

APPENDIX C

Level II Sewer Study

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

Level II Sewer Study

September 21, 2020

Prepared for



and



Prepared by



A handwritten signature in blue ink, appearing to read "Kevin J. Gustorf".

Kevin J. Gustorf, PE
CA PE No. 64755

TABLE OF CONTENTS

1.0	Executive Summary	1
2.0	Introduction.....	3
3.0	Design Criteria & Sewer Flow Information	7
3.1	Design Criteria.....	7
3.2	Sewer Flow Information.....	9
4.0	Sewer Alignments and Facilities	12
5.0	Phasing	13
6.0	Conclusion.....	15

TABLES

Table 2-1: Proposed Project Land Use.....	4
Table 3-1: Design Criteria	9
Table 3-2: ADWF Sewer Flow.....	9
Table 3-3: Ultimate Phase On-site Sewer Flow	10
Table 3-4: Initial Phase On-site Sewer Flow.....	10
Table 4-1: On-Site Backbone Sewer Piping – Ultimate Phase.....	12
Table 5-1: On-Site Backbone Sewer Piping – Initial Phase.....	13

FIGURES

Figure 2-1: Vicinity Map	5
Figure 2-2: Land Use Plan	6
Figure 3-1: Ultimate Phase Sewer Layout	11
Figure 5-1: Initial Phase Sewer Layout	14

APPENDICES

Appendix A: Demand Calculation Table	
Appendix B: Model Output Tables, Sewer Shed and Sewer Model Exhibit	
Appendix C: Cost Estimates	

1.0 Executive Summary

Purpose

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 Level II Sewer Study (study) is to identify the backbone sewer conveyance facilities for the proposed MSC project and the adjacent properties being annexed into the SOI (Grant Line Industrial Annexation Area). This study is part of an overall high-level infrastructure analysis for the Plan Area. This study will demonstrate the feasibility of providing sewer service for the Plan Area and technical compliance with the sewer district's requirements for sewer conveyance. The Project falls within the sewer jurisdiction of the Sacramento Area Sewer District (SASD).

Existing sewer conveyance facilities border the project area to the north and west. It is anticipated that these facilities will be utilized and extended to provide sewer service to the Plan Area. This study has been prepared to present the Project's ultimate build out sewer conveyance facilities for the Plan Area. The study includes identification of backbone trunk mains required to serve the proposed land use within the Plan Area. This study includes a discussion on the proposed project land use alternatives, anticipated sewer flow generation from the Plan Area, estimated trunk sewer alignments and slopes, minimum required pipe diameters and proposed points of connection to the existing system.

Project Land Use and Sewer Flow Characteristics

The Plan Area encompasses approximately 572-acres and will convey sewage for an estimated total of 3,429 Equivalent Single-Family Dwelling Units (ESD's). The City-owned parcels encompass approximately 104-acres of the overall total Plan Area. The Project proposes a mix of land uses including parks and open space, mixed use, light and heavy industrial, and regional commercial. Preliminary site layout planning has begun for the City-owned property, however, site planning for the other parcels has not occurred to date. The full Plan Area at build-out will generate approximately 1.05 million gallons per day (MGD) during average dry weather flow (ADWF) and 2.74 MGD during peak wet weather flow (PWWF).

Analysis and Findings

This study identifies the on-site backbone sewer facilities required to serve the Plan Area and route flows to the existing SASD system. There are two existing points of connection to the SASD system immediately adjacent to the Plan Area. The on-site backbone sewer collection system was laid-out to follow the proposed roadway alignments, and comply with SASD's minimum design standards. Multiple sewer piping layout (routing) options for the on-site system were analyzed and presented to the City and SASD, and the preferred layout is identified within this study. The preferred routing option conveys the on-site flow to the two existing SASD points of connection adjacent to the Plan Area. The two existing SASD points of connection to serve the Plan Area are as follows:

- "Grant Line Road Connection" - 12-inch pipe on the north side of Grant Line Road, near the end of Waterman Court. The 12-inch pipe extends westerly for about 550-feet before becoming a 15-inch pipe. The 15-inch pipe continues westerly in Grant Line Road for about 2,300-feet before tying into a 27-inch trunk line just before Highway 99.

- “Railroad Connection” - 18-inch pipe stubbed beneath the railroad along the west border of the project site. The 18-inch pipe runs below the railroad easement for approximately 110-feet before becoming a 21-inch pipe as it continues westerly.

Both of the existing points of connection are located at depths approximately 20-feet below the existing ground surface. A hydraulic model was developed to analyze the ultimate PWWF flow condition. The model analysis was used to verify the on-site sewage can be conveyed by gravity and determine the minimum required sewer pipe diameters to meet the ultimate PWWF condition.

This study considered two phases of development for the Grant Line Industrial Annexation Area. The analysis conducted for this study evaluates the on-site sewer 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.

Based upon the model analysis of the preferred on-site flow routing option, the ultimate PWWF can be conveyed to the existing SASD points of connection via gravity. SASD has conducted an analysis of the off-site sewer collection system to determine if capacity exists to within the existing downstream conveyance system to serve the 104-acre City-owned parcel, and the ultimate buildout of the Plan Area. The results of the SASD analysis confirmed that the existing off-site conveyance system has adequate capacity to accommodate the ultimate build-out PWWF generated by the Plan Area.

2.0 Introduction

Level of Study

This study is a “Level II Study” for a community plan level sewer assessment, per the SASD requirements. The focus of this study is on the backbone, or trunk, infrastructure required to serve the Plan Area. This study was prepared and reviewed under SASD’s 2019 Standards. This level of study is not sufficient for design and it is anticipated that a “Level III Study,” and/or series of studies, will be required prior to improvement plan approval for development and design of the sewer facilities. Future sewer studies shall be prepared following the latest adopted SASD Standards and Criteria.

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 2-1: Vicinity Map** for a vicinity map of the project site and Plan Area.

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.

