



MECHANICAL, ELECTRICAL, PLUMBING,  
FIRE PROTECTION, AND TECHNOLOGY  
ENGINEERING

BASIS OF DESIGN

SCHEMATIC DESIGN SUBMISSION

OCTOBER 6, 2023

FOR PRICING

NEW ZOO AT ELK GROVE



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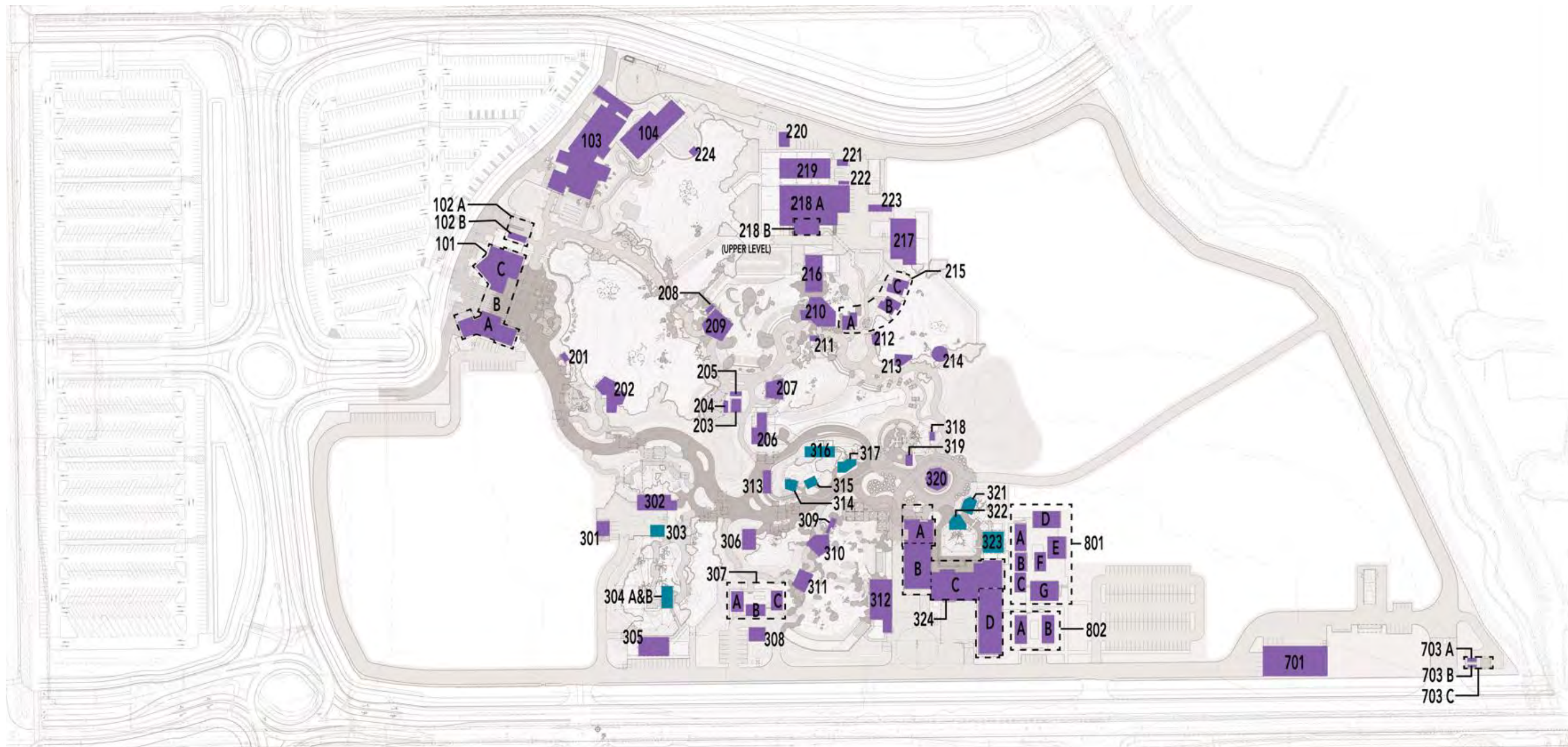
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### A. Project Summary

1.1. The scope of this project covers a new 65 acre zoological park in Elk Grove, CA. The site plans are shown below:

1.1.1. Phase 1a & 1b:







1.2. The building program for this project includes the following main buildings/attractions below:

Phase 1a and 1b

BLDG #	BLDG Name	Size (sf)
101	Guest Services/Restrooms/Ticketing	4,700
101	Retail	5,900
102	Education Entry Restrooms	500
103	The Lodge	12,000
104	Events Pavilion	7,100
201	Dwarf Mongoose Care Quarters	200
202	Giraffe Feeding Shelter Canopy	2,200
202	Giraffe Feeding Shelter Sales Room	150
203	Beer Garden Restrooms	800
204	Beer Service	250
205	Beer Service	250
206	Cheetah Care Quarters	1,800
207	Cheetah View Shelter	1,400
208	Fennec Fox Care Quarters	300
209	Lion View Shelter 1	2,600
210	Lion View Shelter 2	4,600
211	Meerkat Care Quarters	150
212	Rhino View Shelter 1	420
213	Rhino View Shelter 2	720
214	Rhino Encounter Shelter	900
215	Overnight Guest Duplex	900
215	Overnight Guest Duplex	900
215	Overnight Guest Duplex	900
216	Lion Care Quarters	3,200
217	Rhino Care Quarters	4,400
218	Giraffe Care Quarters	11,500
218	Overnight Guest Suite	1,400
219	Hoofstock Care Quarters	4,200
220	Savanna LSS	3,800
221	Walk In Browse Cooler	200
222	Hay Storage	500
223	Event Lawn Giraffe Feeding Shelter	150

BLDG #	BLDG Name	Size (sf)
301	Flamingo LSS	1,400
302	Flamingo Care Quarters/Brooder	2,200
303	Africa Aviary Care Quarters	600
304	Lvl 1: Vestibule	860
304	Lvl 2: Colobus Care Quarters	1,500
305	Okapi Care Quarters	2,200
306	Giant Tortoise Care Quarters	1,100
307	Multipurpose Room	1,000
307	Multipurpose Room	1,000
307	Multipurpose Room	1,000
308	Gelada LSS	1,100
309	Klipsringer/Hyax Holding	430
310	Gelada View Shelter 2	1,500
311	Gelada View Shelter 1	1,300
312	Gelada Care Quarters	4,500
313	Train Depot	1,100
314	Alligator Viewing Shelter 1	500
315	Alligator Viewing Shelter 2	500
316	Alligator & Sq. Monkey Care Quarters	1,600
317	Squirrel Monkey Viewing Shelter	1,000
318	Parrot Care Quarters	250
319	Play Area Restrooms & Lactation Room	650
320	Carousel Pavilion	1,500
321	Lemur View Shelter 1	800
322	Lemur View Shelter 2	1,000
323	Lemur Care Quarters	1,600
324	Quarantine & Nutrition Center)	22,000
701	Maintenance Shed/Shops	8,700
703	Containerized Fodder System	160
703	Walk In Browse Cooler	200
703	Roof	1,500



BLDG #	BLDG Name	Size (sf)
801	Admin Modular 1	1,500
801	Admin Modular 2	900
801	Admin Modular 3	1,000
801	Admin Modular 4	2,300
801	Admin Modular 5	2,000
801	Admin Modular 6	2,500
801	Restrooms - Prefabricated	1,000
802	Animal Staff Modular 1	1,800
802	Animal Staff Modular 2	1,800

**Full Buildout**

BLDG #	BLDG Name	Size (sf)
105	Administration / Staff Support & Offices (2-stories)	9,500
401	Changing Exhibits	5,000
401	Otter Care Quarters & LSS	3,000
401	California Fresh Waters Indoor Exhibits	18,600
401	Beaver Care Quarters	1,100
402	Education & Classrooms	9,000
402	California Deserts Indoor Exhibits	6,000
403	Capybara Care Quarters	800
404	Grizzly Bear View Shelter	6,000
405	Bobcat Care Quarters	1,000
406	Restrooms - California	1,800
407	Food Kiosk	500
408	Big Horned Sheep Care Quarters	1,600
409	Rescue & Rehab Facility	11,000
410	Grizzly Bear Care Quarters & LSS	5,000
501	African Ape Viewing	4,000
502	Hippo Springs View Shelter	1,800
503	Hippo River View Shelter	2,500
504	Food & Restroom Kiosk	800
505	Overnight Arrival Building	2,100
505	Accomodation 1	300
505	Accomodation 2	300
505	Accomodation 3	300
505	Accomodation 4	300
505	Accomodation 5	300
505	Accomodation 6	300
505	Accomodation 7	300
506	Hippo Care Quarters	10,000
507	Hippo+ Tiger Filtration	8,500
508	African Ape CQ	900
509	Wild Dog / Hyena CQ	3,700
510	Rhino Breeding / Hoofstock CQ	5,600



BLDG #	BLDG Name	Size (sf)
601	Wallace Line Gallery Indoor Exhibits	19,000
601	Komodo Dragon/Red Panda C.Q.	1,400
602	Clouded Leopard Care Quarters	3,000
603	Tiger View Shelter	4,800
604	Tiger Care Quarters	3,500
605	Aviary Care Quarters 1	800
606	Restrooms - Asia	1,000
606	Aviary Viewing Shelters	2,900
606	Food Kiosk	500
607	North Water Recovery	4,800
608	Asian Ape View Shelter	2,000
609	Asian Ape Care Quarters	7,500
610	Cassowary Care Quarters	300
611	Australian Aviary Care Quarters	300
612	Clouded Leopard View Shelter	1,400
702	Maintenance Shed/Shops	8,500
705	Greenhouse 2	3,800
706	Greenhouse 1	3,800
707	Event Storage	3,800



MECHANICAL ENGINEERING  
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**1. Executive Summary**

1. Mechanical (HVAC) systems scope shall include heating, ventilating, and air conditioning systems represented in Specification Division 23.

The mechanical systems scope shall include the following general items:

- Ductwork and ventilation systems
- Piping and hydronic systems
- Heating equipment and systems
- Cooling equipment and systems
- HVAC control systems

**2. Applicable Codes, Guidelines and Standards**

1. Design and installation will conform with requirements of identified codes, standards and guidelines. Where differences arise between codes, standards or guidelines, applicable code will prevail. In cases, where edition or year is not indicated, current edition will apply.

- 2.1.1. 2022 California Building Code
- 2.1.2. 2022 California Mechanical Code
- 2.1.3. 2022 California Energy Code
- 2.1.4. 2022 California Fire Code
- 2.1.5. SMACNA (*Sheet Metal & Air Conditioning Contractors' National Association*)
- 2.1.6. NFPA (*National Fire Protection Association*)
- 2.1.7. ANSI/ASHRAE/IESNA Standard 90.1-2013, *Energy Standard for Buildings Except Low-Rise Residential Buildings*
- 2.1.8. ASHRAE 62.1-2010, *Ventilation for Acceptable Indoor Air Quality*

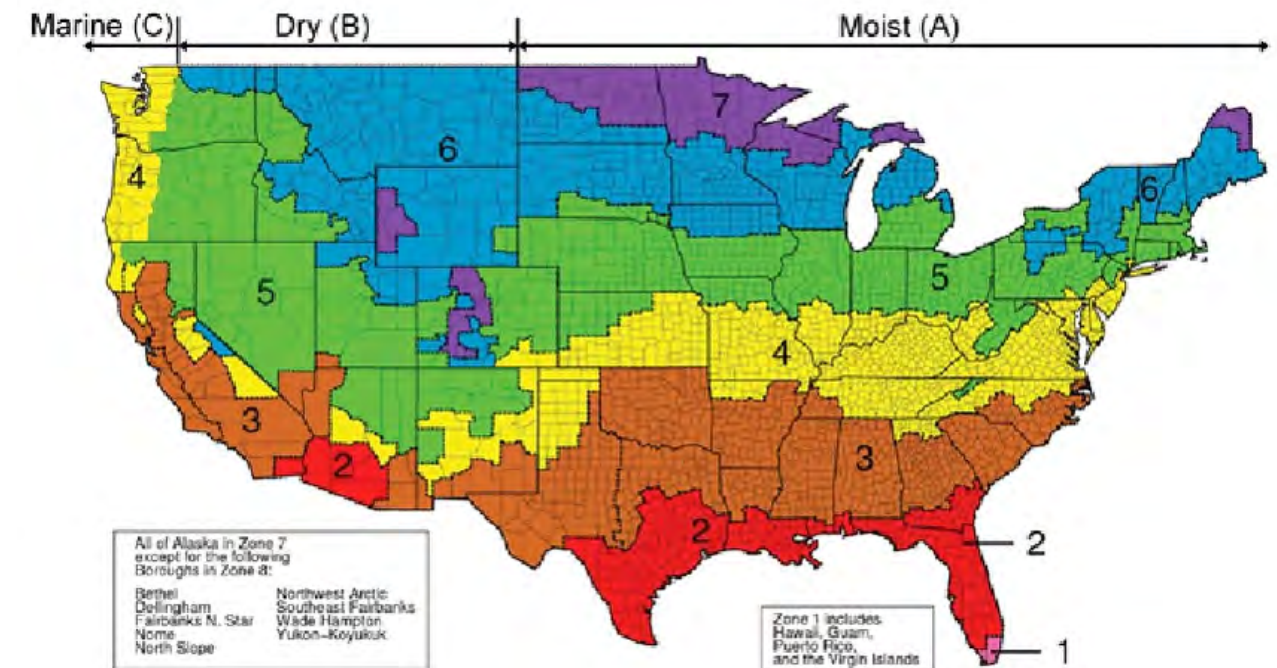
**3. Load Calculation Criteria**

1. Heating and cooling load calculations for the various spaces will be based upon a combination of 3rd party load calculation software (Trane Trace) and EXP's load calculation spreadsheet method. Load calculations for Code compliance for the building envelope will be performed separately as required by the AJH.
2. Outdoor Design Conditions shall be based upon the following, per ASHRAE Fundamentals 2017 – Sacramento Executive AP, CA:

Summer: (0.4%)  
 Dry Bulb = 100.2°F  
 Mean Coincident Wet Bulb = 69.6°F

Evaporation Mean Coincident (for cooling coil selections):  
 Wet Bulb = 72.1°F  
 Mean Coincident Dry Bulb = 95.1°F

Winter: (99.6%)  
 Dry Bulb = 31.5°F  
 5 Year Low = 25.6°F



**FIGURE 1: CLIMATE ZONE MAP (ZONE 3C)**

**3. Indoor Design Conditions.**

- 3.3.1. The heating and cooling load calculations for the mechanical system will be based on the following summary table listing combined electrical and equipment loading for the various spaces. These loads will be used as an overall building average for sizing equipment. Lighting loads will be based on the Space-by-Space Method (Table 9.6.1) of ASHRAE 90.1-2004.
- 3.3.2. Some unique spaces will have internal loads which exceed the general values listed. The internal loading for these spaces will be determined based on the electrical and process requirements of the equipment to located in these spaces.
- 3.3.3. Ventilation loads are summarized in a separate section.



Table 1. Indoor Design Conditions

Room Type	Summer		Winter		Lighting Heat Gain (watts/sf)	Equipment Heat Gain (watts/sf)	Occupant Heat Gain (BTUH/person)	
	Temp (°F)	Maximum Relative Humidity (%)	Temp (°F)	Minimum Relative Humidity (%)			Sensible	Latent
-	-	-	-	-	-	-	-	-
<b>FOOD AND BEVERAGE SERVICE</b>	-	-	-	-	-	-	-	-
Restaurant Dining Rooms	74	55	70	-	-	-	-	-
Cafeterai, Fast Food	74	55	70	-	-	-	-	-
Bars, Cocktail Lounges	74	55	70	-	-	-	-	-
Kitchens (Cooking)	77	58	65	-	-	-	-	-
-	-	-	-	-	-	-	-	-
<b>GENERAL</b>	-	-	-	-	-	-	-	-
Breakrooms	74	55	70	-	-	-	-	-
Coffee Stations	74	55	70	-	-	-	-	-
Conference/Meeting	72	55	70	-	1.5	2	250	200
Corridors	75	55	70	-	0.7	-	225	105
Storage Rooms	77	55	65	-	-	-	-	-
-	-	-	-	-	-	-	-	-
<b>OFFICE BUILDINGS</b>	-	-	-	-	-	-	-	-
Lobbies/Prefunction	74	55	70	-	-	-	-	-
Multi-Purpose Assembly	72	55	70	-	-	-	-	-
Offices, Commercial - General	74	55	70	-	1.5	2	245	155
Offices, Commercial - Perimeter	74	55	70	-	1.5	2	245	155
Offices, Commercial - Interior	74	55	70	-	1.5	2	245	155
Reception Areas	72	55	70	-	-	-	-	-
Telecommunication Centers/Data Entry Areas	72	55	70	-	-	-	-	-
-	-	-	-	-	-	-	-	-
<b>MISCELLANEOUS SPACES</b>	-	-	-	-	-	-	-	-
Computer	72	55	65	-	-	-	-	-
Electrical Equipment Rooms	77	55	60	-	-	-	-	-
Electrical Elevator Machine Rooms	77	55	60	-	-	-	-	-
Photo Studios	72	55	70	-	-	-	-	-
Shipping and Receiving	72	55	20	-	-	-	-	-
Transportation Waiting	72	55	65	-	-	-	-	-
Warehouses	77	55	65	-	-	-	-	-
IDF/MDF Electronic Eqpt	72	55	60	-	-	-	-	-

Room Type	Summer		Winter		Lighting Heat Gain (watts/sf)	Equipment Heat Gain (watts/sf)	Occupant Heat Gain (BTUH/person)	
	Temp (°F)	Maximum Relative Humidity (%)	Temp (°F)	Minimum Relative Humidity (%)			Sensible	Latent
-	-	-	-	-	-	-	-	-
<b>PUBLIC ASSEMBLY SPACES</b>	-	-	-	-	-	-	-	-
Auditorium Seating Areas	72	55	70	-	-	-	-	-
Lobbies	72	55	70	-	-	-	-	-
*Locker Rooms	75	55	72	-	-	-	-	-
*Locker and Dressing Rooms	75	55	72	-	-	-	-	-
*Toilets - Public (light)	75	55	72	-	-	-	-	-
*Toilets - Public (heavy)	75	55	72	-	-	-	-	-
*Toilets - Private (Continuous)	75	55	72	-	-	-	-	-
*Toilets - Private (Intermittent)	75	55	72	-	-	-	-	-
*shower Rooms	75	55	72	-	-	-	-	-
Janitor, Trash, Recycle	75	55	60	-	-	-	-	-
-	-	-	-	-	-	-	-	-
<b>RETAIL</b>	-	-	-	-	-	-	-	-
Sales	72	52	70	30	-	-	-	-
Malls Common Areas	72	52	20	-	-	-	-	-
Barber Shop	72	55	70	-	-	-	-	-
Beauty and Nail Salons	72	55	70	-	-	-	-	-
*Commercial Laundry	77	55	68	-	-	-	-	-
-	-	-	-	-	-	-	-	-
<b>ENTERTAINMENT</b>	-	-	-	-	-	-	-	-
Game Arcades	72	55	70	-	-	-	-	-
Stages, Studios	72	55	70	-	-	-	-	-
*Ticket Booths	72	55	70	-	-	-	-	-
Indoor Coaster	74	55	65	-	-	-	-	-
Dark Ride	74	55	70	-	-	-	-	-
Ride/Gaming Electronics	72	55	65	-	-	-	-	-
Load/Unload	74	55	20	-	-	-	-	-
Maintenance Bay	75	55	68	-	-	-	-	-
Lobbies - Theater	72	55	70	-	-	-	-	-
Queue / Pre-Show	74	55	20	-	-	-	-	-
Stages, Studios	72	55	70	-	-	-	-	-
Ticket Booths	72	55	70	-	-	-	-	-
Indoor Plaza	72	55	68	-	-	-	-	-



4. Outdoor Air Ventilation

3.4.1. The 2022 California Building Energy Efficiency (title-24) Code typically identifies maximum space occupant load (persons per 1000 square feet) and where not otherwise identified occupancy will be based on counts based on seating/furniture layouts (and as directed by Owner), subject to approval by authority having jurisdiction.

3.4.2. Outside air quantities will be per 2022 California Building Energy Efficiency (Title-24) Code

5. Building Occupancy, HVAC System Schedules, Ventilation and Demand Ventilation

HVAC systems located in office areas only during normal business hours will employ a BAS-driven occupancy override system (including maximum or minimum temperature and humidity level control) and will include night operation (setback). HVAC systems serving areas anticipated to be in-service 24-hours a day / 7 day a week will be monitored by the BAS for temperature and humidity levels.

3.5.1. Lobbies, dining areas and function space air handling units will be equipped with code required demand-controlled ventilation. Outdoor air intake dampers will be modulated by space carbon dioxide (CO<sub>2</sub>) sensors and will also employ a BAS-driven occupancy override system (including maximum or minimum temperature and humidity level control) for - occupied operation (setback).

TABLE 120.1-A- Minimum Ventilation Rates

Occupancy Category	Total Outdoor Air Rate <sup>1</sup> R <sub>t</sub> (cfm/ft <sup>2</sup> )	Min Ventilation Air Rate for DCV R <sub>s</sub> (cfm/ft <sup>2</sup> )	Air Class	Notes
<b>Educational Facilities</b>				
Daycare (through age 4)	0.21	0.15	2	
Daycare sickroom	0.15		3	
Classrooms (ages 5-8)	0.38	0.15	1	
Classrooms (age 9 -18)	0.38	0.15	1	
Lecture/postsecondary classroom	0.38	0.15	1	F
Lecture hall (fixed seats)	-	0.15	1	F
Art classroom	0.15		2	
Science laboratories	0.15		2	
University/college laboratories	0.15		2	
Wood/metal shop	0.15		2	
Computer lab	0.15		1	
Media center	0.15		1	A
Music/theater/dance	1.07	0.15	1	F
Multiuse assembly	0.5	0.15	1	F

Table 2:. Minimum Ventilation Rates

Occupancy Category	Total Outdoor Airflow Rate <sup>1</sup> R <sub>t</sub> cfm/ft <sup>2</sup>	Min Ventilation Air Rate for DCV R <sub>s</sub> (cfm/ft <sup>2</sup> )	Air Class	Notes
<b>Food and Beverage Service</b>				
Restaurant dining rooms	0.5	0.15	2	
Cafeteria/fast-food dining	0.5	0.15	2	
Bars, cocktail lounges	0.5	0.2	2	
Kitchen (cooking)	0.15		2	
<b>General</b>				
Break rooms	0.5	0.15	1	F
Coffee Stations	0.5	0.15	1	F
Conference/meeting	0.5	0.15	1	F
Corridors	0.15		1	F
Occupiable storage rooms for liquids or gels	0.15		2	B
<b>Hotels, Motels, Resorts, Dormitories</b>				
Bedroom/living room	0.15		1	F
Barracks sleeping areas	0.15		1	F
Laundry rooms, central	0.15		2	
Laundry rooms within dwelling units	0.15		1	
Lobbies/pre-function	0.5	0.15	1	F
Multipurpose assembly	0.5		1	F
<b>Office Buildings</b>				
Breakrooms	0.5	0.15	1	
Main entry lobbies	0.5	0.15	1	F
Occupiable storage rooms for dry materials	0.15		1	
Office space	0.15		1	F
Reception areas	0.15		1	F
Telephone/data entry	0.15		1	F
<b>Miscellaneous Spaces</b>				
Bank vaults/safe deposit	0.15		2	F
Banks or bank lobbies	0.15		1	F
Computer (not printing)	0.15		1	F
Freezer and refrigerated spaces (<50oF)	-		2	E
General manufacturing (excludes heavy industrial and process using chemicals)	0.15		3	

Table 2:. Minimum Ventilation Rates (cont/d)



Occupancy Category	Total Outdoor Airflow Rate <sup>1</sup> R <sub>t</sub> cfm/ft <sup>2</sup>	Min Ventilation Air Rate for DCV R <sub>s</sub> (cfm/ft <sup>2</sup> )	Air Class	Notes
Pharmacy (prep. Area)	0.15		2	
Photo studios	0.15		1	
Shipping/receiving	0.15		2	B
Sorting, packing, light assembly	0.15		2	
Telephone closets	0.15		1	
Transportation waiting	0.5	0.15	1	F
Warehouses	0.15		2	B
All others	0.15		2	
<b>Public Assembly Spaces</b>				
Auditorium seating area	1.07	0.15	1	F
Places of religious worship	1.07	0.15	1	F
Courtrooms	0.19	0.15	1	F
Legislative chambers	0.19	0.15	1	F
Libraries (reading rooms and stack areas)	0.15		1	
Lobbies	0.5	0.15	1	F
Museums (children's)	0.25	0.15	1	
Museums/galleries	0.25	0.15	1	F
<b>Residential</b>				
Common corridors	0.15		1	F
<b>Retail</b>				
Sales (except as below)	0.25	0.2	2	
Mall common areas	0.25	0.15	1	F
Barbershop	0.4		2	
Beauty and nail salons	0.4		2	
Pet shops (animal areas)	0.25	0.15	2	
Supermarket	0.25	0.2	1	F
Coin-operated laundries	0.3		2	
<b>Sports and Entertainment</b>				
Gym, sports arena (play area)	0.5	0.15	2	E
Spectator areas	0.5	0.15	1	F
Swimming (pool)	0.15		2	C

Table 2.: Minimum Ventilation Rates (cont/d)

Occupancy Category	Total Outdoor Airflow Rate <sup>1</sup> R <sub>t</sub> cfm/ft <sup>2</sup>	Min Ventilation Air Rate for DCV R <sub>s</sub> (cfm/ft <sup>2</sup> )	Air Class	Notes
Swimming (deck)	0.5	0.15	2	C
Disco/dance floors	1.5	0.15	2	F
Health club/aerobics room	0.15		2	
Health club/weight rooms	0.15		2	
Bowling alley (seating)	1.07	0.15	1	
Gambling casinos	0.68	0.15	1	
Game arcades	0.68	0.15	1	
Stages, studios	0.5	0.15	1	D, F

General footnotes for Table 120.1-A:

<sup>1</sup> R<sub>t</sub> is determined as being the larger of the area method and the default per person method. The occupant density used in the default per person method is one half of the maximum occupant load assumed for egress purposes in the CBC.

Specific Notes:

A – For high-school and college libraries, the values shown for “Public Assembly Spaces – Libraries” shall be used.

B – Rate may not be sufficient where stored materials include those having potentially harmful emissions.

C – Rate does not allow for humidity control. “Deck area” refers to the area surrounding the pool that is capable of being wetted during pool use or when the pool is occupied. Deck area that is not expected to be wetted shall be designated as an occupancy category.

D – Rate does not include special exhaust for stage effects such as dry ice vapors and smoke.

E – Where combustion equipment is intended to be used on the playing surface or in the space, additional dilution ventilation, source control, or both shall be provided.

F – Ventilation air for this occupancy category shall be permitted to be reduced to zero when the space is in occupied-standby mode.

Table 2.: Minimum Ventilation Rates (cont/d)



6. Building Envelope:

3.6.1. The 2022 California Building Energy Efficiency (Title-24) Code has the following building envelope prescriptive requirements for each of the different building construction elements (fenestration, walls, roof, etc.).

3.6.2. Building envelope will comply with 2022 California Building Energy Efficiency (Title-24) Code minimum requirements or the output of building performance calculations. The New Zoo at Elk Grove falls into California Building Climate Zone 12.

