Propane System Master Plan

Kirkwood Meadows Public Utility District
25-year Propane System Master Plan

Prepared for:
Kirkwood Meadows Public Utility District

January 14, 2025

Prepared by:
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Project/File:
224202855

Stantec Consulting Services Inc.

Rev	Description	Author	Date	Quality Check	Date	Quality Review	Date
00	Propane System Master Plan (Draft)	TZ, JR, HP	12/02/24	JR	12/02/24	SS	12/01/24
01	Propane System Master Plan	TZ, JR, HP	01/06/25	JR	01/06/25	TZ	01/01/25
02	Propane System Master Plan	TZ, JR, HP	01/14/25	JR	01/14/25	TZ	01/14/25

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Executive Summary

Kirkwood Meadows Public Utility District owns and operates a propane utility system that serves the Kirkwood community and Kirkwood Mountain Resort. Serving more than 400 customers, the propane system includes two large LPG storage tanks and vaporizers located on Loop Road along with an extensive underground propane distribution piping network.

Most of the residences and businesses in the valley depend on propane for heating and cooking so the propane delivery system is a critical utility. Due to limited propane storage capacity within Kirkwood and the related propane delivery risk and uncertainty, the KMPUD Board of Directors adopted Resolution 22-01, which determined that propane service would not be offered to new developments, or to lots in existing developments after January 8, 2025. Instead, the District will provide energy to new development solely through electric service and will encourage its current propane customers to convert their heating and cooking equipment to all electric.

KMPUD intends to continue to provide gas service to existing customers in the valley and will be investing in the system as needed to maintain its reliability and operability. There is no suitable area within Kirkwood that will allow for the expansion of storage capacity while maintaining compliance with laws and regulations. This master plan addresses the upgrades and changes recommended to meet KMPUDs goals, while ensuring safety for the operators as well as the customers over the 25-year period considered by the study.

The underground propane distribution system is in good condition and expected to last through the 25-year period covered in this masterplan. A planned project to replace the gas lateral piping that serves the valley residences will address the known service and safety issues with the existing piping.

The LPG storage tanks are in good condition and were recently inspected and their associate valves were replaced. The two water bath vaporizers have 4 and 8 years of projected remaining operating life, respectively, based on estimates provided by the manufacturer, but decreasing parts availability may shorten the functional operating life of the equipment. To maintain operations and to improve system standby capacity during peak demand times it is recommended that a new vaporizer be added and that the older of the two existing vaporizers be maintained in place as a backup during peak winter demand periods. When the second existing vaporizer reaches the end of its expected service life it is recommended that the oldest unit be replace with a new vaporizer and the current second unit be used as standby for the two replacement vaporizers.

The LPG tanks, valving, and vaporizers are all currently outdoors and subject to heavy snow loads. To gain access to the LPG valves and the vaporizers operations staff often manually digs snow tunnels from the road to access valves. This puts staff at risk of potential snow collapse and puts large loads on the LPG piping. This masterplan recommends installation of canopies over the LPG tanks and valve area as well as the vaporizer area. The tank area canopy can be expanded if desired to provide covered storage area on the west side of the tanks.

The canopies will improve operational safety as well as help to extend the operating life of the mechanical equipment.

1 System Description

The LPG system operated by the Kirkwood Meadows Public Utility District provides propane service to 443 customers, both commercial and residential, located in the Kirkwood Valley. As the primary source of fuel for heating and cooking purposes, the LPG system is a critical utility and its reliable operation is key to both the comfort and safety of the valley residents and guests.

The LPG system consists of a main storage and distribution yard and an extensive underground piping network that connects to customers throughout the valley. The central LPG storage yard is located on Loop Road. The central yard includes two large, above ground LPG storage tanks. One tank has 20,400 gallons of capacity and the adjacent tank has 30,000 gallons of capacity.

Just North of the two tanks, in a small shed, is the LPG delivery point where trucks are unloaded into the tanks. Above ground piping connects the two tanks together and to the delivery station. A truck-mounted pump is used to transfer LPG into the tanks. A small auxiliary transfer pump is located at the delivery station that can also be used to transfer LPG between the tanks and to draw off LPG to fuel portable District-owned containers through a connection in the shed.

A LPG liquid line that is fed from both tanks runs from the East side of the tank area underground to the two water bath vaporizers located adjacent to Loop Road. The vaporizers heat the LPG to make pressurized Propane vapor that is distributed through underground piping that runs throughout the service area. Service laterals from the distribution piping serve the individual customer's gas meters. A small enclosure located North of the water bath vaporizers contains 4 old direct fired vaporizers that have been abandoned in place.

To improve the safety and reliability of the system, KMPUD has performed a number of system upgrades and modifications. The piping and valving for the main LPG storage tanks was recently inspected and upgraded. The smaller tank was upgraded in 2018 and the larger tank was upgraded in 2020.

KMPUD is planning a project to replace lateral piping that serves the individual customers from the main distribution piping. This work will improve safety of the system by providing new piping and relocated isolation valving.

Figure 1 shows the layout of the LPG system and distribution piping throughout the valley. Figure 2 is a process flow diagram of the central LPG storage and vaporization equipment.