Existing Sewer Facilities

The existing SASD sewer facilities in proximity to the Plan Area include:

- “Grant Line Road Connection” - 12-inch pipe on the north side of Grant Line Road, near the end of Waterman Court. The 12-inch pipe extends westerly for about 550-feet before becoming a 15-inch pipe. The 15-inch pipe continues westerly in Grant Line Road for about 2,300-feet before tying into a 27-inch trunk line just before Highway 99. The invert of the 12-inch line at the point of connection is at an elevation of 31.2 feet.
- “Railroad Connection” - 18-inch pipe stubbed beneath the railroad along the west border of the project site. The 18-inch pipe runs below the railroad easement for approximately 110-feet before becoming a 21-inch pipe as it continues westerly. The invert of the 18-inch line at the point of connection is at an elevation of 28.9 feet.

Proposed Land Use

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 2-1: Proposed Project Land Use** and illustrated in **Figure 2-2: Land Use Plan**. The analysis conducted for this study evaluates the on-site sewer 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 2-1: Proposed Project Land Use

Land Use Category		Area¹ (acres)
P/OS	Parks and Open Space	65.1
MU	Mixed Mosher Use	118.9
LI	Light Industrial	216.2
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 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.

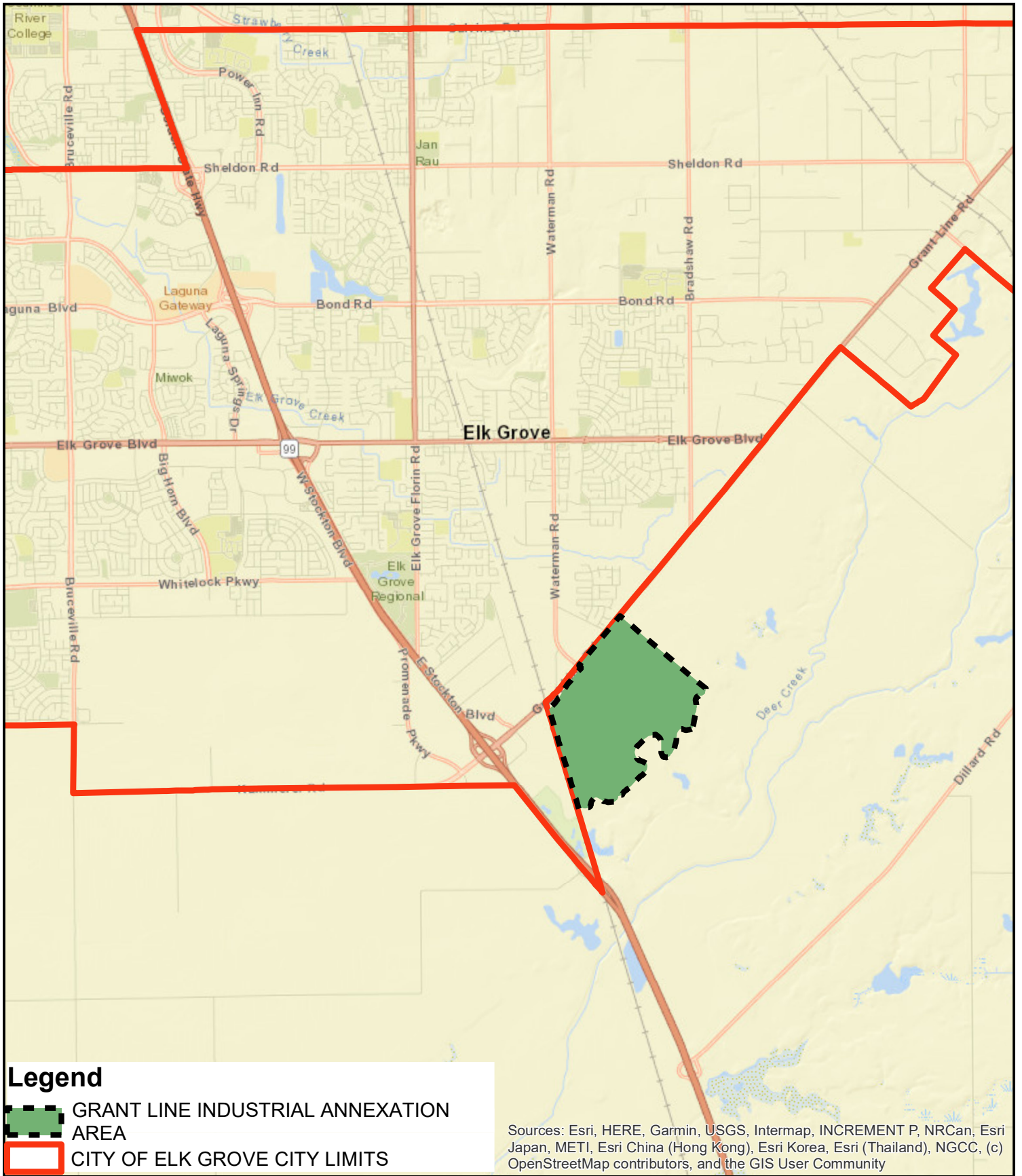
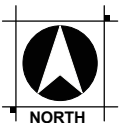
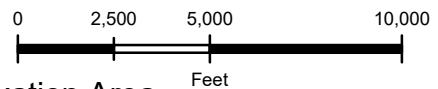


