Demand	5
Table 2-2: Proposed Water Demand – Ultimate Buildout.....	6
Table 2-3: Proposed Water Demand – Initial Phase	6
Table 3-1: Design Criteria	7
Table 3-2: Fire Flow Criteria.....	8
Table 4-1: Hydraulic Model Results	11
Table 6-1: Planning Level Cost Estimate.....	13

FIGURES

Figure 1-1: Vicinity Map	3
Figure 1-2: Land Use Plan	4
Figure 3-1: On-Site Water System Layout – Ultimate Phase	9
Figure 5-1: On-Site Water System Layout – Initial Phase	12

APPENDICES

Appendix A: Water Demand Calculations
Appendix B: Hydraulic Model Data and Results

1.0 Introduction

The City of Elk Grove (City) has acquired two parcels totaling approximately 104-acres of property to develop a Multi-Sport Complex (MSC). The property is located just outside of the southern City limit and requires annexation into the City. The City has initiated the annexation process with the Local Agency Formation Commission (LAFCo). One of the LAFCo conditions to annex the 104-acre City-owned parcels is that adjacent properties also be annexed into the City's Sphere of Influence (SOI). The adjacent properties are located to the west and east of the City-owned parcels, with a total combined area of approximately 572-acres in size (Plan Area or Project). The 572-acre Plan Area, also known as the "Elk Grove Multi-Sport Complex and Grant Line Industrial Annexation Area" includes the 104-acre City-owned property.

The purpose of this water study (study) is to identify the on-site backbone domestic water system required to serve the Plan Area. The study is part of an overall high-level infrastructure analysis for the Plan Area. This study will demonstrate it is possible to construct an on-site domestic water distribution system to meet the proposed Project's ultimate water demand and fire flow requirements within the water purveyor's requirements for water conveyance and operating pressure. The Project falls within the jurisdiction of Zone 40 of the Sacramento County Water Agency (SCWA). An amendment to the SCWA Zone 40 Water Supply Master Plan (Zone 40 WSMP Amendment) is required to incorporate the Plan Area. At the time of preparation of this study, a separate, but concurrent, effort is underway to analyze the existing off-site SCWA system and prepare the Zone 40 WSMP Amendment to determine the water system boundary conditions adjacent to the project site and determine if off-site improvements are required to serve the Plan Area. This study and analysis have been prepared based upon boundary conditions provided from the system analysis performed for the Zone 40 WSMP Amendment.

Existing and planned domestic water facilities border the project area to the north, and west. It is anticipated that these existing facilities will be utilized to provide domestic water service to the Plan Area. This study has been prepared to identify the ultimate build-out on-site backbone domestic water distribution facilities required to serve the Plan Area and meet SCWA's service criteria. This study includes a discussion on proposed land use, water demands, point of connections, hydraulic modeling results, phasing and planning-level cost estimates.

1.1 Multi-Sport Complex and Grant Line Industrial Annexation Area

Location

The Plan Area spans approximately 572-acres of land located just outside the current City of Elk Grove city limits. The Plan Area is immediately adjacent to the southeast portion of the City, located east of Interstate 99 and the railroad tracks and south of Grant Line Road. See **Figure 1-1: Vicinity Map** for a vicinity map of the Project location.

Topography

The majority of the existing site is currently being used for agriculture purposes. The existing topography of the Plan Area is flat with elevations varying from 55 feet to 48 feet, and generally sloping east to west.

Proposed Land Use

The proposed zoning for the City's 104-acre property is "Industrial" and allows a range of land use activities, including warehousing and manufacturing, as well as the proposed sports complex. Historically, a sports complex has been considered the most likely use for the City parcels, although the City is considering the potential sale of a portion of the property to facilitate development of the balance as a sports complex. Parks, or a sports complex, is the most intensive water user of those permitted uses within the industrial land use designation. Therefore, in order to analyze the most conservative Project, this study

has assumed the development of a sports complex as the primary project for consideration for the entirety of the City’s 104-acre property.

The proposed land uses within the Plan Area will consist of mixed use, parks and open space, regional commercial, light industrial, and heavy industrial as provided in **Table 1-1: Proposed Project Land Use** and illustrated in **Figure 1-2: Land Use Plan**. The analysis conducted for this study evaluates the on-site water system required to serve the ultimate buildout of the Plan Area, referred to as the “Ultimate Phase.” This study will also discuss an “Initial Phase” of development, which includes only the 104-acre City-owned parcel.

Table 1-1: Proposed Project Land Use – Ultimate Buildout of Plan Area

Land Use Category		Area ¹ (acres)
P/OS	Parks and Open Space	169.0
MU	Mixed Mosher Use	118.9
LI	Light Industrial	112.2
HI	Heavy Industrial	143.2
RC	Regional Commercial	20.0
ROW	Right-of-Way	8.2
Total		571.5

Source: Land use spreadsheet provided by City of Elk Grove, June 10, 2020

1.2 Existing & Future Water Studies

The Plan Area falls within the jurisdiction of the Sacramento County Water Agency (SCWA), and is located within SCWA’s Central Service Area. The SCWA Zone 40 Water System Infrastructure Plan (WSIP), dated September, 2016 was utilized as the basis for the design criteria discussed in this study. The WSIP, and subsequent Record Drawings, identify existing transmission facilities that run in Waterman Road and Grant Line Road adjacent to the Plan Area. There is an existing 24-inch transmission main in Grant Line Road that extends easterly to the intersection with Waterman Road, at which point it becomes a 16-inch waterline and continues to the east. A 24-inch transmission main located in Waterman Road conveys water supply from the East Elk Grove Groundwater Water Treatment Plant to the 24-inch transmission main in Grant Line Road.

Concurrent to the preparation of this study, an Amendment to the SCWA Zone 40 Water Supply Master Plan (Zone 40 WSMP Amendment) is being prepared to evaluate the capabilities of the existing water supply and transmission system to accommodate the ultimate demands of the proposed Project. Results from the Zone 40 WSMP Amendment, dated June 5, 2020, have been incorporated into the analysis for the on-site backbone water system to serve the Plan Area. The Zone 40 WSMP Amendment will determine if off-site water system improvements are required to serve the Plan Area and meet SCWA’s minimum service criteria.

¹ Acreage values are approximate and reflect high-level master planning. Acreages are subject to change through subsequent development processing in keeping with the policies and procedures provided in the City’s Special Planning Area document.