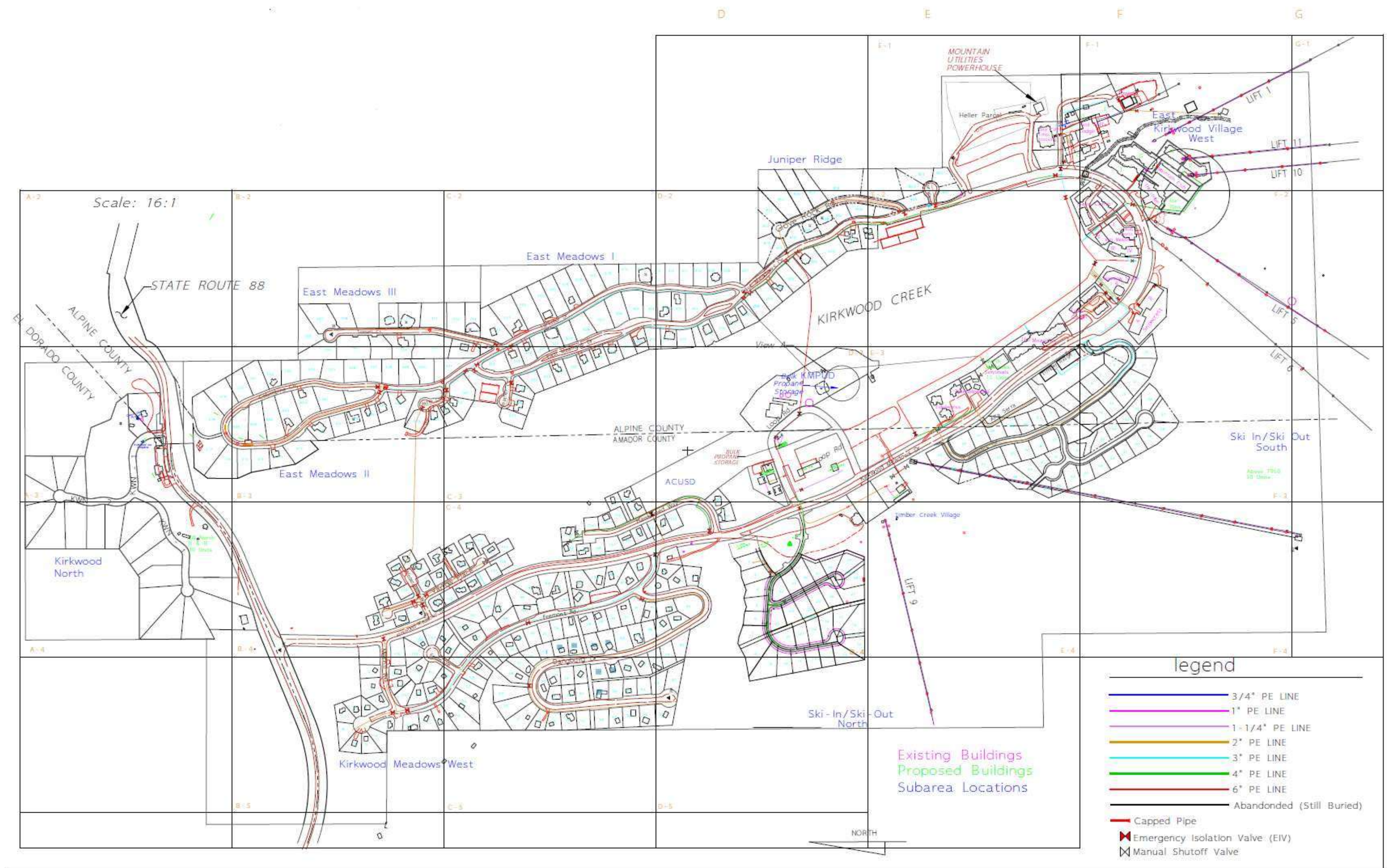

Figure 1 - Kirkwood Meadows Propane Distribution System

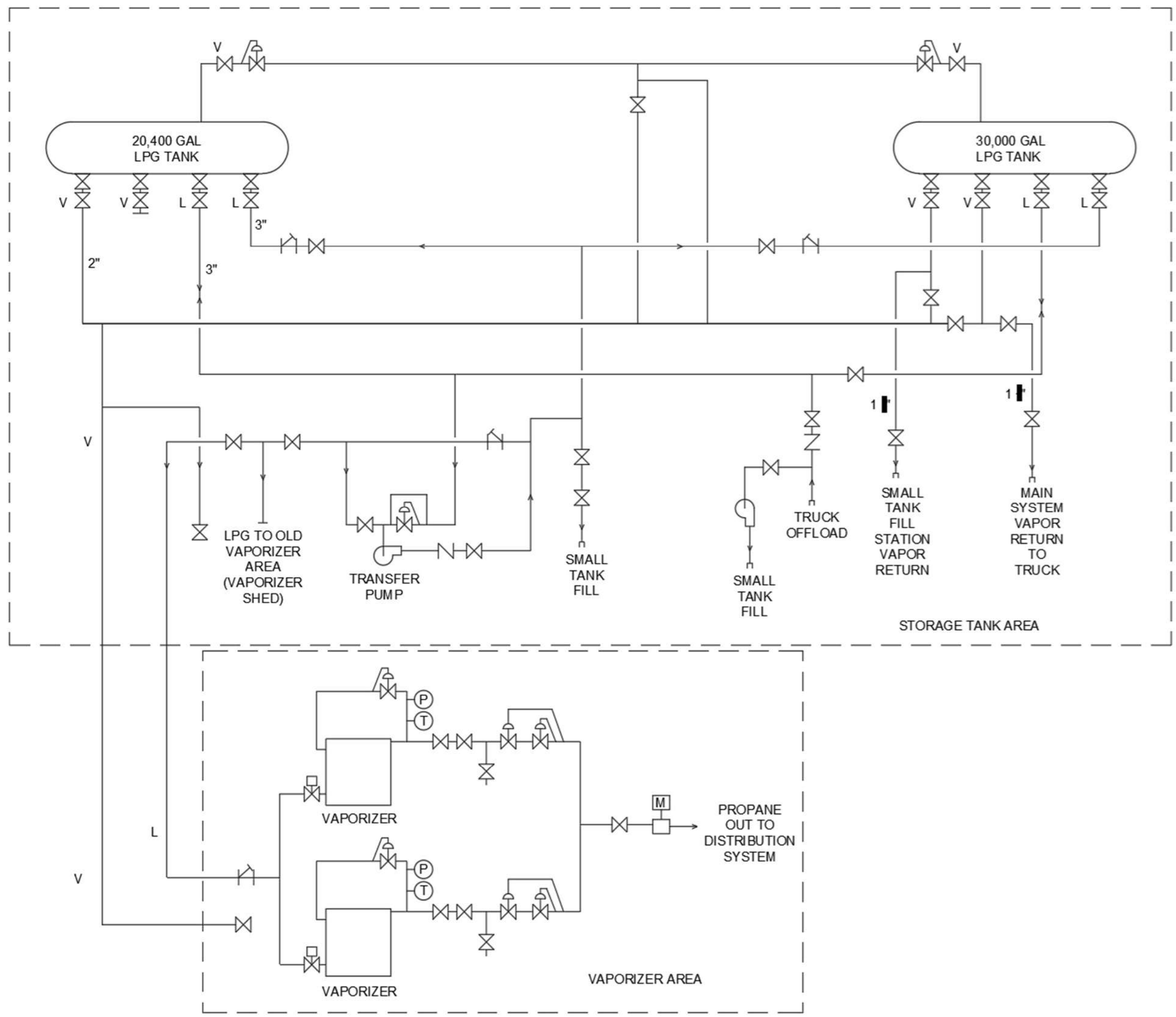

Figure 2 - Kirkwood LPG System Process Flow Diagram

2 Propane System Improvements

KMPUD anticipates operating the LPG and Propane system for at least 25 more years. Since no additional new propane customers will be added and existing customers may electrify, the expectation is that the demand on the system will slowly drop over time. Given the cost of converting to all-electric systems, it is expected that most customers will wait to convert until their existing heating or cooking equipment reaches end of life and requires replacement. This would lead to an increasing rate of conversion over time.

The LPG and Propane system serving the Kirkwood community is in good condition, particularly considering the age of the system and the harsh climate. As noted above, the main storage tanks were inspected and their associated piping and valves were recently replaced (2017-2020). The liquid transfer pump and piping inside the LPG fill and transfer equipment shed has not been updated but appears to be in fair and serviceable condition.

The two water bath vaporizers that are used to make the Propane gas for distribution are both manufactured by Algas SDI, model Q480V. Each of the vaporizers can vaporize up to 480 gallons/hour of LPG. Under operating conditions all of the Propane demand in the valley can be met with a single vaporizer. When the demand exceeds what a single unit can generate, for example on a holiday ski weekend, the second vaporizer can be operated in parallel to increase the total available system supply capacity. Under normal circumstances the two vaporizers provide backup for each other.

One of the vaporizers was installed in 2010 and the other in 2013. The units have reportedly been reliable and have required only typical maintenance and repairs, including the replacement of the burner blowers and other internal parts.

Algas SDI sets the expected baseline operational life of their water bath vaporizers at 10 years. That baseline value is adjusted depending on the vaporizer service conditions, level of maintenance, and environmental factors. Considering how the KMPUD vaporizers are operated and maintained. Algas SDI expects their actual service life to be between 14 and 16 years. Replacement parts for the two vaporizers have become increasingly difficult to source forcing the maintenance staff to have some components repaired locally. Parts availability issues will reduce the remaining viable operating life of the existing vaporizers.

Based on input from the equipment manufacturer, and the availability of spare parts, it is recommended that the existing vaporizers be replaced when the reach 16 years of operation, or earlier if regular inspections identify significant degradation in the glycol system or supporting piping. This would set the projected replacement dates at 2025 and 2029 for the two existing vaporizers.

As noted, except for infrequent peak heating demands, the propane demand can be met with a single vaporizer, with the second vaporizer providing redundancy in the event of a mechanical failure. During the peak demand times when both vaporizers are needed a vaporizer failure would result in a lack of propane supply to KMPUD's customers. Adding a third vaporizer would help to ensure that a backup vaporizer is always available.

It is expected that the annual need to operate two vaporizers simultaneously will drop over time as customers shift away from propane heating. This dynamic will reduce the value of a third vaporizer over time.

The recommended alternative to minimize capital cost and increase reliability is to install a new vaporizer now and keep both existing vaporizers in service. That would provide supply redundancy now, when the system demand is at its highest level. The new vaporizer would be located adjacent to the existing water bath vaporizers. The older of the two existing vaporizers could be held in standby while the two newer units provide regular service. The older unit would be reactivated for use as redundant standby during the peak Winter demand months. In 2029 when the newer of the existing unit reaches its projected service life the 2010 unit would be replaced and the 2013 unit would be moved into the redundant standby service role.

By staggering the replacement schedule and keeping one of the existing vaporizers as a standby unit KMPUD would get a higher level of system redundancy with a minimum of additional cost.

To maintain reliability over the next couple of decades of system operation, the transfer and small tank fill pumps and equipment in the fill shed should be replaced in the next 5-7 years.

3 Site Improvements

The site was evaluated to determine feasible options for improving access to the vaporizer, storage tank, and ancillary equipment, especially during periods of heavy snow. Another key objective of these improvements was to protect the equipment from potential damage caused by vehicles and harsh weather conditions. The proposed solution is to construct canopy structures over the tanks and vaporizers to provide weather protection while ensuring continued access for KMPUD operations staff. Five canopy options were considered, with the final recommendations based on cost-effectiveness, constructability, and overall performance.

Steel-framed canopies emerged as the most practical option, given the significant snow loads and the site's remote location. Most of the fabrication can be completed off-site and delivered to KMPUD when conditions are favorable for construction. The proposed design includes steel-framed canopies supported by concrete piles and continuous footing foundations, with metal deck roofing and siding to enclose the structures.

Figure 3.1 below illustrates the locations of the storage tank and vaporizer at the KMPUD operations facility.

Figure 3.1: Equipment Locations

3.1 Existing Conditions of Equipment

Storage Tanks

Figures 3.2 and 3.3 below depict the current state of the storage tanks. Since these photos were taken, bollards have been added around the perimeter to serve as vehicle barriers. Several of these bollards will need to be removed during the construction of the new canopy.

Figure 3.2: Existing Storage Tanks (looking east)

Figure 3.3: Existing Storage Tanks (looking west)

Vaporizer

Figures 3.4 and 3.5 show the current conditions of the vaporizers. The vaporizers are installed on a slab-on-grade, with bollards positioned around the perimeter as vehicle barriers. The ground west of the equipment slopes upward as you move away from it (as shown in Figure 3.5). It is anticipated that the vaporizer canopy will need to retain several feet of soil, which is why masonry walls are used on the west side of the structure.

Figure 3.4: Existing Vaporizer (looking northwest)

Figure 3.5: Existing Vaporizer (looking north)

3.2 Propane Tank Canopy

Several framing options were developed for the propane tanks, based on the requirements of the KMPUD operations team, as shown in Figure 3.6. A steel truss option offered the largest clearance for the storage area and while maintaining enhanced snow removal capabilities. However, the higher construction costs and the need for additional field welding made this option less desirable. The steel joist option was also rejected due to the significant snow loads in this region, which would require heavy or custom joists. Steel beams, on the other hand, provide the necessary strength and simplify construction, as many connections can be bolted or welded off-site. Since the proximity of the columns to the existing tanks made spread footings impractical, piles were used for all the designs.