			Climate Zone																	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
Envelope	Maximum U-factor	Roofs/Ceilings	Metal Building	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	
			Wood Framed and Other	0.034	0.034	0.034	0.034	0.034	0.049	0.049	0.049	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.034	
		Walls	Metal Building	0.113	0.061	0.113	0.061	0.061	0.113	0.113	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.057	0.061	0.061
				Metal-framed	0.060	0.055	0.071	0.055	0.055	0.060	0.060	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055
				Mass Light <sup>1</sup>	0.196	0.170	0.278	0.227	0.440	0.440	0.440	0.440	0.440	0.170	0.170	0.170	0.170	0.170	0.170	0.170
				Mass Heavy <sup>1</sup>	0.253	0.650	0.650	0.650	0.650	0.690	0.690	0.690	0.690	0.650	0.184	0.253	0.211	0.184	0.184	0.160
				Wood-framed and Other	0.095	0.059	0.110	0.059	0.102	0.110	0.110	0.102	0.059	0.059	0.045	0.059	0.059	0.059	0.042	0.059
	Floors/Soffits	Raised Mass	0.092	0.092	0.269	0.269	0.269	0.269	0.269	0.269	0.269	0.269	0.092	0.092	0.092	0.092	0.092	0.058	0.058	
		Other	0.048	0.039	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.039	0.071	0.071	0.039	0.039	0.039	0.039	
	Roofing Products	Low-sloped	Aged Solar Reflectance	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	
			Thermal Emittance	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
		Steep-Sloped	Aged Solar Reflectance	0.20	0.25	0.20	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
			Thermal Emittance	0.75	0.80	0.75	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
	Air Barrier			REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	
Exterior Doors, Maximum U-factor	Non-Swinging	0.50	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	0.50		
	Swinging	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70		

Table 3.: Perspective Envelope Criteria for Nonresidential Buildings

		Climate Zone																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16			
Envelope	Fenestration	Vertical	Area-weighted Performance Rating	Fixed Window																
				Max U-factor	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.34	0.36	0.34	0.34	0.34	0.36
				Max RSHGC	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.22	0.22	0.22	0.22	0.22	0.22	0.25
				Min VT											0.42					
				Curtainwall or Storefront																
				Max U-factor	0.38	0.41	0.41	0.41	0.41	0.41	0.38	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
				Max RSHGC	0.25	0.26	0.26	0.26	0.26	0.26	0.25	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
				Min VT												0.46				
				Operable Window																
				Max U-factor												0.46				
				Max RSHGC												0.22				
				Min VT												0.32				
				Glazed Doors																
				Max U-factor												0.45				
Max RSHGC												0.23								
Min VT												0.17								
Max WWR%												40%								

		All Climate Zones				
		Glass, Curb Mounted	Glass, Deck Mounted	Plastic, Curb Mounted	Tubular Daylighting Devices (TDDs)	
Skylights	Area-Weighted Performance Rating	Max U-factor	0.58	0.46	0.88	0.88
		Max SHGC	0.25	0.25	NR	NR
		Min VT (Min VT <sub>annual</sub> for TDDs)	0.49	0.49	0.64	0.38
	Maximum SRR%		5%			

Table 3.: Perspective Envelope Criteria for Nonresidential Buildings (cont/d)

7. Building Infiltration, Exfiltration:

3.7.1. Building load calculations will include an infiltration rate based on 0.08 CFM of infiltration air per square foot of above grade exterior walls. Entrance doors will use an infiltration rate of 1.75 CFM per square foot.

8. Space Pressurization Relationships:

3.8.1. The building will have an overall positive pressure relationship to the exterior, or neutral if required by specific codes. Certain internal spaces will be at a slight negative pressure relative to adjacent spaces. In general, the relative pressure relationships will be from clean spaces to 'dirty' or utilitarian spaces. Space pressurization will be achieved utilizing airflow offset, in lieu of actual measurement of space pressures.

4. Sustainability and Energy Efficiency

1. This project will be pursuing LEED Gold certification for Tier 1 buildings. Consideration will be given to applicable energy conservation technologies as allowed by project budget constraints.

2. HVAC-specific sustainable design opportunities planned include:

4.2.1. Variable Air Volume Systems

4.2.2. Variable Frequency Drive on equipment where applicable

4.2.3. Outside Air Delivery Monitoring (demand control ventilation)

4.2.4. Premium Electric Motors

4.2.5. Occupant controlled equipment (provide occupancy sensor which switch room modes to unoccupied if no one is present.)

4.2.6. Low-level Building Automation System [BMS] (For Common Areas, Back-of House and Admin/Support spaces)

5. HVAC Systems

1. The recommended HVAC approach for the buildings that require air conditioning is **packaged air-cooled heat pump systems**. The sizes of the systems are identified in Appendix A and B.

2. The following HVAC systems were considered for the project and were either proposed or eliminated based on the justifications noted hereunder:

i. Water-Cooled Chilled Water:

1. Eliminated due to high first cost and water consumption requirements.

ii. Air-Cooled Chilled Water System:

1. Viable option however this system has high first cost and limitations on the equipment

capacities allowed by the California Building Energy Efficiency Code.

iii. Ground-Loop Water Source Heat Pump:

1. Open Loop:

a. Eliminated as it will require an existing open body of water such as a lake.

2. Closed Loop:

b. This system is the recommended system for the following reasons:

i. Year-round ground constant temperature between 60-65 °F

ii. The availability of open areas where sufficient number of vertical bores could be located for the underground piping loops.

iii. System has high operating energy efficiency (16 EER)



Figure 2: Packaged Ground-Loop Water Source Heat Pump Units and Vertical Ground Loop Piping Layout



iv. Variable Refrigerant Flow (VRF):

1. Air-Cooled:

- a. Viable option however the system has lower efficiency than GSHP.

2. Water-Cooled.

- a. Eliminated due to high water consumption requirements.

v. DX Units:

1. Rooftop Packaged DX Units:

- a. Packaged rooftop units provide the convenience of having the unit located on the roof of the building with the supply and return air ducted into the building. No building interior floor space is required for the air-conditioning equipment with the use of rooftop units. In addition, packaged rooftop units provide a single location for equipment serviceability since all the unit components, such as compressor, condenser and evaporator coils, fans and motors, economizers and controls are all packaged within the unit enclosure.
- b. Viable option however the system has lower efficiency than GSHP.

2. Ductless Split-Type Room A/C Units:

- a. Ductless split-type room A/C units offer the convenience of providing dedicated air-conditioning (cooling/heating) for individual room that are either stand-alone rooms which do not have adjacent A/C units that could serve these rooms, or these rooms have special temperature control requirements and require air-conditioning at times when the main A/C systems are not in operation due to building occupancy schedules and off-hours as dictated by the building energy saving measures.
- b. Viable option however the system has lower efficiency than GSHP.

vi. Evaporative Cooling Units:

- a. Eliminated due to high water consumption requirements.

**6. Ductwork**

- 1. Supply, return, toilet and general exhaust ductwork will be constructed of galvanized sheet metal, constructed in accordance with SMACNA *HVAC Duct Construction Standards*. Transverse and longitudinal joints in HVAC ductwork will be sealed. Pressure testing will be performed on 10% of low-pressure ductwork.

- 2. Exhaust ductwork for damp or moist areas (dishwasher exhaust) will be aluminum construction.
- 3. Kitchen hood exhaust ductwork will be welded black or stainless-steel construction and installed in compliance with the *California Mechanical Code*.
- 4. Flexible ductwork will be pre-insulated UL-181 *Factory-Made Air Ducts and Air Connectors Class 1* for air ducts and air connectors having a flame-spread index of not over 25 and a smoke-developed index of not over 50 when tested in accordance with UL-723/ ASTM E84/NFPA 255 *Test for Surface Burning Characteristics of Building Materials*.
- 5. Flexible ductwork will be installed in lengths not exceeding 8 feet.
- 6. Balancing dampers will be provided at branch take-offs. Fire and fire/smoke dampers will be provided at penetrations of fire/smoke walls (that provide both area and fire-rated separations) and in penetrations of two-hour fire-rated shafts.
- 7. Firestopping will be provided where ductwork penetrates walls, floors, partitions, ceiling assemblies, etc. designated to limit spread of fire and smoke. Through penetration firestop systems to have been tested in accordance with UL-1479/ASTM E814 *Fire Tests of Penetration Firestops* and to be current UL-listed products of manufacturer with listing available on UL Online Certification Directory.
- 8. Ductwork will be sized:
 

Supply - Medium Pressure	0.2" per 100 ft. / 1,750 FPM up to 4,500 CFM 1,750 to 2,000 FPM above 4,500 CFM
Supply - Low Pressure	0.08" per 100 ft. / 1,500 FPM
Return - with return air fan	0.1" per 100 ft. / 1,200 FPM
Return - without return air fan	0.08" per 100 ft. / 1,000 FPM
Exhaust	0.10" per 100 ft. / 1,000 FPM
Grease exhaust	500 FPM minimum
Transfer ductwork	300 FPM maximum

**7. Piping**

- 1. Refrigerant piping will be Type ACR copper. Piping will be sized per the DX equipment manufacturer's recommendations.

**8. Insulation**

- 1. Supply, return and all outside air duct systems, including all horizontal ductwork and risers from DOAS systems, will be insulated.

2. Duct insulation to have a nominal density of three pounds per cubic foot with thermal conductivity of not more than 0.23 at 75°F mean temperature. Determination of interior and exterior is based on envelope thermal and moisture barrier.
  - 8.2.1. Interior duct insulation to be fiberglass wrap with foil scrim Kraft (FSK) vapor retarder.
  - 8.2.2. Exterior duct insulation to be cellular glass with aluminum jacketing or pre-insulated double Wall ductwork.
3. Pipe insulation to be the minimum thickness indicated in Table 1 below:

Minimum Pipe Insulation Thickness Table				
FLUID	Insulation Thickness based on Pipe Diameter (Internal)		All External Piping	Type of Insulation
	≤ 1.5 Inches	≥ 1.5 Inches		
Refrigerant	1"	1"	1"	Flexible Elastomeric (Exterior: Aluminum Jacketing)
Condensate Drain	1/2"	1/2"	1"	Flexible Elastomeric (Exterior: Aluminum Jacketing)

**TABLE 1: MINIMUM PIPE INSULATION SPECIFICATION TABLE**

**9. Air Devices**

1. Variable air volume (VAV) air terminal devices will be internally lined and pressure independent type. Terminal devices will be provided with electric heaters.



**FIGURE 23: EXAMPLE: VARIABLE AIR VOLUME TERMINAL**

2. Grilles, registers and diffusers will be constructed of aluminum. To allow testing adjusting and balancing, each grille, register and diffuser will be provided with opposed blade or damper at branch take-off.

3. Linear slot-type supply diffusers/return grilles will be integrated into building architecture and interior design reflected ceiling plans for front-of-house and public areas. Quantity and type will be refined as design of front-of-house spaces progresses.
4. Sound attenuators may be used on various systems as deemed necessary by the design and/or Project Acoustical Consultant.

**10. Sound and Vibration Control**

1. The design will target the following average noise levels created by the HVAC systems. Noise levels do not include noise from equipment, hoods, and personnel located within spaces. Additional requirements of the systems are addressed by the Project Team Acoustical Consultant.

- Theaters
  - Control Room (Sound) NC = 20 – 25
  - Control Room (Lighting) NC ≤ 30
- Office Spaces NC = 35 - 40
- Restrooms: NC = 40
- Retail: NC = 40-50
- Restaurants: NC = 45
- Kitchen NC = 55
- Corridors/Halls and Lobbies: NC = 40-45
- Service and Support Areas: NC = 40-45
- Electrical/Mechanical Rooms: NC ≤ 70

2. These noise criteria values are considered average and should not require widespread sound attenuation devices on mechanical equipment. Sound attenuators may be required in ductwork for large air handling units located above or adjacent to sensitive spaces, or in some air terminal boxes with higher than average entering air static pressures.
3. If venturi-type air valves are used for noise sensitive spaces, then sound attenuators will be required.
4. Vibration Isolation:
  - 10.4.1. Fans, and other rotating equipment will be isolated from structure with appropriate vibration isolation. This will include spring isolators, spring hangers and inertia bases, by application.
5. Piping connected to rotating equipment will be isolated from equipment with flexible piping connections.





6. Duct borne sound generated by air handling equipment can be reduced by use of lined ductwork or duct sound attenuators.

#### 11. Building Pressure Relationships

1. Conditioned levels of the buildings will have overall neutral pressure relationship to exterior and dedicated outdoor air units (DOAS) and air handling unit relief/exhaust air balance will make-up for exhaust air quantities.
2. Restrooms, kitchens, and janitor closets will be a negative pressure with respect to adjacent spaces. Corridors will be maintained at a slight positive pressure with respect to atmospheric pressure. Building will have an overall neutral pressure relationship to the exterior.

#### 12. Air Handling Unit Requirements

1. All air handling units, components and supporting structures exposed to the elements will be made with corrosion resistant materials. External protective coating spray will be applied regularly where applicable to resist corrosion.
2. All air handling units with outside air intakes will have airflow monitoring stations that will alarm when the outside airflow is 10% lower or higher than the required flow rate. The following spaces will have carbon dioxide sensors to alarm if carbon dioxide levels are 10% beyond what is expected, for example all rooms with an occupant density greater than 25 people per 3,225 square feet.
3. Air handling units will be provided with MERV 8 (30%) and MERV 13 (80%) pre-filters.
4. All air handlers will be provided with supplementary electric heat.
5. Humidity control of high latent areas will be achieved via reheat coils. Reheat coils will be electric.
6. Reheat coils will also be utilized wherever displacement ventilation is used to reach the desired supply temperature of the system. Reheat coils will be electric.
7. For pre-fab buildings such as attraction buildings the preferred AHU location is in a mechanical room. Where it is not possible or practical to locate units inside, they will be located outside on the roof of the building.
8. Since restaurants have so much equipment on the roof (restroom, dishwasher, and grease exhaust fans, etc.) it is acceptable for AHU's to be rooftop mounted or enclosed in a penthouse located on the roof level.
9. For small buildings such as retail and maintenance buildings AHU's will be rooftop mounted or enclosed in a penthouse located on the roof level.
10. Air-side economizers will be required by.

#### 13. Building Automation and Controls

1. Temperature control/building automation will be accomplished utilizing a complete Building Automation System (BAS) utilizing Direct Digital Controls (DDC) in accordance with drawings,

specifications and intent of the design. The BAS system shall include expansion modules to incorporate the integration of Fire Alarm, Security Access and Lighting Control Systems.

2. The control sequences will be clearly indicated as a part of the construction documents clarifying temperature, humidity, and pressure related set points, schedules, and interoperability with each system.
3. The BAS shall comply with the latest ANSI/ASHRAE Standard 135, BACnet. This system is to control all mechanical equipment, including all unitary equipment such as VAV boxes, heat pumps, fan-coils, AC units, etc. and all air handlers, boilers, chillers, and any other listed equipment using native BACnet-compliant components.
4. All components not specifically indicated or specified, but necessary to make the system function within the intent of the specification, are to be included.
5. All electrical products shall be listed and labeled to comply with UL Standards.
6. All control wiring shall be installed in conduit.
7. Field Enclosures: Enclosures shall conform to the local requirements for exterior rating. Finish color shall be of the manufacturer's standard, unless otherwise stated. Damaged surfaces shall be repaired and/or refinished to its original condition.
8. Actuation of dampers, control valves, and air terminals will be accomplished utilizing electronic actuation for all devices. The building automation system and its associated equipment will be connected to standby power, with a plug-in UPS device provided where required by operations.
9. The system will utilize a personal computer with full color graphics.
10. Any control devices subject to corrosion, such as in a wet pump room, shall be provided with appropriate corrosion protection.
11. Several other non-HVAC systems will have their own dedicated control systems, including but not limited to lighting, security, etc. The HVAC control system network should be used to provide scheduling and programming of these non-HVAC control systems.

#### 14. Equipment and Materials

1. Quality Level
  - 14.1.1. The intended quality level of equipment and materials for this project shall be: Commercial.
  - 14.1.2. Commercial – High level of quality for equipment and materials, reflecting heavy daytime use and light nighttime use. This quality level reflects the expectation of the contractors to provide competitively priced equipment and systems which meet the intent of the specifications. The installation approach should be focused on balancing cost-competitiveness with ease of maintenance.
  - 14.1.3. Quality Level Definitions range from the highest expected quality level down to cost competitive quality levels.



2. Proposed Manufacturers List of Major Equipment.

14.2.1. The following represents the expected quality level by manufacturer of several major equipment categories.

Commercial Quality Level – Manufacturer’s List	
Equipment	Manufacturer(s)
Air Handling Units	Temtrol, Trane, York, Carrier
Air Terminal Boxes	Envirotech, Titus, Trane, York, Carrier
Air Valves	Phoenix, Siemens
Exhaust Fans	Greenheck, Cook,
Control Systems / BAS	Trane, JCI, Delta, Siemens, Honeywell

3. Redundancy and Reliability.

14.3.1. The level of redundancy for this project will be as indicated below.

14.3.2. The Redundancy levels are described in terms of system capacity or equipment quantity versus the actual loads. Redundancy also includes spare or reserve capacity included in the base design estimates to hedge against changes late in the design phase, or future owner renovations.

14.3.3. The Reliability level is described in terms of Continuous Availability, or percent availability of capacity designed into the system. This is achieved by providing additional pathways for air and water, supplemental isolation valves, and headered equipment to allow for unexpected failures or unplanned maintenance to occur in parts of the system while the other parts of the system continue to operate and meet the loads.

Redundancy Definitions:

N = Base capacity meeting the expected peak load

N+1 = Quantity of equipment needed for base capacity plus one extra unit.

Firm Capacity = Resulting system capacity (at peak load) if one piece of equipment failed or was down for maintenance. An 80% Firm Capacity would equate to the system capacity being able to meet 80% of the load on a ‘design day’ (hottest or coldest) with one piece of equipment down.

14.3.4. The following table provides a comparison of various Reliability levels.

Reliability Table			
Reliability Level	Availability %	Downtime per year	Redundancy Comments
Normal (Commercial)	98%	7.3 days	N, Life safety backup
Enhanced (Institutional)	99%	3.6 days	N+1 for most equipment, with partial backup.
Robust (Industrial)	99.9% ("three nines")	8.7 hours	N+1 for most systems, with full emergency backup
High- (Mission Critical)	99.99% ("four nines")	52.6 minutes	N+2, dual pathways, concurrent maintenance, full backup
Highest – (Mission Critical)	99.999% ("five nines")	5.2 minutes	2N with full backup

14.3.5. The following table provides a preliminary indication of expected levels of redundancy in the various project systems.

Expected System Redundancy Table			
Equipment or System	Level of Redundancy	Firm Capacity	Reliability
Cooling System	N	n/a	Normal
Heating System	N	n/a	Normal
Exhaust System	N	0%	Normal
Special Exhaust	N+1	100%	Robust

4. Value Engineering Process Management.

14.4.1. Contractor’s participation in the ‘value engineering’ process to reduce the construction cost of the project is anticipated by the owner. The easiest path to reducing costs is to reduce the quality level of equipment and materials below the specified level. The following is a partial list of items which may or may not be considered during the value engineering process to reduce construction costs. If the item has a Yes, then the item will be open for discussion and evaluation of the proposed credit. If the item has a No, then it will not be considered.



**Mechanical Value Engineering Items**

Equipment or System	Considered for VE
Substitute duct board for galvanized duct	No
Reduce mechanical equipment size or capacity	No
Substitute black iron for stainless kitchen exhaust ductwork	Yes
Substitute fire wrap for rigid insulation for kitchen exhaust ductwork	Yes
Substitute fiberglass blanket for rigid duct insulation in exposed areas	Yes
Delete fan-coil unit control connection to BAS	Yes
Substitute alternate duct sealant for fab and mastic	Yes
Substitute plenum rated cable for BAS control wiring	Yes
Delete fire/smoke damper annunciation devices in ceiling	Yes

**15. Occupancy Assumptions**

1. Time of Day Occupancy
  - 15.1.1. The HVAC control system shall be programmed to have an Occupied mode from 6AM – 8PM, then switchover to Unoccupied mode. The Unoccupied mode operation shall consist of expanded temperature ranges (18.3°C-26.67°C) for temperature sensors.
  - 15.1.2. It is common operating practice that HVAC systems shall be in Occupied mode continuously to meet the ventilation requirements of the guests during the day, and the O&M staff during the night time hours.
2. Occupant Density
  - 15.2.1. Based upon the programming documents, the occupant density shall be considered normal.
  - 15.2.2. Based upon the programming documents, the occupant density shall be considered very high for several spaces, requiring additional levels of ventilation.
3. Off-hours HVAC System Operation
  - 15.3.1. The off-hours shall be considered the Unoccupied time period. The system operation would be affected by a reduction or elimination of exhaust fans, reduction of outside ventilation air, and intermittent operation of air handling units to meet expanded temperature ranges of the various spaces in the zone.

**16. Operation and Maintenance**

1. Expectations of Facility Staff for Operation
  - 16.1.1. The Owner has full-time facility staff for preventive maintenance, so the system operation shall be automatic requiring no user input for normal operation.
  - 16.1.2. The Owner expects to provide facility staff to monitor system operations. The Owner expects the front-end monitoring and control systems to be co-located in a central space where the operations staff can continuously monitor operations and quickly dispatch staff to investigate operational problems.
2. Expectations of Facility Staff for Maintenance
  - 16.2.1. The Owner has full-time facility staff performing preventive maintenance. Direct access to equipment shall be planned for during the installation. Directly accessible unions, isolation valves, disconnects, overhead rails, etc., shall be provided for easy replacement of equipment components including filter changing, pulling coils, lifting motors, replacing/calibrating controls devices, exercising valves, etc.

**17. Component Specific Details**

1. Food and Beverage
  - 17.1.1. Kitchens
    - The kitchen areas will be provided with single-zone VAV packaged DX rooftop units. Kitchen outside air dampers shall be modulated based upon space pressure to maintain the kitchen at a negative pressure.
    - Kitchen hood make-up air will be provided with 100% outdoor (filtered) single-zone air variable volume (VAV) packaged DX rooftop units. This pre-conditioned air will be ducted directly to each kitchen hood and will provide approximately 70-80% of the kitchen hood make-up. Heating coils will temper the air up to about 55°F during cold weather. In summer the best practice, resulting from code interpretations, is to cool the make-up air to 67°F.
    - Division 23 contractor shall provide kitchen hood and appurtenances. Kitchen hood shall be exhaust only type with front perforated plenum make-up air module.
    - The hood fire suppression system shall be provided by the hood manufacturer and be a pre-engineered, liquid agent, cartridge operated type with a fixed nozzle agent distribution network equal to Ansul R-102.
    - Kitchen hood exhaust duct insulation shall be fire rated duct wrap capable of maintaining a minimum of a 2-hour fire rating.
    - Applicable Codes, Guidelines and Standards: UL-762 Restaurant Exhaust.
    - Kitchen exhaust system quantities and discharge configurations to be in accordance with the International Building Code and ASHRAE 62.1.



17.1.2. Dining:

- The indoor dining areas will be served with central station variable air volume air handling units. The air handling units will be located on the roof. Each of the zones will be served with individual VAV boxes linked to temperature sensors within each of the respective areas. Interior seating will be temperature controlled separately from seating along the perimeter of the building. Dining areas generally require large amounts of outdoor air for occupant ventilation.
- The VAV air handling units will provide recirculated and outdoor air for the space, based upon load and occupancy.
- Air curtains will be installed at all openings.
- All diffusers, registers, and grilles shall be constructed of aluminum. Each diffuser, register, and grille shall be provided with an opposed blade damper. Supply diffusers located near kitchen exhaust hoods shall be perforated return type diffusers to allow for air “dumping” and to avoid air balance conflicts with kitchen exhaust hoods.

17.1.3. Food Carts/Kiosks:

- No mechanical scope anticipated in the Food Carts/Kiosks.

2. Restrooms

- 17.2.1. Standalone restrooms - A central station 100% outside air constant volume air handling unit with preheat and reheat coils will serve the restrooms.
- 17.2.2. Restrooms Attached to Other Buildings - The exhaust required typically exceeds the amount of air needed to cool the space. The difference in these airflows will be made up from transfer air if it is available. If not available, then the difference will be made up from dedicated air handling units.
- 17.2.3. Restroom exhaust will be achieved by a roof mounted exhaust fan, connected with sheet metal ductwork to grilles located within the ceiling.
- 17.2.4. Restroom exhaust system quantities and discharge configurations to be in accordance with the California Building Code and ASHRAE 62.1. The exhaust rate will be 75cfm per fixture.

3. Retail

- 17.3.1. Large shell retail spaces will be served by multi-zone VAV air handling units. This allows the temperature to be separately controlled by the various retail spaces within one retail building. For smaller retail spaces, a single zone VAV air handling unit can provide heating and cooling. The air handling units will be located on the roof.
- 17.3.2. Each of the zones will be served with individual VAV boxes linked to temperature sensors within each of the respective areas. Refer to materials document for internal conditions.

17.3.3. The air handling unit will be sized for a higher outdoor air volume than code requires, this will allow for the frequency of doors being opened, or open.

17.3.4. The photo processing area will be served with central station single zone variable air volume air handling units. The air handling unit will be located on the roof.

17.3.5. The photo processing area will be served with a separate roof mounted exhaust fan sized to remove contaminants from laser printers and other equipment in the space.

17.3.6. The buildings will be typically pressurized, and a barometric relief hood will eliminate excess air.

17.3.7. Air curtains will be installed at all front of house openings.

17.3.8. Air Devices: All diffusers, registers, and grilles shall be constructed of aluminum. Each diffuser, register and grille shall be provided with an opposed blade damper. Consideration to the selection of supply diffusers will be given to ensure condensation does not form.

17.3.9. No mechanical scope anticipated in the Retail Vendor Carts/Kiosks.

4. Animal Holding / Support

17.4.1. The animal holding areas that are indicated to be air conditioned will be served by central station variable air volume air handling units. The units will be located outdoors, either on grade or on the roof. Each of the zones will be served with individual VAV boxes linked to temperature sensors within each of the respective areas.

17.4.2. The animal holding areas that are indicated to have fans and radiant heat will be provided with a fan system to deliver a minimum of 6 ACH of ventilation air and electric radiant heaters where the individual animals would sleep.

17.4.3. Animal holding buildings that indicate smoke exhaust will be provided with a fan system to deliver a minimum of 6 ACH throughout the building on emergency power.

17.4.4. Any other areas that are indicated to receive no conditioning will not be provided with any HVAC systems.

17.4.5. The buildings with air conditioning will be typically pressurized, and an exhaust fan or barometric relief will be used to remove excess air.

17.4.6. Fan-coil units are generally required for internal rooms with continuous cooling loads such as electrical rooms and server rooms.

5. General and Support Buildings/Areas

17.5.1. Back of House Areas:

- Back of house areas and control rooms will be served with a central station variable air volume air handling units. Each of the zones will be served with individual VAV boxes linked to temperature sensors within each of the respective areas.



#### 17.5.2. Equipment rooms

- All equipment rooms requiring 24-hour conditioning will be served with fan coil units or floor mounted computer room air conditioners (CRAC). Critical equipment spaces, such as server rooms, will not have permanently installed back-up cooling. The intent is to use portable cooling units and open the doors in the event of a cooling problem.
- No enclosed mechanical/electrical space will be ventilated using unconditioned outdoor air.

#### 17.5.3. Offices

- The general office/support areas will be served with a central station multiple zone variable air volume air handling unit. Each office area will be served with a dedicated VAV boxes linked to temperature sensors within each of the respective areas. The air handling unit will be located on the roof.
- Each of the zones will be served with individual VAV boxes linked to temperature sensors within each of the respective areas. VAV boxes on the perimeter zones will have electric heaters.

#### 17.5.4. Maintenance

- The maintenance areas will be served with central station single zone variable air volume air handling units. The air handling units will be located on the roof. The main maintenance area will be served with a single zone VAV unit connected directly to supply diffusers. The support areas will be served with their own dedicated VAV air handling unit connected to individual VAV boxes linked to temperature sensors within each of the respective areas.
- Dedicated exhaust systems will be included for task related operations. (i.e. welding, etc.)
- The vehicle maintenance area will have a dedicated vehicle exhaust system which can be connected directly to vehicle exhaust systems.

#### 17.5.5. Warehousing and Storage

- Air handling units. The air handling unit will be located on the roof. The main maintenance area will be served with a single zone VAV air handling unit connected directly to supply diffusers. The support areas will be served with their own dedicated VAV air handling unit connected to individual VAV boxes linked to temperature sensors within each of the respective areas.
- Each building will be typically pressurized, and an exhaust fan or barometric relief will be used to remove excess air.