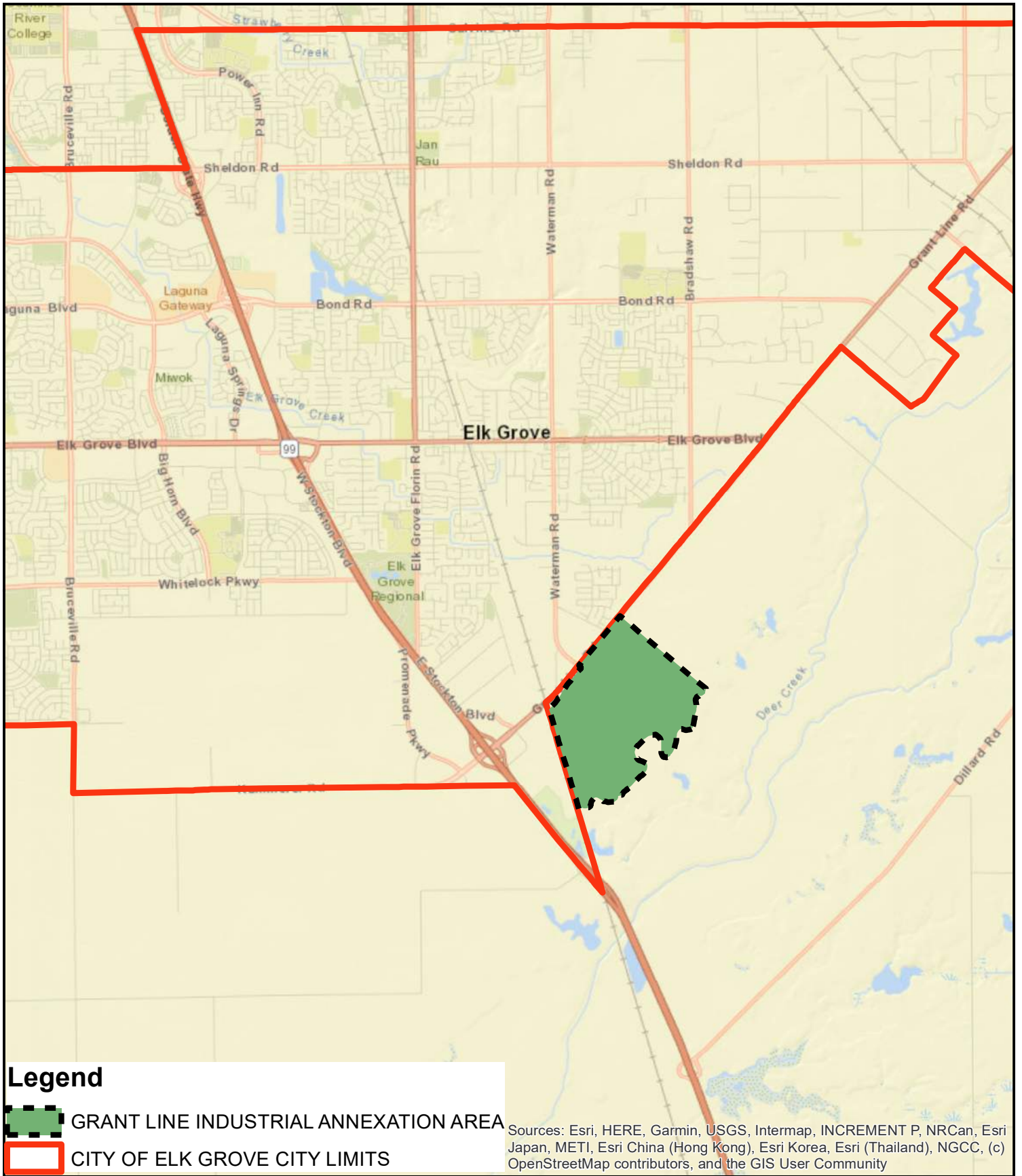
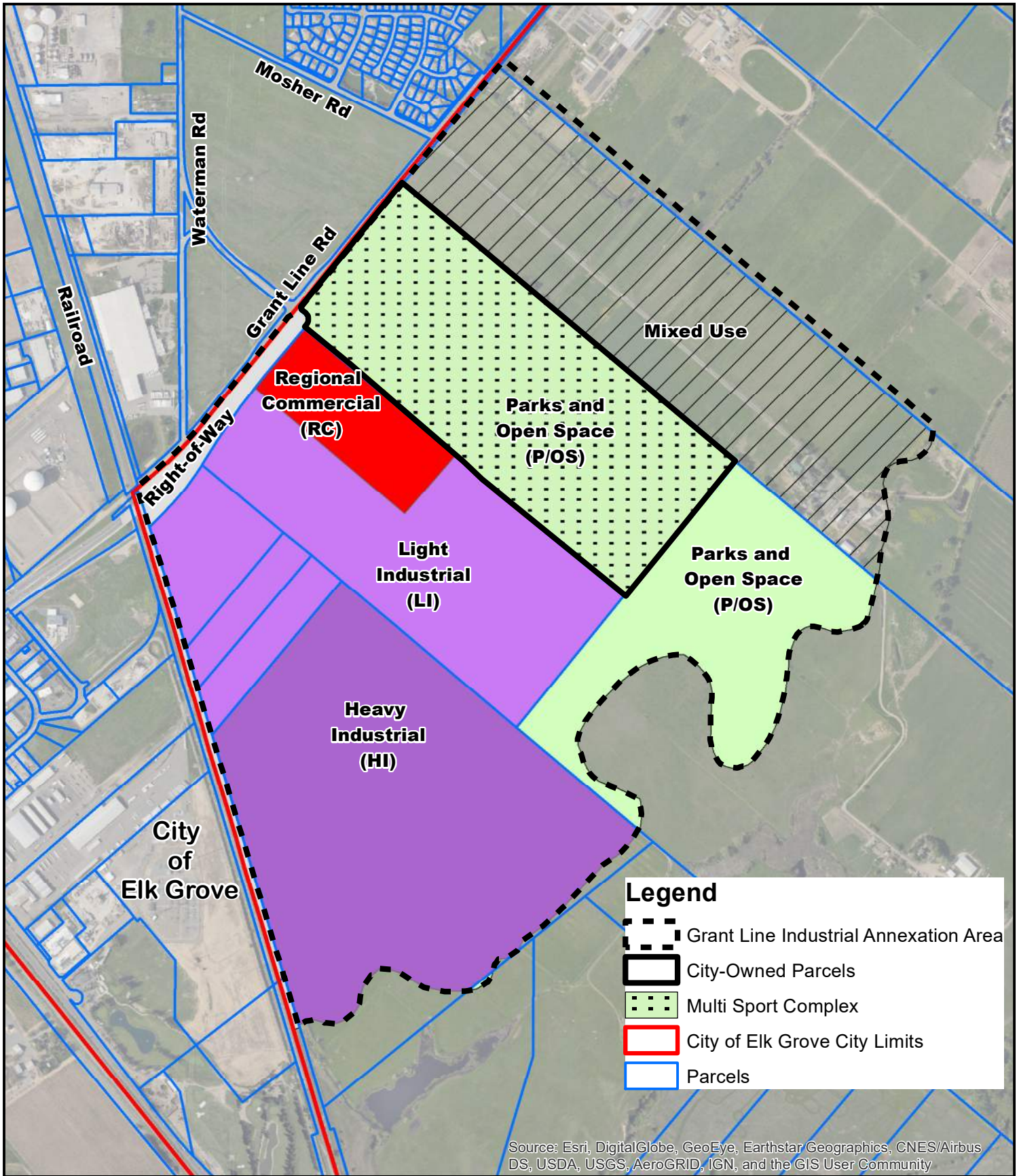


FIGURE 1-1
 Elk Grove Multi-Sport Complex
 and Grant Line Industrial Annexation Area
VICINITY MAP
 ELK GROVE, CALIFORNIA
 JULY, 2020



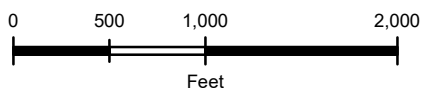


Legend

- Grant Line Industrial Annexation Area
- City-Owned Parcels
- Multi Sport Complex
- City of Elk Grove City Limits
- Parcels

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

FIGURE 1-2
 Elk Grove Multi-Sport Complex
 and Grant Line Industrial Annexation Area
LAND USE PLAN
 ELK GROVE, CALIFORNIA
 JULY, 2020



2.0 Project Water Demands

The proposed project water demands were determined based on the land use area and the corresponding SCWA demand factors. The Project water demands were determined by multiplying the annual demand factor by the land use area to determine the average annual demand. Annual demand factors utilized in this study are shown in **Table 2-1: Water Demand Factors and Average Annual Water Demand**. Some of the proposed land uses are not explicitly referenced in the WSIP, therefore assumptions were made to align the proposed land use with a corresponding demand factor consistent with the WSIP.