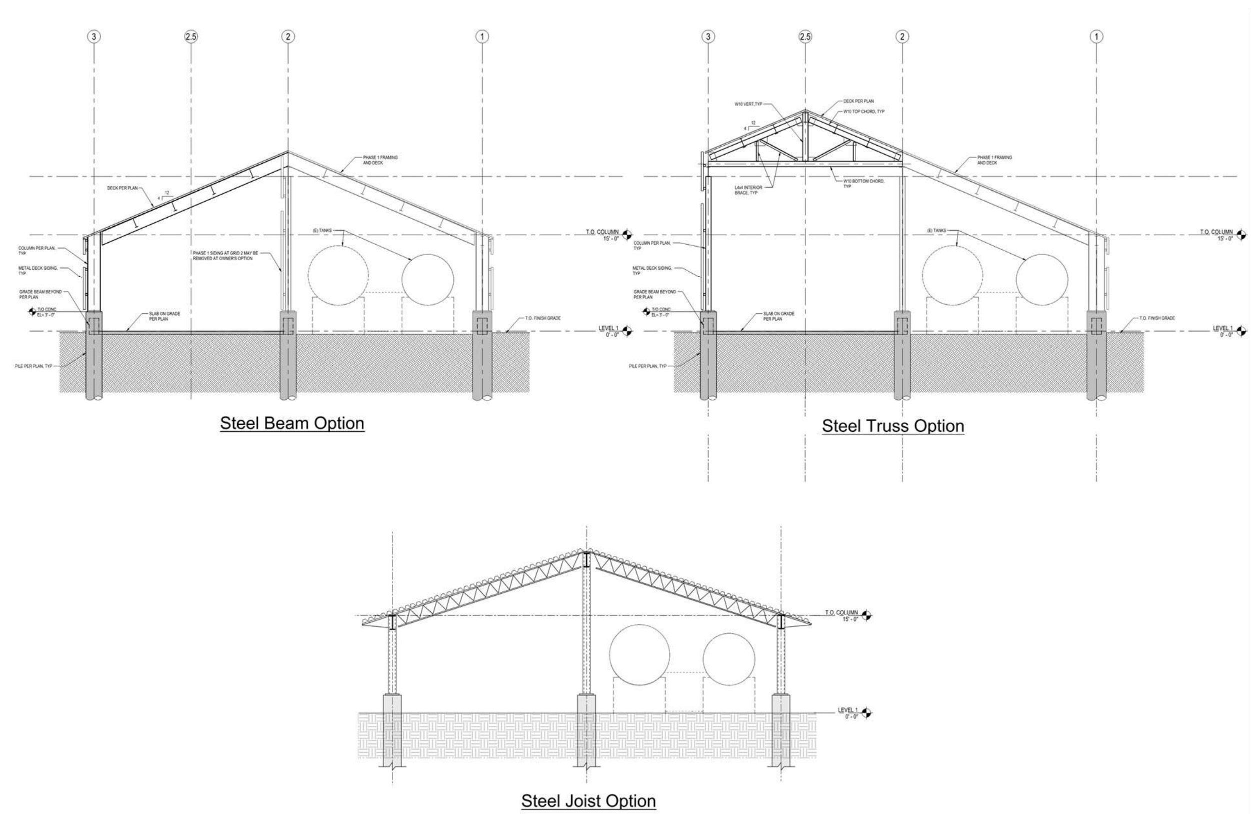

Figure 3.7: Storage Tank Canopy Framing Options

Several canopy coverage plans were also developed, offering varying levels of protection over the tanks and surrounding areas. Figure 3.7 illustrates the options, which range from full coverage over the tanks to designs focused solely on providing access to essential equipment. To balance these goals, a phased approach was selected for the final design. This plan divides the construction into two phases. Phase 1 consists of a partial canopy that covers the essential ancillary equipment and approximately one-quarter of the tanks. This structure is independent and can serve as a permanent solution if Phase 2 is not pursued. Phase 2 would extend the Phase 1 structure, attaching to the existing columns and providing an additional 600 square feet of storage space for KMPUD staff.

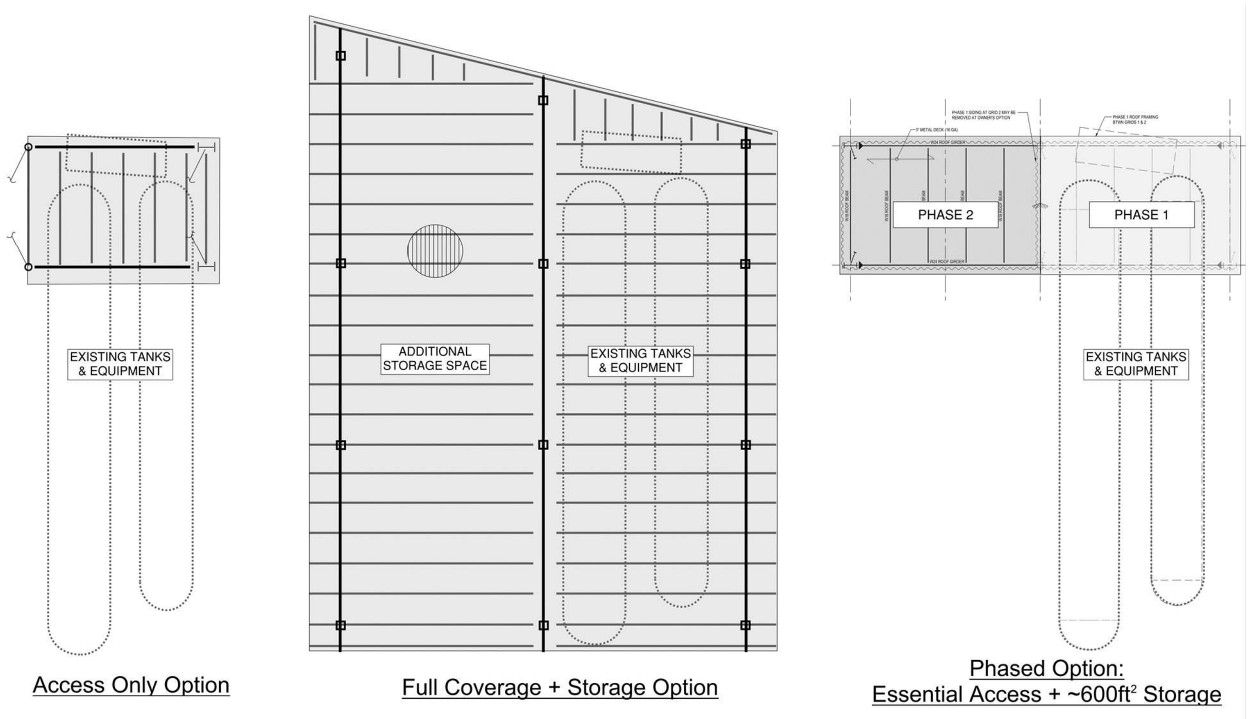

Figure 3.7: Storage Tank Canopy Coverage Area Options

The structural system for both Phase 1 and Phase 2 canopies consists of steel columns, beams, and girders supported by cast-in-place concrete piles. In the north-south direction, pile foundations are connected with concrete grade beams. The structure is enclosed with metal roof decking and siding on three sides, shielding the equipment and storage space from the elements, while the north side remains open. The lateral force-resisting system uses moment frames at the corners of the structure in the east-west direction and cable bracing between the columns in the north-south direction.

Concept drawings for the proposed tank canopy are provided in Appendix B.

3.3 Vaporizer Canopy

The vaporizer canopy will enclose the vaporizer and its ancillary piping. The structure consists of steel roof beams supported by steel columns and masonry walls. The initial design used columns supported by cast-in-place piles. However, after receiving feedback from KMPUD, the design was revised to eliminate piles by using offset columns and concrete grade beams. The foundation system for the final design includes concrete grade beams, footings below CMU walls, and a new slab-on-grade that will connect to the existing slab-on-grade supporting the vaporizer.

The lateral force-resisting system uses masonry shear walls in the east-west direction. In the north-south direction, lateral forces are resisted by both masonry shear walls and an ordinary steel moment frame. The structure will be enclosed with metal deck roofing and siding on three sides, with the east side remaining open for equipment access.

Concept drawings for the proposed vaporizer canopy are provided in Appendix B.