18. Appendix A: Estimated HVAC Loads - Phase 1a and 1b

BLDG #	BLDG Name	Conditioned Yes = heated and cooled via central furnace	Smoke Exhaust?	Cooling tons	Cooling Demand MBH	Heating Demand MBH
101	Guest Services/Restrooms/Ticketing	Yes		16	188	212
101	Retail	Yes		20	236	266
102	Education Entry Restrooms	Yes		2	20	23
103	The Lodge	Yes		80	960	540
104	Events Pavilion	Fans, Radiant Heat				
201	Dwarf Mongoose Care Quarters	Yes		0	5	9
202	Giraffe Feeding Shelter Canopy	Fans, Radiant Heat				44
202	Giraffe Feeding Shelter Sales Room	Yes		1	6	7
203	Beer Garden Restrooms	Yes		3	32	36
204	Beer Service	Yes		1	10	11
205	Beer Service	Yes		1	10	11
206	Cheetah Care Quarters	Fans, Radiant Heat		4	43	36
207	Cheetah View Shelter					28
208	Fennec Fox Care Quarters	Fans, Radiant Heat		1	7	14
209	Lion View Shelter 1	No				52
210	Lion View Shelter 2	No				92
211	Meerkat Care Quarters	Fans, Radiant Heat		0	4	7
212	Rhino View Shelter 1					8
213	Rhino View Shelter 2					14
214	Rhino Encounter Shelter					18
215	Overnight Guest Duplex	Yes		2	22	41
215	Overnight Guest Duplex	Yes		2	22	41
215	Overnight Guest Duplex	Yes		2	22	41
216	Lion Care Quarters	Yes		6	77	144
217	Rhino Care Quarters	Fans, Radiant Heat		9	106	198
218	Giraffe Care Quarters	Yes	Yes	23	276	518
218	Overnight Guest Suite	Yes		3	34	63
219	Hoofstock Care Quarters	Yes		8	101	189
220	Savanna LSS	No		0	0	0
221	Walk In Browse Cooler	Yes		0	0	0
222	Hay Storage	No				10
223	Event Lawn Giraffe Feeding Shelter	No				3

BLDG #	BLDG Name	Conditioned Yes = heated and cooled via central furnace	Smoke Exhaust?	Cooling tons	Cooling Demand MBH	Heating Demand MBH
301	Flamingo LSS	No		0	0	0
302	Flamingo Care Quarters/Brooder	Yes (1,000 SF)		2	24	45
303	Africa Aviary Care Quarters	Yes				12
304	Lvl 1: Vestibule	No		2	21	39
304	Lvl 2: Colobus Care Quarters	Yes		3	36	68
305	Okapi Care Quarters	Fans, Radiant Heat		4	53	99
306	Giant Tortoise Care Quarters	Radiant Heat & Fan		2	26	50
307	Multipurpose Room	Yes		3	40	45
307	Multipurpose Room	Yes		3	40	45
307	Multipurpose Room	Yes		3	40	45
308	Gelada LSS	No		0	0	0
309	Klipspringer/Hyax Holding	Heat		1	10	19
310	Gelada View Shelter 2					30
311	Gelada View Shelter 1					26
312	Gelada Care Quarters	Yes		9	108	203
313	Train Depot	No				
314	Alligator Viewing Shelter 1	No				10
315	Alligator Viewing Shelter 2	No				10
316	Alligator & Sq. Monkey Care Quarters	Heat		3	38	72
317	Squirrel Monkey Viewing Shelter	No				20
318	Parrot Care Quarters	No		1	6	11
319	Play Area Restrooms & Lactation Room	Yes		2	26	29
320	Carousel Pavilion	No				
321	Lemur View Shelter 1	No				16
322	Lemur View Shelter 2	No				20
323	Lemur Care Quarters	Yes		3	38	72
324	Quarantine & Nutrition Center)	plan for extents of		73	880	990
701	Maintenance Shed/Shops	Heat (2000 sf				174
703	Containerized Fodder System	Yes				
703	Walk In Browse Cooler	Yes		0	0	0
703	Roof	Fans, Radiant Heat				30



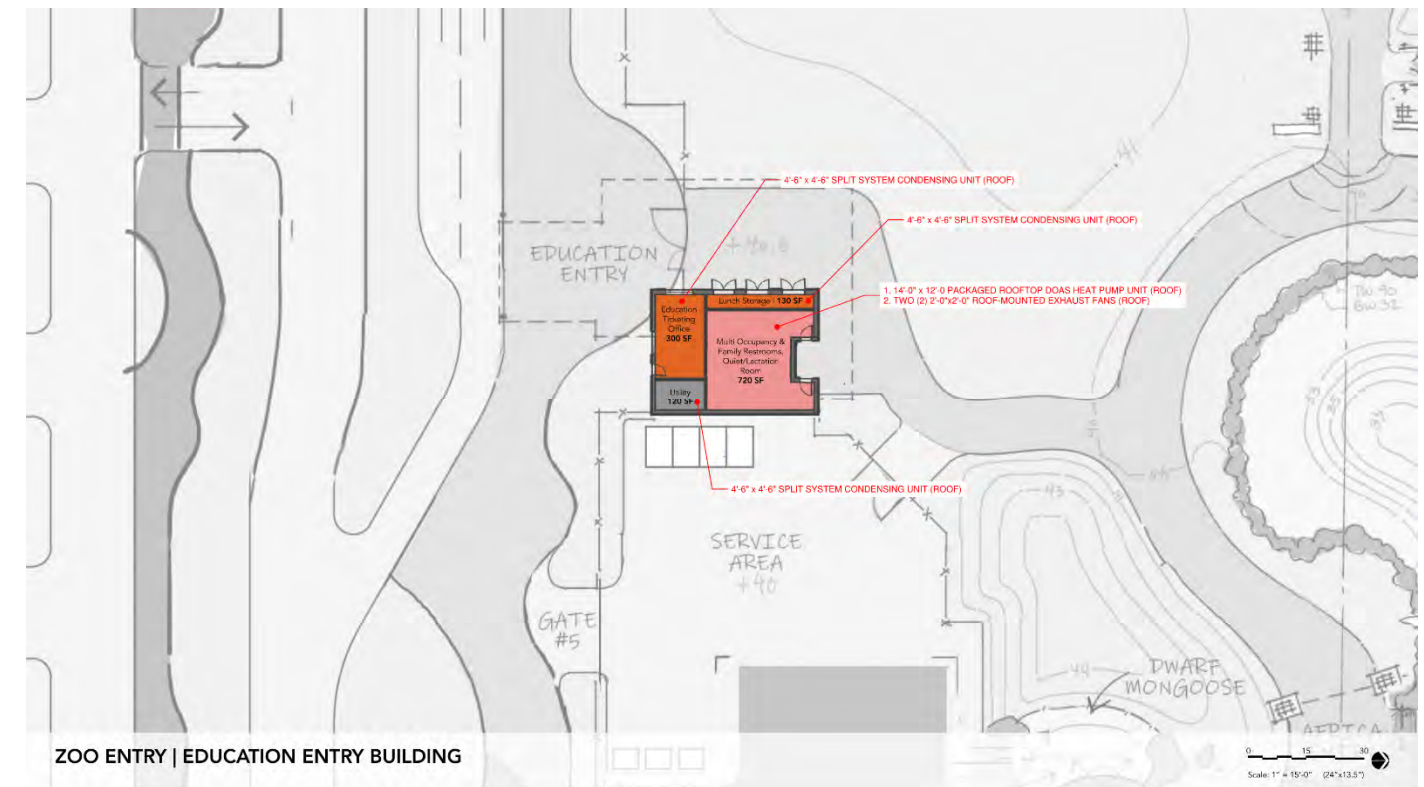
19. Appendix B: Estimated HVAC Loads – Full Buildout

BLDG #	BLDG Name	Conditioned Yes = heated and cooled via central furnace	Smoke Exhaust?	Cooling tons	Cooling Demand MBH	Heating Demand MBH
801	Admin Modular 1	Yes		0	0	0
801	Admin Modular 2	Yes		0	0	0
801	Admin Modular 3	Yes		0	0	0
801	Admin Modular 4	Yes		0	0	0
801	Admin Modular 5	Yes		0	0	0
801	Admin Modular 6	Yes		0	0	0
801	Restrooms - Prefabricated	Yes		3	40	45
802	Animal Staff Modular 1	Yes		0	0	0
802	Animal Staff Modular 2	Yes		0	0	0

BLDG #	BLDG Name	Conditioned Yes = heated and cooled via central furnace	Smoke Exhaust?	Cooling tons	Cooling Demand MBH	Heating Demand MBH
105	Administration / Staff Support & Offices (2-stories)	Yes		32	380	428
401	Changing Exhibits	Yes				100
401	Otter Care Quarters & LSS	Yes				60
401	Exhibits	Yes		37	446	837
401	Beaver Care Quarters	Yes				22
402	Education & Classrooms	Yes		30	360	405
402	California Deserts Indoor Exhibits	Yes		12	144	270
403	Capybara Care Quarters	Yes				16
404	Grizzly Bear View Shelter					120
405	Bobcat Care Quarters	Yes				20
406	Restrooms - California	Yes		4	43	81
407	Food Kiosk	Yes		1	12	23
408	Big Horned Sheep Care Quarters	Yes				32
409	Rescue & Rehab Facility	Yes				220
410	Grizzly Bear Care Quarters & LSS	Yes				100
501	African Ape Viewing					80
502	Hippo Springs View Shelter					36
503	Hippo River View Shelter					50
504	Food & Restroom Kiosk	Yes		2	19	36
505	Overnight Arrival Building	Yes		7	84	95
505	Accommodation 1	Yes		1	7	14
505	Accommodation 2	Yes		1	7	14
505	Accommodation 3	Yes		1	7	14
505	Accommodation 4	Yes		1	7	14
505	Accommodation 5	Yes		1	7	14
505	Accommodation 6	Yes		1	7	14
505	Accommodation 7	Yes		1	7	14
506	Hippo Care Quarters	Yes		20	240	450
507	Hippo+ Tiger Filtration	area		17	204	383
508	African Ape CQ	Yes		2	22	41
509	Wild Dog / Hyena CQ	Yes		7	89	74
510	Rhino Breeding / Hoofstock CQ	Yes	Yes	11	134	252

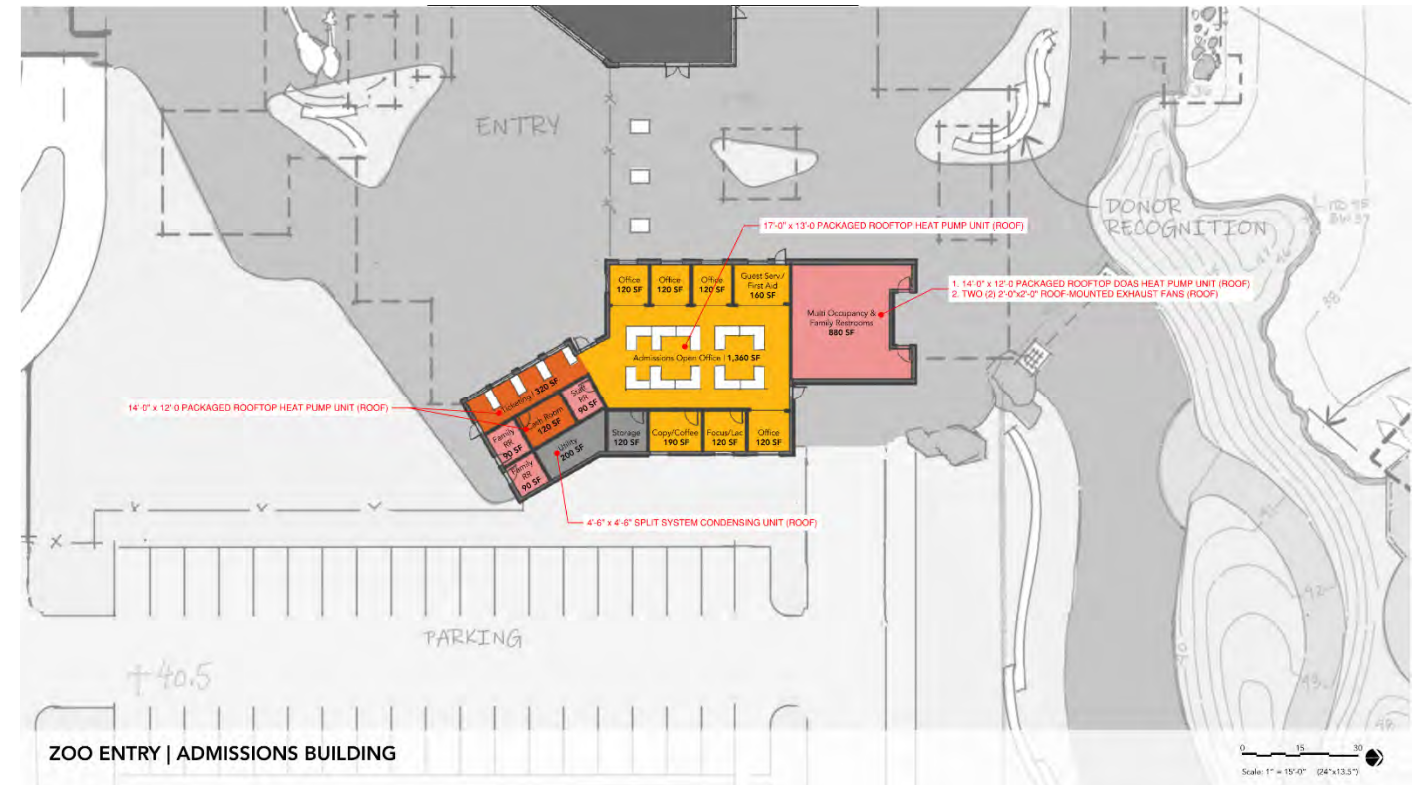
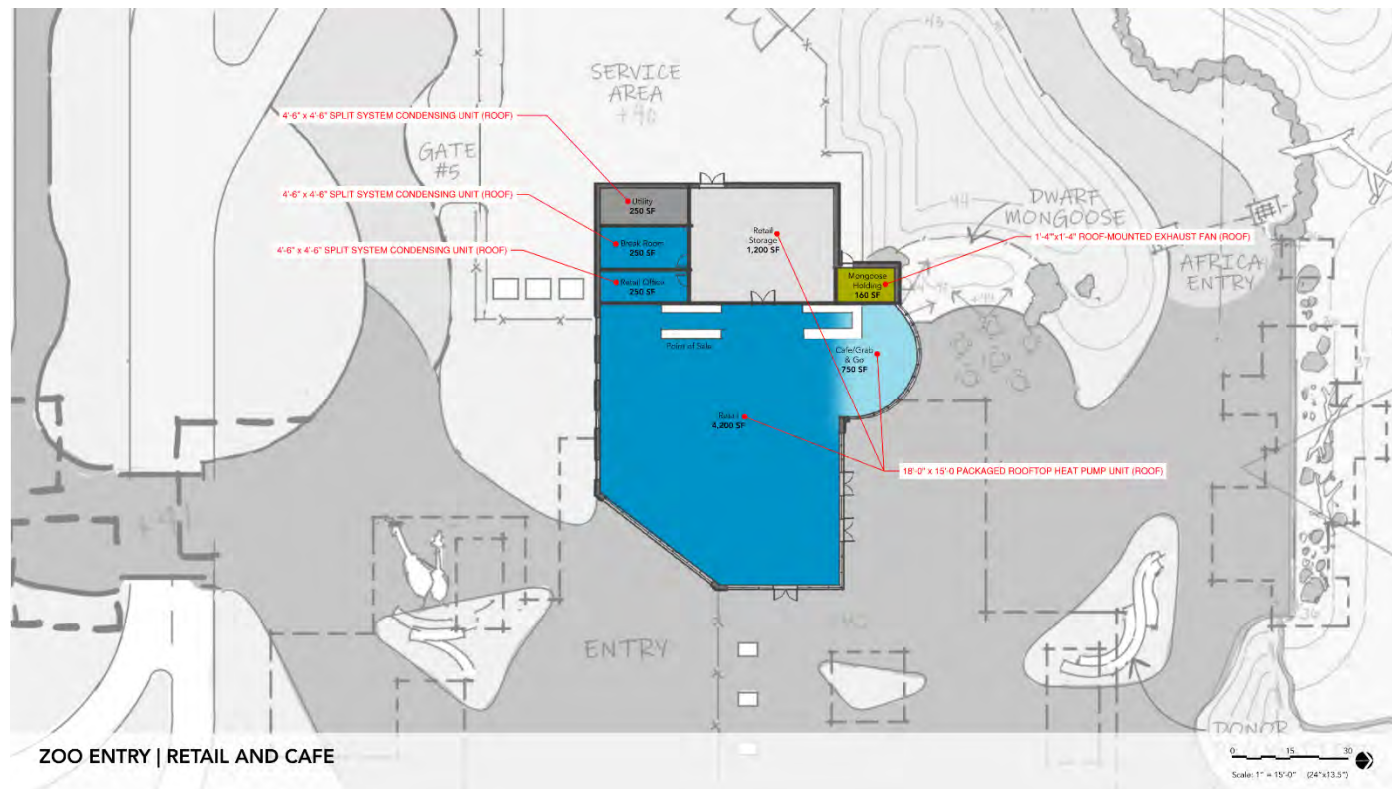
BLDG #	BLDG Name	Conditioned Yes = heated and cooled via central furnace	Smoke Exhaust?	Cooling tons	Cooling Demand MBH	Heating Demand MBH
601	Wallace Line Gallery Indoor Exhibits	Yes		38	456	855
601	Komodo Dragon/Red Panda C.Q.	Yes				28
602	Clouded Leopard Care Quarters	Yes				60
603	Tiger View Shelter	Fans & Radiant Heat				96
604	Tiger Care Quarters	Yes				70
605	Aviary Care Quarters 1	Yes				16
606	Restrooms - Asia	Yes		2	24	45
606	Aviary Viewing Shelters	Yes				58
606	Food Kiosk	Yes		1	12	23
607	North Water Recovery			0	0	0
608	Asian Ape View Shelter	Fans & Radiant Heat				40
609	Asian Ape Care Quarters	Yes				150
610	Cassowary Care Quarters	Yes		1	7	14
611	Australian Aviary Care Quarters	Yes				6
612	Clouded Leopard View Shelter	Fans & Radiant Heat				28
702	Maintenance Shed/Shops	Fans & Radiant Heat				170
705	Greenhouse 2	Yes		8	91	171
706	Greenhouse 1	Yes		8	91	171
707	Event Storage	No				76

20. Appendix C: Mechanical Equipment Space Requirements



ZOO ENTRY | EDUCATION ENTRY BUILDING













ELECTRICAL ENGINEERING  
BASIS OF DESIGN  
SCHEMATIC DESIGN SUBMISSION  
OCTOBER 6, 2023  
FOR PRICING  
NEW ZOO AT ELK GROVE



**1. Executive Summary**

1.1. Electrical systems for the New Zoo at Elk Grove includes a utility provided medium voltage loops normal power distribution, emergency power generation and distribution, interior and exterior lighting, centralized lighting control, support of LSS systems, grounding, surge suppression and a substantial amount of photo voltaics.

**2. Applicable Codes, Guidelines and Standards**

2.1. Design will conform to the following Codes, Standards and Guidelines. Where differences arise between any Code, Standard or Guideline, Codes shall prevail. In all cases, where an edition number is not indicated, the current accepted edition will be used.

2.1.1. 2022 California Building Code

2.1.2. 2022 California Energy Code

2.1.3. 2022 California Fire Code

2.1.4. 2022 California Electrical Code

2.1.5. IESNA Lighting Handbook, 10<sup>th</sup> Edition

2.1.6. 2015 NFPA 101 (Life Safety Code)

2.1.7. Local Decrees, Ordinances, Standards, and Acts

2.2. Equipment selections will be from manufacturers whose products comply will current industry accepted design and testing standards as will be based on Zoo preferred manufacturers whenever possible.

**3. Design Criteria**

3.1. Conceptual overall normal building power demand for the zoo is anticipated to be roughly 5 MVA at full build out. A summary of the loads is presented in the Appendix.

3.2. Conceptual overall emergency building power demand for this land is anticipated to be 1.1 MVA.

3.2.1. Systems anticipated to be on emergency that are included in the above calculation include the following; select components of Aquatic Life Support Systems (LSS) systems, select food service coolers and freezers, fire alarm system components, select computer systems, IT racks, and emergency lighting. Elevators may be placed on emergency power if required for emergency building egress.

3.3. Lighting levels will be in accordance with recommendations of the Illuminating Engineering Society (IES) and shall be generally as indicated below. Areas designed by the Lighting Designer will have maintained levels as selected by that designer.

Area	Maintained Footcandles
General Circulation	5-15
Offices	30-40
Meeting Rooms	30-40
Video Conference Rooms	50-60
Toilet and Locker Rooms	10-20
Kitchens	50-60
Mechanical and Electrical Rooms	20-30
Low Voltage System Rooms	30-40
Elevator Machine Rooms	25-30
Elevator Pits	20-30
Exterior Walkways	1-3
Exterior Entrances	5-15
Loading Docks	10-20

**4. Electrical Quality Level**

4.1. The intended quality level of this project shall be: Commercial

4.2. Quality Level Definitions ranging from the highest expected quality level down to cost competitive quality levels:

Industrial – Highest level of quality for equipment and materials. This level reflects the expectation for a lot of custom or special-built equipment, heavy gauge materials, long life cycle duty with zero unscheduled downtime.

Institutional – Very High level of quality for equipment and materials, reflecting heavy continuous use for a very long life cycle. The Owner expects very little unscheduled system downtime for up to 30+ years of continuous service. This quality level reflects the expectation for the major pieces of equipment to be custom-built or provided with substantial additional features. The installation approach should be focused on full and complete accessibility to all equipment and systems for facility maintenance staff.

Commercial – High level of quality for equipment and materials, reflecting heavy daytime use and light nighttime use. This quality level reflects the expectation of the contractors to provide competitively priced equipment and systems which meet the intent of the specifications. The installation approach should be focused on balancing cost-competitiveness with ease of maintenance.



Light Commercial – Cost competitiveness of equipment and materials is encouraged by the Owner since the duty of the systems will be light. The expectation of installation quality and workmanship shall be high. Cost competitive equipment and material substitutions will be entertained as long as minimum code standards are maintained.

- 4.3. Equipment selection, specification and installation practices will reflect a commitment to long- term longevity of system, ease of maintenance and energy efficiency.
- 4.4. Proposed manufacturers of major equipment will be as indicated below. Alternate manufacturers may be used as approved by the design team and Owner.

Equipment	Manufacturer(s)
Medium Voltage Transformers	Utility Provided
Medium Voltage Switches	Utility Provided
Power Distribution Equipment	Square D, Eaton, Siemens, GE
Generators	Cummins, Caterpillar, Kohler, Detroit Diesel
Automatic Transfer Switches	ASCO, Cummins, Kohler
Wiring Devices	Hubbell, Leviton, Pass & Seymour
Surge Protective Devices	Surge Suppression Inc.

- 4.5. Spare capacities for this project will be as indicated below.

Equipment	Spare Capacity
Switchboards (1600A and larger)	10%
Panelboards (600A to 1600A)	15%
Panelboards (400A and smaller)	25%
Motor Control Centers	20%
Transformers	20%

## 5. Description of Systems

### 5.1. Power Distribution System

#### 5.1.1. System Description

- The power distribution system is comprised of normal and emergency power systems. Major system components include medium voltage switches, transformers, switchboards, panelboards, motor control centers, battery systems and transfer switches.

- The medium voltage distribution system will be 12.47 kV, 3 phase, 4 wire. System will be utility operated (Sacramento Municipal Utilities District aka SMUD). Contractor will provide raceways, pads and pullboxes, SMUD will provide conductors, pad mounted switches and transformers.
- Metering of the normal services will be achieved at secondary voltage by utility- provided metering equipment.
- CEC 700 loads in all facilities will utilize lighting inverters. The emergency electrical services will include battery system at facilities with substantial LSS systems and the Animal Care Building. Batteries will tie into the electrical distribution based on requirements from the Owner. These Optional Stand by loads will connection through a Automatic Transfer Switch (ATS).

### 5.1.1 Photovoltaic System

- Design intent includes the incorporation of photovoltaic panels (PV) as required by code with an option to include additional PV based on LEED. A minimum area of 15% of the square foot for PV panels on building roofs will be developed to maximize the potential use of this renewable resource. T24 requires certain occupancies to have PV and battery storage, these buildings will be provided with arrays. This generally applies to all buildings where 80% or more of the use is retail, office and/or restaurants. Space will be provided in each building that accommodates rooftop PV to support inverters and capacitor storage of PV not utilized during daylight hours.
- The PV requirement for LEED Gold is approximately 36,000 Square Feet. At this time a large amount of this PV would be over parking spaces. Larger roofs within the Zoo could be utilized as well. In particular, the roof of the animal care facility will have maximum amount of PV possible (up to ~10,000 SF). This will tie into the back up battery system to provide power during outages.
- PV storage will be utilized to either support non-daylight hours or peak load hours to offset utility demand hours. In areas where several buildings are in close proximity to each a centralized kWh storage system will be considered to consolidate and reduce impact on individual building programmed area.

#### 5.1.2. Explanation of Operation

- Under normal conditions, power distribution throughout the zoo will be achieved via a combination of power generated from PV system along utility provided normal power system. Upon loss of utility power, power distribution will switch over to the optional stand by power distribution systems. Optional standby loads should be restored within 60 seconds.

## 6. System Design Criteria

### 6.1. Distribution Switchboards

- 6.1.1. Comparable to Square D; front-connected, front-accessible; rated for 3 phase, 4 wire, 60 Hz service and listed for use as service entrance equipment (when required).



- 6.1.2. Switchboards will be used as the main point of distribution in each building, holding area, or distribution center as needed for the 480V, 3 phase power. Where required, a separate switchboard will be provided to isolate different types of loads such as general facility, audio / visual, etc.
- 6.1.3. Each switchboard will have a 100% rated main circuit breaker with adjustable trips that will coordinate with the bus rating. The main breaker will be located in its own section with branch breakers located in adjacent sections. The main breaker to have accessories such as shunt trip and residual current.
- 6.1.4. Enclosure will be NEMA 1 for indoor dry locations and NEMA 3R for outdoor locations.
- 6.1.5. Main devices to be fixed, individually mounted. Branch devices to be panel mounted.
- 6.1.6. Phase, neutral and ground buses will be hard-drawn copper, tin-plated. All busses will be uniform capacity for entire length of switchboard and shall allow for future extensions from both ends. Neutral bus will be 100% of the ampacity of the phase buses.
- 6.1.7. Conductor connectors will be compression type.
- 6.1.8. All switchboards will be floor mounted on a housekeeping pad.
- 6.2. Panelboards
  - 6.2.1. Comparable to SquareD; panelboards are to be dead front construction with 100% copper busses for distribution of 277/480 volt power inside buildings and attractions. Where required panel boards will be rated for service entrance use.
  - 6.2.2. Enclosures will be NEMA 1 for indoor dry locations, NEMA 3R for outdoor locations, NEMA 4X stainless steel for kitchens or saltwater environments, NEMA 3R for other wet or damp indoor locations, and NEMA 12 for indoor locations subject to dust, falling dirt and dripping non-corrosive liquids.
  - 6.2.3. Each panelboard to have a main circuit breaker unless located within sight of its source switchboard. All breakers to be rated for short circuit per the electrical drawings. Breakers to be bolt on style.
  - 6.2.4. A bare uninsulated copper ground bus bar to be provided along with full sized copper bus with suitable lugs for loads requiring a neutral connection.
  - 6.2.5. Conductor connectors will be compression type.
  - 6.2.6. All panelboards to have one 3/4 in. conduit from flush mounted enclosures to ceiling areas for every three spare circuit breakers or circuit spaces or parts thereof. Panelboards to have 25% spare capacity minimum as well as 25% spare breakers or bus space for future.
  - 6.2.7. Panelboards supplying non-linear loads, as indicated on the drawings shall be listed for use with non-linear loads and have neutral rated for 200% of panelboard phase current. Also, provide these panels will an isolation ground bus bar.
  - 6.2.8. Operable Breaker Panelboards shall have a web enabled controller that can be networked together on the facility network. The main controller to be provided with accessories so it can be connected to a copper or a fiber network as needed and shown on the electrical drawings. Where a slave panel is used, wiring per manufacturers recommendations shall be provided for a fully functional system. Panelboards to be provided with a full-length control bus to allow for future additions of operable breakers.
  - 6.2.9. All panelboards in public areas will be flush mounted. All panelboards in back of house areas shall be surface mounted unless subject to potential damage in which case they will be flush mounted.
- 6.3. Motor Control Centers (MCC)
  - 6.3.1. When a large quantity of motors are located in one area, a motor control center shall be provided for housing of the over current devices and starters. The MCC shall be comprised of modular sections with front access only. The enclosure shall be a dead front construction of steel; comparable to SquareD.
  - 6.3.2. Phase, neutral and ground buses will be hard-drawn copper, tin-plated. All busses will be uniform capacity for entire length of MCC and will allow for future extensions from both ends. Neutral bus will be 100% of the ampacity of the phase buses.
  - 6.3.3. Conductor connectors will be compression type.
  - 6.3.4. Each MCC line up shall have a 100% rated main circuit breaker.
  - 6.3.5. Compartments will be modular with individual doors. Interlocks shall be provided on combination controller units requiring disconnecting means in off position before door can be opened or closed.
  - 6.3.6. A wiring channel will be provided in each vertical section for vertical and horizontal wiring to each unit compartment.
  - 6.3.7. Overcurrent protection integral to compartments will be thermal magnetic circuit breakers.
  - 6.3.8. Accessories (Hand-Off-Auto, LED pilot lights, auxiliary contacts, etc) will be provided as required.
  - 6.3.9. Each MCC shall be installed on 4 in. concrete housekeeping pad.
- 6.4. Back Up Power Systems
  - 6.4.1. A battery standby system will be the primary source of back up power for the animal care building. The run time will need to be determined by the Owner once the program is known. It is understood the clinic function and night time heating are the largest concerns for back up power. The battery cabinet will be located outside of the building and can be also used for load peaking as well as back up power. This will only be CEC 702 loads (Optional Stand By). The battery banks will have fans, but typically 70dB or less at 1 meter.
  - 6.4.2. Generator connections will be provided at animal care facility in case there is a longer outage the batteries and solar cannot support.