FIGURE 2-1

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



VICINITY MAP

ELK GROVE, CALIFORNIA
AUGUST 2020



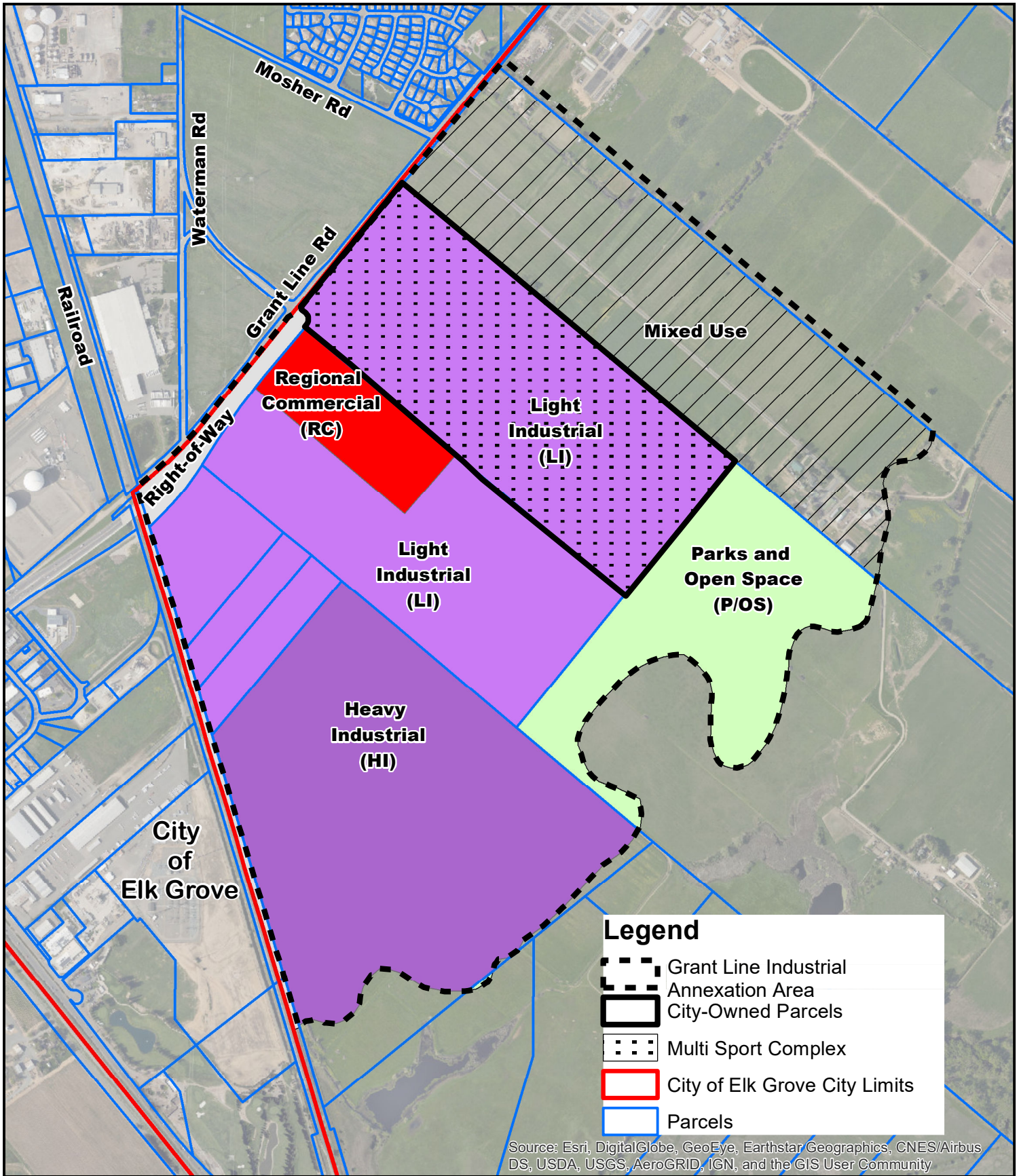
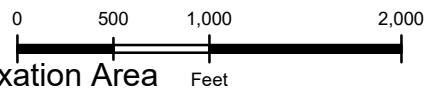


FIGURE 2-2

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

LAND USE PLAN

ELK GROVE, CALIFORNIA
AUGUST, 2020



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

3.0 Design Criteria & Sewer Flow Information

Multiple options for routing sewer flows were developed and analyzed as a part of this study. Ultimately, a preferred option was selected by the City and SASD, and is presented in this study. The preferred on-site sewer system layout analyzed for this study is shown in **Figure 3-1: Preferred On-Site Layout – Ultimate Phase**. The sewage generation and model output results are included in **Appendix A and B**, respectively. The proposed sewer layout illustrated in the above referenced Figure is based upon the subsequent discussion in this section.

3.1 Design Criteria

The sewer study consisted of calculating the sewer flows under the land use alternative, and routing and sizing the backbone sewer system to serve the Plan Area. The SASD Design Standards, dated March 13, 2019, and the Minimum Sewer Study Requirements, dated February 25, 2009, were utilized as the basis for the on-site sewer system layout developed for this study.

Assumptions

There were a number of assumptions that were included in the design approach for this study. It is understood that as this Plan Area develops a Level III Sewer Study will be prepared for the City-owned properties and these assumptions may require further refinement. The assumptions are as follows:

- Existing SASD sewer facilities within Grant Line Road and the existing 18-inch sewer stub crossing beneath the railroad on the west side of the project site were represented in the analysis using as-built information.
- There will be no upstream development or significant increase in on-site densities that will affect the planned on-site sewer facilities.
- The study includes only the major trunk (backbone) lines. Pipes were assumed to be located within the proposed roadways, wherever possible. Pipes were sized based on the SASD design standards and adhere to SASD “Minimum Sewer Study Requirements” criteria for slope and capacity. Actual alignments will be determined once improvement plans are prepared.
- Manholes are located at all changes of directions, confluence of multiple pipes and/or changes of diameter.
- All manhole inverts account for a drop across the manhole that complies with SASD standards, 0.05 foot for a straight through condition, 0.1 foot for a change in direction greater than 20-degrees, and matching crown of pipe for a change in diameter.
- For a Level II Study, manholes are not required to be depicted at the maximum spacing, however, for pipe lengths that exceed manhole spacing requirements, the pipe slope takes into account the drop across those future manholes.
- At the time of this study a grading study of the Plan Area had not been developed. The existing topographic contours have been utilized to determine manhole rim elevations, pipe depths and invert elevations. It is assumed that the ultimate project will not require significant changes to the surface elevations.
- Providing minimum slopes in accordance with SASD standards and conveying the PWWF were the driving factors for sizing the backbone sewer system.

Approach

Sewage generation for the Plan Area was determined per SASD guidelines and as described herein in Section 3.2, and shown in Appendix A. The on-site sewer system was modeled using the InnoVize InfoSewer hydraulic modeling program to simulate both ADWF and PWWF conditions. The preferred sewer routing option was developed to convey all flows by gravity and avoid the installation of an on-site lift station. The preferred sewer routing option is described as follows:

The preferred on-site layout option routes approximately 77% of the flows generated from the Plan Area to the existing 18-inch sewer stub at the railroad crossing. The remaining 23% of sewer flows generated from the Plan Area are routed to the existing 12-inch sewer line in Grant Line Road. This option was developed because it generally follows the existing topography and because it routes a large portion of the on-site flows to the Railroad Connection which includes an 18-inch/21-inch trunk line that currently does not have many connections, and likely has adequate capacity. See Figure 3-1 for the preferred on-site layout.