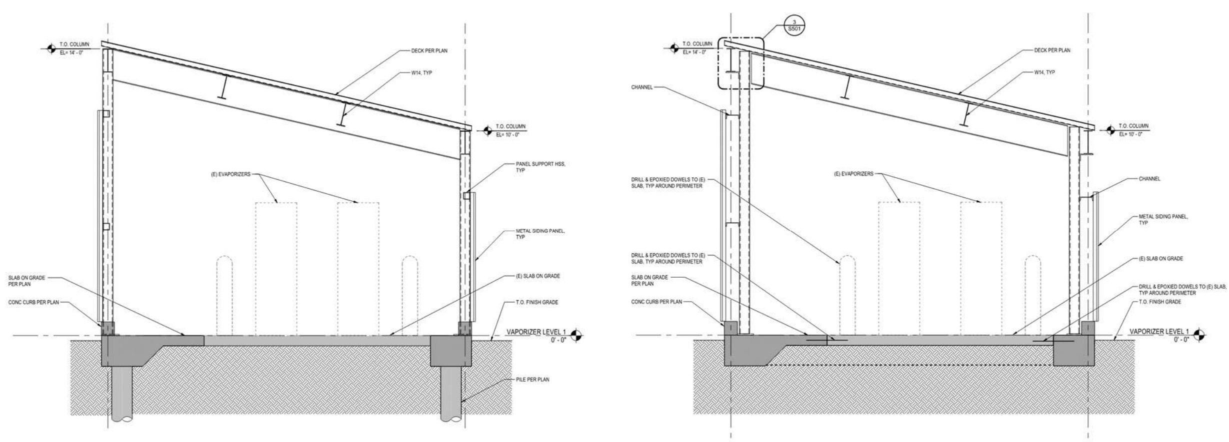

Figure 3.8: Vaporizer Canopy Foundation & Framing Options

3.4 Design Criteria

3.4.1 Loading

Live Loads

- Roof Live Load – 20psf

Snow Loads

- Ultimate Ground Snow Load – 811psf

- Ultimate Roof Snow Load – 647psf

Wind Loads
- Ultimate Wind Speed – 95mph

Seismic Loads
- Risk Category II
- Site Class – D (assumed)
- Seismic Design Category – D
- Sds – 1.01g
- Sd1 – 0.60g

Foundation Design Parameters (assumed)
- Active soil pressure – 35pcf
- Passive soil pressure – 300pcf
- Coefficient of friction – 0.30
- Soil weight – 110pcf
- Allowable soil bearing pressure – 2000psf
- Pile Design Parameters
    - Soil Type – Medium dense sand
    - Effective Unit Weight – 90pcf
    - Friction Angle – 30deg
- Groundwater – No groundwater

3.4.2 Design Codes

The project is designed to conform to the following applicable design codes:

- 2022 California Building Code
- ASCE/SEI 7-22, Minimum Design Loads for Buildings and Other structures
    - To be adopted by 2025 CBC based on the 2024 International Building Code and go into effect January, 2025.

3.4.3 Material Codes

The project is designed to conform to the following applicable codes as they apply to the structure.

- ACI 318-19: Building Code Requirements for Structural Concrete
- AISC 360-16: Specifications for Structural Steel Buildings
- AISC 341-16: Seismic Provisions for Structural Steel Buildings
- AWS D1.5: Structural Welding Code – Steel
- TMS 402-16: Building Code for Masonry Structures

3.4.4 Construction Material

Concrete (Normal Weight)

- Foundations and slab-on-grade , f’c = 4,000 psi

Reinforcing Steel

- Deformed bars – ASTM A615, Grade 60, Fy = 60ksi, Fu = 75ksi

Structural Steel

- Wide flange shapes – ASTM A992
- Angles and channels – ASTM A36
- Base plates – ASTM A36
- Connection material and embedded plates – ASTM A572 (GR 50)
- Bolts – ASTM A325 or ASTM A490
- Anchor rods in concrete or masonry – ASTM F1554 (GR 36)
- Welding electrodes – ASTM E70xx

4 Capital Improvement Plan

4.1 Capital Improvement Plan

Year	Item	Capital Expense
2025	Phase 1 Canopy	**$237,000**
	Phase 2 Canopy (Add-alternate)	*$209,000*
	Vaporizer Area Canopy	**$167,000**
	New (3rd) Vaporizer	**$115,000**
2026	Service Line Replacement	**$60,000**
2027	Replace Transfer Pump	**$18,000**
	Service Line Replacement	**$300,000**
2028	Service Line Replacement	**$300,000**
2029	New Vaporizer (Replace Oldest Unit)	**$105,000**
2040	Replace Oldest Vaporizer	**$105,000**
2044	Replace Oldest Vaporizer	**$105,000**

4.2 Capital Improvement Costs

Capital expenses presented represent our Level 5 ROM cost estimate of improvements outlined in the master plan. These costs include material and installation labor based on typical regional unit prices and budgetary prices from equipment suppliers.

Equipment values quoted are in 2025 dollars based on vendor budgetary quotes.

Breakdown of Canopy structure cost estimates are provided in Appendix C.

Appendix A

Equipment Cutsheets


FM
APPROVED
TÜV NORD
ISO 9001
Certified
Algas-SDI
AQUAVAIRE®
VERTICAL WATERBATH VAPORIZERS
The SAFEST,
most RELIABLE, and
most EFFICIENT gas-fired
LPG waterbath vaporizer
on the market.
START HERE
AQUAVAIRE®
VERTICAL WATERBATH VAPORIZERS

The **SAFEST**, most **RELIABLE**, and most **EFFICIENT** gas-fired LPG waterbath vaporizer on the market.

AQUAVAIRE® Specifications by Model

FM APPROVED · TÜV NORD · ISO 9001 Certified

		Q320V	Q480V	Q640V	Q800V	Q960V	Q1120V	Q1375V	Q1650V
Rated Capacity	Kg/Hr	614	921	1230	1535	1840	2150	2640	3332
	Million BTU/Hr	29.1	43.7	58.2	72.8	87.4	102	125.1	150.2
	Million Kcal/Hr	7.3	11	14.7	18.4	22	25.7	31.5	37.8
Nominal Capacity	US Gallons/Hr	320	480	640	800	960	1,120	1,375	1,650
Heat Exchanger Surface Area	Ft^2	30.5	40.6	58.6	90.5	90.5	99	99	140.7
	m^2	2.83	3.77	5.45	8.41	8.41	9.2	9.2	13.07
Heat Exchanger Design Pressure	PSIG	250	250	250	250	250	250	250	250
	Bar	17.2	17.2	17.2	17.2	17.2	17.2	17.2	17.2
Heat Exchanger Test Pressure	PSIG	375	375	375	375	375	375	375	375
	Kg/cm^2	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9
Waterbath Water/Glycol Volume	US Gallons	116	136	237	294	294	505	505	505
	Liters	431	511	893	1101	1101	1911	1911	1929
Waterbath Operating Temperature *(Adjustable)*	°F	160	160	160	160	160	160	160	160
	°C	71	71	71	71	71	71	71	71
Burner Fuel Input	BTU/Hr	370,000	550,000	710,000	880,000	999,000	1,240,000	1,520,000	1,825,000
	Kcal/Hr	93,240	138,600	178,920	221,760	251,748	312,480	383,040	459,890
Shipping Weight	Lbs	1,821	2,076	2,784	2,994	2,994	3,387	3,387	3,587
	Kg	826.0	941.0	1273.0	1358.0	1358.0	1536.0	1536.0	1627.0
Operating Weight *(with 50/50 Glycol/Water)*	Lbs	2,801	3,236	4,804	5,484	5,484	7,717	7,717	7,957
	Kg	1266	1,471	2,183	2,488	2,488	3,496	3,496	3,607
Electrical *Specify 50Hz or optional voltage if required*	Voltage	120	120	120	120	120	120	120	120
	Hz	60	60	60	60	60	60	60	60
	Phase	1	1	1	1	1	1	1	1
	Amperage	10.9	10.9	13.4	15.5	15.5	16.9	16.9	26.5

Algas-SDI

AQUAVAIRE® VERTICAL WATERBATH VAPORIZERS

From the Algas SDI website:

What is the useable life of a vaporizer?

The question of vaporizer design life is a very popular and appropriate question which has been asked many times in the past by our customers. LP-Gas suppliers and end users alike need to know what they can expect as the typical life expectancy for a particular type of vaporizer placed on site under given conditions. This information is needed to both establish the front-end economics and to establish a safe and responsible maintenance and replacement program.

As the manufacturer, we can anticipate a variety of site and operating conditions and incorporate that information into our design basis. However, as the manufacturer it is not practical to calculate the life of the vaporizer under every possible set of field and site conditions. The most appropriate approach for permanent installations is to use the formula below to establish the expected physical lifespan:

Expected Physical Lifespan = Vaporizer Design Life x (1- (Environmental Factor + Maintenance Factor))

Vaporizer Design Life:
ZIMMER – 8 years
TORREXX – 8 years
TORREXX w/hermetic relay – 10 years
POWER P-Series – 10 years
Direct Fired – 8 years

Environmental Factor (0 = best to 0.3 = worst): Evaluated based on the severity of the physical atmosphere where the vaporizer is placed. Considerations – salt air, acid atmosphere, flooding, etc.

Maintenance Factor (-0.5 = best to 0.5 = worst): No maintenance over the life of the vaporizer results in the worst case and a regular maintenance program, appropriate for the type of vaporizer and one that effectively addresses and prevents problems including those related to LPG quality, results in the best case. For example, a vaporizer processing HD-5 propane beginning with a new (un-used) tank and a regular periodic preventive maintenance program would use a factor of -0.5.