6.4.3. Emergency (CEC 700) loads would be from a UL 924 listed inverter system.

#### 6.5. Automatic Transfer Switches

6.5.1. ATS(s) shall be comparable to ASCO 300 series.

6.5.2. ATS(s) will be 3 or 4-pole depending on application.

6.5.3. Enclosure(s) will be NEMA 1 when indoor and NEMA 3R when outdoors.

6.5.4. ATS(s) will be wall mounted or on a concrete housekeeping pad.

#### 6.6. Overcurrent Protective Devices

6.6.1. All circuit breakers will be provided with AL/CU listed connector lugs and will be bolt on type.

6.6.2. Circuit breakers to be molded case, bolt on type with frame sizes as indicated on the electrical drawings. Breakers to have permanent thermal and instantaneous magnetic trips on each pole. The instantaneous magnetic trip shall be adjustable on all breakers with a frame size above 150 amps.

6.6.3. Adjustable, instantaneous-trip circuit breakers will be provided with a front-mounted, field-adjustable trip setting magnetic trip element.

6.6.4. Ground fault circuit interrupter (GFCI) type circuit breakers shall be provided as noted on plans and/or panel schedules. The typical areas of use include wet locations around sinks, pools and water attractions. GFCI circuit breakers shall provide ground-fault protection for people. The GFCI circuit breaker shall trip when a fault current to ground is 6 milliamperes or more.

6.6.5. Circuit breakers shall be fully rated for available fault current. Series rating is not acceptable.

6.6.6. Where required to achieve systems coordination with upstream and downstream overcurrent devices, solid-state electronic trip circuit breakers will be provided. Electronic trip circuit breakers will be provided with field-replaceable rating plug, rms sensing and with the following field-adjustable settings; instantaneous trip, long- and short-time pickup levels, long- and short-time adjustments, ground-fault pickup level, time delay and I2t response.

6.6.7. Fuses to be used on this project shall be Class L, CC, RK1, and RK5, as needed. Fuses to be rated for 200,000 RMS symmetrical interrupting current. Type L fuses shall be used for protecting service entrances and large feeders. Class CC fuses shall be used for motor control circuits, lighting ballasts, control transformers and street lights. Class RK1 shall be used when protecting circuit breakers. Class RK5 shall be used for protecting motors.

6.6.8. Fuses will be non-renewable cartridge fuses with voltage ratings consistent with circuit voltages.

#### 6.7. Motor and Circuit Disconnects

6.7.1. Motor and circuit disconnects will be used for all equipment including but not limited to LSS, mechanical, plumbing, architectural and specialty equipment.

6.7.2. A disconnect switch shall be provided at every motor location and equipment location that does not have a cord and plug.

6.7.3. Disconnects will be located directly adjacent to equipment being served unless such an installation would prove a safety hazard.

6.7.4. Combination controller/disconnects shall be used wherever practical.

6.7.5. Generally, non-fusible switches shall be used for loads below 250V or where the fault current is below 10,000A. Generally, fusible switches shall be used for loads above 250V or where the fault current is above 10,000A.

6.7.6. Disconnect switches, located at motors controlled by an adjustable frequency drive shall be provided with a late make, early break auxiliary contact rated for ten amps continuous duty. This auxiliary contact shall be wired into the AFD emergency shutdown (coast to stop) circuit to ensure shutdown of the AFD in the event of the disconnect being opened.

6.7.7. For smaller single-phase equipment not requiring a starter, surface or recessed horsepower rated switches will be mounted in enclosure suited to its location. Contacts shall be visible from both sides and shall have a direct mechanical linkage to the operator handle. The enclosure shall be furnished with a handle guard having locking provisions.

6.7.8. All disconnect switches to be surface mounted, heavy duty type sheet steel enclosed that are fusible or non-fusible. Switches shall be quick make, quick break type; constructed so that switch blades are visible in 'Off' position with door open and is capable of being padlocked in 'Off' position. Switches shall have a cover interlock to prevent unauthorized opening of the switch door when the handle is in the "ON" position.

6.7.9. Enclosure shall be steel NEMA 1 for interior dry locations; NEMA 3R for exterior wet locations; NEMA 4X fiberglass for interior corrosive areas and NEMA 4X stainless steel for exterior corrosive areas.

6.7.10. Fusible and non-fusible switches shall be provided with an equipment ground kit, neutral kit, auxiliary contact kit ((2) NO/NC form "C" contacts) and compression type lugs.

6.7.11. Elevator disconnect switches shall consist of a single enclosure that houses the elevator disconnecting means as well as necessary relays, control transformers, auxiliary contacts, and other accessories as shown on the drawings and as described herein.

#### 6.8. Motor Controllers

6.8.1. Enclosure shall be steel NEMA 1 for interior dry locations; NEMA 3R for exterior wet locations; NEMA 4X fiberglass for interior corrosive areas and NEMA 4X stainless steel for exterior corrosive areas.

6.8.2. Manual controllers shall be general purpose, Class A, with "quick-make, quick-break" toggle action, marked to show whether unit is "Off", "On" or "Tripped".



6.8.3. Magnetic controllers shall be Class A, full voltage, non-reversing, across the line unless noted otherwise. Reduced voltage controllers shall be used wherever a standard controller would cause a greater than 10% voltage dip.

6.8.4. Large motors that will provide energy savings or require speed control will have adjustable frequency drives (AFD). AFDs shall be solid state with a pulse width modulated output waveform. The controller shall employ a full wave rectifier, AC input line reactor, totaling a minimum of 5% equivalent impedance, capacitors and IGBTs as the output switching device. The AFDs will have a 3-position Hand-Off-Auto switch, digital LCD screen with a controller allowing full adjustability and manual control. When the enclosure is opened, the power shall be shunted so the electrical components are not energized.

6.8.5. Controllers will be located directly adjacent to equipment being served unless such an installation would prove a safety hazard. Controllers will be located in motor control centers where large groups of equipment are located together and within plane site of the motor control center.

6.8.6. Combination controller/disconnects shall be used wherever practical.

6.9. Wires, Cables and Connectors

6.9.1. Conductors on this project are to be copper or aluminum (for #1 AWG and larger) based on cost and engineering decision. Solid, single conductors shall be used for #10 and smaller. #12 is the minimum wire size for general use wiring. Stranded, single conductor shall be used for #8 and larger for general use wiring. Stranded, single conductor, #12 and larger, shall be used for motors and other installations where vibration is generated. All control wiring to be stranded, single conductor, #14.

6.9.2. Conductors to first device on a branch circuit shall be #10 minimum.

6.9.3. Conductors shall be continuous from outlet to outlet and no splices shall be made except within outlet or junction boxes.

6.9.4. When flexible cords and cables are used for the connection of special equipment as indicated on the electrical drawings, the maximum length is 6 feet.

6.10. Feeder Circuits

6.10.1. All feeder circuits are to extend at their full capacity from origin to termination.

6.10.2. Each raceway will contain only those conductors constituting a single feeder circuit.

6.10.3. Where feeder conductors are run in parallel, conductors shall be of same length, same material, circular-mil area, insulation type, and terminated in same manner.

6.10.4. Where parallel feeder conductors are run in separate raceways, raceways shall have same physical characteristics. Each raceway will contain a conductor or each phase and neutral, if used, and a grounding conductor.

6.10.5. Feeders shall follow most accessible routes, concealed in construction in finished areas, exposed to the minimum temperature gradient and to minimum temperature fluctuation.

6.10.6. Feeders will be sized for a maximum voltage drop of 2%.

6.11. Branch Circuits

6.11.1. For branch circuits, all 20 amp, 120 volt branch circuit homeruns (to panelboard) serving receptacles, equipment, and lighting shall be 4.0mm<sup>2</sup> minimum to first outlet or light fixture. No more than three circuits shall be allowed in a single home run.

Distance	Wire Size
0 – 100 ft from panelboard to first outlet	#10 solid minimum
100 ft – 150 ft from panelboard to first outlet	#8 stranded min
150 ft – 250 ft from panelboard to first outlet	#6 stranded min

6.11.2. Branch circuit conductors shall be sized so that voltage drop does not exceed 3% and shall have a dedicated neutral conductor. All neutral conductors will be considered current carrying for derating purposes.

6.11.3. When isolated ground receptacle circuits are used, provide a dedicated neutral conductor and a dedicated isolated ground conductor for each circuit.

6.11.4. Any branch circuit protected by a RCCB circuit breaker shall be provided with a dedicated neutral conductor.

6.12. Wireway

6.12.1. Where called for in the drawings, wireway shall be used where allowed by local code. Separate wireways shall be provided for each different system such as, but not limited to, power, audio, data, and BMS.

6.12.2. Wireways shall be galvanized steel with no lid. These wireways shall be run parallel and perpendicular to building structure. This routing to follow conduit, cable trays, and other facility utilities.

6.12.3. Wireway used for pulling purposes, the wireways shall be steel painted with a rust-inhibiting phosphatizing grey paint and a screw type lid.

6.12.4. All wireway to be smooth as to not nick or destroy any wiring isolation. Standard junctions and intersections are to be used for general routing and negotiating other obstructions.

6.13. Conduit

6.13.1. Conduit shall be provided for all general routing where wireway is not used, additionally for conductors located in walls, in slabs, below grade, interior corrosive areas, and all exterior applications.



- 6.13.2. Conduit to be concealed except in mechanical and utility areas and where noted exposed. Conduit run concealed above suspended ceilings shall be routed parallel or perpendicular (at right angles to construction using as long of bends as possible) and shall be grouped. Run exposed conduit parallel to or at right angles with lines of building.
- 6.13.3. In themed areas, conduit to be carefully coordinated with show sets, theming, and architectural details. If conduit is to be run exposed, it shall be painted to match surroundings.
- 6.13.4. Spare conduit shall be provided to future panelboard and other equipment locations. These conduits shall be stubbed a minimum of 6 inches above finish slab and capped with a pull string.
- 6.13.5. (1) 1 inch spare conduit from panelboard to above accessible ceiling will be provided for each (3) spaces or spare breakers in panelboards. All spare conduits will be provided with a pull string and will be labeled at each end with the terminus of opposite end.
- 6.13.6. Rigid nonmetallic conduit shall be used in the following locations:
- When exposed in areas designated as “water treatment” or “wet”, including but not limited to: chemical rooms; water treatment zones; tank areas; and outdoors.
  - When run in grade or in slabs, however, should be transitioned to RGS within 4 inches of leaving the slab.
- 6.13.7. Rigid metallic conduit shall be used for interior spaces for general wiring unless noted otherwise. Die cast fittings will not be allowed. The largest size allowed shall be 4 inch.
- 6.13.8. All conduit located in and around fuel dispensing equipment and tanks shall be black mastic coated galvanized rigid steel. Conduit seals shall be installed in each conduit entering or leaving a fuel dispenser or passing through a hazardous area.
- 6.13.9. Conduit type will be as indicated below:

Location	Conduit Type
Exterior Exposed	RGS
Exterior Concealed	RGS
Underground (outside building foundation)	PVC Sch 40 (normal) PVC Sch 80 (emergency)
Underground (below slab)	PVC Sch 40
In Concrete	PVC Sch 40
Interior Dry (not exposed to physical damage)	EMT
Interior Dry (exposed to physical damage)	RGS (below switch height)

	EMT (above switch height)
Interior Dry (concealed)	EMT
Interior Damp/Wet	PVC Sch 40
Interior Corrosive	PVC Sch 40
Connection to Vibrating Equipment	FMC (dry) LFNC (damp/wet/corrosive)

#### 6.14. Supporting Devices

- 6.14.1. When equipment hangers, supports and any other mechanism is used to support conduit, wireway, equipment, cable, etc. the material classification shall be one of the following, “corrosive service” or “normal service”. “Corrosive-service” mechanical support devices to be used in areas designated as “water treatment” or “wet”, including but not limited to: areas over and within 15 feet of open water tanks, pools or basins; splash zones; submerged conditions; chemical rooms; other water treatment zones, and exterior spaces.
- 6.14.2. Suspended equipment shall have a second means of support in accordance with Universal Guidelines. Architectural track lights mounted directly to the structure do not require a second means of support except where recommended by the manufacturer of the track system.
- 6.14.3. Hangers and supports will be as indicated below.

Location	Support Material
Exterior	Hot-Dip Galvanized Steel
Interior Dry	Hot-Dip Galvanized Steel
Interior Damp/Wet	Non-Metallic
Interior Corrosive	Non-Metallic

#### 6.15. Boxes

- 6.15.1. Standard electrical boxes to be used in all interior construction unless noted to be a corrosive area. Refer to the Supporting Devices section for areas defined as corrosive. All boxes used in exterior locations shall be considered in a corrosive environment.
- 6.15.2. Weatherproof boxes are to be NEMA 4X polycarbonate, stainless steel or cadmium plated malleable iron for concealed outlet and ferraloy cast box complete with threaded conduit ends or NEMA 4X polycarbonate for surface receptacles. Provide cast metal or polycarbonate face plate with stainless steel spring-hinged, waterproof cap configured for each application. Include face plate gasket and stainless steel fasteners. Weatherproof receptacles shall be flush mounted unless otherwise indicated on plans.



6.15.3. Large electrical pull boxes located in themed front of house areas to have the lids and box lip modified to accept various paving/topping materials. This will allow a large pullbox to be concealed in walkways and other guest paths with minimal visual intrusion. The topping shall not exceed three inches to keep the weight of the lids to a reasonable amount.

6.15.4. Large electrical pull boxes that are in back of house areas or in landscaping to have standard metal lids.

#### 6.16. Terminal Cabinets

6.16.1. Cabinet to have doors with concealed hinges, door locks (keyed alike with panelboards), a 3/4 in plywood back plate and finished with black insulating varnish or paint.

6.16.2. The size will be indicated on drawings to accommodate terminal blocks with 10% spare capacity. As well as specify panelboard type trims, flush or surface mounting, code gauge galvanized steel and color. Regardless of color, all finishes are to be baked enamel.

#### 6.17. Wiring Devices

6.17.1. Interior convenience receptacles will be located throughout the facility such that any point along the floor can be reached with a 25 ft extension cord. Exterior convenience receptacles will be located adjacent to exterior entrances.

6.17.2. Receptacles for servicing of audio, telecommunications, POS and other sensitive electronic loads shall be of the isolated ground type.

6.17.3. Receptacles installed in all exterior and interior damp/wet locations will be of the RCD type and provided with in-use weatherproof covers.

6.17.4. Receptacles in back-of-house service areas, mechanical/electrical spaces and kitchens will be mounted a minimum of 48" AFF. All other receptacles will be mounted at 18" AFF unless specific needs require otherwise.

- Offices shall have at a minimum, (1) double receptacle on the back wall and (2) more receptacles on side walls.
- A dedicated receptacle shall be provided for large office equipment such as copiers, coffee makers printers, etc.
- Maintenance receptacles shall be mounted at 48" AFF unless noted other wise and shall be spaced no further apart than 36" on workbench walls.
- Back of house locker rooms, used by park employees, will have a duplex receptacle mounted 18"mm above lavatory counter back splash, at each end of the counter space for personal grooming items such as razors, hair driers, etc.

6.17.5. Devices circuited from normal power panels shall be white in color for back of house spaces. In front of house spaces the devices shall match surrounding finishes as best as possible. Devices circuited from emergency power panels shall be red in color.

6.17.6. Receptacle faceplates shall be impact resistant nylon matching the device color except in back of house areas where faceplates will be stainless steel.

6.17.7. Simplex receptacles to be single heavy duty type receptacles, 2 pole, 3 wire, grounding, with green hexagonal equipment ground screw, 20 ampere, 125 volts.

6.17.8. Duplex receptacles to be double heavy duty type receptacles, 2 pole, 3 wire, grounding, with green hexagonal equipment ground screw, 20 ampere, 125 volts.

6.17.9. GFCI devices to be heavy duty duplex receptacles, capable of being installed in a 2-1/2 inch deep outlet box without adapter. Shall be grounding 125 volts, 60 Hz; with solid-state ground fault sensing and signaling; with 6 milliamperes ground fault trip level.

6.17.10. Isolation ground receptacles to be single heavy duty type receptacles, 2 pole, 3 wire, grounding, with green hexagonal equipment ground screw, 20 ampere, 125 volts.

6.17.11. Switches shall be mounted at 48" AFF unless specific needs require otherwise.

6.17.12. Switches shall be manufacturer's specification grade toggle switch with thermoplastic abuse resistant toggle, quiet action, and heavy duty contact arm.

6.17.13. Dimmer switches for fluorescent lighting shall be single pole, full-wave semi-conductor modular type; rated for 125V, 60 Hz, and with electromagnetic filters to reduce noise, RF and TV interference to minimum.

6.17.14. Switch wall plates shall be stainless steel in back of house areas and smooth nylon in front of house spaces in a color that matches other electrical devices. A single cover shall be provided when more than one switch is ganged in a junction box.

6.17.15. Switches and receptacles mounted in exterior or interior wet locations subject to splashing or washdown shall be hinged NEMA 3R rated with a neoprene gasket.

#### 6.18. Grounding

6.18.1. The grounding system of the zoo will provide an equipotential grounding system for all electrical equipment and large exposed metal structures. The grounding system shall consist of conductors, bus bars, rods, building steel, large footings, counter poise loops, metal water pipes, service grounding equipment.

6.18.2. Systems to be bonded together to common ground include but are not limited to all power distribution systems, low voltage systems, building steel structural system and water habitat / pool systems. At no point shall multiple, independently grounded system exist.

6.18.3. Ground bus bars will be provided in all electrical and low voltage system rooms. Ground bus bars in electrical rooms will be bonded back to the main electrical ground bus bar. All ground bus bars in low voltage system rooms will be bonded together with #4 AWG minimum back to the main electrical room ground bus bar. At no point will low voltage system ground bus bars be bonded to electrical room ground bus bars except at the main electrical room.



- 6.18.4. All low voltage cable tray, conduits and equipment racks will be bonded with #6 AWG minimum.
- 6.18.5. Service ground will consist of ground rods in quantity as required (minimum of three) to achieve indicated resistance to ground values. Ground rods shall be a minimum of 10' long, spaced 6' apart.
- 6.18.6. Service ground will bond building steel, water piping, rebar, ground ring (if provided) and ground rods together to one common ground bus bar located in the main electrical room in accordance with NEC requirements.
- 6.18.7. Main grounding conductor shall be continuous without splice from water service ground to service equipment.
- 6.18.8. The housing of all motors located outside of a building footprint to be bonded to the rebar of the slab it will be installed on. If this slab is independent of a building, this rebar shall be bonded to the nearest park grounding system.
- 6.18.9. Hand railings, water feature components, and other metallic towers shall be bonded back to the nearest grounding system.
- 6.18.10. All grounding connections to be exothermically welded except ground rods which can be mechanically fastened.
- 6.18.11. Resistance to ground will be as per NEC.
- 6.18.12. Bus Bars will be predrilled rectangular bars of annealed copper located in main electrical and telecommunications rooms. Bars will be provided with stand-off insulators.
- 6.18.13. Pipe connections will be copper or copper alloy, bolted pressure type with at least two bolts; bus bar connections will be cast silicon bronze, solderless compression type, long-barrel with two bolts; all welded connections will be exothermic type.
- 6.18.14. Ground rods for lightning protection system and service entrance will be copper-clad steel, 3/4 in diameter by 10' long sections.
- 6.19. Lighting
- 6.19.1. Lighting Fixtures
- All lighting in back of house areas with a ceiling grid such as offices and corridors shall have 2' x 2' or 2' x 4' LED troffers.
  - All lighting in administrative or other non-animal related back of house and support areas without ceilings shall be 48" LED strip fixtures with wire guards.
  - Light fixtures in animal care areas and back of house wet support areas will be 48" vaporlume LED fixtures.
- 6.19.2. Lighting Control
- Site pathway lighting will be provided by decorative fixtures atop 15' poles spaced evenly along walkways throughout the site
  - Site landscape and sign lighting will be LED grade mounted uprights
  - Back of house bathroom rooms and locker rooms to have down lights installed main circulation and locker areas. A single lamp perimeter cove light shall be provided over bathroom stalls and over sink and counter top areas. Shower shall have a gasketed down light in each shower stall.
  - Light fixtures in exterior back of house areas will be LED wall packs for paved surfaces, service areas, and walking paths.
  - Exit signs in back of house areas will be thermoplastic. Exit signs in front of house areas will be either thermo plastic or edge lit as coordinated with architect and theming.
  - Emergency and exit/egress lighting will be provided in accordance with all applicable codes.
  - Roadway lighting will be provided on the entire service. Since expansion buildings will not be in place, smaller service transformers (30kVA) will be placed in a distance to not exceed 2,000 feet. LED pole lights will be placed along the route. Controls will be wireless and interconnected via a site wide system.
- Exterior lighting control system will be provided by astronomical time clocks.
  - Control of interior back of house areas to be provided via occupant sensors.
  - Occupancy sensors are used in locations where occupancy is deemed intermittent. Occupancy sensors will turn lights off at a predetermined amount of time. Where occupancy sensing switches are used, the occupant will be given the ability to turn the lights off upon exiting the room.
  - Kitchens, mechanical rooms, and elevator pits shall have wall switches.
  - Electrical rooms, low voltage system rooms, and elevator machine rooms shall have timer switches.
  - Lighting control types shall be based on minimum requirements of applicable energy code.
  - Wall switches are used in locations where an unsafe condition would exist if the lights were turned off automatically, such as kitchens, mechanical rooms, and elevator pits.
  - For emergency lighting controlled by a wall switch, an ELCU will be provided to automatically turn emergency lighting on in the event of loss of normal power. The ELCU shall be capable of accepting emergency branch circuit wiring, switch leg wiring



and normal sense wiring. Upon loss of normal sense power, ELCU will automatically override switch leg wiring and turn connected lights on.

#### 6.19.3. Emergency Lighting

- Under normal conditions, lighting will be provided by the normal lighting fixtures. Upon loss of normal power, the emergency generator will start and restore power to the normal lighting fixtures circuited to the emergency branch panel.

#### 6.19.4. General Fixture Characteristics

- Light fixtures shall be listed for the ambient conditions where installed. Fixtures located exterior to the building and/or in unconditioned damp spaces and under cover from direct weather exposure shall be listed as suitable for damp locations. Fixtures located exterior to the building and/or in unconditioned wet spaces and in direct contact with the weather or in washdown areas shall be listed as suitable for wet locations. Fixtures installed with direct contact with insulation shall have an 'IC' rating for direct contact with insulation.
- Mount wall and ceiling fixtures independent and secure so that they are not dependent on finish or ceiling system for support and cannot be rotated or displaced. Fixtures shall be supported from structure.

#### 6.20. Surge Suppression Equipment

- 6.20.1. All main service entrances will have a parallel surge suppression device to protect the facility equipment. Branch panelboard devices will be installed as needed depending on the location of the panel. The device shall be installed with leads less than 18" of the over current protection device with minimal bends.
- 6.20.2. Any panel with branch circuits serving exterior equipment shall be provided with surge protective devices (SPD).
- 6.20.3. SPD to provide protection for all 10 modes of the electrical system and be self-sacrificing with no replaceable components.
- 6.20.4. Brand panels to have true sine-wave tracking directly connected protection elements for each mode of the electrical system.
- 6.20.5. Enclosures shall be NEMA 12 enclosures for indoor installations where fire suppression systems are utilized and NEMA 4X when installed in outdoor/wet locations.

### 7. Operation and Maintenance

#### 7.1. Expectations of Facility Staff for Operation

- 7.1.1. The Owner has full-time facility staff for preventive maintenance, so the system operation shall be automatic requiring no user input for normal operation.

#### 7.2. Expectations of Facility Staff for Maintenance

- 7.2.1. The Owner has full-time facility staff performing preventive maintenance. Direct access to equipment shall be planned for during the installation. Directly accessible disconnects, motor controllers, etc., shall be provided for easy replacement of equipment components including fuses, control components, etc.

### 8. Component Specific Details

Supplemental information for each general type of facility is provided in the following sections

#### 8.1. Food and Beverage

##### 8.1.1. Power Distribution

- A main electrical room will be provided to house the incoming power panels, additional lighting and appliance panelboards as well as the fire alarm control panel. Room size will be as indicated on the electrical floor plans.
- The incoming panelboard will serve additional lighting and appliance panelboards throughout the facility as well as large mechanical and kitchen loads.
- When multiple panelboards are required to serve the dining area, at least one panelboard will be provided for servicing sensitive electronic loads such as audio, telecommunications and POS equipment. This panel will be provided with an isolation ground bar, isolation ground connection and oversized neutral.
- Lighting and appliance panelboards for kitchen equipment loads will be flush mounted and located within the kitchen space itself with a stainless steel cover. Panel will be located within sight of as many pieces of kitchen equipment as possible to allow for the option of using the circuit breaker as the equipment disconnecting means.
- A shunt trip lighting and appliance panelboard will be provided where there are more than ten circuits serving equipment underneath a kitchen hood. The shunt trip on the main circuit breaker in this panel will be triggered by activation of the hood fire suppression system.
- All cords provided for connection of kitchen equipment shall be SO type.

##### 8.1.2. Wiring Devices

- Wiring devices in kitchens areas shall be provided with stainless steel cover plates.
- All receptacles within kitchen areas, and all connections to equipment will be at 48" AFF minimum. Where receptacles or connections are located within casework, they shall be located a minimum of 6" from the bottom of the casework, and shall not interfere with the use of the casework.
- Recessed clock receptacles for connection of fly lights shall be provided at all entrances into dining and kitchen areas.



- Receptacles shall be provided above all display windows that are 12' in length or major fraction thereof.
- RCD receptacles shall not be used for servicing of kitchen equipment loads. Only RCCD circuit breakers shall be used.
- All kitchen equipment which is furnished as a hardwired connection shall be provided with a cord and plug for connection to a receptacle. In no instance shall safety switches be used in kitchen areas for connection of kitchen equipment.

#### 8.1.3. Lighting

- Light fixtures in back of house kitchen areas will be 24" x 48" LED troffers with extra thick lenses and gasketing.
- Light fixtures in coolers, freezers and kitchen hoods will be provided by the equipment manufacturer.

#### 8.1.4. Lighting Control

- Front of house fixtures will be controlled via occupancy sensors
- Control of all kitchen fixtures will be via local manual switching.

### 8.2. Restrooms

#### 8.2.1. Power Distribution

- Power distribution will be provided from a panelboard located in the restroom building. This panel will provide power for mechanical equipment, lighting, and general loads.

### 8.3. Retail

#### 8.3.1. Power Distribution

- A main electrical room will be provided to house the incoming power panel, additional lighting and appliance panelboards, and the fire alarm control panel. Room size will be as indicated on the electrical floor plans.
- The incoming panelboard will serve additional lighting and appliance panelboards throughout the facility, as well as large mechanical and retail loads.
- Sensitive electrical loads such as photo racks, printers, special building systems, and POS stations will be served from panels with an isolation ground bar, isolation ground connection and oversized neutral.