The following general procedure was used in the development of this study.

1. Gross developable acreages were based on the proposed land use alternative provided by the City of Elk Grove, and did not deduct any acreage for future public roadway/right-of-way.
2. Existing right-of-way did not have any sewage generation.
3. Sewer generation factors are per the SASD standard of 6 ESD/acre at 310 gpd/ESD, which equates to 1,860 gpd/acre.
4. 310 gallons per day is assumed to be the average dry weather flow (ADWF) for an equivalent single-family dwelling unit (ESD).
5. SASD peaking formulas were applied to determine the Peak Flow and Peak Wet Weather Flow (PWWF).
6. This study does not include lateral mains or detailed internal piping layouts.
7. Due to the flat terrain, minimum slopes were utilized to determine inverts and route sewer lines to the upstream portions of the Plan Area. Pipe slopes are based on the SASD design criteria published in Table 202-1 of the SASD standard specifications.
8. Minimum sewer depth was set between five to six feet from existing elevation to the top of pipe.
9. Drop manholes, where proposed, abide by the drop connection criteria in SASD standards.
10. A schematic backbone trunk system was established along all proposed roadway alignments.
11. Thiessen polygons were used to spatially allocate the ADWF and PWWF sewage generation to the model nodes.

Design Criteria

SASD Standards and Specifications, dated March 13, 2019, were used as the basis for this study. The flows were generated using the information found in Chapter 201 (Capacity Design) of the standards and specifications. The design criteria used to develop the proposed sewer system layout and evaluate its performance are presented in **Table 3-1: Design Criteria**.

Table 3-1: Design Criteria

Flow Generation	
Office	6 ESD/acre
Commercial	6 ESD/acre
Light Industrial / Flex Space	6 ESD/acre
Mixed Use	6 ESD/acre
Open Space / Public Recreation	6 ESD/acre
Peaking Factor	$PF = 3.5 - 1.8 * Q_{ADWF}^{0.05}$ (Minimum PF = 1.2)
Minimum Velocity	2 fps at pipe half full
Maximum Velocity	8 fps
d/D Ratio	0.7 for PWWF (< 12") 1.0 for PWWF (12" and larger)
Rainfall Infiltration Factor	New areas: 1,400 gpd per acre
Hydraulic Grade Line	Maximum HGL at crown of pipe at Peak Wet Weather Flow
Friction Factor (Manning's n-value)	0.013

Source: Sacramento Area Sewer District

3.2 Sewer Flow Information

On-site Sewer Flows

On-site sewer flows were generated based on the flow generation criteria identified in Table 3-1 and the proposed land use. The total project area consists of approximately 572 acres, with about 564 acres generating sewer flow. The remaining 8 acres that does not produce flow is the existing right-of-way along Grant Line Road that is within the site boundary. The total ADWF for the Plan Area is the 1.05 MGD (728 gpm) as shown in **Table 3-2: ADWF Sewer Flow**. The PDWF flow is calculated based on a peaking formula and is 1.96 MGD (1,358 gpm). An additional inflow and infiltration (I&I) factor was applied to each parcel to determine the PWWF, which was calculated to be 2.74 MGD (1,906 gpm). Detailed calculations for the ADWF, PDWF and PWWF generation are included in **Appendix A**.

Table 3-2: ADWF Sewer Flow

Land Use Category	Area (acres)	Sewer Generation Factor (gallon/day/acre)	Sewer Flow (GPD)	Sewer Flow (GPM)
P/OS Parks and Open Space	65.1	1,860	121,086	84.1
MU Mixed Use	118.9	1,860	221,154	153.6
LI Light Industrial	216.2	1,860	402,132	279.3
HI Heavy Industrial	143.2	1,860	266,352	185.0
RC Regional Commercial	20.0	1,860	37,200	25.8
ROW Right of Way	8.2	0	0	0.0
Total	571.5		1,047,924	727.7

The proposed zoning for the City’s 104-acre property is light 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. For sewer generation and planning purposes, the generation factor is the same for each land use type that is being considered, so the ultimate land use determination will have minimal to no impact to the proposed sewer system identified herein.

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

Off-site Sewer Flow & Flow Routing

There are no upstream flows anticipated to pass through the Plan Area. Flows generated within the Plan Area will connect to existing SASD sewer facilities that serve adjacent areas. This study determined a preferred option to convey project flows by gravity to the two existing points of connection: the 12-inch “Grant Line Road” connection and the 18-inch “Railroad Connection.” A summary of the ultimate build-out sewer flows to be routed to each existing point of connection under the preferred option is shown in **Table 3-3: Ultimate Phase On-Site Sewer Flow by Connection Shed.**

Table 3-3: Ultimate Phase On-site Sewer Flow by Connection Shed

Sewer Connection Shed	ADWF		PWWF	
	(gpm)	(MGD)	(gpm)	(MGD)
to Grant Line Rd. Connection (12-inch)	165	0.24	433	0.62
to Railroad Connection (18-inch)	563	0.81	1,473	2.12
Total Sewer Flow	728	1.05	1,906	2.74

It is likely that the City-owned parcels will be developed first as the Initial Phase. The flows generated by the city-owned parcels that will be conveyed to the existing SASD sewer system points of connection under the preferred routing option is shown in **Table 3-4: Initial Phase On-Site Sewer Flow by Connection Shed.**

Table 3-4: Initial Phase On-site Sewer Flow by Connection Shed

Sewer Connection Shed	ADWF		PWWF	
	(gpm)	(MGD)	(gpm)	(MGD)
to Grant Line Rd. Connection (12-inch)	31	0.04	82	0.12
to Railroad Connection (18-inch)	103	0.15	356	0.51
Total Sewer Flow	134	0.19	438	0.63

FIGURE 3-1
ULTIMATE PHASE SEWER LAYOUT
 ELK GROVE MULTI-SPORT COMPLEX
 AND GRANT LINE INDUSTRIAL ANNEXATION AREA
 ELK GROVE, CA
 OCTOBER, 2020

Legend

- Manhole
- Outlet
- Gravity Main**
- XX** Pipe Diameter
- Proposed Sewer
- - Existing Sewer
- Parcel Lines
- Project Boundary
- City Owned Parcel
- - - SASD Boundary

Ex. MH- 260-185-1001
 TOT. AREA = 136 ac
 TOT. ESD = 767
 TOT. PWWF = 432 gpm = 0.62 MGD

Ex. MH- 258-185-1003
 TOT. AREA = 435 ac
 TOT. ESD = 2613
 TOT. PWWF = 1473 gpm = 2.12 MGD



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

4.0 Sewer Alignments and Facilities

Interim Facilities

There are currently no interim facilities proposed for this project. It is recommended to size the sewer facilities to accommodate the ultimate build-out of the Plan Area, and construct the facilities required to serve the ultimate build-out as the development plans are phased. As individual developments within the Plan Area move forward with proposals, interim facilities may be considered and should be evaluated.