Per the Algas SDI factory representative:

"Considering that the existing vaporizers are each operated only 50% of the time (one unit can meet the service demands) the expected life is"

Expected Life = 10 years * (1- (.2 + -.5)) * 1.15 = 15 years (Range 14-16 years)

Appendix B

Canopy Concept Drawings

Stantec

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KMPUD LPG System Assessment

ATTACHMENT B: CANOPY 30% STRUCTURAL DRAWINGS

KIRKWOOD MEADOWS, CA

MASTER PLAN
JANUARY 06, 2025

Stantec Project Number: 224202855

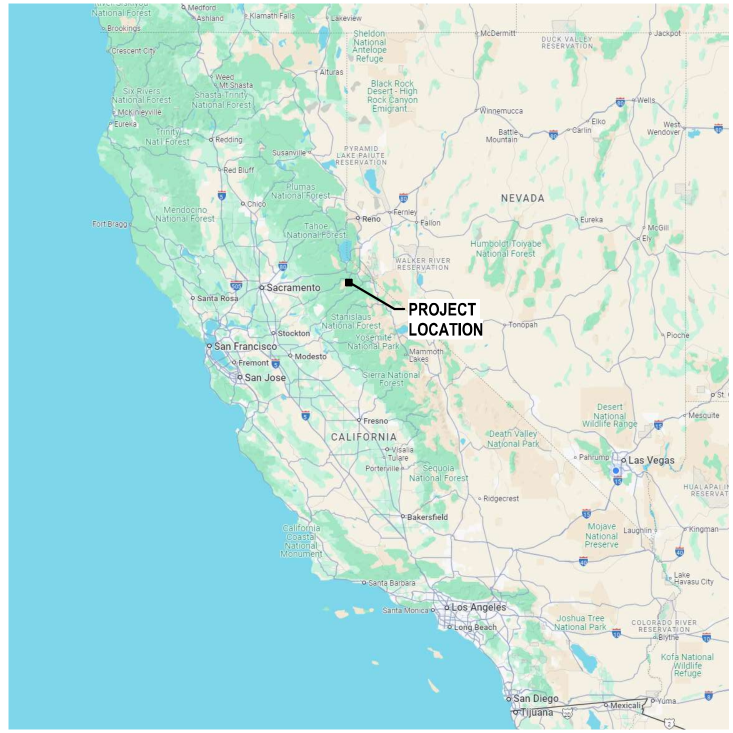


IMAGE COURTESY OF GOOGLE MAPS

TRUE NORTH

IMAGE COURTESY OF GOOGLE MAPS

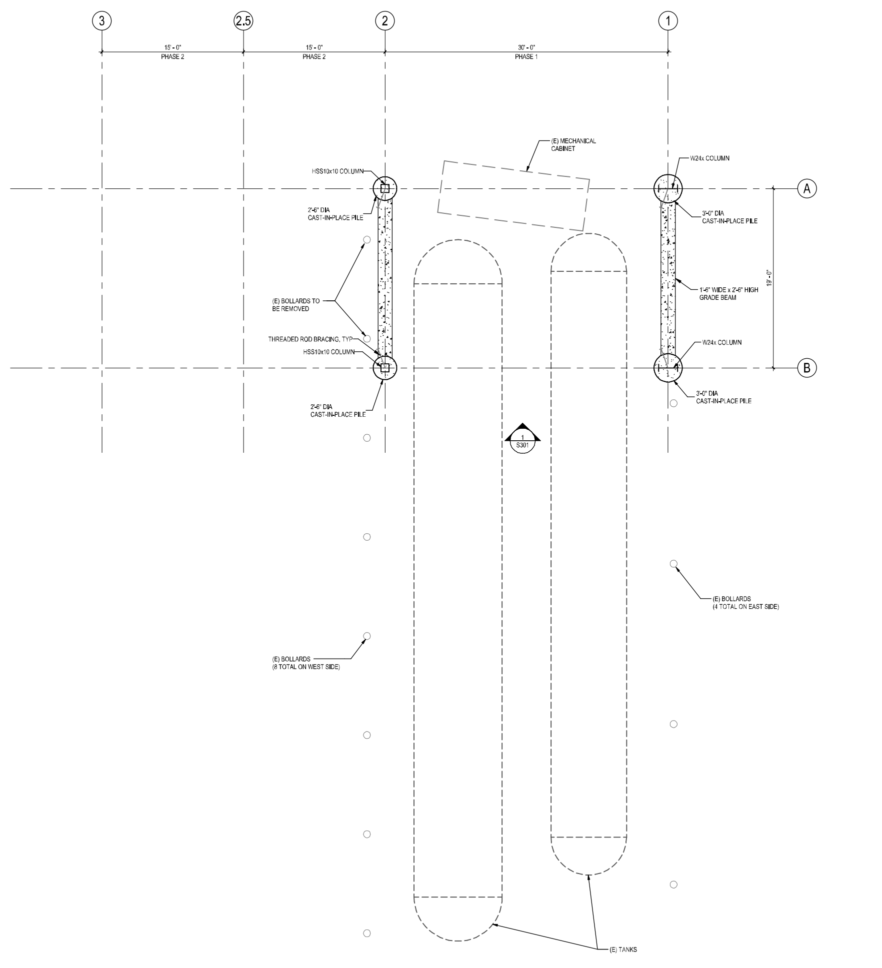
TRUE NORTH

SYMBOLS

- GRID BUBBLE
- ELEVATION MARK
- SECTION MARK
- ELEVATION
- DETAIL MARK
- RIDGE

ABBREVIATIONS

BO	BOTTOM OF
BTWN	BETWEEN
CL	CENTERLINE
CMU	CONCRETE MASONRY UNIT
COL	COLUMN
CONT	CONTINUOUS
DWG	DRAWING
EA	EACH
EXIST, (E)	EXISTING
GALV	GALVANIZED
HSS	HOLLOW STRUCTURAL STEEL
L	ANGLE
NEW, (N)	NEW
NWC	NORMAL WEIGHT CONCRETE
OC	ON CENTER
PL	PLATE
SC	SLIP CRITICAL
T&B	TOP AND BOTTOM
TO	TOP OF
TOC	TOP OF CONCRETE
TOF	TOP OF FOUNDATION
TOS	TOP OF STEEL
TOW	TOP OF WALL
TYP	TYPICAL
UON	UNLESS OTHERWISE NOTED
VIF	VERIFY IN FIELD
W/	WITH
W/O	WITHOUT
WP	WORK POINT



TANKS CANOPY FOUNDATION PLAN - PHASE 1

3/16" = 1'-0"

SITE: LOOKING NORTHWEST

SITE: LOOKING SOUTHWEST

FOUNDATION PLAN NOTES:

1. SEE SHEET S500 FOR PILE DETAILS.

Stantec

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Consultant

Client

Key Plan:

Revision	By	Appd	YYYY.MM.DD

Issued	By	Appd	YY.MM.DD
CONCEPT DRAWINGS	HP	JR	24.11.12

File Name: N/A — Dwn. Dsgn. Chkd. YY.MM.DD

Permit/Seal

CONCEPT DRAWINGS FOR KMPUD PROPANE SYSTEM MASTER PLAN ONLY NOT FOR CONSTRCUTION

Not for permits, pricing or other official purposes. This document has not been completed or checked and is for general information or comment only.

Client/Project Logo

Client/Project
Kirkwood Meadows Public Utility District

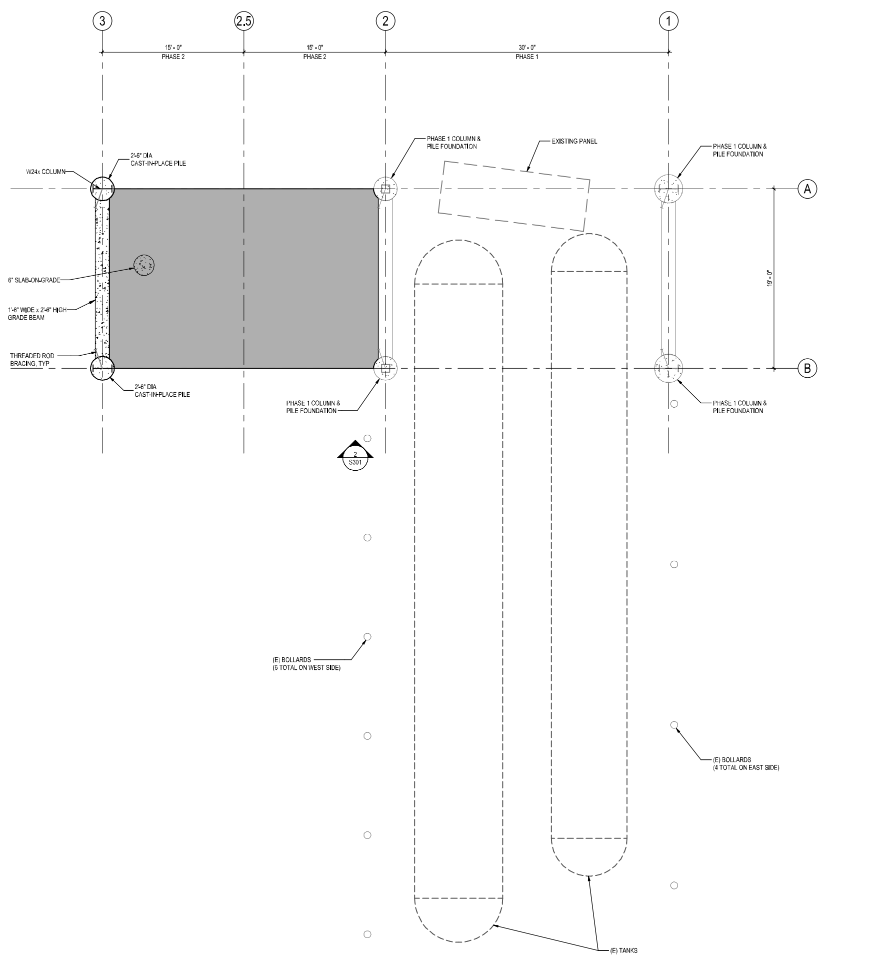
KMPUD LPG System Assessment

KIRKWOOD MEADOWS, CA

Title
TANKS CANOPY FOUNDATION PLAN - PHASE 1

Project No.	Scale
224202855	As indicated
Revision	Drawing No. S101

ORIGINAL SHEET - ARCH E1



TANKS CANOPY FOUNDATION PLAN - PHASE 2

3/16" = 1'-0"

SITE: LOOKING NORTHWEST

SITE: LOOKING SOUTHWEST

FOUNDATION PLAN NOTES:

1. SEE SHEET S500 FOR PILE DETAILS.

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Consultant

Client

Key Plan:

Revision	By	Appd	YYYY.MM.DD
CONCEPT DRAWINGS	HP	JR	24.11.12
Issued	By	Appd	YY.MM.DD

File Name: N/A	Dwn.	Dsgn.	Chkd.	17.09.26 YY.MM.DD

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Kirkwood Meadows Public Utility District

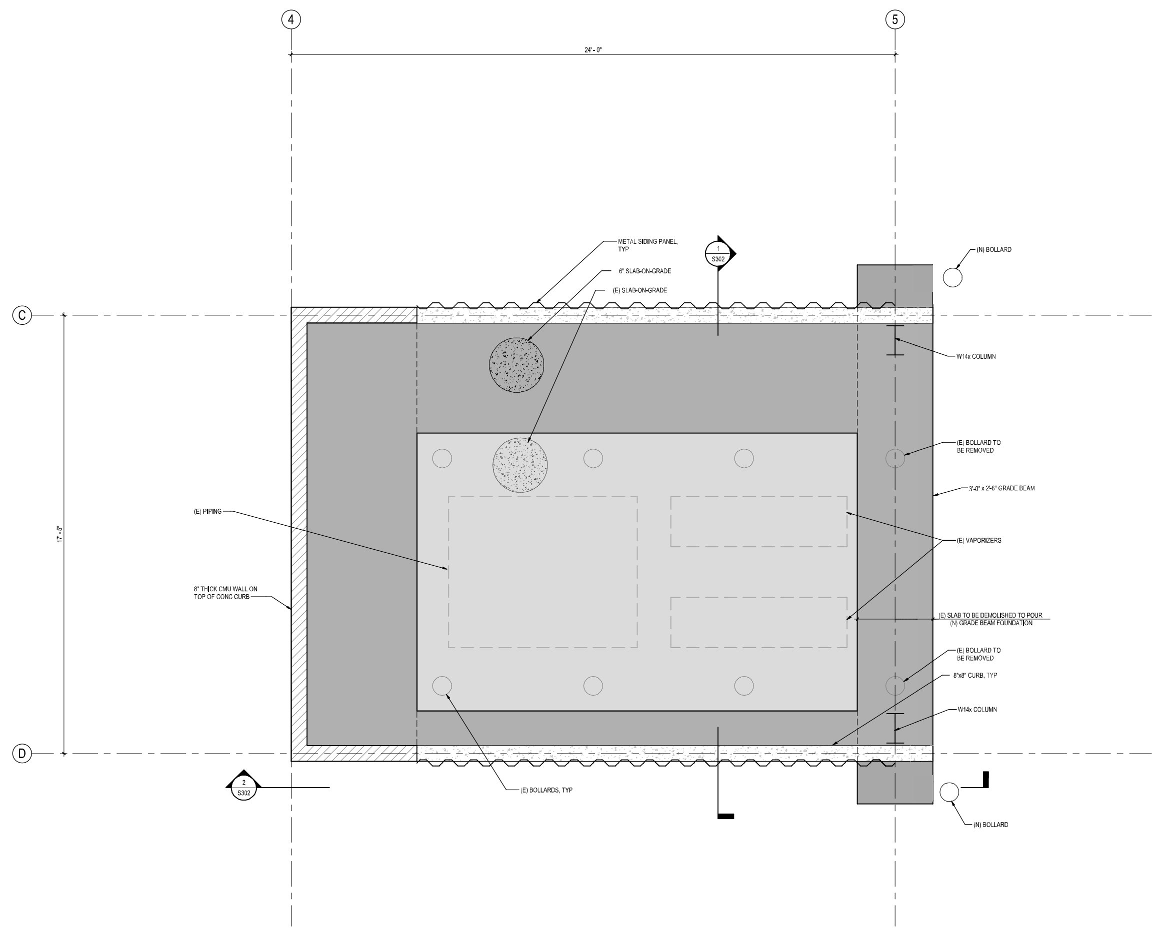
KMPUD LPG System Assessment

KIRKWOOD MEADOWS, CA

Title
TANKS CANOPY FOUNDATION PLAN - PHASE 2

Project No.	Scale
224202855	As indicated
Revision	Drawing No.
	S102

ORIGINAL SHEET - ARCH E1



VAPORIZERS CANOPY FOUNDATION PLAN

1/2" = 1'-0"

SITE: LOOKING NORTHWEST

SITE: LOOKING NORTHEAST

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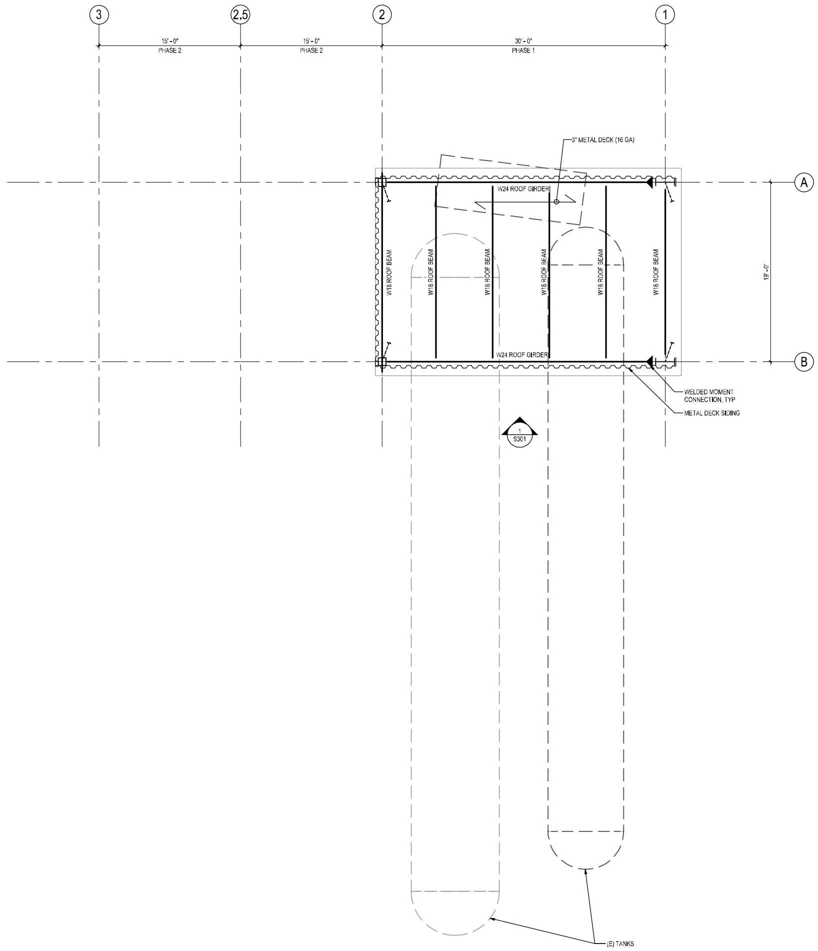
Title
VAPORIZERS CANOPY FOUNDATION PLAN

Project No.	Scale
224202855	As indicated
Revision	Drawing No.
	S103



TANKS CANOPY ROOF FRAMING PLAN - PHASE 1

3/16" = 1'-0"

SITE: LOOKING WEST

SITE: LOOKING SOUTHEAST

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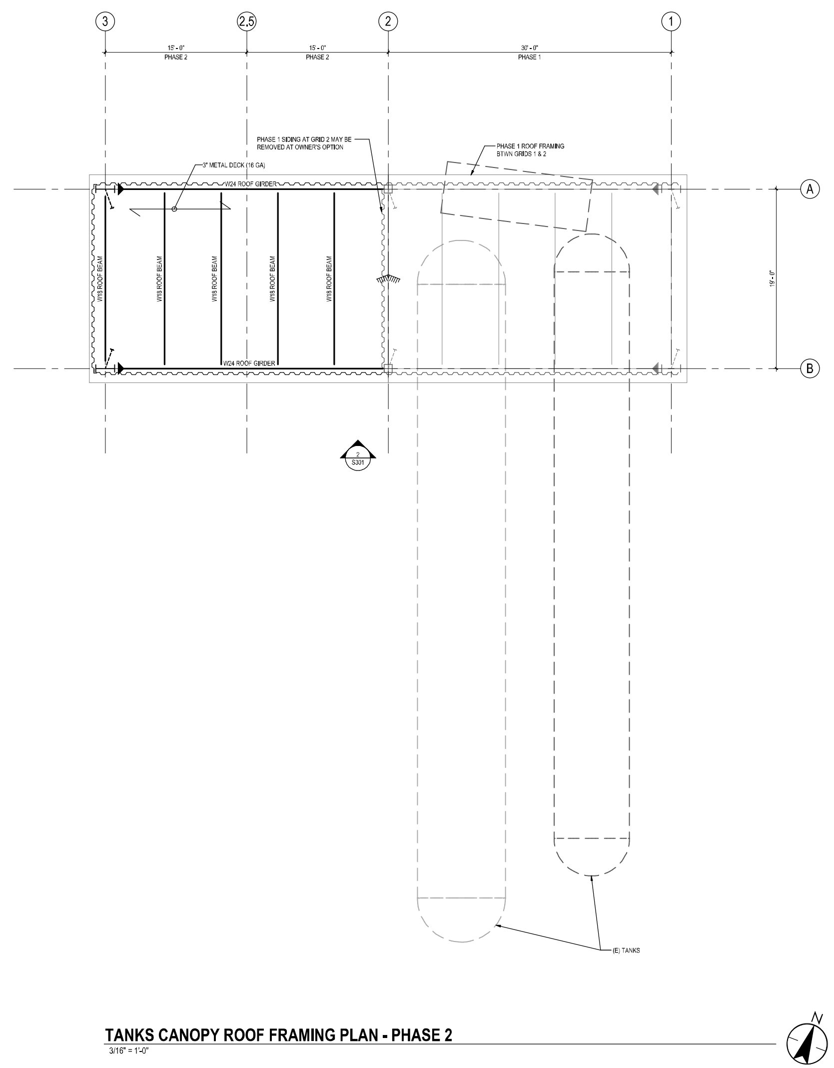
Title
TANKS CANOPY ROOF FRAMING PLAN - PHASE 1