#### 8.3.2. Wiring Devices

- Receptacles shall be provided above all display windows that are 12' in length or major fraction thereof.

- Client may require that receptacles be provided along the roof perimeter for special event lighting. These receptacles shall be controlled by remotely operated circuit breakers.
- Four receptacles will be provided for each POS station for additional sale equipment. These receptacles will be provided with isolated grounds.
- Recessed receptacles to be mounted in the wall for video monitors. The mounting heights will be coordinated so the receptacles are behind the monitors.
- Power for the photo racks will be provided to power strips located in the racks. A junction box will be located over the racks and then whip down in flexible conduit where a connection to the rack can be made.

### 8.4. Animal Care Quarters

#### 8.4.1. Power Distribution

- A main electrical room will be provided to house the facility panelboards, additional lighting and appliance panelboards as well as the fire alarm control panel. Room size will be as indicated on the electrical floor plans.
- For larger care quarters, or for care quarters where LSS systems are adjacent to the building, an incoming switchboard will be provided which will serve additional lighting and appliance panelboards throughout the facility as well as large mechanical and loads.
- LSS power distribution will consist of Motor Control Centers, feeders to LSS equipment, and local disconnects at every pump or motor.

#### 8.4.2. Wiring Devices

- Receptacles will be provided within the holding area corridors as well as above the counter in food prep areas

#### 8.4.3. Lighting

- Lighting for care areas will be provided via LED vaporlume fixtures.

#### 8.4.4. Lighting Control

- Lighting will be controlled via local switches in holding areas

#### 8.4.5. Fire Alarm System

- A fire alarm system consisting of a local fire alarm control panel, pull stations at exits, audio/visual notification devices in food prep areas, visual notification devices in holding areas, heat detectors in holding areas, and flow/tamper switch monitoring where buildings are sprinkled will be provided.

#### 8.4.6. Radiant Heaters



- Electric radiant heaters will be provided in unconditioned care areas. Local disconnects will be provided for radiant heaters.

#### 8.5. Area Development

##### 8.5.1. Site Power

- Convenience receptacles will be provided in landscape areas for maintenance. Receptacles will be GFCI and have an in-use weatherproof enclosure.
- Power to be provided for all signage as required.
- Power for irrigation controllers to be provided by local panels.

##### 8.5.2. Site Lighting

- Site pathway lighting will be provided by decorative fixtures atop 15' poles spaced evenly along walkways throughout the site
- Site landscape and sign lighting will be LED grade mounted uplights

##### 8.5.3. Animal Exhibit Areas

- Convenience receptacles will be provided in landscape areas for maintenance. Receptacles will be GFCI and have an in-use weatherproof enclosure.
- Power to be provided for hot wire, hot grass, electric fences and waterers as required.

##### 8.5.4. Covered Viewing Areas

- In most cases branch circuits for convenience outlets, ceiling fans and lighting will be provided to covered viewing areas. New panels will be required. Disconnecting means will be localized switching
- Lighting in Viewing Areas will be LED fixtures integrated into structures
- At least one convenience receptacle will be provided in the area with a weather proof cover where exposed to the exterior.

##### 8.5.5. Small Food and Retail Carts

- An NEMA 4X fiberglass power enclosure or individual receptacles will be provided and sized appropriately to for the electrical connections required by the food vendor.
- Raceway to be provided from the power enclosure or receptacle(s) and stubbed into floor boxes under the intended equipment. A drain penetration will be provided in this floor box to handle wash down and rain water. The raceway will be sized to handle pulling equipment cords and plugs for connection in the power enclosure or receptacle(s).

- Where a POS system is included, the power to POS and printers shall have dedicated ground conductors.
- At least one convenience receptacle will be provided in the area with a weather proof cover

##### 8.5.6 Electric Vehicle Charging

- All Owner fleet vehicles, maintenance vehicles, golf carts etc will be all electric. Chargers will be located in back of house areas to power these vehicles
- Electric Vehicle Charging will be provided for the Zoo work vehicles as follows:
  - 40 spaces will be provided with Level 2 EVSE (40-amp)
- Refer to the Civil Site package for EV charging in guest parking areas.





9. Appendix

Appendix A: Summary of Load Estimates

Summary	kW Connected	kW Demand	Estimated overall demand factor
			0.70
<b>Phase 1</b>	4,370	3,059	
<b>Phase 2</b>	5,774	4,042	
<b>Subtotal</b>	10,144	7,100	
<b>Peak Coincidence factor - 95%</b>	0.95	0.95	
<b>Estimated total</b>	9,636	6,745	

Appendix B: Estimated Electrical Loads – Phase 1a and 1b

BLDG #	BLDG Name	Voltage	Normal Power kW (connected)	Emerg. Power kW	Fire Alarm
101	Guest Services/Restrooms/Ticketing	480/3	75	47	YES
101	Retail	480/3	48	10	YES
102	Education Entry Restrooms	208/3	9	2	YES
103	The Lodge	480/3	225	104	YES
104	Events Pavilion	208/3	75	3	YES
201	Dwarf Mongoose Care Quarters	208/3	6	1	YES
202	Giraffe Feeding Shelter Canopy	208/3	3	1	NO
202	Giraffe Feeding Shelter Sales Room	208/3	5	2	NO
203	Beer Garden Restrooms	208/3	12	2	NO
204	Beer Service	480/3	15	8	NO
205	Beer Service	480/3	15	8	NO
206	Cheetah Care Quarters	208/3	28	6	YES
207	Cheetah View Shelter	208/3	3	1	NO
208	Fennec Fox Care Quarters	208/3	6	1	YES
209	Lion View Shelter 1	208/3	3	1	NO
210	Lion View Shelter 2	208/3	5	1	NO
211	Meerkat Care Quarters	208/3	6	1	YES
212	Rhino View Shelter 1	208/3	3	1	NO
213	Rhino View Shelter 2	208/3	3	1	NO
214	Rhino Encounter Shelter	208/3	3	1	NO
215	Overnight Guest Duplex	208/3	5	1	YES
215	Overnight Guest Duplex	208/3	5	1	YES
215	Overnight Guest Duplex	208/3	5	1	YES
216	Lion Care Quarters	480/3	49	10	YES
217	Rhino Care Quarters	480/3	105	21	YES
218	Giraffe Care Quarters	480/3	359	72	YES
218	Overnight Guest Suite	208/3	5	1	YES
219	Hoofstock Care Quarters	480/3	141	28	YES
220	Savanna LSS	480/3	60	12	YES
221	Walk In Browse Cooler	208/3	3	1	NO
222	Hay Storage	208/3	6	1	YES
223	Event Lawn Giraffe Feeding Shelter	208/3	3	1	NO



Estimated Electrical Loads – Phase 1a and 1b (Con'd)

BLDG #	BLDG Name	Voltage	Normal Power kW (connected)	Emerg. Power kW	Fire Alarm
301	Flamingo LSS	208/3	3	1	NO
302	Flamingo Care Quarters/Brooder	480/3	71	14	YES
303	Africa Aviary Care Quarters	208/3	6	1	YES
304	Lvl 1: Vestibule	208/3	6	1	YES
304	Lvl 2: Colobus Care Quarters	208/3	6	1	YES
305	Okapi Care Quarters	208/3	6	1	YES
306	Giant Tortoise Care Quarters	208/3	6	1	YES
307	Multipurpose Room	480/3	20	47	NO
307	Multipurpose Room	480/3	20	47	NO
307	Multipurpose Room	480/3	20	47	NO
308	Gelada LSS	208/3	3	1	YES
309	Klipsringer/Hyax Holding	208/3	6	1	YES
310	Gelada View Shelter 2	208/3	3	1	NO
311	Gelada View Shelter 1	208/3	3	1	NO
312	Gelada Care Quarters	480/3	94	19	YES
313	Train Depot	208/3	10	2	NO
314	Alligator Viewing Shelter 1	208/3	3	1	NO
315	Alligator Viewing Shelter 2	208/3	3	1	NO
316	Alligator & Sq. Monkey Care Quarters	208/3	35	7	YES
317	Squirrel Monkey Viewing Shelter	208/3	3	1	NO
318	Parrot Care Quarters	208/3	6	1	YES
319	Play Area Restrooms & Lactation Room	208/3	12	2	NO
320	Carousel Pavilion	208/3	8	0.5	NO
321	Lemur View Shelter 1	208/3	3	1	NO
322	Lemur View Shelter 2	208/3	3	1	NO
323	Lemur Care Quarters	208/3	32	6	YES
324	Quarantine & Nutrition Center)	480/3	367	73	YES
701	Maintenance Shed/Shops	480/3	101	20	YES
703	Containerized Fodder System	120/1	1	0	NO
703	Walk In Browse Cooler	208/3	3	1	NO

Estimated Electrical Loads – Phase 1a and 1b (Con'd)

BLDG #	BLDG Name	Voltage	Normal Power kW (connected)	Emerg. Power kW	Fire Alarm
801	Admin Modular 1	208/1	20	47	NO
801	Admin Modular 2	208/1	13	47	NO
801	Admin Modular 3	208/1	14	47	NO
801	Admin Modular 4	208/1	33	47	NO
801	Admin Modular 5	208/1	30	47	NO
801	Admin Modular 6	208/1	34	47	NO
801	Restrooms - Prefabricated	208/1	12	2	NO
802	Animal Staff Modular 1	208/1	25	47	NO
802	Animal Staff Modular 2	208/1	25	47	NO



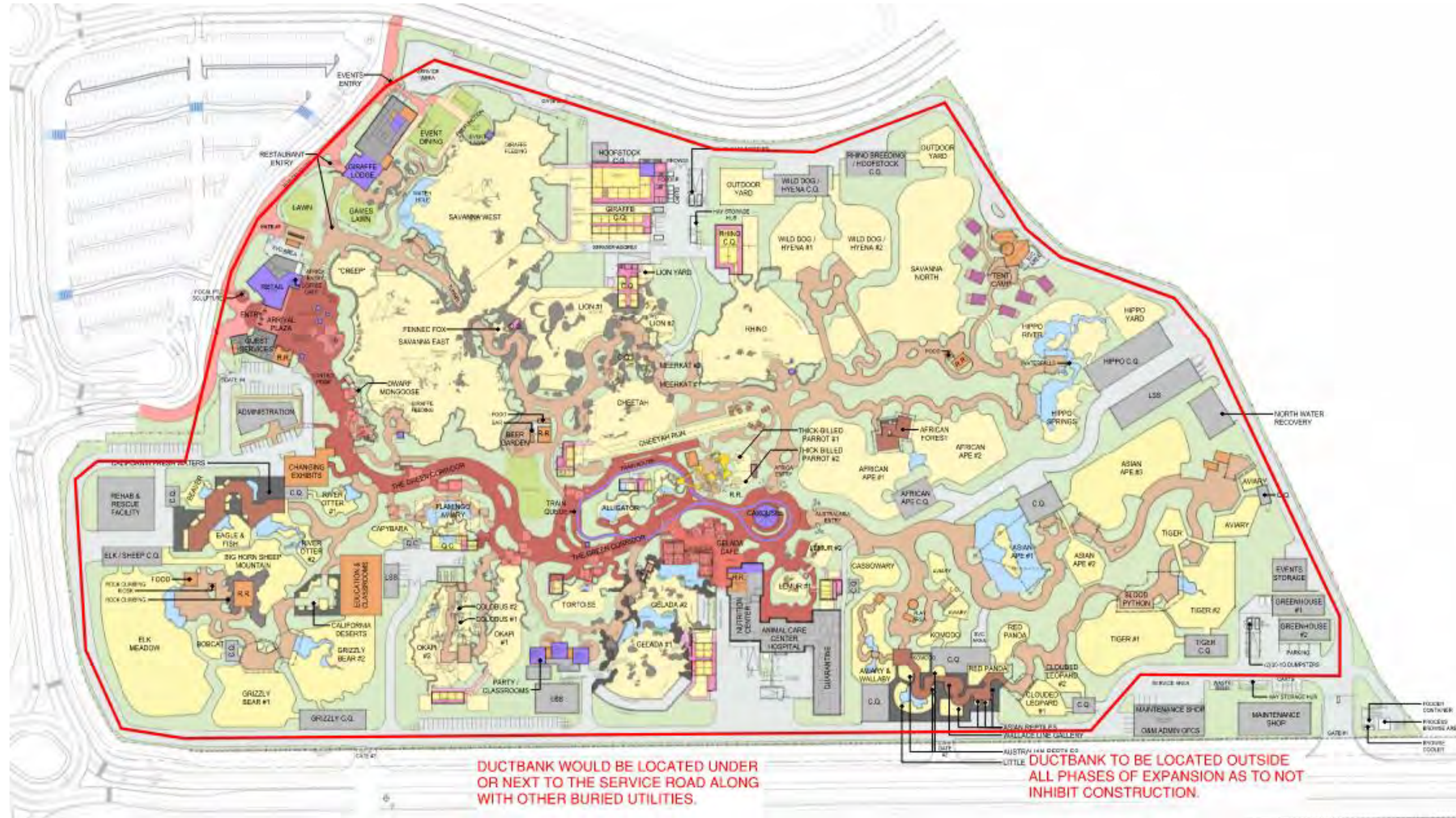
Appendix C: Estimated Electrical Loads – Full Buildout

BLDG #	BLDG Name	Voltage	Normal Power kW (connected)	Emerg. Power kW	Fire Alarm
105	Administration / Staff Support & Offices (2-stories)	480/3	236	47	YES
401	Changing Exhibits	480/3	96	19	YES
401	Otter Care Quarters & LSS	480/3	75	15	YES
401	Exhibits	480/3	291	58	YES
401	Beaver Care Quarters	208/3	31	6	YES
402	Education & Classrooms	480/3	236	47	YES
402	California Deserts Indoor Exhibits	480/3	180	69	YES
403	Capybara Care Quarters	480/3	18	15	YES
404	Grizzly Bear View Shelter	480/3	130	26	NO
405	Bobcat Care Quarters	208/3	19	4	YES
406	Restrooms - California	208/3	14	3	NO
407	Food Kiosk	208/3	9	2	NO
408	Big Horned Sheep Care Quarters	208/3	31	6	YES
409	Rescue & Rehab Facility	480/3	212	42	YES
410	Grizzly Bear Care Quarters & LSS	480/3	130	26	YES
501	African Ape Viewing	208/3	3	1	NO
502	Hippo Springs View Shelter	208/3	3	1	NO
503	Hippo River View Shelter	208/3	3	1	NO
504	Food & Restroom Kiosk	208/3	9	2	NO
505	Overnight Arrival Building	208/3	34	7	YES
505	Accomodation 1	208/3	5	1	YES
505	Accomodation 2	208/3	5	1	YES
505	Accomodation 3	208/3	5	1	YES
505	Accomodation 4	208/3	5	1	YES
505	Accomodation 5	208/3	5	1	YES
505	Accomodation 6	208/3	5	1	YES
505	Accomodation 7	208/3	5	1	YES
506	Hippo Care Quarters	480/3	208	42	YES
507	Hippo+ Tiger Filtration	480/3	218	44	YES
508	African Ape CQ	208/3	17	3	YES
509	Wild Dog / Hyena CQ	480/3	75	15	YES
510	Rhino Breeding / Hoofstock CQ	480/3	105	21	YES

Estimated Electrical Loads – Full Buildout (Con'd)

BLDG #	BLDG Name	Voltage	Normal Power kW (connected)	Emerg. Power kW	Fire Alarm
601	Exhibits	480/3	347	69	YES
601	Komodo Dragon/Red Panda C.Q.	208/3	31	6	YES
602	Clouded Leopard Care Quarters	480/3	58	12	YES
603	Tiger View Shelter	208/3	6	1	NO
604	Tiger Care Quarters	480/3	75	15	YES
605	Aviary Care Quarters 1	208/3	12	4	YES
606	Restrooms - Asia	208/3	8	2	NO
606	Aviary Viewing Shelters	208/3	4	1	NO
606	Food Kiosk	208/3	10	6	NO
607	North Water Recovery	480/3	60	12	NO
608	Asian Ape View Shelter	480/3	39	8	NO
609	Asian Ape Care Quarters	480/3	156	31	YES
610	Cassowary Care Quarters	208/3	6	1	YES
611	Australian Aviary Care Quarters	208/3	6	1	YES
612	Clouded Leopard View Shelter	208/3	27	5	NO
702	Maintenance Shed/Shops	480/3	101	20	YES
705	Greenhouse 2	208/3	11	2	NO
706	Greenhouse 1	208/3	11	2	NO
707	Event Storage	208/3	15	3	YES

Appendix D: Medium Voltage Site Plan

















PLUMBING ENGINEERING  
BASIS OF DESIGN  
SCHEMATIC DESIGN SUBMISSION  
OCTOBER 6, 2023  
FOR PRICING  
NEW ZOO AT ELK GROVE

## 1. Executive Summary

- 1.1. The plumbing systems in each building will be designed as indicated below. Depending on the requirements of each building, as outlined in the Component Specific Details section below, not every building will be provided with every service.

## 2. Applicable Codes, Guidelines and Standards

- 2.1. Design will conform with requirements of identified codes, standards, and guidelines. Where differences arise between codes, standards or guidelines, applicable code will prevail. In cases where edition of year is not indicated, current edition will apply.
- 2.1.1. 2022 California Building Code
  - 2.1.2. 2022 California Plumbing Code
  - 2.1.3. 2022 California Energy Code
  - 2.1.4. 2022 California Green Building Standards Code

## 3. Sanitary/Vent System

- 3.1. System Description
- 3.1.1. The sanitary sewer system shall drain by gravity and will collect waste from all plumbing fixtures located within each building to a point of connection on the site, no further than five (5) feet beyond each building's foundation. These connection points will be indicated on the site/civil documents.
  - 3.1.2. The sanitary waste and vent system will be designed as a conventional waste and vent system throughout the building.
  - 3.1.3. Traps subject to infrequent use will be provided with ASSE 1018 or 1044 type trap primer valve to prevent sewer gases from entering building. Trap primers will be provided to all floor drains not receiving indirect waste.
- 3.2. Material
- 3.2.1. All sanitary and vent piping will be schedule 40 PVC DWV piping with solvent weld fittings.
  - 3.2.2. All piping within an HVAC plenum space shall meet ASTM E84. Should any HVAC plenums be present, no-hub cast iron piping will be used in these spaces.

## 4. Grease Waste System

- 4.1. System Description
- 4.1.1. A dedicated grease waste system will convey effluent from all FOG (fats, oils, and grease) producing fixtures and equipment located in kitchens and bars to grease interceptors. Each restaurant and/or food kiosk will have its own grease interceptor.

- 4.1.2. The grease interceptors will be in ground passive tank interceptors. This type of interceptor works by reducing the velocity of the grease waste, allowing the grease to separate, with the solids falling to the bottom of the interceptor and the grease rising to the top. The liquid waste then passes through the interceptor.
- 4.1.3. The basis of design for the grease interceptor will be epoxy coated steel multi chambered tank as manufactured by Highland Tank. The interceptors shall be located under or along the back of house access roadways looping around the park to allow for easy maintenance.

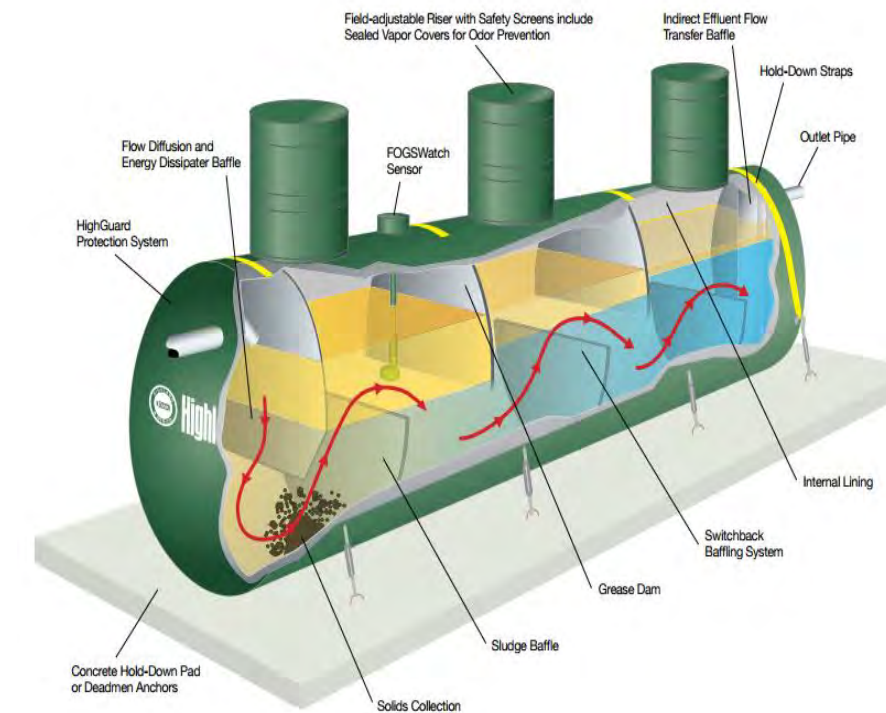


FIGURE 1: GREASE INTERCEPTOR

- 4.1.4. The grease interceptors shall be sized based on the local code requirements and that of the California Plumbing Code. The discharge from grease interceptors shall first pass through a sample basin and then connect to site/civil sanitary sewer. Sizing will be refined once equipment and fixture information is received from the food service consultant.
- 4.1.5. Civil utilities will connect to sanitary waste piping downstream of the grease interceptor.
- 4.1.6. In cases where the length of the grease waste line (main) exceeds 100' to the interceptor from grease producing waste the waste line will be heat traced and insulated to keep the grease waste from congealing. The intent will be to locate the interceptors so heat trace is not required on the project.

- 4.2. Material



- 4.2.1. Grease waste piping below grade shall be high performance coated cast iron pipe and fittings equal to that of Charlotte Pipe HP Edge. This piping will not only be able to withstand the high temperatures from items such as tilt kettles and dishwashers but will also be able to withstand corrosive waste from items such as beverage stations, making it an ideal product for kitchen waste applications.
- 4.2.2. Waste from food kiosks/carts will utilize PVC piping as these locations will not have any high temperature waste entering into the drainage system.
- 4.2.3. Vent piping shall be schedule 40 solid wall DWV PVC with solvent weld fittings.
- 4.2.4. All piping within an HVAC plenum space shall meet ASTM E84. Should any HVAC plenums be present, no-hub cast iron piping will be used in these spaces.

## 5. Storm Water System

### 5.1. System Description

- 5.1.1. All sloped roofs will discharge rainwater to perimeter gutters and downspouts, provided and indicated on the architectural documents. Should the downspouts connect to the civil utilities, the architect shall coordinate this directly with the civil engineer, without interface by the plumbing engineer.
- 5.1.2. For the flat roof areas, a storm water drainage system will be provided. Primary roof drains will convey the storm water drainage to a point of connection on the site, no further than five (5) feet beyond the building's foundation. These connection points will be indicated on the site/civil documents.
- 5.1.3. A secondary drainage system will be provided for the flat roofs. Scuppers will terminate through the parapet wall in a visible location as designed by the architect. Secondary roof drains will be provided where scuppers are not utilized, and the piping will terminate through the building wall approximately 18" above grade using a cast bronze down spout nozzle.

### 5.2. Material

- 5.2.1. Storm water piping above slab on grade shall be either service weight no-hub cast iron with standard duty couplings or solid wall schedule 40 PVC DWV.
- 5.2.2. Storm water piping below grade piping shall be schedule 40 solid wall DWV PVC with solvent weld fittings.
- 5.2.3. All piping within an HVAC plenum space shall meet ASTM E84. Should any HVAC plenums be present, no-hub cast iron piping will be used in these spaces.

## 6. Domestic Cold Water System

### 6.1. System Description

- 6.1.1. The domestic water service shall originate from a point of connection on the site approximately (5) feet from each building's footprint. The piping upstream of this will be

indicated on the civil site drawings. The civil drawings shall indicate the piping routing around the site.

- 6.1.2. The water service will enter each building in a back of house room/space and be provided with a building shutoff valve. As the entire site will be protected with an RPZ type backflow preventer, it will be confirmed with the AHJ if additional backflow preventers per building are also required. Exp recommends they not be provided to reduce the resulting pressure loss from the device.
- 6.1.3. Backflow preventers will also be provided for specific connections to the potable water system including at various food service equipment, connections to mechanical equipment, connections to pool equipment, etc. Each of these devices will be located inside of a building.
- 6.1.4. Each building will not have individual water meters. Meters shall be provided on the water service(s) to the park and indicated on the civil drawings.
- 6.1.5. The park is in a freezing environment and all piping, valving and accessories located exterior to the building will be insulated to protected in such a way that they will not freeze.
- 6.1.6. It is anticipated that the site pressure will be adequate such that there is no need for any water booster pumps located in any buildings. A flow test will be required to confirm this.
- 6.1.7. Hose bibbs will be provided at flat roof levels having HVAC equipment on them to allow for maintenance. Additional hose bibbs will be provided exterior to the building at maximum of 100' on center. Hose bibbs on exterior of building shall be wall hydrant type encased in a stainless-steel type hinged enclosure.
- 6.1.8. Water hammer arrestors shall be provided to all groups of plumbing fixtures utilizing quick closing valve such as ice machines, ware washers, and clothes washers.

### 6.2. Materials

- 6.2.1. Piping shall be Type 'L' copper with Pro Press or soldered joints. Any piping located below ground or located within a block wall shall be wrapped to protect the piping from corrosion.

## 7. Domestic Hot Water System

### 7.1. System Description

- 7.1.1. Each building requiring hot water will be provided with its own water heating system. The vast majority of spaces will utilize tank type electric water heaters, which will be located in back of house spaces such as equipment rooms or janitor closets.
- 7.1.2. Areas with large hot water demand will be provided with heat pump or electric tank type water heaters, to include the Food service buildings (kitchens).
- 7.1.3. The heating system will be set at 140°F in kitchen/food service buildings. This temperature will be piped to all the kitchen equipment including dishwashers, 3-compartment scullery sinks, prep sinks, janitor's sinks and hand sinks. At the sinks not requiring 140°F water, such as hand sinks, a point-of-use thermostatic mixing valve will be provided at each fixture, located below it. This valve will be set at about 110°F to limit the hot water temperature.

- 7.1.4. In buildings where, there is no food preparation the water heating system will heat the water to 140°F and blend the water down to about 120° F for distribution. This lower temperature will eliminate the potential for scalding concerns.
- 7.1.5. Every public lavatory will be provided with a point of use ASSE 1070 mixing valve to limit the supply to a maximum of 110 degrees F.
- 7.1.6. Hot water systems will be provided with a hot water return system to minimize the wait for hot water delivery at each fixture.
- 7.1.7. The majority of systems utilizing hot water return will have a single hot water loop. These systems will be provided with a manual balancing valve located at the circulation pump to manually balance/control the system.
- 7.1.8. Each hot water return system will be provided with its own hot water return pump. The recirculation pumps will run based on a time clock and aquastats.

7.2. Materials

- 7.2.1. Piping material shall be the same as that of the cold water.

**8. Reclaimed (non-potable) Water System**

8.1. System Description

- 8.1.1. The reclaimed water service shall originate from a point of connection on the site approximately (5) feet from each building’s footprint. The piping upstream of this will be indicated on the civil site drawings. The civil drawings shall indicate the piping routing around the site as well as the master meter.
- 8.1.2. The water service will enter each building in a back of house room/space and be provided with a building shutoff valve. As this is a non-potable water service, there should not be the need for any backflow prevention, but that will be confirmed with the AHJ.
- 8.1.3. This service will be piped around the site to use for irrigation as well as toilet and urinal flushing. As this is a separate water service from that of the domestic, this will indeed require a dual piped system on the site and within buildings having flushing fixtures.
- 8.1.4. The park is in a freezing environment and all piping, valving and accessories located exterior to the building will be insulated to protected in such a way that they will not freeze.
- 8.1.5. It is anticipated that the site pressure will be adequate such that there is no need for any water booster pumps located in any buildings. A flow test will be required to confirm this.
- 8.1.6. Water hammer arrestors shall be provided to all flush valves.

8.2. Materials

- 8.2.1. Piping shall be Type ‘L’ copper with Pro Press or soldered joints. Any piping located below ground or located within a block wall shall be wrapped to protect the piping from corrosion.