Ultimate Phase Facilities

Utilizing the SASD design guidelines, the existing topography within the Plan Area, the proposed layout of the internal roadways, and the invert elevations at the two existing points of connection, the preferred on-site sewer routing option was developed and analyzed. A hydraulic model was developed to analyze the on-site sewer routing option and determine the minimum required diameter to convey the ultimate PWWF.

This study schematically shows the proposed on-site backbone sewer pipe alignments and sizes required to convey the ultimate flows generated within the Plan Area to the existing points of connection for the off-site conveyance system. The proposed layout for the on-site system is shown on Figure 3-1. The total on-site length of pipe, per diameter, for the backbone system required to convey the ultimate build-out sewer flows generated within the Plan Area is summarized in **Table 4-1: On-Site Backbone Sewer Piping – Ultimate Phase**.

Table 4-1: On-Site Backbone Sewer Piping – Ultimate Phase

Diameter	Length (feet)
8-Inch	4,150
12-Inch	8,645
15-Inch	3,030
Total	15,825

It is noted that the on-site sewer conveyance option will require further refinement as more detailed information is developed with respect to the site development, roadway alignments and final grades. The purpose of this analysis was to demonstrate that an option exists to convey the ultimate build-out sewer to the existing SASD points of connection via gravity. This study conservatively uses minimum slopes to size the proposed pipelines. It may be determined during the development of the improvement plans that smaller diameter pipes could be installed if the slopes can be steepened. SASD suggests designing the pipelines with steeper slopes when the grade is available in order to allow for a margin of error during construction. This analysis should occur when the improvement plans are being developed.

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 later, 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.

Initial Phase Facilities

The Initial Phase of development includes the entire city-owned 104-acre property. Flow generated from the city-owned property will be conveyed to both points of connection, and therefore a majority of the backbone sewer infrastructure is required to serve the city parcels. Flow generated from approximately 24-acres located adjacent to Grant Line Road is proposed to be conveyed to the 12-inch line in Grant Line Road. Flow generated from the remaining 80-acres of city-owned property is proposed to be conveyed to the 18-inch railroad crossing. The facilities required to serve the Initial Phase of development are shown on **Figure 5-1: Preferred On-Site Layout – Initial Phase**. The total on-site length of pipe, per diameter, for the backbone system required to convey the sewer flows generated from the city-owned property is summarized in **Table 5-1: On-Site Backbone Sewer Piping – Initial Phase**.

Table 5-1: On-Site Backbone Sewer Piping – Initial Phase

Diameter	Length (feet)
8-Inch	1,055
12-Inch	8,645
15-Inch	3,030
Total	12,730

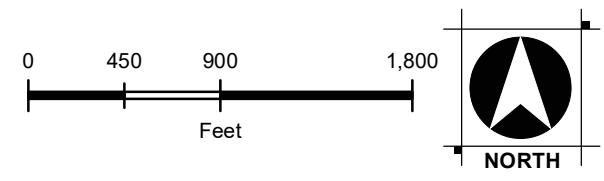
After completion of the sewer infrastructure to serve the Initial Phase, approximately 3,100 LF of 8-inch piping remains to provide service for the Ultimate Phase.

For purposes of the City’s annexation process, planning level cost estimates to construct the on-site backbone sewer infrastructure for the Initial Phase and Ultimate Phase have been prepared and are included in **Appendix C**. These cost opinions account for the on-site infrastructure required to convey the on-site sewage generation to the existing points of connection. It does not account for any off-site improvements.

FIGURE 5-1
INITIAL PHASE SEWER LAYOUT
 ELK GROVE MULTI-SPORT COMPLEX
 AND GRANT LINE INDUSTRIAL ANNEXATION AREA
 ELK GROVE, CA
 AUGUST 2020