Table 2-1: Water Demand Factors and Average Annual Water Demand

Land Use Category		Annual Demand Factor per WSIP (AFY/acre)	Annual Demand Factor ² (AFY/acre)	Annual Demand ² (AFY)
P//OS	Parks and Open Space	2.80	3.01	509
MU	Mixed Mosher Use	2.15	2.31	275
LI	Light Industrial	2.02 ³	2.17	244
HI	Heavy Industrial	2.02 ³	2.17	311
RC	Regional Commercial	2.02 ⁴	2.17	43
ROW	Right-of-Way	0.18	0.19	2
Total				1,383

In determining the demand assumptions to use for the Project a number of factors have been considered, including the proposed zoning and the range of land activities (e.g., warehousing and distribution, manufacturing, retail, office) that are permitted or conditionally permitted within the zoning, as well as the proposed sports complex use for the City’s 104-acre property. Generally, the most common use within the proposed zoning have been selected (e.g., warehousing and manufacturing in industrial, retail in commercial).

The proposed zoning for the City’s 104-acre property is “Industrial” and allows a range of land activities including warehousing and manufacturing, as well as the proposed sports complex. Historically, a sports complex has been considered the most likely use for the City parcels, although the City is considering the potential sale of a portion of the property to facilitate development of the balance as a sports complex. Parks, or a sports complex, is the most intensive water user of those permitted uses within the industrial land use designation, as shown in Table 2-1. Therefore, in order to analyze the most conservative Project, this study has assumed the development of a sports complex as the primary project for consideration for the entirety of the City’s 104-acre property.

As depicted in **Table 2-2: Proposed Water Demand – Ultimate Buildout**, the water demand assumptions for a 104-acre sports complex are more intensive than for development of either a portion of the site or the full site with an industrial use (inclusive of both daily water demand and fire flow).

² Includes 7.5% system losses.

³ WSIP does not contain specific or separate unit demand factors for “light and heavy industrial.” This study assumes the same demand factor as industrial land use.

⁴ WSIP does not contain a unit demand factor for “regional commercial.” This study assumes the same demand factor as commercial land use.

Furthermore, this report does not assume or analyze the potential impacts associated with a significant water user (e.g., beverage producer). Additional analysis would be necessary should a project that includes a significant water user be proposed for the City’s 104-acre parcel, or any other property within the Project area.

The average day, maximum day and peak hour water demands utilized for the hydraulic modeling analysis are shown in **Table 2-2: Proposed Water Demand – Ultimate Buildout**. The average day demand is calculated by taking the average annual demand (AFY) from Table 2-1 and converting it into gallons per minute (gpm).

Per the WSIP, the maximum day demand is the highest demand expected on any given day throughout the year. Typically, this demand occurs in the summer when temperatures are excessively warm. The maximum day demand is assumed to be twice the average day demand. The maximum day demand is also utilized for fire flow scenarios in the model analysis.

The peak hour demand is the highest expected demand for any given hour throughout the year. The peak hour demand is two times the maximum day demand. A detailed breakdown of the water demand calculations per parcel is included in **Appendix A**.

Table 2-2: Proposed Water Demand – Ultimate Buildout

Land Use Category		Area (acres)	Average Annual Demand (AFY)	Average Day Demand (gpm)	Maximum Day Demand (gpm)	Peak Hour Demand (gpm)
P/OS	Parks and Open Space	169.0	509	315.5	631.0	1262.0
MU	Mixed Mosher Use	118.9	275	170.4	340.8	681.6
LI	Light Industrial	112.2	244	151.3	302.7	605.3
HI	Heavy Industrial	143.2	311	192.9	385.7	771.4
RC	Regional Commercial	20.0	43	26.9	53.9	107.7
ROW	Right-of-Way	8.2	1.6	1.0	2.0	3.9
Total		571.5	1,383	858.0	1,716.0	3,432.0

The “Initial Phase” of the development will be the 104-acre city-owned parcels. The water demands associated with the city-owned parcels are summarized in **Table 2-3: Proposed Water Demand – Initial Phase**.

Table 2-3: Proposed Water Demand – Initial Phase

Land Use Category		Area (acres)	Average Annual Demand (AFY)	Average Day Demand (gpm)	Maximum Day Demand (gpm)	Peak Hour Demand (gpm)
P/OS	Parks and Open Space	103.9	313	193.9	387.8	775.7
Total		103.9	313	193.9	387.8	775.7

3.0 Service Description and System Criteria

The proposed water mains are to be designed to provide the required flow deliveries while maintaining acceptable service pressures to all customers within the Plan Area. A description of the proposed water system, operating goals, and facility sizing requirements are discussed in this section.

3.1 Service Description

The proposed water system piping layout is represented by distribution main sizes of 8-inch and 12-inch and a transmission main size of 16-inch, that will comprise the Plan Area’s backbone system. The basis of the proposed domestic water backbone infrastructure layout within the Plan Area is in conformance with the criteria identified in SCWA’s 2016 WSIP. The backbone water system follows the proposed roadway layout identified in the Elk Grove Multi-Sport Complex Transportation Master Plan, dated September 29, 2020. A layout of the proposed water system to serve the Ultimate Phase of the Plan Area is shown on **Figure 3-1: On-Site Water System Layout – Ultimate Phase.**

Further discussion regarding the design criteria, connection to the existing SCWA system and the on-site facilities to serve the Plan Area are included below.

3.2 System Criteria

The WSIP outlines system criteria for both distribution and transmission main design. Included in **Table 3-1: Design Criteria** are the design criteria and operating goals utilized in this study to determine the sizing of the domestic water system for the Plan Area.

Water Main Design System Criteria

The responsibility for operation and maintenance of the water facilities within the Plan Area is SCWA Zone 40, the retail zone of SCWA. SCWA has developed minimum operating goals to be used in the planning of new water distribution and transmission systems. The operating goals help ensure adequate pressure and flow are available to serve existing and future customers on a daily basis and also during emergency fire flow conditions. The operating goals used in this study to size the on-site water pipelines are identified in **Table 3-1: Design Criteria.**

Table 3-1: Design Criteria

Criteria	Operating Goal
Maximum System Pressure in Distribution Main	65 psi
Minimum Pressure in Distribution Main at PHD	35 psi
Minimum Pressure in Distribution Main at MDD +FF	20 psi
Maximum System Pressure in Transmission Main	75 psi
Minimum Pressure in Transmission Main at PHD	40 psi
Minimum Pressure in Transmission Main at MDD +FF	25 psi
Maximum Pipe Velocity at ADD	5 fps
Maximum Pipe Velocity at PHD	7 fps
Maximum Pipe Velocity at MDD + FF	10 fps
Unit Headloss	3 to 5 ft/1,000 ft

Source: Sacramento County Water Agency, Zone 40 WSIP, September 2016

Fire Flow Criteria

For the purposes of system analysis, the required fire flow is assumed to occur during a maximum day demand condition. In the WSIP, the fire flow requirements are identified by land use types, and are summarized in **Table 3-2: Fire Flow Criteria**. Due to differences in the land use descriptions between the Multi-Sport Complex and Grant Line Industrial Annexation Area and the given SCWA designations, assumptions were made in assigning fire flows for corresponding land uses. The Mixed Mosher Use, Regional Commercial, and Light Industrial were assigned to “Commercial/Industrial” with a corresponding fire flow requirement of 3,000 gpm. Parks and Open Space was assigned to “Single Family Residential (<3,600 sq ft)” with a corresponding fire flow requirement of 1,500 gpm. The Heavy Industrial land use was assigned to “Industrial/Institution” with a corresponding fire flow requirement of 4,000 gpm.