**9. Natural Gas System**

- 9.1. It is assumed that this will be an all electric project and natural gas will not be utilized.
  - 9.1.1. Kitchens will utilize electric appliances.
  - 9.1.2. HVAC heating will use electric heat when needed.

**10. Medical Gas Systems**

10.1. System Description

- 10.1.1. The Animal Care building will have operating and recovery facilities in which the facility wants piped medical gases. At this time, it is not yet known which gases are indeed desired, and input is needed from ownership. Provisions have been made for space allocation for medical air, vacuum, nitrous oxide, nitrogen, and oxygen.
- 10.1.2. All of the medical gas systems will be designed to meet NFPA 99, which is the standard for medical gases for humans. However, as there not a standard for animal care, NFPA 99 will be followed.
- 10.1.3. The vacuum will be served from a duplex tank mounted vacuum pump with separate floor mounted vacuum filter. The compressed air will be served from a duplex tank mounted air compressor with integral desiccant dryers. These will share a room with minimum measurements of 15’x12’.
- 10.1.4. A separate room will be provided (direct access to the exterior is recommended, though not required) to house the manifolds serving oxygen, nitrous, and nitrogen. The oxygen is estimated to require a 3x3 manifold and each the nitrous and the nitrogen are estimated to require a 1x1 manifold. Spare cylinders will also be kept within this room having minimum size of 9’x9’.

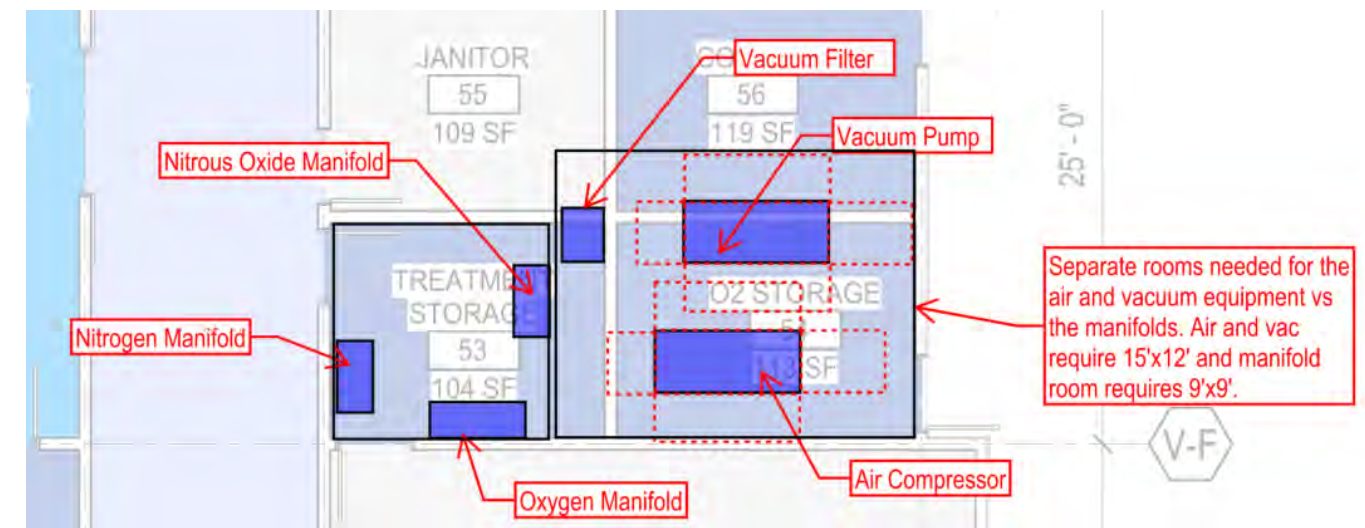


FIGURE 2: MEDICAL GAS SPACE REQUIREMENTS

10.1.5. Valves and alarms will be provided to meet NFPA 99.

10.2. Materials:

10.2.1. All materials will be copper piping that is capped for cleanliness and fittings bagged for cleanliness. Piping will be brazed.

**11. Insulation**

- 11.1. All cold, hot water, and hot water re-circulating piping shall be insulated with fiberglass.
- 11.2. All horizontal storm water piping, including the connection to the drain and the drain body, within the building shall be insulated with closed cell elastomeric.
- 11.3. All heat traced piping shall be insulated. At this time there is no anticipation that there will be any heat tracing on the project.
- 11.4. All fittings shall utilize pre-molded type insulation.
- 11.5. All exposed hot and cold water, and drain lines under handicapped lavatories shall be insulated, per ADA requirements, and be similar to TRUEBRO®.
- 11.6. Hot water pipe insulation thickness shall comply with the California Plumbing and Energy Codes.
- 11.7. Rigid fiberglass insulation will be covered with an all service jacket equal to Owens Corning Co. Fiberglass 25 ASJ vapor barrier jacketing. Fitting and valve covers will be pre-molded PVC covers with fiberglass insert.

**12. Plumbing Fixtures**

- 12.1. Plumbing fixtures will all be commercial grade vitreous china with low flow rates.
- 12.2. Public lavatories and flush valves shall be battery powered, sensor operated.
- 12.3. All plumbing fixtures will be of the water conserving variety.
- 12.4. Stop valves will be provided at all water consuming fixtures and equipment.
- 12.5. All fixtures and equipment operated by 'quick closing' valves will be provided with water hammer arrestors. This includes flush valves, ice machines, dishwashers, and other equipment operated by a solenoid valve.



FIGURE 3: WATER HAMMER ARRESTORS

- 12.6. All hose bibbs will be provided with integral vacuum breakers. Hose bibbs will be located on the perimeter of the building only where there are no site hydrants, provided by the civil engineer, within approximately 100 feet. Hose bibb locations shall be coordinated with the site hydrant location to ensure all areas are adequately covered.
- 12.7. Any kitchen equipment, janitors sinks, and other fixtures in which the valves can potentially be left open, will have check valves on the hot and cold water supplies to prevent cross over.
- 12.8. Exposed trap tailpieces, etc., will be tubular brass with a polished chrome finish. Concealed trap tailpieces can be PVC.

**13. Identification**

- 13.1. All piping, valves and equipment shall be provided with labels and flow direction.
- 13.2. Piping will be labeled with Craftmark, Seaton or equal markers at 20'-0" on center intervals. Color coding markers will be per OSHA Standards.

**14. Hangers and Supports**

- 14.1. All piping shall be supported from the building structure by means of approved hangers and supports.
- 14.2. Piping shall be supported to maintain required grading and pitching of lines, to prevent vibration and to secure piping in place, and shall be so arranged to provide for expansion and contraction.
- 14.3. Hangers in contact with copper will be either copper or PVC coated with electroplated rods, nuts and bolts.
- 14.4. Hanger associated materials and methods will be per MSS standards.
- 14.5. All piping and equipment shall be seismically braced and supported.



## 15. Component Specific Details

### 15.1. Food and Beverage

#### 15.1.1. Water

- The 2019 Elk Grove Water District indicates the water hardness ranges from 18-220 grains, being from 1 gpg up to 13 gpg. The hardness ions (calcium and magnesium) are what cause spotting on glassware and scale buildup in water heaters. Each kitchen building will be provided with a water softener on the hot water system to eliminate scale buildup as well as eliminate the spotting.
- A mechanical room will be required within or adjacent to each kitchen to house the water softener, water heating equipment and hot water recirculation pump. Hot water within kitchens will be produced with heat pump or electric storage type water heaters. The water will be heated to 140°F which will serve all equipment. Point of use mixing valves will be provided at hand and prep sinks to limit the temperature to 110°F. The hot water shall be maintained through the use of hot water recirculation pumps.
- Heat pump or electric tank type water heater(s) will be utilized.
- Backflow preventers will be installed on the various pieces of equipment to ensure there is no cross contamination.
- Reclaimed water will be piped to flush valves on water closets and urinals.

#### 15.1.2. Grease Waste Drainage System

- Buildings with kitchens will require grease interceptors to be located exterior of the building in a service area, accessible by pump trucks.
- Dedicated grease piping will extend to all floor drains, floor sinks, and equipment located within the kitchen. The lines will extend to the exterior of the building and discharge into a grease interceptor.
- Should there be any food preparation at Food kiosks they will not be provided with a grease waste drainage system.
- As food carts are portable and mostly self-contained, they will not be provided with grease waste piping.

#### 15.1.3. Plumbing Fixtures

- The following plumbing fixtures shall be provided for employee usage in addition to the kitchen equipment:
  - Water closets
  - Lavatories

- Service Sinks

### 15.2. Restrooms

#### 15.2.1. Water

- Water will be plumbed to all plumbing fixtures throughout the building.
- A storage type electric water heater will be provided for lavatories (hand sinks) in toilet rooms and other sinks throughout the building.
- Reclaimed water will be piped to flush valves on water closets and urinals.

#### 15.2.2. Sanitary Sewer

- A sanitary sewer will be piped to all of the plumbing fixtures and equipment located within the building.

### 15.3. Retail

15.3.1. Typically, there is not a requirement for plumbing within a retail building. However, should plumbing fixtures exist, the following will be followed.

#### 15.3.2. Water

- Water will be plumbed to all plumbing fixtures throughout the building.
- A storage type electric water heater will be provided for lavatories (hand sinks) in toilet rooms and other sinks throughout the building.

#### 15.3.3. Sanitary Sewer

- A sanitary sewer will be piped to all the plumbing fixtures and equipment located within the building.

15.3.4. No plumbing scope is anticipated for Retail Vendor Carts.

### 15.4. Animal Holding

#### 15.4.1. Water

- Water will be provided at each plumbing fixture and pieces of equipment requiring water. Typically, in holding buildings there will be hose bibbs for washdown, a sink for animal food preparation, and water connected to the animal drinkers.
- The animal drinkers will have a backflow preventer connected upstream from them.
- Reclaimed water will potentially be piped to hose bibbs.

- A storage type electric water heater will be provided for sinks. Should there only be a single sink, an instantaneous electric water heater located under the fixture will be utilized instead of the tank type heater.

15.4.2. Sanitary Drainage

- A sanitary system will be connected to all plumbing fixtures and equipment within the building.
- Drains will be located/coordinated based on the type of animal it serves. Some holding pens/stall will not have drains in them, but instead directly outside of them in the keeper corridor. Others will have drains within the pen/stall.
- Some holding areas will be provided with solids interceptors to prevent items such as animal bedding (straw and/or saw dust) from entering the sewer system.
- The requirements for covered animal areas are being confirmed with the Authority Having Jurisdiction (AHJ).

15.5. Area Development

15.5.1. Food Carts

- The food cart could either be permanently installed or it can be movable.
- Domestic water will connect to the food cart via an in-ground yard hydrant. This hydrant will be located in a valve box located under the cart. It will be freeze-less style.
- A point-of-use electric water heater will be provided for a hand sink within the Food Cart. This shall be integral to the food cart and will not be reflected on the plumbing drawings.
- An in-ground box with lid, similar to a floor sink, will be used for the sanitary drainage. Once the food cart is in place, the waste hose from the sink will be dropped into the box for drainage. As this trap will be located within the frost depth, the piping shall be 'winterized' by blowing out the trap out with compressed air. A temporary plug can then be put in the tailpiece.
- The food cart will be hard plumbed for both water and sanitary to the civil piping utilities where required.

15.6. General and Support Buildings/Areas

15.6.1. Water

- Water will be plumbed to all plumbing fixtures throughout the building to include toilet rooms, break rooms, and hose bibbs/wall hydrants.

- A storage type electric water heater will be provided for lavatories (hand sinks) in toilet rooms and other sinks throughout the building provided with a hot water circulation system.
- Reclaimed water will be piped to flush valves on water closets and urinals.

15.6.2. Sanitary Sewer

- A sanitary sewer will be piped to all of the plumbing fixtures and equipment located within the building.

16. **Building Space Requirements**

- 16.1. The floor plans below identify the space requirements for the larger buildings. These are in addition to that for the medical gases shown in an image above.

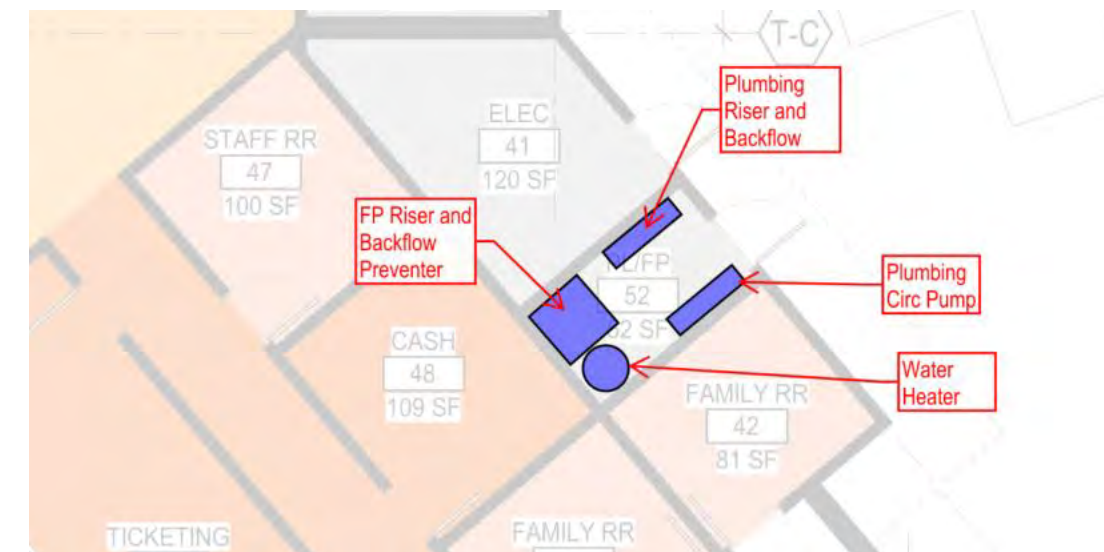


FIGURE 4: ENTRY BUILDING PLUMBING EQUIPMENT



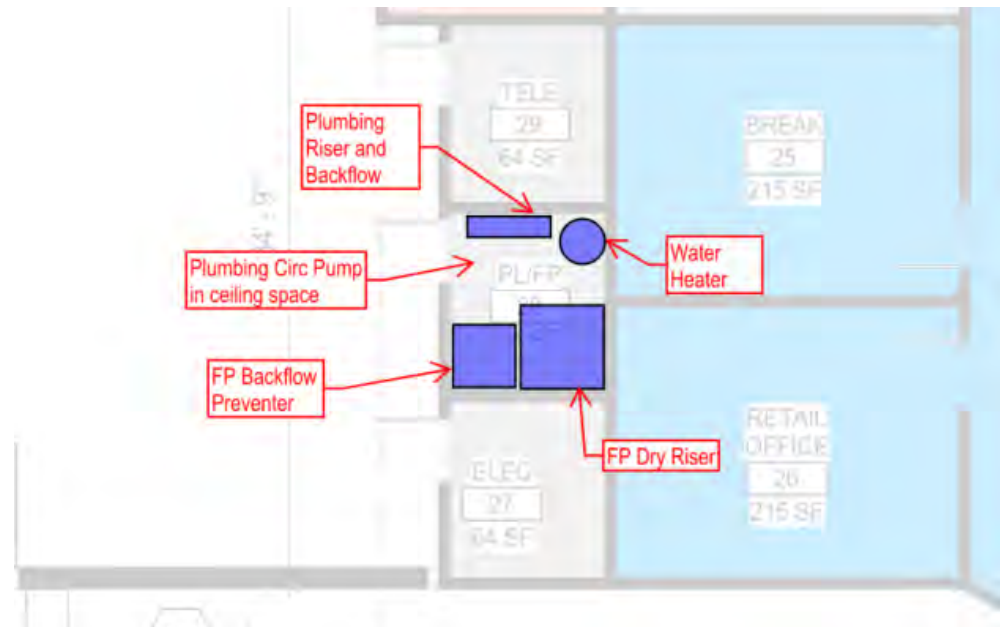


FIGURE 5: ENTRY BUILDING PLUMBING EQUIPMENT

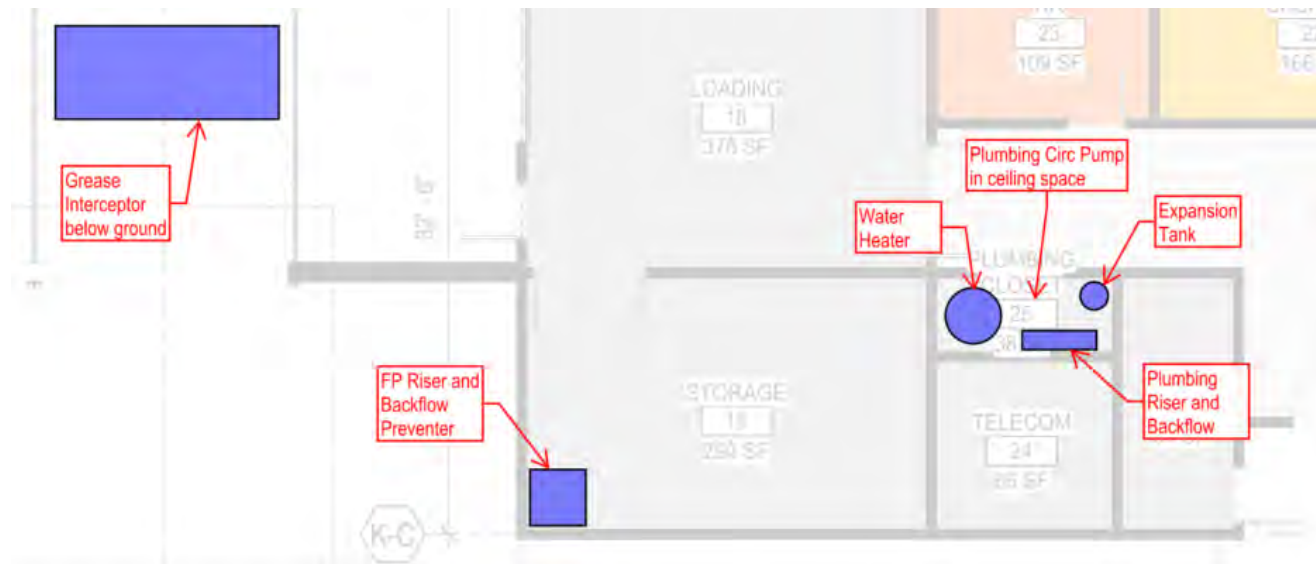


FIGURE 6: LODGE BUILDING PLUMBING EQUIPMENT

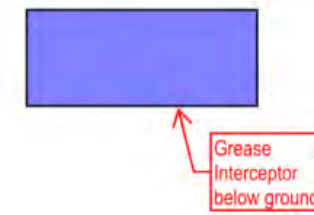
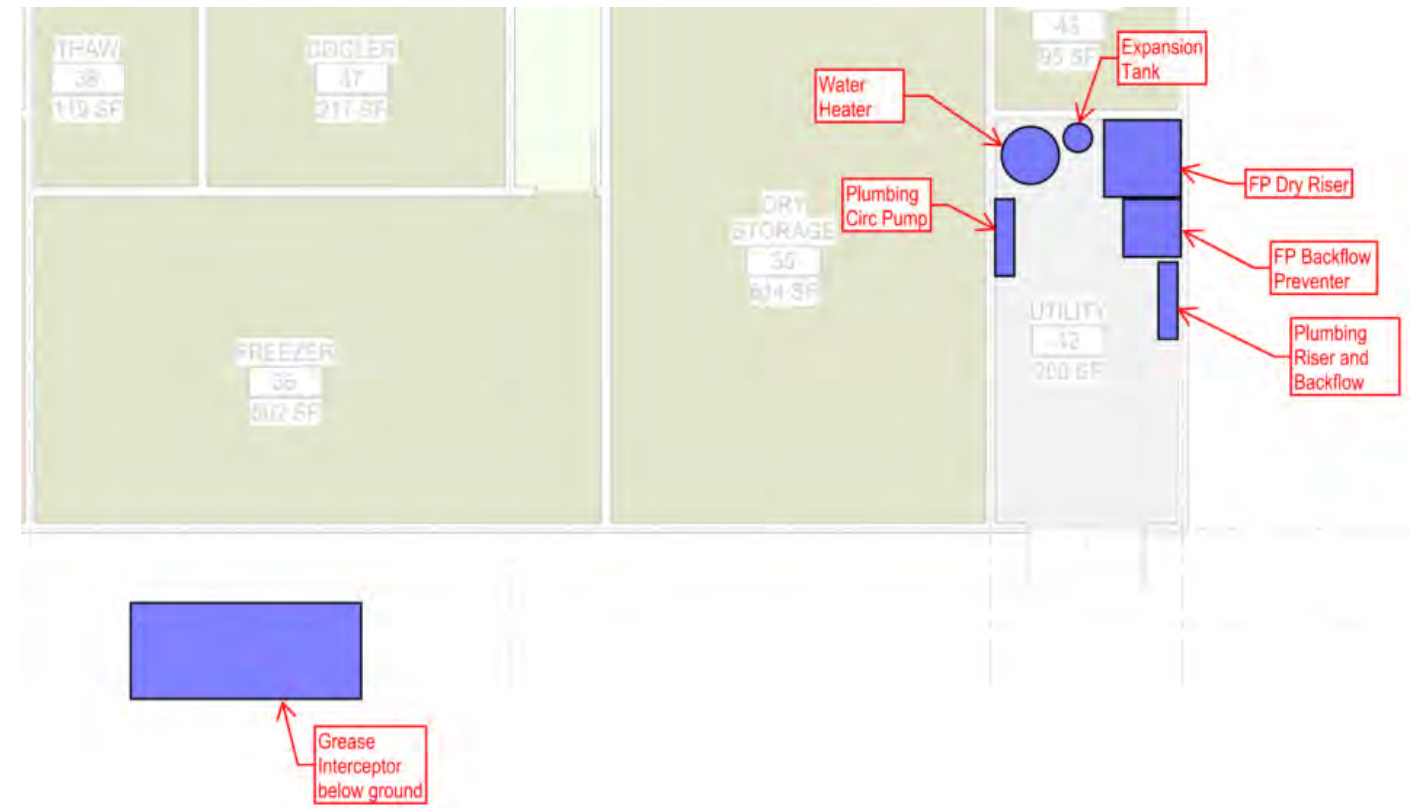


FIGURE 7: ANIMAL CARE BUILDING PLUMBING EQUIPMENT

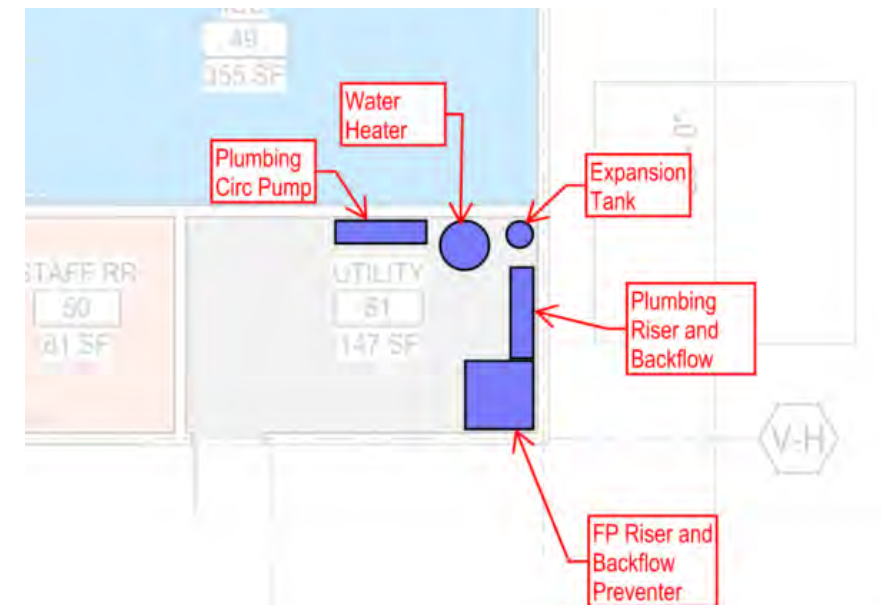


FIGURE 8: ANIMAL CARE BUILDING PLUMBING EQUIPMENT



**17. Overall Project Loads**

17.1. The chart below identifies the estimated loads for the entire project.

	ELECTRICAL DEMAND		TOTAL WATER DEMAND			SANITARY WASTE WATER DEMAND
	NORMAL CONNECTED KW	NORMAL DEMAND KW	POTABLE WATER (GALLONS PER DAY) WITHOUT FUTURE LSS RECOVERY	POTABLE WATER (GALLONS PER DAY) WITH FUTURE LSS RECOVERY	RECLAIMED WATER (GALLONS PER DAY)	WASTE WATER (GALLONS PER DAY)
<b>Phase 1A &amp; 1B Total</b>	4,370	3,059	45,852	45,852	91,040	43,284
<b>Phase 1C, 2-4 Total</b>	5,774	7,100	127,921	40,167	58,193	126,187
<b>OVERALL TOTAL</b>	<b>10,144</b>	<b>7,100</b>	<b>173,773</b>	<b>86,019</b>	<b>149,233</b>	<b>169,471</b>

Breakdown of the above water numbers include the following:

	LSS		FLUSHING WATER (GALLONS PER DAY)	WASHDOWN		LANDSCAPE IRRIGATION (GALLONS PER DAY)	PARKING AND STREET LANDSCAPE IRRIGATION (GALLONS PER DAY)
	WITHOUT RECOVERY (GALLONS PER DAY)	WITH RECOVERY (GALLONS PER DAY)		INDOOR (GALLONS PER DAY)	OUTDOOR (GALLONS PER DAY)		
<b>Phase 1A &amp; 1B Total</b>	13,746	13,746	12,530	5,108	19,411	38,698	32,931
<b>Phase 1C, 2-4 Total</b>	106,254	18,500	8,113	4,980	12,538	45,655	-
<b>OVERALL TOTAL</b>	<b>120,000</b>	<b>32,246</b>	<b>20,643</b>	<b>10,088</b>	<b>31,949</b>	<b>84,353</b>	<b>32,931</b>

- Notes:
1. Flushing Water is included in the Potable Total Demand.
  2. Indoor Washdown is included in the Potable Total Demand.
  3. Outdoor Washdown is included in the Reclaimed Total Demand.
  4. Irrigation is included in the Reclaimed Total Demand.
  5. The LSS recovery is only an option for the future phases. The current phases will not utilize recovery.