Legend

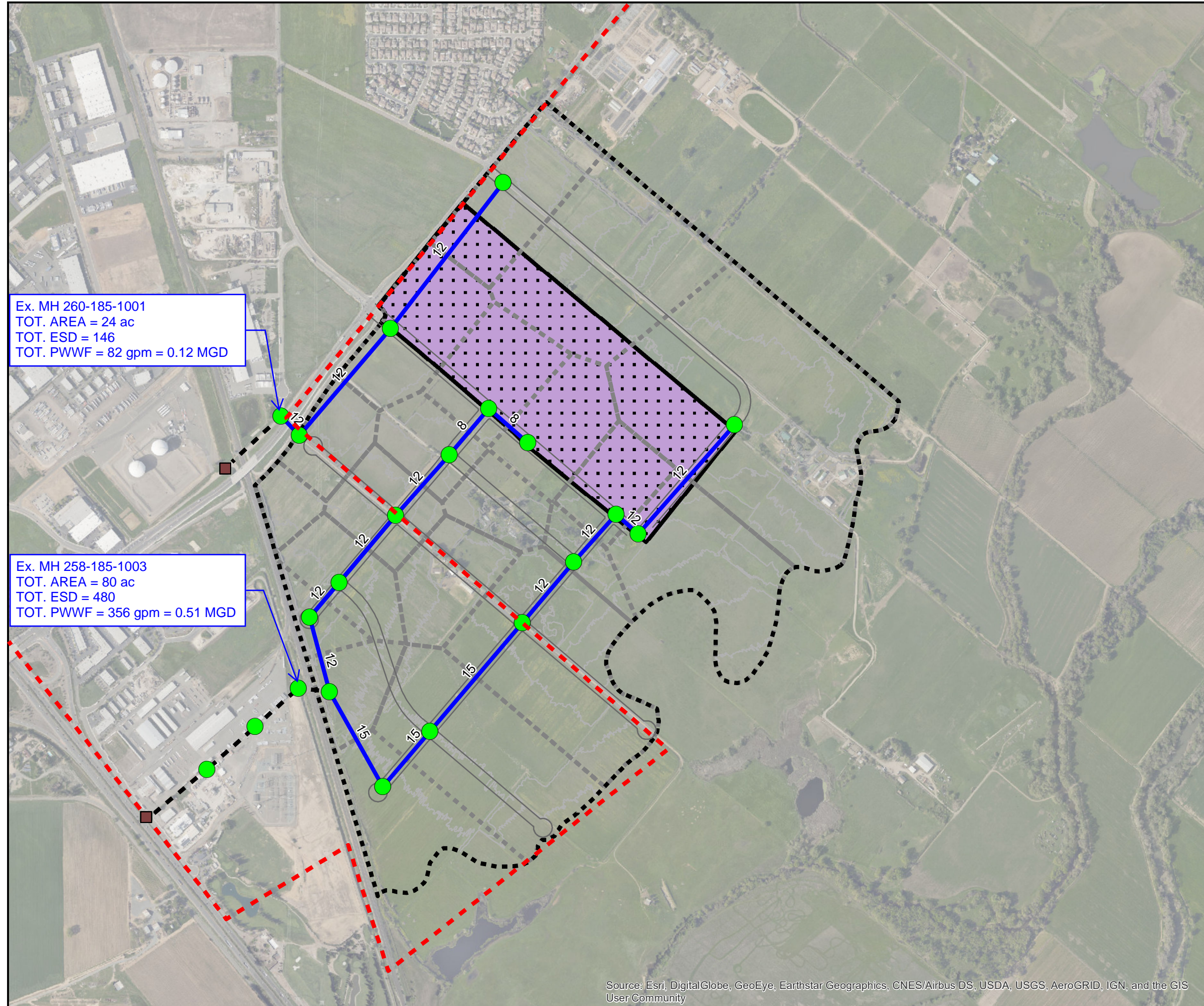
- Manhole
- Outlet
- Gravity Main**
- XX** Pipe Diameter
- Proposed Sewer
- - Existing Sewer
- Landuse**
- Existing Right-of-Way (ROW), no APN
- Heavy Industrial (HI)
- Light Industrial (LI)
- Mixed Mosher Use
- Parks and Open Space (P/OS)
- Regional Commercial (RC)
- Sewer Shed
- Grant Line Industrial Annexation Area
- City Owned Parcel
- SASD Service Area



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

Ex. MH 260-185-1001
 TOT. AREA = 24 ac
 TOT. ESD = 146
 TOT. PWWF = 82 gpm = 0.12 MGD

Ex. MH 258-185-1003
 TOT. AREA = 80 ac
 TOT. ESD = 480
 TOT. PWWF = 356 gpm = 0.51 MGD



6.0 Conclusion

This study has been prepared in accordance with SASD design guidelines to identify backbone sewer conveyance facilities to serve the City of Elk Grove Multi-Sport Complex and Grant Line Industrial Annexation Area. The 572-acre plan area will generate approximately 1.05 MGD (728 gpm) of ADWF and 2.74 MGD (1,906 gpm) during PWWF. There are two existing points of connection for which to convey the on-site flow: a 12-inch pipeline on Grant Line Road (Grant Line Road Connection) and an 18-inch pipeline that is stubbed out below the railroad on the west perimeter of the plan area (Railroad Connection). The inverts of both existing points of connection are deep, approximately 20 feet below the existing grade. The depth of these points of connection allow for the entire Plan Area to be conveyed to the existing system by gravity flow.

A preferred on-site piping routing option was determined based upon the proposed roadway layout and sized to accommodate the ultimate PWWF based upon SASD's criteria for depth, slope, diameter and depth/diameter ratio. Under the preferred option, approximately 23% of the on-site flow is routed to the 12-inch Grant Line Road Connection, and 77% of the on-site flow is routed to the 18-inch Railroad Connection. This option is preferred by SASD and the City because it conveys a majority of the on-site flow to the Railroad Connection, which has more available downstream capacity, and does not require any off-site improvements.

Appendix A Demand Calculation Table

City of Elk Grove
Multi-Sport Complex and Grant Line Industrial Annexation Area
Sewer Generation Projections

Parcel No.	Acreage	Proposed Land Use	Sewer Generation Factor ^[1] (gallon/day/acre)	Generation Projections (ADWF)		Generation Projections (PDWF)			Generation Projections (I/I)			Generation Projections (PWWF)	
				(gallon/day)	(gallon/minute)	PF ^[2]	(gallon/day)	(gallon/minute)	I/I ^[3]	(gallon/day)	(gallon/minute)	(gallon/day)	(gallon/minute)
13401900020000	118.9	Mixed Mosher Use	1,860	221,103	154	1.83	404,800	281	0.17	166,421	116	571,221	397
13401900030000	65.0	Parks and Open Space (P/OS)	1,860	120,836	84	1.88	227,232	158	0.09	90,952	63	318,184	221
13401900090000 ^[4]	60.0	Light Industrial (LI)	1,860	111,625	78	1.89	210,626	146	0.08	84,019	58	294,645	205
	43.9	Light Industrial (LI)	1,860	81,568	57	1.91	155,959	108	0.06	61,395	43	217,354	151
13401900100000	77.5	Light Industrial (LI)	1,860	144,100	100	1.87	268,916	187	0.11	108,463	75	377,379	262
	20.0	Regional Commercial (RC)	1,860	37,200	26	1.97	73,401	51	0.03	28,000	19	101,401	70
13401900130000	143.2	Heavy Industrial (HI)	1,860	266,330	185	1.82	483,447	336	0.20	200,463	139	683,910	475
13401900260000	0.2	Parks and Open Space (P/OS)	1,860	299	0	2.30	687	0	0.00	225	0	912	1
13401900290000	8.5	Light Industrial (LI)	1,860	15,724	11	2.04	32,037	22	0.01	11,835	8	43,872	30
13401900300000	9.7	Light Industrial (LI)	1,860	18,112	13	2.03	36,715	25	0.01	13,633	9	50,348	35
13401900320000	16.7	Light Industrial (LI)	1,860	30,996	22	1.99	61,590	43	0.02	23,331	16	84,920	59
ROW	8.2	Existing Right-of-Way (ROW), no APN	0	0	0	3.50	0	0	0.00	0	0	0	0
Grand Total	571.5			1,047,893	728		1,955,409	1,358		788,737	548	2,744,146	1,906

[1] SASD Standards and Specifications - Table 201-1 (March 13, 2019). 6 ESDs / ac @ 310 gpd/ESD

[2] Peak Factor (PF) = 3.5-1.8*ADWF^{0.05}

[3] I/I = 1,400 gpd/ac*(acres)/1,000,000

[4] City-owned parcels are highlighted in light green above.