Table 3-2: Fire Flow Criteria

SCWA Land Use Type (building size)	Fire Flow Requirement	Corresponding Project Land Use
Single family residential (<3,600 sq ft)	1,500 gpm	Parks and Open Space
Single family residential (≥3,600 sq ft)	2,000 gpm	-
Commercial/Industrial	3,000 gpm	Mixed Mosher Use / Regional Commercial / Light Industrial
Industrial/Institution	4,000 gpm	Heavy Industrial

Source: Sacramento County Water Agency, Zone 40 WSIP, September 2016

System Assumptions

A hydraulic model was developed to analyze and size the proposed on-site water system. The hydraulic model, model analysis and results are further discussed in Section 4.0. The following assumptions and criteria were utilized in the development of the on-site hydraulic model:

- Model demands do not take into account water demand outside the boundary of the Plan Area.
- Node elevations were assigned based upon the existing topography. It is assumed that the precise grading will closely follow the existing contours.
- A Hazen-Williams “C” value of 125 was used to represent the friction factor for all pipe material, included ductile iron, welded steel, concrete cylinder, and polyvinyl chloride mains.
- Preliminary model analysis of the existing off-site SCWA system has been performed as a part of the Zone 40 WSMP Amendment. Results from the off-site model analysis were used to simulate the system boundary conditions at the proposed points of connection to the existing transmission system in Grant Line Road.
- The preliminary model results utilized from the Zone 40 WSMP Amendment analysis were based on the existing system conditions only, and did not account for future system improvements.
- Based on discussions with SCWA staff, 14-inch diameter distribution mains are not allowed.

FIGURE 3-1

**ON-SITE WATER SYSTEM LAYOUT
ULTIMATE PHASE**

ELK GROVE MULTI-SPORT COMPLEX
AND GRANT LINE INDUSTRIAL ANNEXATION AREA
ELK GROVE, CA
OCTOBER 2020

Legend

CITY OF ELK GROVE CITY LIMITS

Model Elements

Junctions

'XX' Node ID Number

Proposed Water Main

8-Inch Diameter

12-Inch Diameter

16-Inch Diameter

Existing Conditions

Existing Water Main

Existing Contours

'XX' Existing Contour Labels

Landuse Alternative A

Existing Right-of-Way (ROW), no APN

Heavy Industrial (HI)

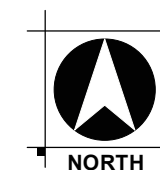
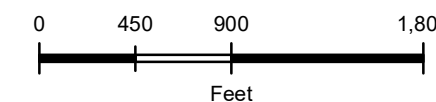
Light Industrial (LI)

Mixed Mosher Use

Parks and Open Space (P/OS)

Regional Commercial (RC)

Multi Sport Complex



EXISTING 24" SCWA TRANSMISSION MAIN

EXISTING 24" SCWA TRANSMISSION MAIN

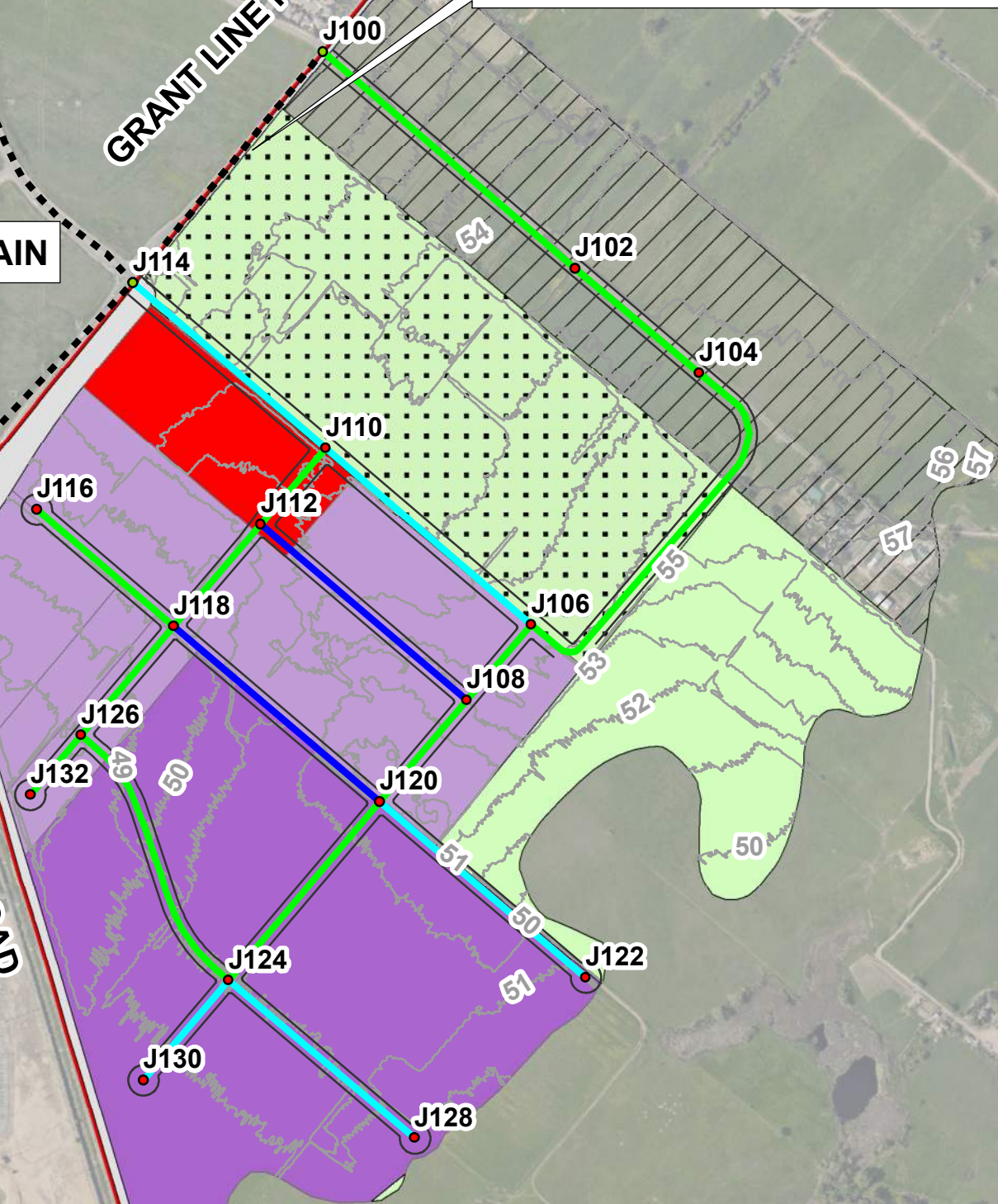
EXISTING 16" SCWA TRANSMISSION MAIN

CITY OF ELK GROVE

WATERMAN RD.