**18. Building Loads**

18.1. The charts below identify the estimated services for each building.

**Phase 1a and 1b**

BLDG #	BLDG Name	Water Demand GPM	Water Connect. Inches	Sewer Demand GPM	Sewer Connect. Inches	Storm Demand GPM	Storm Connect. Inches	Grease Trap Gallons
101	Guest Services/Restrooms/Ticketing	125	3	94	4	73	6	-
101	Retail	5	1	5	4	92	6	-
102	Education Entry Restrooms	150	3	113	6	8	3	-
103	The Lodge	150	3	113	6	187	8	2000
104	Events Pavilion	75	2.5	56		111	6	
201	Dwarf Mongoose Care Quarters	5	1	5	4	3	3	-
202	Giraffe Feeding Shelter Canopy	5	1	5	4	34	4	-
202	Giraffe Feeding Shelter Sales Room	150	3	113	6	2	3	-
203	Beer Garden Restrooms	150	3	113	6	12	3	-
204	Beer Service	15	1.25	15	4	4	3	-
205	Beer Service	15	1.25	15	4	4	3	-
206	Cheetah Care Quarters	5	1	5	4	28	4	-
207	Cheetah View Shelter	5	1	5	4	22	3	-
208	Fennec Fox Care Quarters	5	1	5	4	5	3	-
209	Lion View Shelter 1	5	1	5	4	41	4	-
210	Lion View Shelter 2	5	1	5	4	72	6	-
211	Meerkat Care Quarters	5	1	5	4	2	3	-
212	Rhino View Shelter 1	5	1	5	4	7	3	-
213	Rhino View Shelter 2	5	1	5	4	11	3	-
214	Rhino Encounter Shelter	5	1	5	4	14	3	-
215	Overnight Guest Duplex	8	1	8	4	14	3	-
215	Overnight Guest Duplex	8	1	8	4	14	3	-
215	Overnight Guest Duplex	8	1	8	4	14	3	-
216	Lion Care Quarters	5	1	5	4	50	4	-
217	Rhino Care Quarters	5	1	5	4	69	6	-
218	Giraffe Care Quarters	5	1	5	4	179	8	-
218	Overnight Guest Suite	8	1	8	4	22	3	-
219	Hoofstock Care Quarters	5	1	5	4	65	6	-
220	Savanna LSS	60	2.5	250	8	59	6	-
221	Walk In Browse Cooler							-
222	Hay Storage	5	1	5	-	8	3	-
223	Event Lawn Giraffe Feeding Shelter	5	1	5	4	2	3	-



BLDG #	BLDG Name	Water Demand GPM	Water Connect. Inches	Sewer Demand GPM	Sewer Connect. Inches	Storm Demand GPM	Storm Connect. Inches	Grease Trap Gallons
301	Flamingo LSS	60	2.5	250	8	22	3	
302	Flamingo Care Quarters/Brooder	5	1	5	4	34	4	-
303	Africa Aviary Care Quarters	5	1	5	4	9	3	-
304	Lvl 1: Vestibule	5	1	5	4	13	3	-
304	Lvl 2: Colobus Care Quarters	5	1	5	4	23	3	-
305	Okapi Care Quarters	5	1	5	4	34	4	-
306	Giant Tortoise Care Quarters	5	1	5	4	17	3	-
307	Multipurpose Room	125	3	94	4	16	3	-
307	Multipurpose Room	125	3	94	4	16	3	-
307	Multipurpose Room	125	3	94	4	16	3	-
308	Gelada LSS	60	2.5	250	8	17	3	
309	Klipsringer/Hyax Holding	5	1	5	4	7	3	-
310	Gelada View Shelter 2	5	1	5	4	23	3	-
311	Gelada View Shelter 1	5	1	5	4	20	3	-
312	Gelada Care Quarters	10	1.25	10	4	70	6	-
313	Train Depot	5	1	5	4	17	3	
314	Alligator Viewing Shelter 1	5	1	5	4	8	3	-
315	Alligator Viewing Shelter 2	5	1	5	4	8	3	-
316	Alligator & Sq. Monkey Care Quarters	5	1	5	4	25	3	-
317	Squirrel Monkey Viewing Shelter	5	1	5	4	16	3	-
318	Parrot Care Quarters	5	1	5	4	4	3	-
319	Play Area Restrooms & Lactation Room	150	3	113	6	10	3	-
320	Carousel Pavilion					23	3	
321	Lemur View Shelter 1	5	1	5	4	12	3	-
322	Lemur View Shelter 2	5	1	5	4	16	3	-
323	Lemur Care Quarters	5	1	5	4	25	3	-
324	Quarantine & Nutrition Center)	150	3	113	6	343	8	2000
701	Maintenance Shed/Shops	15	1.25	15	4	136	6	-
703	Containerized Fodder System					2	3	
703	Walk In Browse Cooler							-
703	Roof	5	1	5	4	23	3	-

BLDG #	BLDG Name	Water Demand GPM	Water Connect. Inches	Sewer Demand GPM	Sewer Connect. Inches	Storm Demand GPM	Storm Connect. Inches	Grease Trap Gallons
801	Admin Modular 1	125	3	94	4	0	3	-
801	Admin Modular 2	125	3	94	4	0	3	-
801	Admin Modular 3	125	3	94	4	0	3	-
801	Admin Modular 4	125	3	94	4	0	3	-
801	Admin Modular 5	125	3	94	4	0	3	-
801	Admin Modular 6	125	3	94	4	0	3	-
801	Restrooms - Prefabricated	150	3	113	6	16	3	-
802	Animal Staff Modular 1	125	3	94	4	0	3	-
802	Animal Staff Modular 2	125	3	94	4	0	3	-



Full Buildout

BLDG #	BLDG Name	Water Demand GPM	Water Connect. Inches	Sewer Demand GPM	Sewer Connect. Inches	Storm Demand GPM	Storm Connect. Inches	Grease Trap Gallons
105	Administration / Staff Support & Offices (2-stories)	125	3	94	4	74	6	-
401	Changing Exhibits	20	1.5	20	4	39	6	-
401	Otter Care Quarters & LSS	5	1	5	4	23	4	-
401	California Fresh Waters Indoor Exhibits	20	1.5	20	4	145	8	-
401	Beaver Care Quarters	5	1	5	4	9	3	-
402	Education & Classrooms	125	3	94	4	70	6	-
402	California Deserts Indoor Exhibits	20	1.5	20	4	47	6	-
403	Capybara Care Quarters	5	1	5	4	6	3	-
404	Grizzly Bear View Shelter	5	1	5	4	47	6	-
405	Bobcat Care Quarters	5	1	5	4	8	3	-
406	Restrooms - California	150	3	113	6	14	4	-
407	Food Kiosk	10	1.25	10	4	4	3	750
408	Big Horned Sheep Care Quarters	5	1	5	4	12	3	-
409	Rescue & Rehab Facility	50	2	38	4	86	8	-
410	Grizzly Bear Care Quarters & LSS	5	1	5	4	39	6	-
501	African Ape Viewing	5	1	5	4	31	6	-
502	Hippo Springs View Shelter	5	1	5	4	14	4	-
503	Hippo River View Shelter	5	1	5	4	19	4	-
504	Food & Restroom Kiosk	10	1.25	10	4	6	3	750
505	Overnight Arrival Building	50	2	38	4	16	4	-
505	Accommodation 1	8	1	8	4	2	3	-
505	Accommodation 2	8	1	8	4	2	3	-
505	Accommodation 3	8	1	8	4	2	3	-
505	Accommodation 4	8	1	8	4	2	3	-
505	Accommodation 5	8	1	8	4	2	3	-
505	Accommodation 6	8	1	8	4	2	3	-
505	Accommodation 7	8	1	8	4	2	3	-
506	Hippo Care Quarters	50	2	38	4	78	6	-
507	Hippo+Tiger Filtration	150	3	600	12	66	6	-
508	African Ape CQ	5	1	5	4	7	3	-
509	Wild Dog / Hyena CQ	5	1	5	4	29	4	-
510	Rhino Breeding / Hoofstock CQ	5	1	5	4	44	6	-

BLDG #	BLDG Name	Water Demand GPM	Water Connect. Inches	Sewer Demand GPM	Sewer Connect. Inches	Storm Demand GPM	Storm Connect. Inches	Grease Trap Gallons
601	Wallace Line Gallery Indoor Exhibits	20	1.5	20	4	148	8	-
601	Komodo Dragon/Red Panda C.Q.	5	1	5	4	11	3	-
602	Clouded Leopard Care Quarters	5	1	5	4	23	4	-
603	Tiger View Shelter	5	1	5	4	37	6	-
604	Tiger Care Quarters	5	1	5	4	27	4	-
605	Aviary Care Quarters 1	5	1	5	4	6	3	-
606	Restrooms - Asia	150	3	113	4	8	3	-
606	Aviary Viewing Shelters	5	1	5	4	23	4	-
606	Food Kiosk	10	1.25	10	4	4	3	750
607	North Water Recovery	60	2.5	250	8	37	6	-
608	Asian Ape View Shelter	5	1	5	4	16	4	-
609	Asian Ape Care Quarters	5	1	5	4	58	6	-
610	Cassowary Care Quarters	5	1	5	4	2	3	-
611	Australian Aviary Care Quarters	5	1	5	4	2	3	-
612	Clouded Leopard View Shelter	5	1	5	4	11	3	-
702	Maintenance Shed/Shops	15	1.25	15	4	66	6	-
705	Greenhouse 2	50	2	38	4	30	6	-
706	Greenhouse 1	50	2	38	4	30	6	-
707	Event Storage	-	-	-	-	-	-	-



FIRE PROTECTION ENGINEERING  
BASIS OF DESIGN  
SCHEMATIC DESIGN SUBMISSION  
OCTOBER 6, 2023  
FOR PRICING  
NEW ZOO AT ELK GROVE



**1. Executive Summary**

1.1. The fire protection systems in each building will be designed as indicated below. Depending on the requirements of each building, as outlined in the Component Specific Details section, not every building will be provided with every service.

**2. Applicable Codes, Guidelines and Standards**

1.1. The fire protection systems will be designed in accordance with all applicable codes, guidelines, and standards as noted below.

1.1.1. 2022 California Building Code

1.1.2. 2022 California Fire Code

1.1.3. Local building and fire protection ordinances and adopted revisions to the codes

1.1.4. NFPA Standards

- NFPA 1 – Fire Code
- NFPA 13 – Standard for the Installation of Sprinkler Systems.
- NFPA 14 – Standard for the Installation of Standpipe and Hose Systems
- NFPA 20 – Standard for the installation of Stationary Pumps for Fire Protection
- NFPA 22 – Standard for Water Tanks for Private Fire Protection
- NFPA 24 – Standard for the Installation of Private Fire Service Mains and Their Appurtenances
- NFPA 25 – Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems.
- NFPA 72 – National Fire Alarm Code.
- NFPA 101 – Life Safety Code

2.1.1. NFPA 2001 – Clean Agent Fire Extinguishing Systems

**3. Design Criteria**

3.1. Seismic requirements: This project is in seismic design category D. Equipment shall be seismically braced, and systems shall be seismically supported as required per code.

3.2. All areas of the facility will be designated with an occupancy hazard classification (light hazard thru extra hazard Group II) in accordance with NFPA 13.

3.3. All design densities and hazard classifications will have to be reviewed with insurance company for compliance. Design densities and hazard classifications are subject to change.

3.4. Building areas such as the lobby, animal viewing areas, lounge, restaurant seating areas, and meeting rooms are classified as light hazard. Fitness area, restaurant service areas, kitchen, animal housing areas and mechanical/electrical equipment rooms are classified as Ordinary Hazard Group 1. Loading dock, storage and retail, are classified as Ordinary Hazard Group 2.

3.5. Areas designated as light hazard will be hydraulically designed for the operation of 1,500 square feet at 0.10 gpm/sq.ft. to provide a minimum flow of approximately 22.5 gpm per sprinkler. The hose stream allowance shall be 100 gpm with a minimum water supply duration of 30 minutes.

3.6. Areas designated as ordinary hazard group 1 will be hydraulically designed for the operation of 1,500 square feet at 0.15 gpm/sq.ft. to provide a minimum flow of approximately 19.5 gpm per sprinkler. The hose stream allowance shall be 250 gpm with a minimum water supply duration of 60 minutes.

3.7. Areas designated as ordinary hazard group 2 will be hydraulically designed for the operation of 1,500 square feet at 0.20 gpm/sq.ft. to provide a minimum flow of approximately 26.0 gpm per sprinkler. The hose stream allowance shall be 250 gpm with a minimum water supply duration of 60 minutes.

3.8. Areas designated as extra hazard group 1 will be hydraulically designed for the operation of 2,500 square feet at 0.30 gpm/sq.ft. to provide a minimum flow of approximately 30.0 gpm per sprinkler. The hose stream allowance shall be 500 gpm with a minimum water supply duration of 90 minutes.

3.9. Sprinkler service mains and risers shall include exterior PIV with tamper switch, and fire department connections

**4. Quality Level**

4.1. Equipment selection, specification and installation practices will reflect a commitment to long term longevity of system, ease of maintenance and energy efficiency.

4.2. All equipment and material used will be listed for Fire Protection use by UL.

4.3. The intended level of quality of all wiring devices will be specification commercial grade.

4.4. Proposed manufacturers of major equipment will be as indicated below.

TABLE 1: PROPOSED MANUFACTURERS

Equipment	Manufacturers
Sprinklers	Viking, Reliable, Tyco, Globe
Sprinkler Piping	Allied, Wheatland, Bullmoose
Fittings	Victaulic, Anvil, Ward
Valves	NIBCO, Milwaukee, Grinnell, Victaulic
Fire Hose Valves	Potter-Roemer, Elkhart Brass, Croker, American Fire Hose Cabinet Co.
Dry Riser Assemblies	Viking, Victaulic, Reliable, Tyco, Total PAC
Fire Alarm Devices	System Sensor, Notifier, Siemens, Simplex

**5. Systems and Equipment**

5.1. Wet Sprinkler Systems

5.1.1. System Description

- Each building will be protected throughout with hydraulically calculated sprinkler systems which, except for special protection needs, will be wet pipe systems. All areas of the buildings will be protected, including electrical rooms (switchgear, transformers, generators, closets, etc.), and mechanical rooms. Sprinkler protection may be omitted for electrical rooms and vaults with 2 hour rated enclosures that comply with NFPA 13.

5.1.2. System Design Criteria

- The sprinkler system for each building will be designed and installed in accordance with NFPA 13 and local requirements.
- The water supply requirements for the sprinkler system shall be determined using hydraulic calculations based on the density/area method of NFPA 13. All systems will be hydraulically calculated with a computer calculation program using the Hazen-Williams method.
- The system demand will be based on the most remote area for the most demanding building hazard. The following design densities will be used for each hazard classification:

TABLE 2: WET-PIPE SPRINKLER SYSTEM DESIGN DENSITIES

Hazard Classification	Design Density, gpm per sq. ft.	Minimum Remote Area, sq. ft.
Light Hazard	0.10	1,500
Ordinary Hazard, Group 1	0.15	1,500
Ordinary Hazard, Group 2	0.20	1,500
Extra Hazard, Group 1	0.30	2,500

5.1.3. Distribution

- A minimum of one sprinkler system zone will be provided per floor level. Maximum wet-pipe sprinkler system protection area is 52,000 sq. ft. per zone.
- Additional sprinkler zones may be provided as required to ensure sprinkler zones match fire alarm system / smoke zones.

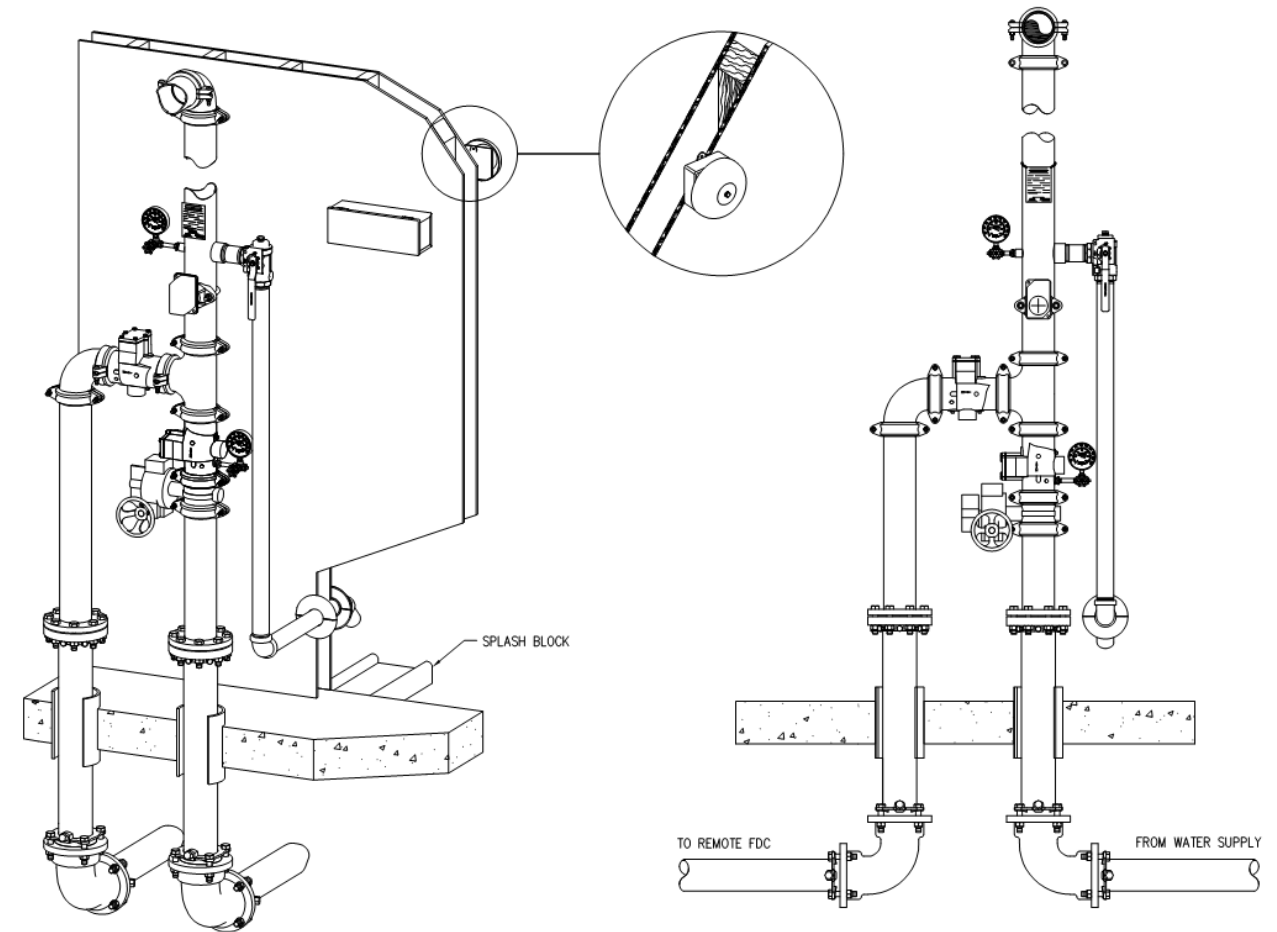


FIGURE 1: TYPICAL SPRINKLER RISER

- The piping for the wet pipe sprinkler system will be black steel. Piping 2" and smaller in size will be Schedule 40 with threaded joints. Piping larger than 2" will be Schedule 10 with welded or rolled groove couplings or Schedule 40 with welded or threaded couplings.
- All sprinklers will be of quick response type if available for the application. The type of sprinkler used in specific areas will be selected by EXP and the Architect. Concealed sprinklers will be installed in areas of high visibility and quality of finishes. Recessed sprinklers will be installed in areas with suspended ceilings. Pendent or upright sprinklers will be installed in areas without ceilings. Upright sprinklers will be installed in parking levels. Sidewall sprinklers will be used only when other types cannot be used.
- Intermediate temperature sprinklers will be installed in elevator machine rooms, mechanical rooms, electrical rooms, exterior locations, kitchens and near heat sources.
- Sprinkler protection is typically required at the bottom and top of each elevator hoist way

per NFPA 13. However, enclosed, non-combustible elevator shafts that do not contain combustible hydraulic fluid shall not require the sprinkler at the bottom of the hoist way. In addition, the sprinkler at the top of the hoist way is permitted to be omitted where hoist way for passenger elevators is noncombustible or limited-combustible and the car enclosure materials meet the requirements of ASME A17.1, Safety Code for Elevators and Escalators.

## 5.2. Dry Sprinkler Systems

### 5.2.1. System Description

- Areas where freezing may occur will be protected with a dry sprinkler system. Dry pendent or sidewall sprinklers may be used on the wet system where appropriate in lieu of a dry system. A dry pipe system will be required for protection of the Porte cochere and entry canopy area.

### 5.2.2. System Design Criteria

- Dry sprinkler systems will be designed and installed in accordance with NFPA 13. All systems will be hydraulically calculated with a computer calculation program using the Hazen-Williams method (or Darcy-Weisbach where applicable based on size of system).
- The system demand will be based on the most remote area for the most demanding building hazard. For dry-pipe systems, the area of sprinkler operation shall be increased by 30% without revising the design density. The following design densities will be used for each hazard classification:

TABLE 3: DRY-PIPE SPRINKLER SYSTEM DESIGN DENSITIES

Hazard Classification	Design Density, gpm per sq. ft.	Minimum Remote Area, sq. ft.
Light Hazard	0.10	1,950
Ordinary Hazard, Group 1	0.15	1,950
Ordinary Hazard, Group 2	0.20	1,950
Extra Hazard, Group 1	0.30	3,250

- The pipe sizing for the systems will be as required to satisfy the hydraulic demand with a minimum safety factor of 10 psi.

### 5.2.3. Distribution

- A 4ft x 4ft room will be required to house the dry pipe valve for each zone. Dry-pipe valve room shall be heated or constructed such that temperature of room is maintained above 40 degrees Fahrenheit. All system valving, switches and drains will be located in this room.



FIGURE 2: TYPICAL DRY-PIPE VALVE ASSEMBLY

- The piping for the dry sprinkler system will be black steel. Piping 2" and smaller in size will be Schedule 40 with threaded joints. Piping larger than 2" will be Schedule 10 with welded or rolled groove couplings or Schedule 40 with welded or threaded couplings.
- Subject to fire department approval, sprinkler protection for exterior projections may be permitted to be omitted where the canopy is constructed with materials that are noncombustible, limited-combustible, or fire retardant-treated wood as defined in NFPA 703, and provided the area below the canopy is not used for storage of combustible materials such as combustible furniture below canopy for occupant use.

## 5.3. Fire Service

5.3.1. A fire flow test will be required to determine the available water flow rate and pressures from the public waterworks system.

### 5.3.2. Equipment and Material

- A 4" fire bulk supply main will supply water to each building.
- Tamper switches shall be provided on all valves. The sprinkler system will be monitored by the building's fire alarm system per NFPA 72. An alarm bell shall be provided at an





accessible location on the outside wall. All components will be UL listed for the application.

- One 5" Storz or one 4-way Siamese fire department connections shall be provided for each building over 2000 SQ FT. FDCs shall be sited at an accessible location as approved by the AHJ. FDCs are required to be located at a maximum of 100-feet from the nearest fire hydrant.
- All components will be UL listed for the application and for system maximum working pressures.

5.3.3. Distribution

- Inside the building, the piping will be Schedule 40 with flanged or welded joints or Schedule 10 with roll-grooved couplings.

**6. Corrosive Environments**

6.1. Corrosive environments are those in which the air or water quality is such that accelerated degradation of the system components are likely. Corrosive environments and corrosive services shall utilize piping and supports that will not corrode or oxidize due to the environment in which they are located nor due to the fluid contained within the piping. These locations include:

6.1.1. Fountain piping services

6.1.2. Outdoors or any areas exposed to environmental conditions.

6.2. All piping in corrosive environments shall be epoxy coated

6.3. All sprinklers in exterior corrosive areas shall have nickel coating.

6.4. All piping services in corrosive environments utilizing flanged connections shall be provided with 316L stainless steel hardware including bolts, nuts and washers.

6.5. All piping supports, and hangers shall be 316L stainless steel

**7. Testing Criteria**

7.1. Sprinkler System

7.1.1. The contractor will notify the authority having jurisdiction and Owner's representative of the time and date of the test.

7.1.2. The contractor will test the piping systems as per NFPA. The sprinkler piping shall be isolated and tested at 200 psi or 50 psi over the system working pressure, whichever is greater for two hours.

**8. Appendix**

**Appendix A: Estimated Fire Protection Requirements – Phase 1a and 1b**

BLDG #	BLDG Name	Fire Sprinkler Demand GPM	Fire Sprinkler Connect. Inches
101	Guest Services/Restrooms/Ticketing	650	4
101	Retail		
102	Education Entry Restrooms	650	4
103	The Lodge	650	4
104	Events Pavilion	650	4
201	Dwarf Mongoose Care Quarters		
202	Giraffe Feeding Shelter Canopy		
202	Giraffe Feeding Shelter Sales Room		
203	Beer Garden Restrooms	650	4
204	Beer Service		
205	Beer Service		
206	Cheetah Care Quarters		
207	Cheetah View Shelter		
208	Fennec Fox Care Quarters		
209	Lion View Shelter 1		
210	Lion View Shelter 2		
211	Meerkat Care Quarters		
212	Rhino View Shelter 1		
213	Rhino View Shelter 2		
214	Rhino Encounter Shelter		
215	Overnight Guest Duplex	650	4
215	Overnight Guest Duplex	650	4
215	Overnight Guest Duplex	650	4
216	Lion Care Quarters	650	4
217	Rhino Care Quarters	650	4
218	Giraffe Care Quarters	650	4
218	Overnight Guest Suite	650	4
219	Hoofstock Care Quarters	650	4
220	Savanna LSS		
221	Walk In Browse Cooler		
222	Hay Storage	650	4
223	Event Lawn Giraffe Feeding Shelter		



Estimated Fire Protection Requirements – Phase 1a and 1b (Con'd)

BLDG #	BLDG Name	Fire Sprinkler Demand GPM	Fire Sprinkler Connect. Inches
301	Flamingo LSS		
302	Flamingo Care Quarters/Brooder		
303	Africa Aviary Care Quarters		
304	Lvl 1: Vestibule		
304	Lvl 2: Colobus Care Quarters		
305	Okapi Care Quarters		
306	Giant Tortoise Care Quarters		
307	Multipurpose Room	650	4
307	Multipurpose Room		
307	Multipurpose Room		
308	Gelada LSS		
309	Klipspringer/Hyax Holding		
310	Gelada View Shelter 2		
311	Gelada View Shelter 1		
312	Gelada Care Quarters		
313	Train Depot		
314	Alligator Viewing Shelter 1		
315	Alligator Viewing Shelter 2		
316	Alligator & Sq. Monkey Care Quarters		
317	Squirrel Monkey Viewing Shelter		
318	Parrot Care Quarters		
319	Play Area Restrooms & Lactation Room	650	4
320	Carousel Pavilion		
321	Lemur View Shelter 1		
322	Lemur View Shelter 2		
323	Lemur Care Quarters		
324	Quarantine & Nutrition Center)	650	4
701	Maintenance Shed/Shops	650	4
703	Containerized Fodder System		
703	Walk In Browse Cooler		
703	Roof		

Estimated Fire Protection Requirements – Phase 1a and 1b (Con'd)

BLDG #	BLDG Name	Fire Sprinkler Demand GPM	Fire Sprinkler Connect. Inches
801	Admin Modular 1	650	4
801	Admin Modular 2	650	4
801	Admin Modular 3	650	4
801	Admin Modular 4	650	4
801	Admin Modular 5	650	4
801	Admin Modular 6	650	4
801	Restrooms - Prefabricated	650	4
802	Animal Staff Modular 1	650	4
802	Animal Staff Modular 2	650	4



Appendix B: Estimated Fire Protection Requirements – Full Buildout

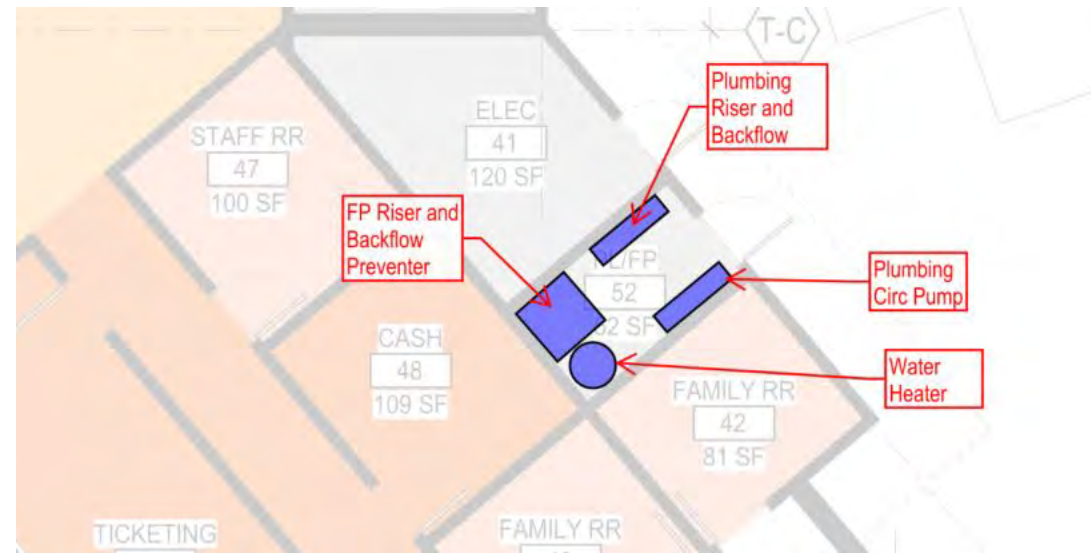
BLDG #	BLDG Name	Fire Sprinkler Demand GPM	Fire Sprinkler Connect. Inches
105	Administration / Staff Support & Offices (2 stories)	650	4
401	Changing Exhibits	650	4
401	Otter Care Quarters & LSS		
401	California Fresh Waters Indoor Exhibits	650	4
401	Beaver Care Quarters		
402	Education & Classrooms	650	4
402	California Deserts Indoor Exhibits	650	4
403	Capybara Care Quarters		
404	Grizzly Bear View Shelter		
405	Bobcat Care Quarters		
406	Restrooms - California		
407	Food Kiosk		
408	Big Horned Sheep Care Quarters		
409	Rescue & Rehab Facility	650	4
410	Grizzly Bear Care Quarters & LSS		
501	African Ape Viewing		
502	Hippo Springs View Shelter		
503	Hippo River View Shelter		
504	Food & Restroom Kiosk		
505	Overnight Arrival Building	650	4
505	Accommodation 1		
505	Accommodation 2		
505	Accommodation 3		
505	Accommodation 4		
505	Accommodation 5		
505	Accommodation 6		
505	Accommodation 7		
506	Hippo Care Quarters		
507	Hippo+ Tiger Filtration		
508	African Ape CQ	650	4
509	Wild Dog / Hyena CQ		
510	Rhino Breeding / Hoofstock CQ	650	4