Appendix B Model Output Tables, Sewer Shed and Sewer Model Exhibit

System Hydraulic Data

Proposed System Attribute Information										Contributing Land Use and ESDs - Manhole		Contributing Land Use and ESDs - Cumulative		Hydraulic Model Results									
Pipe ID	U/S MH ID	D/S MH ID	U/S MH Rim Elev. (ft) ^[1]	D/S MH Rim Elev. (ft) ^[1]	U/S MH Inv (ft)	D/S MH Inv (ft)	Pipe Diameter (in)	Length (ft)	Pipe Slope	Total		Total		ADWF					PWWF				
										Acre	ESD	Acre	ESD	U/S MH Loading (gpm)	Total Flow (gpm)	Total Flow (gpd)	Velocity (ft/s)	d/D	U/S MH Loading	Total Flow (gpm)	Total Flow (gpd)	Velocity (ft/s)	d/D
41	40	34	54.0	54.0	48.33	41.58	8	1,109	0.0061	55	327	55	327	70.0	70.0	100,800	2.0	0.2	185.0	184.6	265,797	2.6	0.5
35	34	36	54.0	51.0	41.25	37.74	12	1,399	0.0025	28	165	82	492	36.0	106.0	152,640	1.6	0.2	93.0	277.7	399,832	2.0	0.4
37	36	38	51.0	50.0	37.69	34.42	12	1,298	0.0025	26	153	108	646	33.0	139.0	200,160	1.7	0.3	86.0	364.1	524,339	2.2	0.5
49	48	38	53.0	50.0	47.30	43.42	8	638	0.0061	7	42	7	42	9.0	9.0	12,960	1.1	0.1	24.0	23.9	34,386	1.5	0.2
39	38	260-185-1001	50.0	50.0	34.32	33.60	12	247	0.0029	13	80	128	768	17.0	165.0	237,600	1.9	0.3	45.0	433.2	623,854	2.5	0.5
65	56	42	53.0	51.0	47.33	43.39	8	486	0.0081	21	125	21	125	27.0	26.9	38,792	1.7	0.1	71.0	70.6	101,606	2.2	0.3
73	42	68	51.0	52.0	43.29	39.82	8	570	0.0061	22	131	43	256	28.0	54.9	79,112	1.9	0.2	74.0	144.5	208,079	2.4	0.4
67	66	68	53.0	52.0	47.33	44.36	8	486	0.0061	13	78	13	78	17.0	16.8	24,250	1.3	0.1	44.0	44.1	63,508	1.8	0.2
69	68	44	52.0	51.0	39.49	37.63	12	755	0.0025	14	84	70	418	18.0	89.8	129,295	1.5	0.2	47.0	235.8	339,504	2.0	0.4
83	44	72	51.0	52.0	37.58	35.51	12	819	0.0025	17	101	86	519	22.0	111.8	160,975	1.6	0.3	59.0	292.5	421,252	2.1	0.4
85	72	46	52.0	50.0	35.46	34.39	12	428	0.0025	17	104	104	623	22.0	134.2	193,199	1.7	0.3	59.0	351.1	505,636	2.2	0.5
71	46	24	50.0	48.0	34.29	32.50	12	721	0.0025	7	42	111	665	9.0	143.2	206,159	1.7	0.3	24.0	374.9	539,803	2.2	0.5
53	52	76	55.0	54.0	49.33	45.91	12	1,362	0.0025	101	604	101	604	130.0	130.0	187,200	1.6	0.3	340.0	340.4	490,234	2.2	0.5
87	76	54	54.0	54.0	45.81	45.15	12	275	0.0024	39	234	140	838	50.0	180.4	259,739	2.0	0.4	132.0	472.4	680,213	2.1	0.5
75	54	70	54.0	53.0	45.05	43.58	12	594	0.0025	15	92	155	929	20.0	200.4	288,539	2.2	0.5	52.0	524.1	754,636	2.5	0.6
77	70	60	53.0	51.0	43.53	41.69	12	745	0.0025	8	48	163	977	10.0	210.7	303,391	2.2	0.5	27.0	551.1	793,521	2.5	0.7
61	58	60	53.0	51.0	47.33	42.06	8	861	0.0061	19	116	19	116	25.0	25.0	35,958	1.5	0.1	65.0	65.4	94,176	2.0	0.3
59	60	74	51.0	51.0	41.44	38.93	15	1,336	0.0019	52	315	235	1,408	68.0	303.4	436,903	2.1	0.5	177.0	793.9	1,143,153	2.4	0.6
81	74	62	51.0	49.0	38.88	37.62	15	677	0.0019	48	288	283	1,696	62.0	365.4	526,241	2.2	0.6	162.0	956.3	1,377,130	2.6	0.7
63	62	24	49.0	48.0	37.52	35.58	15	1,018	0.0019	29	172	311	1,868	37.0	402.5	579,573	2.2	0.6	97.0	1,053.3	1,516,807	2.6	0.8
21	24	258-185-1003	48.0	48.0	28.89	28.76	18	110	0.0012	13	79	435	2,612	17.0	562.6	810,212	1.9	0.7	44.0	1,472.6	2,120,534	2.3	0.8

[1] Manhole rim elevations are estimated based upon existing topography (not proposed).