GRANT LINE RD.

RAILROAD



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



4.0 Hydraulic Model Analysis and Results

Wood Rodgers developed a hydraulic model of the on-site backbone water system to serve the Plan Area to determine the required size of the proposed facilities to meet the SCWA operating criteria. The model was developed utilizing the hydraulic model program InfoWater developed by Innovyze. The model was developed to analyze the varying demand conditions and fire flow requirements for the ultimate buildout of the Plan Area. Upon request, an electronic copy of the water model is available.

Point of Connection and Boundary Conditions

To serve the Plan Area, domestic water will be conveyed to the Project site from SCWA's supply sources through existing transmission mains as identified in the Zone 40 WSMP Amendment. Per the Zone 40 WSMP Amendment, water for the Plan Area will primarily be supplied from the East Elk Grove Groundwater Treatment Plant, located on Waterman Road about one mile north of the Plan Area. Water will be conveyed to the Plan Area through an existing 24-inch transmission main in Waterman Road. Water will also be delivered to the Project site through an existing 24-inch and 16-inch transmission located in Grant Line Road. The 24-inch transmission main originates west of the project site, and extends easterly in Grant Line Road to the intersection of Waterman Road. From Waterman Road, the transmission main continues easterly as a 16-inch diameter transmission main.

There are two proposed points of connection to the existing transmission main in Grant Line Road, one at the intersection of Waterman Road, and one at the intersection of Mosher Road.

The boundary conditions utilized for the on-site hydraulic model were based upon the hydraulic modeling results performed for the Zone 40 WSMP Amendment. The boundary conditions were simulated by using a single fixed-head reservoir with an HGL of 177 feet at the location of the East Elk Grove Groundwater Treatment Plant as the water supply source, and routing flows only through the 24-inch transmission main in Waterman Road to Grant Line Road. The HGL of the fixed head reservoir was set to simulate a system pressure of approximately 49 psi in the transmission main in Grant Line Road at the point of connection to the Plan Area at the intersection of Waterman Road, based upon the model results for a maximum day plus 4,000 gpm fire flow demand condition. This was determined to be a conservative assumption. SCWA guarantees that a minimum pressure of 40 psi is available in the system transmission mains.

Allocated Water Demands

Water demands, as previously discussed in this study, were distributed to the model nodes (or junctions) throughout the Plan Area based upon adjacent land use areas. See **Appendix B** for the detailed allocation of water demands to the model nodes for the proposed land use.

Model Results

The model was set-up with three demand scenarios: average day, maximum day, and peak hour. Under the maximum day scenario, a system-wide fire flow analysis was conducted to determine the critical fire flow location. The critical fire flow location was determined to be node J128. An additional scenario was set-up that included the maximum day demand plus a 4,000 gpm fire flow at J128.

Utilizing the boundary conditions described in this study, along with SCWA's criteria for transmission and distribution main systems, pipe sizes were determined and optimized for the proposed build-out of the on-site backbone domestic water system. It is noted that the "Heavy Industrial" land use requires a 4,000-gpm fire flow, which is the driver for the pipe diameters. There is a total of five (5) pipe segments within the Plan Area that require a 16-inch diameter transmission main. Two of those segments are the main fee off of Grant Line Road on the extension of Waterman Road. The other three segments are dead-end lines in cul-de-sacs within the Heavy Industrial land use area. Model results for the project area are summarized in **Table 4-1: Hydraulic Model Results**. Detailed model results for each scenario are included in **Appendix B**. The results indicate that the on-site proposed system, as presented in Figure 3-1, is adequate to meet SCWA's operating goals.

Table 4-1: Hydraulic Model Results

Demand Scenario	Minimum Pressure	Maximum Pressure	Maximum Velocity	Maximum Headloss
Average Day Demand ^[1]	52.5 psi	55.5 psi	1.0 fps	0.3 ft/kft
Peak Hour Demand	48.2 psi	51.9 psi	4.0 fps	3.7 ft/kft
MDD + 4,000gpm Fire Flow @ J128	22.2 psi	49.0 psi	7.0 fps	15.1 ft/kft

[1] It is noted that the maximum pressure under the average day demand condition will likely be higher than shown. The assumed HGL at the point of connection is based upon a maximum day plus fire flow condition.

5.0 Phasing

It is anticipated that the 104-acre city-owned parcels will be developed first. The remainder of the Plan Area will be developed at a later date, but a detailed development plan has yet to be established. For the purpose of this study, it is assumed that there are two phases: the “Initial Phase,” which includes the development of the 104-acre city-owned parcels, and the “Ultimate Phase,” which includes development of the entire Plan Area. It is assumed that the water infrastructure required to serve the Initial Phase will be built at the diameters required to serve the Ultimate Phase.

The pipe segments required to be constructed to serve the city-owned parcels in the Initial Phase include the 16-inch transmission main (approximately 3,000 LF) in the extension of Waterman Road which runs along the west side of the city-owned parcels, as shown on **Figure 5-1: On-Site Water System Layout – Initial Phase**.

**FIGURE 5-1
ON-SITE WATER SYSTEM LAYOUT
INITIAL PHASE**

ELK GROVE MULTI-SPORT COMPLEX
AND GRANT LINE INDUSTRIAL ANNEXATION AREA
ELK GROVE, CA
JULY 2020

Legend

CITY OF ELK GROVE CITY LIMITS

Model Elements

Junctions

'XX' Node ID Number

Proposed Water Main

8-Inch Diameter

12-Inch Diameter

16-Inch Diameter

Existing Conditions

Existing Water Main

Existing Contours

'XX' Existing Contour Labels

Landuse Alternative A

Existing Right-of-Way (ROW), no APN

Heavy Industrial (HI)

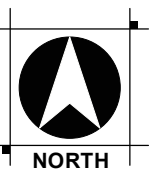
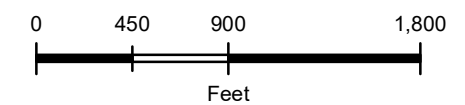
Light Industrial (LI)