Project No.	Scale
224202855	As indicated
Revision	Drawing No. S201



TANKS CANOPY ROOF FRAMING PLAN - PHASE 2

3/16" = 1'-0"

SITE: LOOKING WEST

SITE: LOOKING SOUTHEAST

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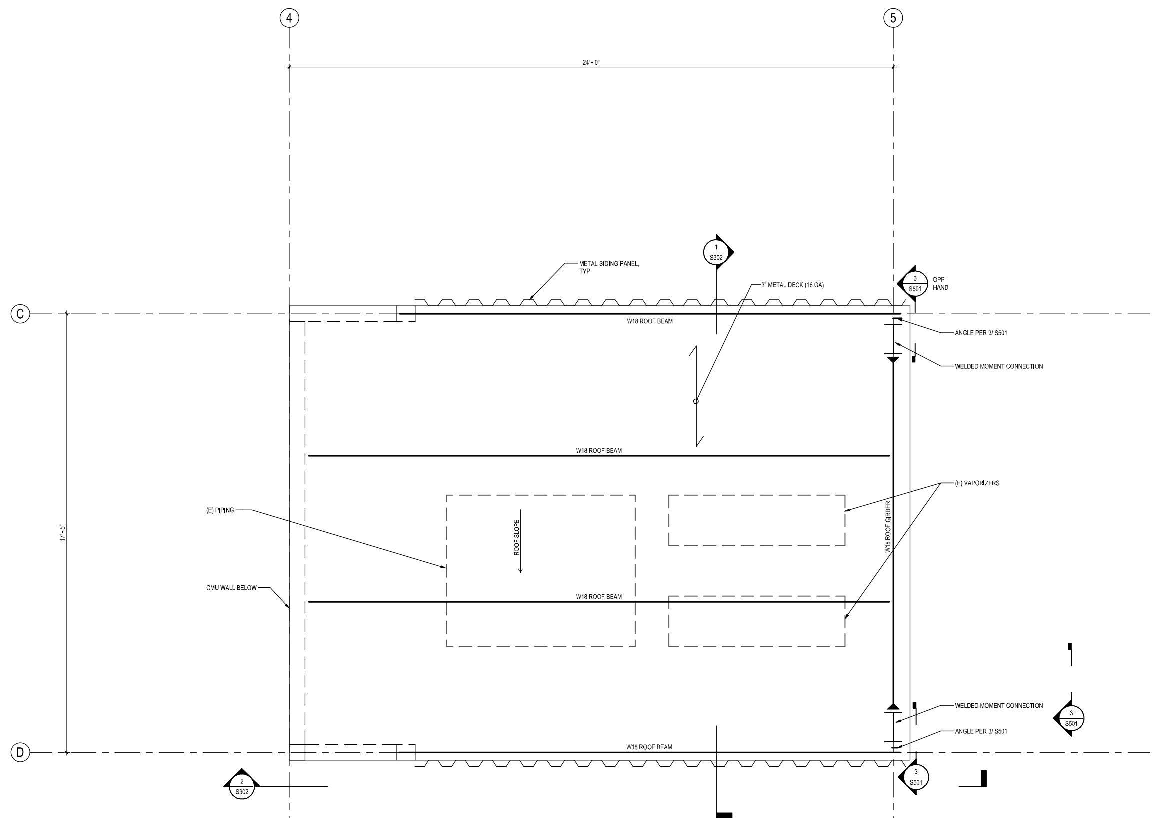
Title
TANKS CANOPY ROOF FRAMING PLAN - PHASE 2

Project No. 224202855
Scale As indicated
Revision
Drawing No. S202



VAPORIZERS CANOPY ROOF FRAMING PLAN

1/2" = 1'-0"

SITE: LOOKING NORTHWEST

SITE: LOOKING NORTHEAST

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KIRKWOOD MEADOWS, CA

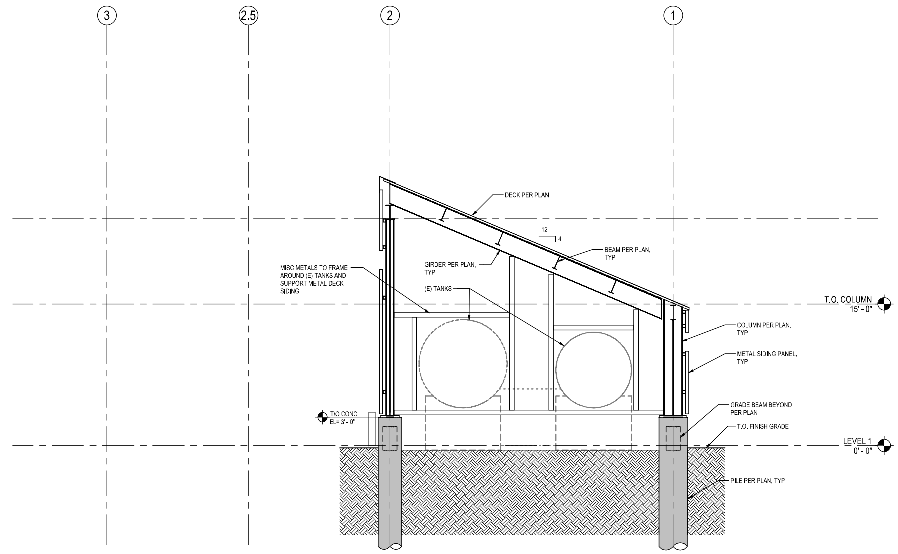
Title
VAPORIZERS CANOPY ROOF FRAMING PLAN

Project No. 224202855

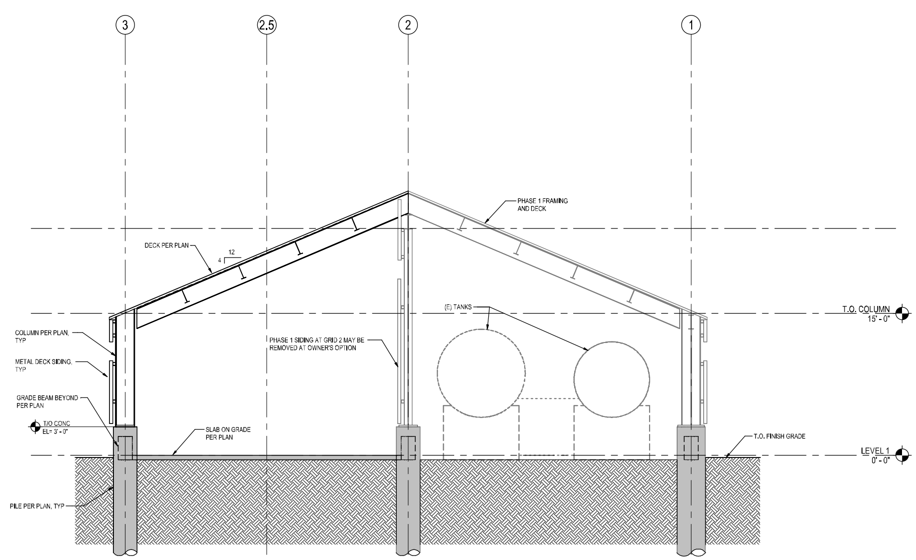
Scale As indicated

Revision

Drawing No.
S203



1 S301 **FRAMING ELEVATION - PHASE 1**
3/16" = 1'-0"



2 S301 **FRAMING ELEVATION - PHASE 2**
3/16" = 1'-0"

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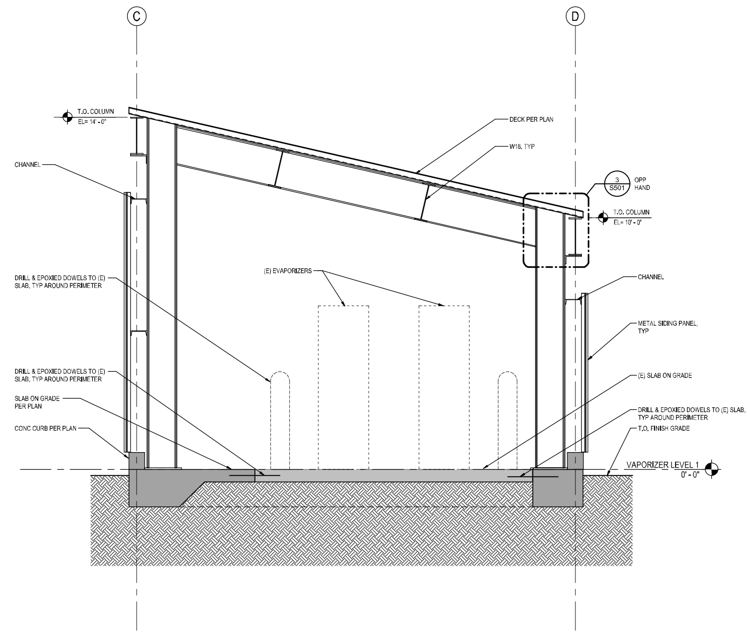
KMPUD LPG System Assessment