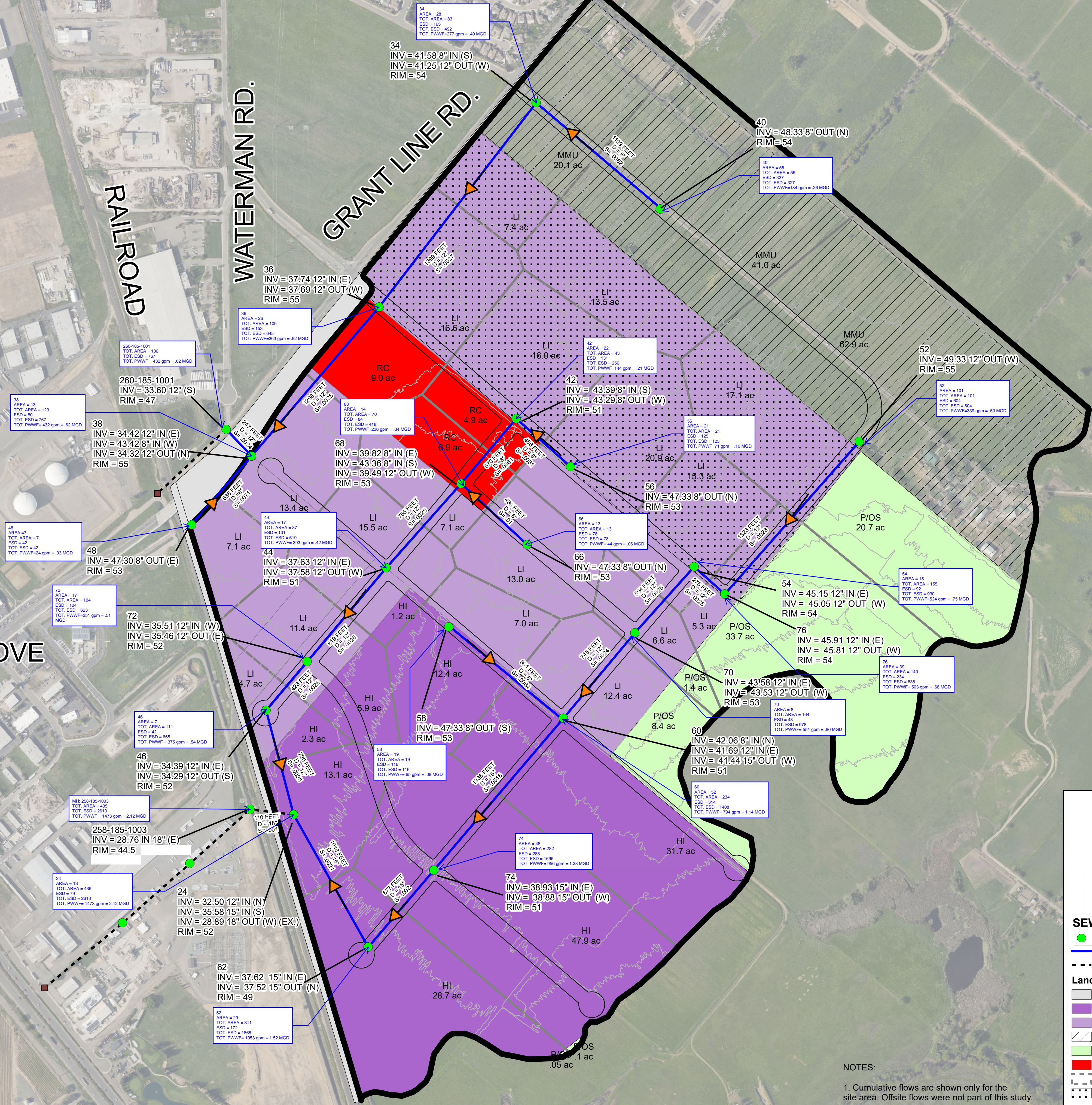
[2] There is 8 acres of City right-of-way within the project boundary. The acreage is shown as tributary to existing MH 260-185-1001 on the system map, however there is no sewer flow attributed to the ROW.

CITY OF ELK GROVE

RAILROAD

WATERMAN RD.

GRANT LINE RD.



APPENDIX B ELK GROVE MULTI-SPORT COMPLEX AND GRANT LINE INDUSTRIAL ANNEXATION AREA

SEWER SHED EXHIBIT

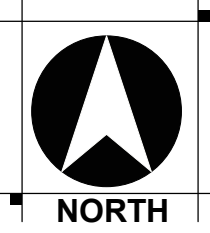
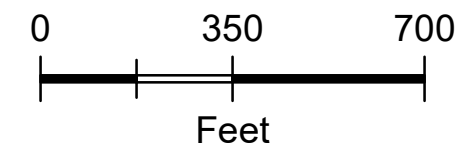
ELK GROVE, CA
AUGUST, 2020

SEWER SYSTEM

- Manhole
- Proposed Pipe
- - - Existing Pipe

Landuse

- 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)
- Sewer Sheds
- City Owned Parcel
- Grant Line Industrial Annexation Area Border



NOTES:

1. Cumulative flows are shown only for the site area. Offsite flows were not part of this study.
2. Existing Right of way does not produce any sewage and was not included in the cumulative sewage calculation.



Appendix C Preliminary Construction Cost Estimates

On-Site Backbone Sewer Piping - Initial Phase

Description	Quantity	Unit	Unit Cost	Total
8-inch pipe	1,056	LF	\$ 120 /LF	\$ 126,720
12-inch pipe	8,643	LF	\$ 180 /LF	\$ 1,555,655
15-inch pipe	3,031	LF	\$ 225 /LF	\$ 681,975
Manhole ^[1]	40	EA	\$ 7,500 /EA	\$ 300,000
Subtotal				\$ 2,664,350
Contingency			30%	\$ 799,305
Total				\$ 3,463,656

On-Site Backbone Sewer Piping - Ultimate Phase

Description	Quantity	Unit	Unit Cost	Total
8-inch pipe	3,094	LF	\$ 120 /LF	\$ 371,280
12-inch pipe	0	LF	\$ 180 /LF	\$ -
15-inch pipe	0	LF	\$ 225 /LF	\$ -
Manhole ^[1]	10	EA	\$ 7,500 /EA	\$ 75,000
Subtotal				\$ 446,280
Contingency			30%	\$ 133,884
Total				\$ 580,164

Notes:

[1] Manholes are assumed to be located at a maximum 400-foot spacing.

[2] All costs are estimated in 2020 dollars.