Mixed Mosher Use

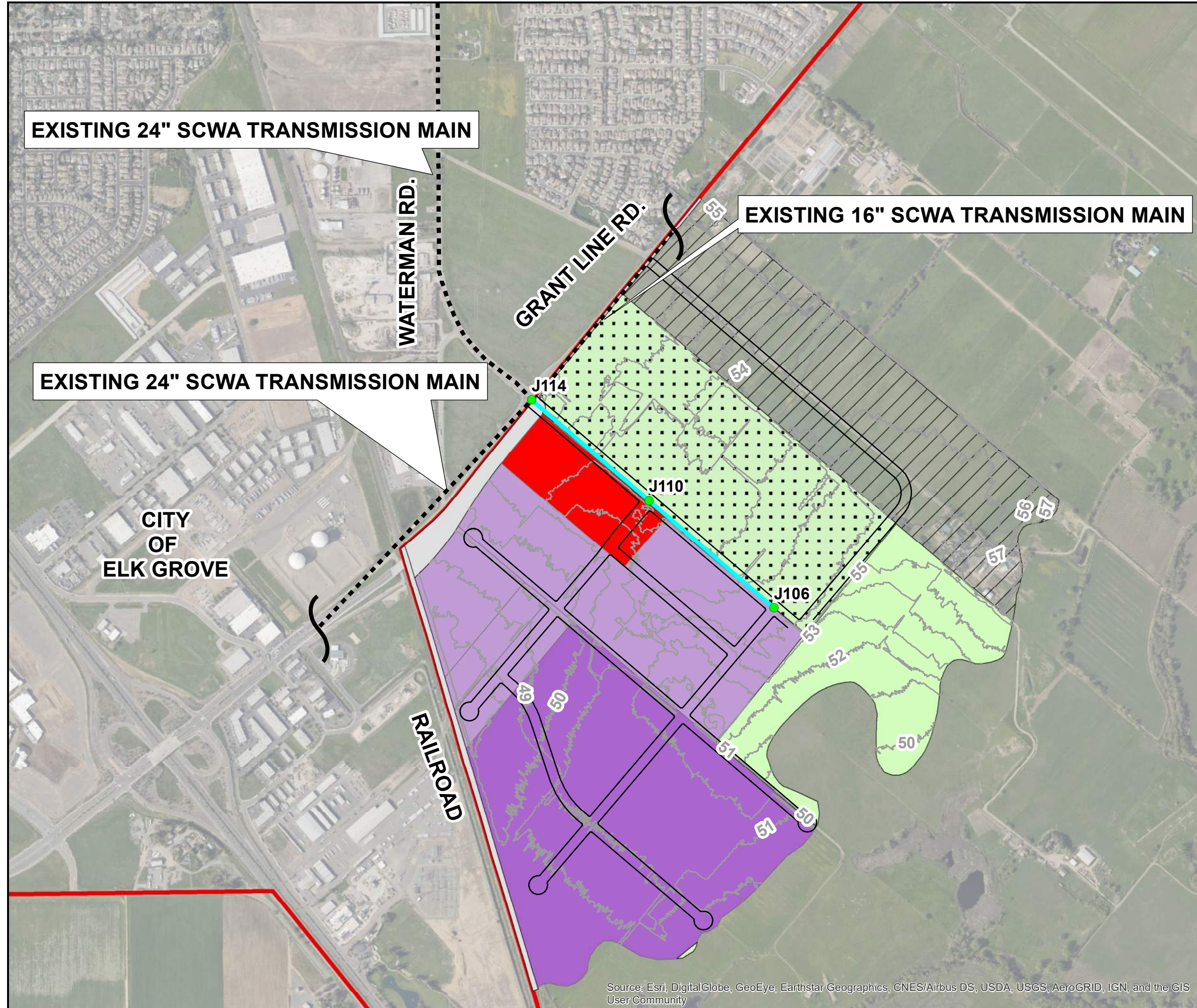
Parks and Open Space (P/OS)

Regional Commercial (RC)

Multi Sport Complex



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



6.0 Cost Estimate

Table 6-1: Planning Level Cost Estimate contains a conceptual opinion of probable construction costs to construct the on-site backbone water infrastructure. The costs are broken down for the Initial Phase of development, the 104-acre city-owned parcel, and to construct the remainder of the system to serve the Ultimate Phase.

These cost opinions account for the on-site infrastructure required to meet the on-site water demand and fire flow requirements. It does not account for any off-site improvements, if required. The per foot cost to install the pipe is assumed to include all appurtenances, including isolation valves, fire hydrants, service connections, blow-offs, air-vac valves, etc. and assumes pipes will be installed at normal depth (approximately 4-feet of cover).

Table 6-1: Planning Level Cost Estimate

Initial Phase

Description	Quantity	Unit	Unit Cost	Total Cost
16-inch	2,980	LF	\$ 340	\$ 1,013,207
<i>Subtotal</i>				\$ 1,013,207
Contingency			30%	\$ 303,962
Total Initial Phase				\$ 1,317,000

Ultimate Phase

Description	Quantity	Unit	Unit Cost	Total Cost
8-inch	3,079	LF	\$ 180	\$ 554,296
12-inch	13,092	LF	\$ 260	\$ 3,404,016
16-inch	3,665	LF	\$ 340	\$ 1,246,253
<i>Subtotal</i>				\$ 5,204,565
Contingency			30%	\$ 1,561,369
Total Ultimate Phase				\$ 6,766,000

7.0 Conclusion

This study has been prepared in accordance with SCWA design guidelines and criteria to identify on-site backbone water facilities to serve the City of Elk Grove Multi-Sport Complex and Grant Line Industrial Annexation Area. The 572-acre Plan Area will require an average annual water demand of approximately 1,383 AFY under the Ultimate Phase. The average annual water demand translates into an average daily demand (ADD) of 858 gpm, maximum day demand (MDD) of 1,716 gpm and a peak hour demand (PHD) of 3,432 gpm. The maximum required fire flow is 4,000 gpm. Projected water demands under the Initial Phase are projected to be 194 gpm (ADD), 388 gpm (MDD) and 776 gpm (PHD).

A 16-inch / 24-inch SCWA transmission main exists within Waterman Road and Grant Line Road adjacent to the Project site that will deliver water to the site. There are two proposed points of connection to the Grant Line Road transmission main, one at the intersection with Waterman Road and one at the intersection with Mosher Road. The Waterman Road point of connection is proposed as a 16-inch diameter connection, and the Mosher Road point of connection is proposed as a 12-inch diameter connection.

The on-site backbone domestic water system was laid out to follow the proposed roadway alignment. The water system was analyzed, optimized and sized to meet SCWA's minimum and maximum service criteria and operating goals. The boundary conditions utilized for the on-site hydraulic model were based upon information provided in the Zone 40 WSMP Amendment, and based upon SCWA providing minimum service pressures. The boundary conditions were simulated by using a single fixed-head reservoir with an HGL of 177.0 feet as the water supply source at the East Elk Grove Groundwater Treatment Plant, which represented a 49-psi service pressure in the transmission main at the intersection of Grant Line Road and Waterman Road. All water supply was routed through the existing 24-inch transmission main on Waterman Road to Grant Line Road. This was determined to be a conservative assumption.

The recommended on-site water system identified in this study will provide the ultimate water demand and meet the fire flow requirements, while in compliance with SCWA's criteria. Initial results provided by others from the analysis conducted for the Zone 40 WSMP Amendment indicate that no additional off-site improvements are required to serve the Plan Area from those that have already been identified in SCWA's Phase 3 CIP.