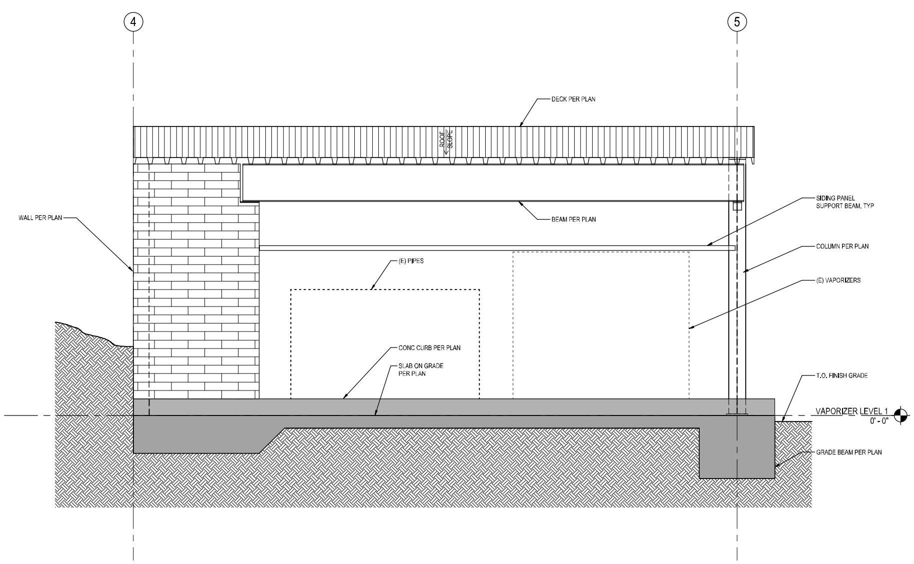
KIRKWOOD MEADOWS, CA

Title
TANKS CANOPY BUILDING SECTIONS

Project No. 224202855
Scale 3/16" = 1'-0"
Revision
Drawing No. **S301**



1
S302
VAPORIZERS SECTION 1
1/2" = 1'-0"



2
S302
VAPORIZERS SECTION 2
1/2" = 1'-0"

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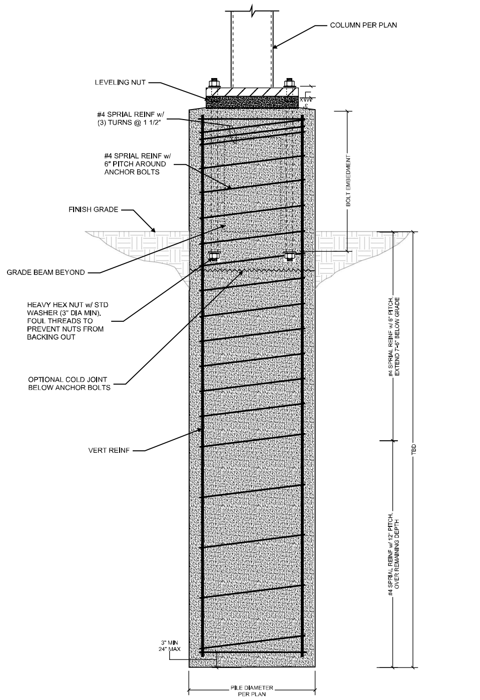
KMPUD LPG System Assessment

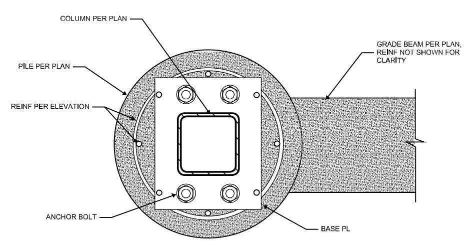
KIRKWOOD MEADOWS, CA

Title
VAPORIZERS CANOPY BUILDING SECTIONS

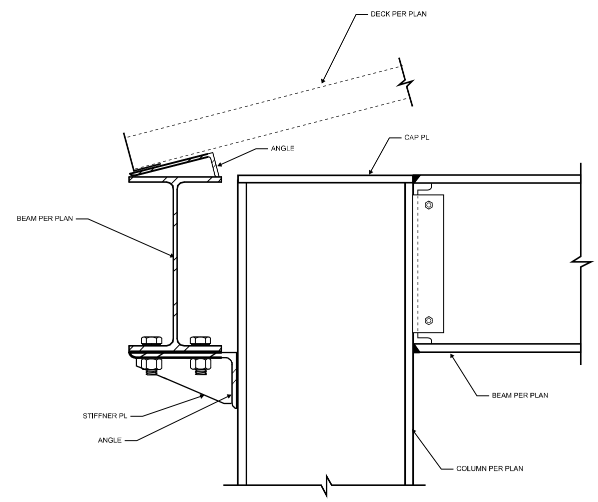
Project No. 224202855
Scale 1/2" = 1'-0"
Revision
Drawing No.
S302



1 S501 **PILE & PEDESTAL DETAIL**
NOT TO SCALE



2 S501 **BASE PL DETAIL**
NOT TO SCALE



3 S501 **OFFSET BEAM TO COLUMN CONNECTION**
NOT TO SCALE

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CONCEPT DRAWINGS	HP	JR	24.11.12
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	Dwn.	Dsgn.	Chkd.	YY.MM.DD

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KMPUD LPG System Assessment

KIRKWOOD MEADOWS, CA

Title
DETAILS

Project No. 224202855
Scale As indicated
Revision
Drawing No. **S501**

Appendix C

Cost Estimate Data

Phase 1 - Storage Tank Canopy				
CATEGORY	QTY	UNIT	UNIT COST	COST
Existing Conditions				
Remove Ex Bollards	2	Each	400	$800
Sawcut/Remove Ex Pavement at Foundations	2	Each	600	$1,200
Protect in place existing equipment				$6,000
Earthwork				$4,000
Exterior Improvements				$8,000
Concrete				
Concrete Caissons	4	Each	5000	$20,000
Grade Beams	38	LF	150	$5,700
Metals				
16 GA N-Type Metal Deck	600	SF	15	$9,000
Structural Steel	8	Ton	5000	$40,000
Rod Bracing	100	LF	30	$3,000
Misc Metals	0.8	Ton	5000	$4,000
Thermal and Moisture Protection				
Formed Metal Roof Panels	600	SF	25	$15,000
Formed Metal Wall Panels	1000	SF	25	$25,000
Subtotal				$141,700
General Conditions	15%			$21,255
Design/Estimate Contingency	10%			$14,170
Escalation	10%			$14,170
Design Fees				$20,000
Subtotal				$211,295
Bonds	2%			$4,226
Contractor's Fee	10.0%			$21,130
Total				**$237,000**
			Square Footage	**600**
			$/SF	**395**

Phase 2 - Storage Tank Canopy				
CATEGORY	QTY	UNIT	UNIT COST	COST
Existing Conditions				
Sawcut/Remove Ex Pavement at Foundations	1	Each	1200	$1,200
Earthwork				$8,000
Exterior Improvements				$8,000
Concrete				
Slab on Grade	600	SF	20	$12,000
Concrete Caissons	2	Each	5000	$10,000
Grade Beams	19	LF	150	$2,850
Metals				
16 GA N-Type Metal Deck	600	SF	15	$9,000
Structural Steel	7.2	Ton	5000	$36,000
Rod Bracing	100	LF	30	$3,000
Misc Metals	0.72	Ton	5000	$3,600
Thermal and Moisture Protection				
Formed Metal Roof Panels	600	SF	25	$15,000
Formed Metal Wall Panels	600	SF	25	$15,000
Subtotal				$123,650
General Conditions	15%			$18,548
Design Contingency	10%			$12,365
Escalation	10%			$12,365
Design Fee				$20,000
Subtotal				$186,928
Bonds	2%			$3,739
Contractor's Fee	10.0%			$18,693
Total				**$209,000**
			Square Footage	**600**
			$/SF	**348**

Vaporizer Canopy				
CATEGORY	QTY	UNIT	UNIT COST	COST
Existing Conditions				
Remove Ex Bollards and pad	2	Each	800	$1,600
Sawcut/Remove Ex Pavement at Foundations	2	Each	800	$1,600
Protect in place existing equipment				$3,800
Earthwork				$8,000
Exterior Improvements				$6,000
Concrete				
Slab on Grade	230	SF	20	$4,600
Concrete Foundations	10	CY	800	$8,000
Grade Beams	20	LF	300	$6,000
Masonry				
8" CMU Block Wall - Full Grout & Reinf	350	SF	35	$12,250
Metals				
16 GA N-Type Metal Deck	450	SF	15	$6,750
Structural Steel	3.1	Ton	5000	$15,500
Misc Metals	0.31	Ton	5000	$1,550
Thermal and Moisture Protection				
Formed Metal Roof Panels	450	SF	25	$11,250
Formed Metal Wall Panels	360	SF	25	$9,000
Subtotal				$95,900
General Conditions	15%			$14,385
Design Contingency	10%			$9,590
Escalation	10%			$9,590
Design Fees				$20,000
Subtotal				$149,465
Bonds	2%			$2,989
Contractor's Fee	10.0%			$14,947
Total				**$167,000**
			Square Footage	**450**
			$/SF	**371**

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