Appendix A Water Demand Calculations

City of Elk Grove
Multi-Sport Complex and Grant Line Industrial Annexation Area
Water Demand Projections

Parcel No.	Acreage	Proposed Land Use	Water Demand Factor ^[1] (ac-ft/acre/yr)	7.5% Water Loss Factor (ac-ft/acre/yr)	Demand Projections (Average Day)			Demand Projections (Maximum Day) ^[2]		Demand Projections (Peak Hour)		Fire Flow Allocations (gallon/minute) ^[3]
					(ac-ft/yr)	(gallon/day)	(gallon/minute)	(gallon/day)	(gallon/minute)	(gallon/day)	(gallon/minute)	
13401900020000	118.9	Mixed Mosher Use	2.15	2.31	274.7	245,388	170.4	490,775	340.8	981,550	681.6	3,000
13401900030000	65.0	Parks and Open Space (P/OS)	2.80	3.01	195.5	174,653	121.3	349,306	242.6	698,611	485.1	1,500
13401900090000	103.9	Parks and Open Space (P/OS)	2.80	3.01	312.6	279,235	193.9	558,470	387.8	1,116,940	775.7	1,500
13401900100000	77.5	Light Industrial (LI)	2.02	2.17	168.3	150,309	104.4	300,619	208.8	601,238	417.5	3,000
	20.0	Regional Commercial (RC)	2.02	2.17	43.4	38,790	26.9	77,579	53.9	155,158	107.7	3,000
13401900130000	143.2	Heavy Industrial (HI)	2.02	2.17	310.9	277,710	192.9	555,420	385.7	1,110,839	771.4	4,000
13401900260000	0.2	Parks and Open Space (P/OS)	2.80	3.01	0.5	432	0.3	864	0.6	1,728	1.2	1,500
13401900290000	8.5	Light Industrial (LI)	2.02	2.17	18.4	16,396	11.4	32,792	22.8	65,583	45.5	3,000
13401900300000	9.7	Light Industrial (LI)	2.02	2.17	21.1	18,886	13.1	37,772	26.2	75,544	52.5	3,000
13401900320000	16.7	Light Industrial (LI)	2.02	2.17	36.2	32,321	22.4	64,642	44.9	129,283	89.8	3,000
ROW	8.2	Existing Right-of-Way (ROW), no APN	0.18	0.19	1.6	1,411	1.0	2,822	2.0	5,644	3.9	N/A
Grand Total	571.5				1,383	1,235,530	858	2,471,059	1,716	4,942,118	3,432	

[1] SCWA Zone 40/41 (Central Service Area) Factors - 2016 WSIP

[2] Maximum Day Peaking Factor = 2.0 x Average Day

[3] Fire Flow allocations from WSIP Zone 40 Master Plan

City-owned parcels highlighted in green.

Appendix B Hydraulic Model Data and Results

**ELK GROVE MULTI-SPORT COMPLEX AND GRANT LINE INDUSTRIAL ANNEXATION AREA
ULTIMATE PHASE - AVERAGE DAY WATER DEMAND ALLOCATION**

Model Node ID	Land Use Designation						Total Demand		
	Mixed Mosher Use (gpm)	Parks and Open Space (gpm)	Regional Commercial (gpm)	Light Industrial (gpm)	Heavy Industrial (gpm)	ROW (gpm)	ADD	MDD	PHD
							(gpm)	(gpm)	(gpm)
J100							0	0	0
J102	85						85	170	341
J104	85	79					164	328	656
J106		79	5				84	168	337
J108			5	22			27	54	108
J110		79	5				84	168	337
J112			5	22			27	54	108
J114						1	1	2	4
J116			5	22			27	54	108
J118				22			22	43	86
J120				22	39		60	120	241
J122		79			39		117	235	469
J124					39		39	77	154
J126				22			22	43	86
J128		0			39		39	78	155
J130					39		39	77	154
J132				22			22	43	86
Total	170	315	27	151	193	1	858	1,716	3,432

**ELK GROVE MULTI-SPORT COMPLEX AND GRANT
LINE INDUSTRIAL ANNEXATION AREA
AVERAGE DAY DEMAND MODEL OUTPUT**

JUNCTION REPORT				
JUNCTION NODE ID	DEMAND (gpm)	ELEVATION (feet)	HEAD (feet)	PRESSURE (psi)
J100	0	54	176.6	53.1
J102	85	54	176.2	53.0
J104	164	55	176.2	52.5
J106	95	54	176.2	52.9
J108	30	53	176.1	53.3
J110	95	51	176.3	54.3
J112	30	52	176.2	53.8
J114	1	53	176.7	53.6
J116	30	50	176.1	54.6
J118	14	51	176.1	54.2
J120	53	50	176.0	54.6
J122	118	51	176.0	54.2
J124	39	51	176.0	54.2
J126	14	48	176.0	55.5
J128	39	48	176.0	55.5
J130	39	50	176.0	54.6
J132	14	48	176.0	55.5

**ELK GROVE MULTI-SPORT COMPLEX AND GRANT LINE INDUSTRIAL ANNEXATION AREA
AVERAGE DAY DEMAND MODEL OUTPUT**

PIPE REPORT									
PIPE ID	FROM NODE	TO NODE	LENGTH (ft)	DIAMETER (in)	ROUGHNESS (C-value)	FLOW (gpm)	VELOCITY (ft/s)	HEADLOSS (ft)	HL/1000 (ft/kft)
<i>P102</i>	<i>J100</i>	<i>J114</i>	1699	16	125	-236	0.4	0.1	0.1
P104	J100	J102	1889	12	125	236	0.7	0.4	0.2
P106	J102	J104	920	12	125	151	0.4	0.1	0.1
P110	J106	J110	1540	16	125	-287	0.5	0.1	0.1
P112	J110	J114	1440	16	125	-624	1.0	0.4	0.3
P114	J110	J112	568	12	125	242	0.7	0.1	0.2
P116	J106	J108	564	12	125	178	0.5	0.1	0.1
P118	J112	J108	1540	8	125	33	0.2	0.1	0.0
P120	J108	J120	760	12	125	181	0.5	0.1	0.1
P122	J112	J118	760	12	125	179	0.5	0.1	0.1
P124	J116	J118	1021	12	125	-30	0.1	0.0	0.0
P126	J118	J120	1539	8	125	34	0.2	0.1	0.0
P128	J120	J122	1538	16	125	118	0.2	0.0	0.0
P130	J120	J124	1330	12	125	44	0.1	0.0	0.0
P132	J124	J128	1384	16	125	39	0.1	0.0	0.0
P134	J124	J130	743	16	125	39	0.1	0.0	0.0
P136	J126	J124	1660	12	125	73	0.2	0.0	0.0
P138	J118	J126	813	12	125	101	0.3	0.0	0.0
P140	J126	J132	444	12	125	14	0.0	0.0	0.0
P142	J104	J106	2364	12	125	-14	0.0	0.0	0.0
<i>P69</i>	<i>RES10</i>	<i>J114</i>	4632	24	125	860	0.6	0.3	0.1

Notes:

Pipes P69 and P102 are a part of the existing off-site system, therefore not a part of proposed system.

Pipes required to serve the city-owned parcels in the Initial Phase

**ELK GROVE MULTI-SPORT COMPLEX AND GRANT LINE INDUSTRIAL ANNEXATION AREA
MAXIMUM DAY DEMAND + FIRE FLOW MODEL OUTPUT**

JUNCTION ID	STATIC DEMAND (gpm)	STATIC PRESSURE (psi)	STATIC HEAD (feet)	FIRE FLOW DEMAND (gpm)	RESIDUAL PRESSURE (psi)	AVAILABLE FLOW AT HYDRANT (gpm)	AVAILABLE FLOW PRESSURE (psi)
J102	170	52.1	174.3	3,000	39.6	5,540	20
J104	328	51.6	174.0	3,000	38.2	5,469	20
J106	190	52.0	174.0	3,000	43.7	7,453	20
J108	60	52.3	173.8	3,000	41.6	6,214	20
J110	190	53.5	174.4	3,000	46.6	8,736	20
J112	60	52.9	174.0	3,000	42.8	6,513	20
J116	60	53.6	173.6	3,000	31.0	3,876	20
J118	28	53.2	173.7	4,000	33.0	5,484	20
J120	106	53.5	173.5	4,000	32.5	5,484	20
J122	236	53.0	173.4	4,000	25.6	4,725	20
J124	78	53.0	173.4	4,000	26.3	4,643	20
J126	28	54.4	173.5	4,000	29.6	4,925	20
J128	78	54.3	173.4	4,000	22.2	4,242	20
J130	78	53.5	173.4	4,000	23.8	4,389	20
J132	28	54.4	173.5	4,000	22.7	4,228	20

Notes:

Critical Fire Flow Node

**ELK GROVE MULTI-SPORT COMPLEX AND GRANT LINE INDUSTRIAL
ANNEXATION AREA
MAXIMUM DAY DEMAND + FIRE FLOW AT NODE J128 MODEL OUTPUT**

JUNCTION REPORT				
JUNCTION NODE ID	DEMAND (gpm)	ELEVATION (feet)	HEAD (feet)	PRESSURE (psi)
J100	0	54	164.2	47.8
J102	170	54	155.8	44.1
J104	328	55	152.6	42.3
J106	190	54	148.2	40.8
J108	60	53	140.9	38.1
J110	190	51	151.0	43.3
J112	60	52	142.4	39.2
J114	2	53	166.1	49.0
J116	60	50	133.0	36.0
J118	28	51	133.0	35.5
J120	106	50	130.0	34.7
J122	236	51	130.0	34.2
J124	78	51	111.8	26.3
J126	28	48	125.7	33.7
J128	4078	48	99.2	22.2
J130	78	50	111.8	26.8
J132	28	48	125.7	33.7

Notes:

Critical Fire Flow Node

**ELK GROVE MULTI-SPORT COMPLEX AND GRANT LINE INDUSTRIAL ANNEXATION AREA
MAXIMUM DAY DEMAND + FIRE FLOW AT NODE J128 MODEL OUTPUT**

PIPE REPORT									
PIPE ID	FROM NODE	TO NODE	LENGTH (ft)	DIAMETER (in)	ROUGHNESS (C-value)	FLOW (gpm)	VELOCITY (ft/s)	HEADLOSS (ft)	HL/1000 (ft/kft)
<i>P102</i>	<i>J100</i>	<i>J114</i>	1699	16	125	-1307	2.1	1.9	1.1
P104	J100	J102	1889	12	125	1307	3.7	8.5	4.5
P106	J102	J104	920	12	125	1137	3.2	3.2	3.5
P110	J106	J110	1540	16	125	-1699	2.7	2.8	1.8
P112	J110	J114	1440	16	125	-4411	7.0	15.1	10.5
P114	J110	J112	568	12	125	2522	7.2	8.6	15.1
P116	J106	J108	564	12	125	2318	6.6	7.3	12.9
P118	J112	J108	1540	8	125	195	1.2	1.5	1.0
P120	J108	J120	760	12	125	2453	7.0	10.9	14.4
P122	J112	J118	760	12	125	2267	6.4	9.4	12.4
P124	J116	J118	1021	12	125	-60	0.2	0.0	0.0
P126	J118	J120	1539	8	125	284	1.8	2.9	1.9
P128	J120	J122	1538	16	125	236	0.4	0.1	0.1
P130	J120	J124	1330	12	125	2395	6.8	18.3	13.7
P132	J124	J128	1384	16	125	4078	6.5	12.6	9.1
P134	J124	J130	743	16	125	78	0.1	0.0	0.0
P136	J126	J124	1660	12	125	1839	5.2	14.0	8.4
P138	J118	J126	813	12	125	1895	5.4	7.2	8.9
P140	J126	J132	444	12	125	28	0.1	0.0	0.0
P142	J104	J106	2364	12	125	809	2.3	4.4	1.8
<i>P69</i>	<i>RES10</i>	<i>J114</i>	4632	24	125	5721	4.1	10.9	2.4

Notes:

Pipes P69 and P102 are a part of the existing off-site system, therefore not a part of proposed system.

Pipes required to serve the city-owned parcels in the Initial Phase

**ELK GROVE MULTI-SPORT COMPLEX AND GRANT
LINE INDUSTRIAL ANNEXATION AREA
PEAK HOUR DEMAND MODEL OUTPUT**

JUNCTION REPORT				
JUNCTION NODE ID	DEMAND (gpm)	ELEVATION (feet)	HEAD (feet)	PRESSURE (psi)
J100	0	54	171.7	51.0
J102	341	54	167.1	49.0
J104	657	55	166.1	48.2
J106	380	54	166.2	48.6
J108	120	53	165.3	48.7
J110	380	51	167.5	50.5
J112	120	52	166.0	49.4
J114	4	53	172.7	51.9
J116	120	50	164.9	49.8
J118	56	51	164.9	49.4
J120	212	50	164.2	49.5
J122	472	51	163.9	48.9
J124	156	51	164.1	49.0
J126	56	48	164.5	50.5
J128	156	48	164.0	50.3
J130	156	50	164.0	49.4
J132	56	48	164.5	50.5

ELK GROVE MULTI-SPORT COMPLEX AND GRANT LINE INDUSTRIAL ANNEXATION AREA PEAK HOUR DEMAND MODEL OUTPUT

PIPE REPORT									
PIPE ID	FROM NODE	TO NODE	LENGTH (ft)	DIAMETER (in)	ROUGHNESS (C-value)	FLOW (gpm)	VELOCITY (ft/s)	HEADLOSS (ft)	HL/1000 (ft/kft)
<i>P102</i>	<i>J100</i>	<i>J114</i>	1699	16	125	-943	1.5	1.0	0.6
P104	J100	J102	1889	12	125	943	2.7	4.6	2.4
P106	J102	J104	920	12	125	602	1.7	1.0	1.1
P110	J106	J110	1540	16	125	-1148	1.8	1.3	0.9
P112	J110	J114	1440	16	125	-2495	4.0	5.3	3.7
P114	J110	J112	568	12	125	966	2.7	1.5	2.6
P116	J106	J108	564	12	125	714	2.0	0.8	1.5
P118	J112	J108	1540	8	125	131	0.8	0.7	0.5
P120	J108	J120	760	12	125	725	2.1	1.1	1.5
P122	J112	J118	760	12	125	715	2.0	1.1	1.5
P124	J116	J118	1021	12	125	-120	0.3	0.1	0.1
P126	J118	J120	1539	8	125	134	0.9	0.7	0.5
P128	J120	J122	1538	16	125	472	0.8	0.3	0.2
P130	J120	J124	1330	12	125	175	0.5	0.1	0.1
P132	J124	J128	1384	16	125	156	0.3	0.0	0.0
P134	J124	J130	743	16	125	156	0.3	0.0	0.0
P136	J126	J124	1660	12	125	293	0.8	0.5	0.3
P138	J118	J126	813	12	125	405	1.2	0.4	0.5
P140	J126	J132	444	12	125	56	0.2	0.0	0.0
P142	J104	J106	2364	12	125	-55	0.2	0.0	0.0
<i>P69</i>	<i>RES10</i>	<i>J114</i>	4632	24	125	3442	2.4	4.3	0.9

Notes:

Pipes P69 and P102 are a part of the existing off-site system, therefore not a part of proposed system.

Pipes required to serve the city-owned parcels in the Initial Phase