Estimated Fire Protection Requirements – Full Buildout (Con'd)

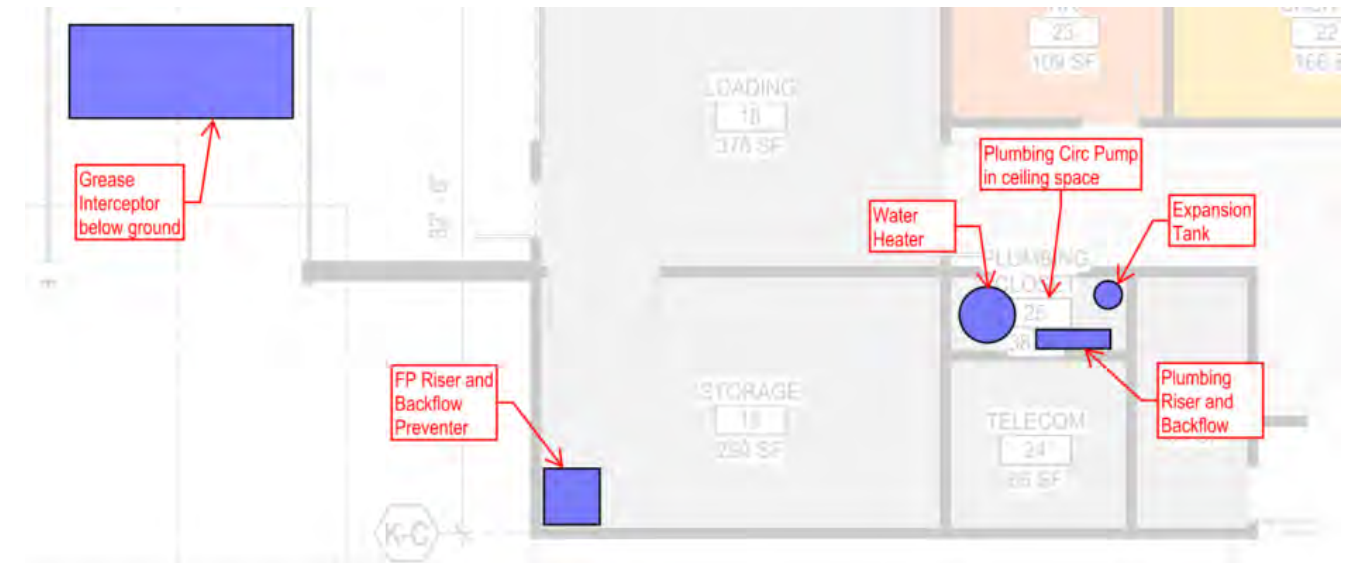
BLDG #	BLDG Name	Fire Sprinkler Demand GPM	Fire Sprinkler Connect. Inches
601	Wallace Line Gallery Indoor Exhibits	650	4
601	Komodo Dragon/Red Panda C.Q.		
602	Clouded Leopard Care Quarters		
603	Tiger View Shelter		
604	Tiger Care Quarters		
605	Aviary Care Quarters 1		
606	Restrooms - Asia		
606	Aviary Viewing Shelters		
606	Food Kiosk		
607	North Water Recovery		
608	Asian Ape View Shelter		
609	Asian Ape Care Quarters	650	4
610	Cassowary Care Quarters		
611	Australian Aviary Care Quarters		
612	Clouded Leopard View Shelter		
702	Maintenance Shed/Shops	650	4
705	Greenhouse 2		
706	Greenhouse 1		
707	Event Storage	650	4

**Appendix C: Building Space Requirements**

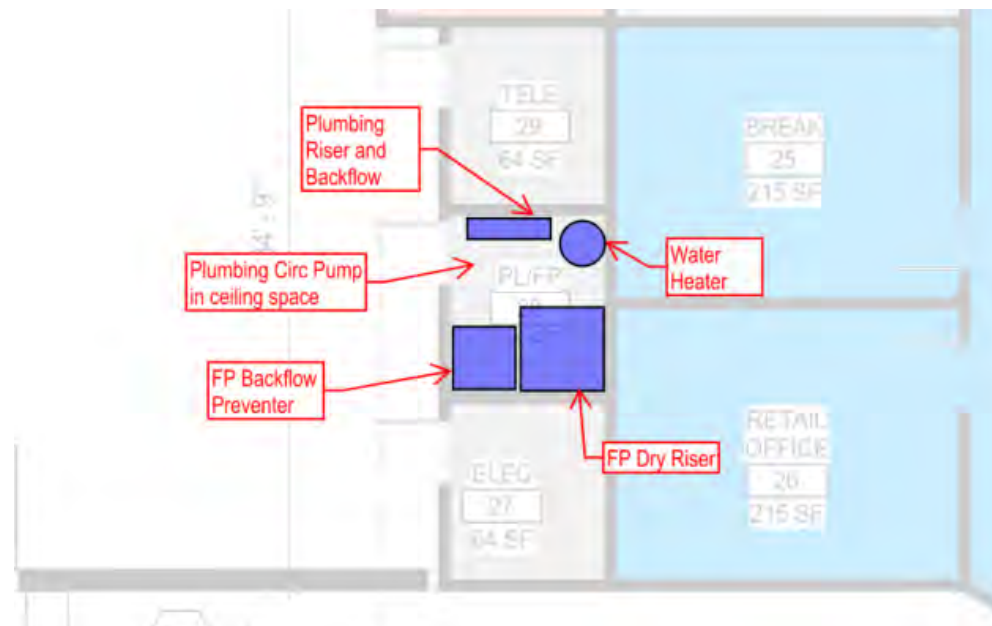
Entry Building – Fire Protection Equipment:



Lodge Building – Fire Protection Equipment:

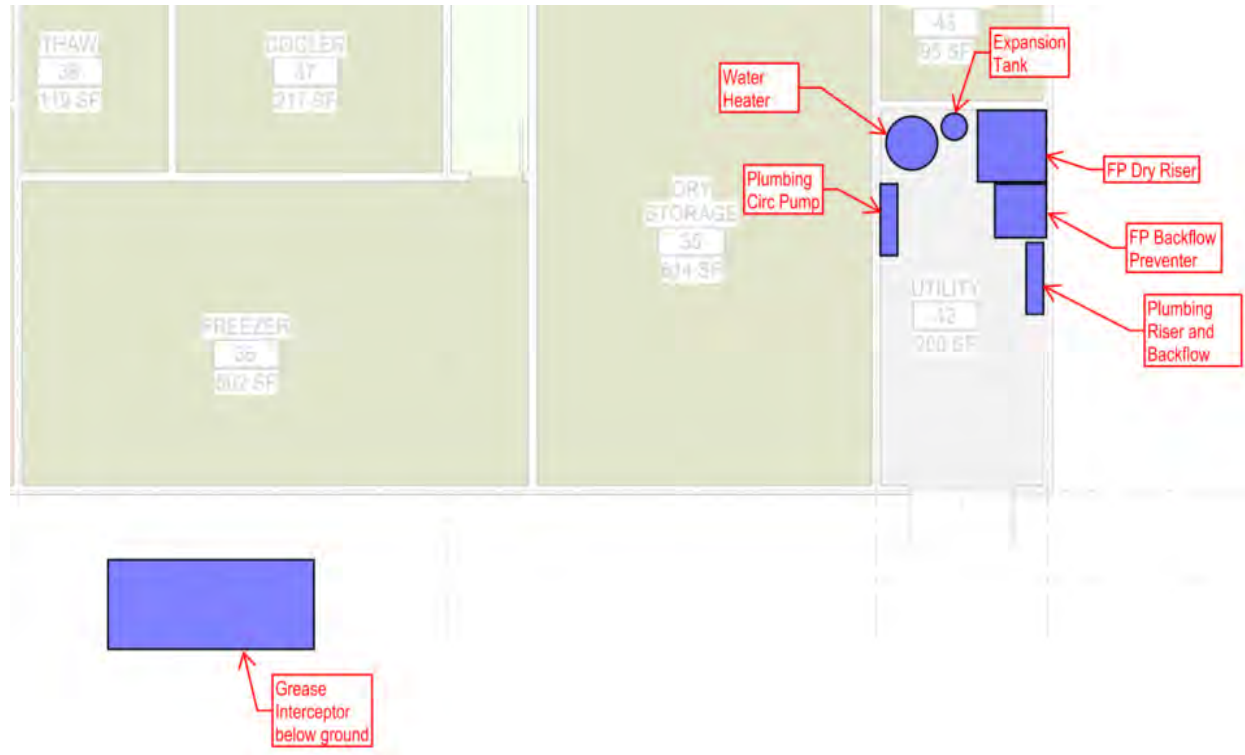


Entry Building – Fire Protection Equipment:

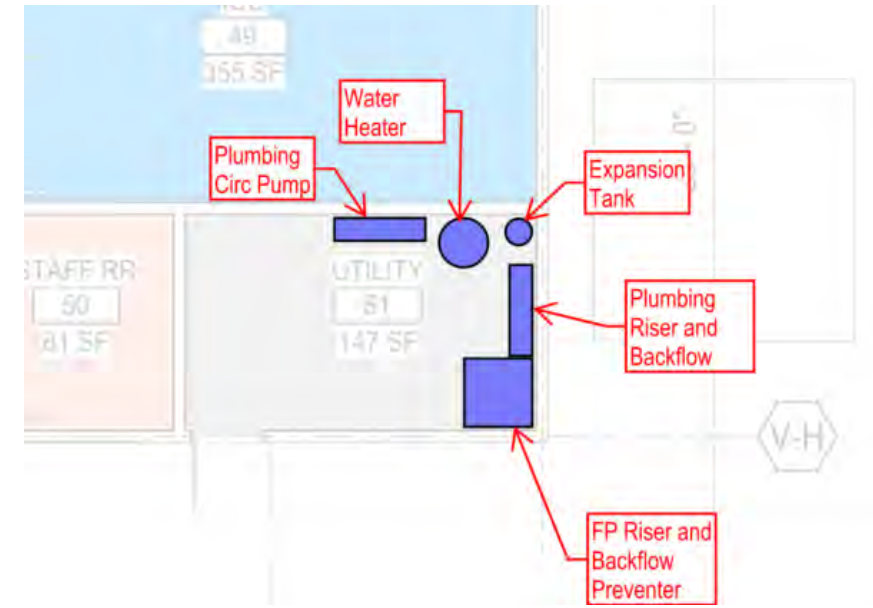


**Appendix D: Building Space Requirements (Continued)**

Animal Care Building – Fire Protection Equipment:



Animal Care Building – Fire Protection Equipment:





TECHNOLOGY DESIGN  
BASIS OF DESIGN  
SCHEMATIC DESIGN SUBMISSION  
OCTOBER 6, 2023  
NEW ZOO AT ELK GROVE



## 1. Executive Summary

- 1.1. The Technology Design scope of work shall be comprised of the Structured Cabling Systems (SCS), Backbone and horizontal cabling design and specification.
- 1.2. The systems included in the Technology Design scope of work shall support the operational needs of the facility. This shall be completed by providing available, robust, and flexible systems that allow for moves, additions and changes to each system while minimizing the operational impact to the facility (downtime).
- 1.3. The systems included in the Technology Design scope of work shall be designed to support both phase 1 and phase 2 of the project. The construction of phase 2 shall have no impact on the operation of phase 1.

## 2. Applicable Codes, Guidelines & Standards

- 2.1. Design will conform to the following Codes, Standards and Guidelines. Where differences arise between any Code, Standard or Guideline, Codes shall prevail. In all cases, where an edition number is not indicated, the current accepted edition will be used.
  - 2.1.1. 2022 California Building Code
  - 2.1.2. NFPA 70 2014 Edition (National Electrical Code)
  - 2.1.3. ANSI/TIA Standards
  - 2.1.4. IEEE Standards
  - 2.1.5. ISO/IEC Standards
  - 2.1.6. BICSI Standards
- 2.2. Equipment selections will be from manufacturers whose products comply will current industry accepted design and testing standards.

## 3. Telecommunications Utilities Routing

- 3.1. Park Wide Incoming Utilities
  - 3.1.1. The primary incoming communication utility connections shall be routed to building 1.1.1, Administration / Staff Support & Offices, for connection to the primary Campus MDF. This utility connection shall be routed through dedicated conduit from the utility right of way to the building main point of entry.
- 3.2. Distribution Duct Bank
  - 3.2.1. A distribution duct bank shall provide a pathway for the fiber optic backbone cabling. The distribution duct bank shall connect to the Campus MDF at two geographically separate locations. The distribution duct bank shall follow the same routing around the perimeter service road as other utilities.

- 3.2.2. The distribution duct shall consist of two (2) 4" conduits routed at a minimum of 24" below finished grade.
- 3.2.3. The primary fiber optic backbone shall consist of a single 288-Strand Single Mode Outside plant rollable ribbon fiber optic cable.

## 4. Telecommunications Equipment Rooms

- 4.1. Park Wide Systems Equipment Room (PSER)
  - 4.1.1. The PSERs shall serve as distribution points for voice, data, audio, video, IPTV, and security systems transitioning between backbone fiber optic cabling and horizontal fiber optic cabling.
  - 4.1.2. PSERs shall be located within buildings identified as node building and provided with fiber optic connections to the primary fiber optic backbone loop.
  - 4.1.3. PSERs shall be located as close as possible to the back side of facility where maintenance access has least impact on operational impact.
  - 4.1.4. PSERs shall have interior dimensions of 150 square feet dedicated for the use of distribution equipment. The PSER shall easily fit 2 cabinets.
  - 4.1.5. Ceiling height shall not be below 10 feet.
  - 4.1.6. Fire sprinklers and water/liquid source pipes shall not be run over PSER
  - 4.1.7. PSERs shall be provided with a single 36-inch, 8-foot tall, metal, weather tight door with no windows.
- 4.2. Intermediate Data Frame (IDF)
  - 4.2.1. IDF rooms shall be utilized when a facility is too large for a single PSER to reach all areas of the facility due to cable distance limitations.
  - 4.2.2. IDFs shall have interior dimensions of 120 square feet dedicated for the use of distribution equipment. The IDF shall easily fit 1 cabinet.
  - 4.2.3. IDFs shall have cameras monitoring room entrance and each cabinet row.
  - 4.2.4. Ceiling height shall not be below 10 feet.
  - 4.2.5. Fire sprinklers and water/liquid source pipes shall not be run over IDF.
  - 4.2.6. IDFs shall be provided with a single 36-inch, 8-foot tall, metal, weather tight door with no windows.
- 4.3. Electrical
  - 4.3.1. The electrical panel serving each PSERs shall be dedicated exclusively to the equipment located in the ER/TR being served.



- 4.3.2. Telecommunications equipment mounted in equipment racks typically requires 30A, 120V circuits.
- 4.3.3. PSERs shall be supplied with both 120v and 208v
- 4.3.4. Convenience power receptacles shall be located throughout each PSER shall be located on a shared 20A, 120V circuit.
- 4.3.5. A minimum equivalent of 50 foot-candles as measured from 36 inches above finished floor (AFF) shall be provided.
- 4.3.6. PSERs with 10 or more cabinets shall have room level UPS, rooms with less than 10 cabinets shall have UPS in each cabinet.
- 4.3.7. Life safety equipment shall have 20 minutes of UPS power if backed by a generator and 1 hour of UPS if there is no generator.

#### 4.4. Mechanical

- 4.4.1. The HVAC system shall maintain the temperature of the room at 61-81 degrees Fahrenheit +/- with a relative humidity between 40-55%.
- 4.4.2. Maintain positive pressure with a minimum of one air change per hour in each PSER.
- 4.4.3. All HVAC equipment serving PSER's shall be backed up by generator power.
- 4.4.4. The atmosphere within each PSER shall be dust-free.

### 5. Structured Cabling System (SCS)

- 5.1. The Structured Cabling System shall provide a structured information transportation environment designed for efficient adaptation to constantly changing connectivity requirements.
- 5.2. Backbone / Riser Cabling
  - 5.2.1. The backbone/ riser structured cabling system shall provide high bandwidth connectivity between PSERs.
  - 5.2.2. Optical Fiber Cabling
    - 5.2.2.1. All outside plant backbone optical fiber shall be rollable ribbon OSP cabling.
    - 5.2.2.2. All inside plant riser optical fiber cabling shall be tight buffered cabling.
    - 5.2.2.3. Single mode optical fiber cabling shall be 9/125µm (OS1) cabling terminated on LC style duplex connectors.
  - 5.2.3. Copper Cabling

- 5.2.3.1. Copper cabling shall be Category 3 unshielded twisted pair (UTP) multi-pair cabling. All backbone copper cabling shall be terminated on 8P8P modular jacks (1 pair per jack).

- 5.2.3.2. Backbone / Riser cabling shall be plenum rated cabling where required.

#### 5.3. Backbone/ Riser Cabling Allocations

- 5.3.1. PSER minimum connectivity shall be:

- 5.3.1.1. 12 Strands Single Mode Optical Fiber: 6 strand serving as the A-Link and 6 strands serving as the B-Link.

- 5.3.1.2. Each primary PSER link to the backbone fiber optic loop shall be provided with an A-Link traveling the loop clockwise to the Campus MDF and a B-Link traveling the loop counterclockwise to the campus MDF. Using this architecture each 12-Strand building connection shall occupy 6-strands of backbone fiber optic cable.

#### 5.4. Horizontal Cabling

- 5.4.1. Copper

- 5.4.1.1. The base horizontal copper data cabling shall consist of Category 6 4-Pair Unshielded Twisted Pair (UTP) cabling.

- 5.4.1.2. All Category 6 UTP/STP cabling shall be terminated on 8P8P modular jacks.

- 5.4.1.3. All channels shall adhere to EIA/TIA and BICSI standards and shall maintain a manufacturer's 25 year channel guarantee.

- 5.4.2. Horizontal Cabling Allocations:

- 5.4.2.1. Refer to the Components breakouts (beginning in Section 10) for more detailed information regarding Horizontal Cabling allocations.

#### 5.5. Equipment Cabinets/ Enclosures / Racks

- 5.5.1. All equipment racks and enclosures shall contain a standard EIA 19" wide equipment mounting channel with universal mounting holes pattern of 5/8" – 5/8" – 1/2" spacing.

- 5.5.2. Equipment racks shall have a minimum of 45 RMU of available equipment mounting space.

- 5.5.3. Equipment racks shall include power distribution, vertical and horizontal cable management and completely grounding packages. Enclosed equipment cabinet shall include ventilation and cool air routing properties.

- 5.5.4. Equipment racks devoted to network connectivity such as edge and workgroup equipment, switching, terminations and cross connects shall be open two-post frame equipment racks manufactured by Chatsworth (CPI).





- 5.5.5. Equipment racks devoted to surveillance management, recording and storage equipment, terminations and cross connects shall be open four-post equipment racks manufactured by Middle Atlantic.
- 5.5.6. Equipment racks devoted to audio/visual equipment shall typically be open frame four post.
- 5.5.7. Wall-mounted equipment racks shall be used in buildings where a full-sized TR is not feasible. Wall-mounted equipment rack shall have a minimum 18 RMU of available equipment mounting space.

#### 5.6. Cable Pathways

- 5.6.1. Cable pathways within the telecommunications equipment and server rooms shall be ladder tray and fiber ducts. Ladder tray shall be routed above the equipment racks and along any wall containing cable connectivity and terminations.
- 5.6.2. Cable pathways through hallways with accessible ceiling and accessible horizontal chases shall be a combination of j-hooks and wire cable basket tray.
  - 5.6.2.1. J-hooks shall be mounted a maximum of 4'-0" apart.
  - 5.6.2.2. J-hooks shall be manufactured in a fashion that does not deform the cabling as cabling is laid into the cable pathway system.
  - 5.6.2.3. Wire basket tray shall be a minimum of 6" wide and 4" deep.
- 5.6.3. Cable pathways above hard ceiling and through inaccessible horizontal chases shall be conduit.
- 5.6.4. All sleeves through fire-rated wall shall be sealed with a UL listed fire stop system.
- 5.6.5. Telecommunications and Surveillance cable pathways shall be shared cable pathways.

#### 6. Voice Over IP (VOIP) Telephony System

- 6.1. The VOIP system shall provide voice switching, voicemail, an automated attendant and automatic call distribution for the hotel.
- 6.2. VOIP Basic Feature Set
  - 6.2.1. Automated Call Distribution
  - 6.2.2. Automated Attendant
  - 6.2.3. Voice Mail
  - 6.2.4. Call forwarding
  - 6.2.5. Desk/ Wireless Handset Coupling

#### 6.3. VOIP Handsets

- 6.3.1. Handsets throughout the park shall consist of single line, four line and eight line handsets.

#### 7. Wireless Systems

##### 7.1. Wireless Network

- 7.1.1. A wireless facility network shall provide internet access to staff throughout the park.
- 7.1.2. A wireless guest network shall provide internet access to guests throughout the park.
- 7.1.3. The wireless guest network shall be completely isolated from the park's facility network and shall only provide internet access to park guests.
- 7.1.4. Coverage shall be 100% saturation. Wireless access point drops shall be cabled back to the nearest ER/TR for termination.
- 7.1.5. Approximate quantity of wireless access point (WAP) devices to be installed is 175.

##### 7.2. Cellular Reinforcement/ Mobile Radios

- 7.2.1. A manufacturer agnostic bi-directional amplifier (BDA) infrastructure shall be installed throughout the park. BDA antennas shall be distributed to provide 100% saturation.
- 7.2.2. Space shall be allocated for BDA head-end equipment and manufacturer equipment in the ER/EF.
- 7.2.3. A separate fiber optic infrastructure shall be provided to each building for use in the distributed antenna system.

#### 8. Audio/ Visual Systems

##### 8.1. Community Access Television (CATV)

- 8.1.1. All CATV connections shall be IP based and utilize the fiber optic and category cabling backbone.

##### 8.2. Digital Signage

- 8.2.1. The digital signage system shall include the following capabilities:
  - 8.2.1.1. Schedulable Content Display
  - 8.2.1.2. Branding/ Event Broadcasting
  - 8.2.1.3. Facility Specific Content Push (to mobile devices)
  - 8.2.1.4. Wayfinding



8.2.1.5. Interactive Touchscreen Capabilities

8.2.2. Digital signage monitors shall be located throughout the common spaces and concentrated at entrances/ exits to the park and at guest relations locations.

8.3. Background Music/ Overhead Paging Systems

8.3.1. The background music/ overhead paging system shall consist of a distributed audio system providing coverage throughout the park, zoned as per owner requirements.

8.3.2. The background music/ overhead paging system shall be IP based.

8.3.3. Background music content shall be provided via an owner-provided music source, satellite feeds and local content players.

8.3.4. Speakers shall be a combination of in-ground and pendant-mounted devices, designed to blend into the features and themes.

8.4. Control Systems

8.4.1. A centralized control system shall provide user control of the audio/ visual systems.

8.4.2. Control interfaces shall consist of wall and podium/desk mounted touch screen panels. Panels shall be configurable to allow customizable control levels and password access to control functions.

8.4.3. The control system shall manage a minimum of the following by zone: volume, content selection and content activation. The meeting room control shall include local source control.

9. Security Systems

9.1. The security systems shall consist of video surveillance and electronic access control.

9.2. Surveillance System

9.2.1. The surveillance system shall consist of a video management system managing IP cameras.

9.2.2. A dedicated surveillance network shall be created. The surveillance data network, management appliances and network video storage appliances shall be located in the datacenter.

9.2.3. Camera cabling shall be routed to PSERs for access to the surveillance network.

9.2.4. Surveillance camera cabling shall consist of Category 6 UTP cabling routed from each camera to the nearest PSER for termination and cross connection to the surveillance data network. The surveillance structured cabling system shall be designed to meet TIA-568-C.2 cabling standards to allow for seamless transition to IP cameras.

9.2.5. Cameras shall be powered via Power Over Ethernet (POE) utilizing POE injectors or POE-enabled switches.

9.2.6. The surveillance system provides documentation of a period in time. Surveillance camera images are used in legal cases, establish liability and act as a physical deterrent.

9.2.7. Minimum surveillance coverage (specific camera counts shall be determined by the size and shape of areas being covered and shall be determined by the documentation needs of each individual space):

9.2.7.1. Refer to the Components Descriptions (beginning with Section 10) for more detailed information regarding the minimum surveillance coverage.

9.2.8. The surveillance system shall process and record all video. Specific individual camera stream resolution, image recording rate and storage duration shall be determined by the owner during a later design phase.

9.2.8.1. The minimum camera resolution shall be 5 megapixels with cameras being recorded at 30 images per second.

9.2.8.2. The video management system (VMS) shall manage both live and stored surveillance video.

9.2.8.3. Video analytic capabilities shall include but not limited to: object counting, area intrusion, directional motion, loitering detection, left object and object removal.

9.2.8.4. Video exporting via a commonly playable file format.

9.2.9. Monitoring and Control:

9.2.9.1. Each monitoring station shall include (2) 21" LCD monitors, a keyboard and mouse.

9.3. Electronic Access Control (EAC) System

9.3.1. The access control system shall consist of door hardware restricting access to authorized personnel only via proximity cards/badges, pin codes and biometric data.

9.3.2. The system shall allow access to individual doors based on personnel status, time of day, or event scheduling and shall create a record of authorized and unauthorized attempts to access controlled doors.

9.3.3. All access controlled doors shall include two card readers: one controlling access and located on the unsecure side of the door and a second card reader monitoring egress.

9.3.4. The EAC system shall integrate into the surveillance VMS. The events within the EAC system shall trigger camera steering, recording, and tagging of surveillance video. The EAC and surveillance systems shall operate as a single cohesive system.

9.3.5. The EAC system shall be IP based.

9.3.6. Access cards shall be 125 kHz proximity cards.

9.3.7. Door Control Panels and EAC Servers



- 9.3.7.1. The electronic access control servers dedicated to the park EAC system shall be located in the datacenter.
- 9.3.7.2. Individual door controllers shall be located either above the door being controlled or in the nearest PSER.
- 9.3.7.3. Door hardware requiring power shall be power either via Power Over Ethernet (PoE) or via dedicated power supplies located in the nearest PSER.
- 9.3.8. Electronic Access Control Scope
- 9.3.8.1. Refer to the Components Descriptions (beginning with Section 10) for more detailed information regarding the minimum surveillance coverage.

## 10. Component Specific Details

### 10.1. Food and Beverage

#### 10.1.1. Voice and Data System

- 10.1.1.1. An IDF or PSER room shall be provided to house the incoming telecommunications service, telecommunications equipment backboard, and telecommunications equipment racks. Room size shall be as indicated on the Technology Design (TD) floor plans.
- 10.1.1.2. Voice, Data and POS horizontal cables shall be connected to the parkwide communications network.
- 10.1.1.3. Voice and Data outlets shall be located as follows:
  - 10.1.1.3.1. Office Space: Voice and Data connections at each work station / desk
  - 10.1.1.3.2. POS Station: Voice and Data outlet for Phone and POS
  - 10.1.1.3.3. General kitchen areas: Voice outlets for wall phones
  - 10.1.1.3.4. General back of house areas: Voice outlets for wall phones

#### 10.1.2. Surveillance System

- 10.1.2.1. Closed Circuit Television (CCTV) equipment shall be housed in the telecommunications equipment rack and mounted to the telecommunications equipment backboard as required. All CCTV camera power supplies shall be mounted to the telecommunications equipment backboard.
- 10.1.2.2. CCTV Cameras shall be located as follows:
  - 10.1.2.2.1. All POS locations
  - 10.1.2.2.2. All cash handling locations

10.1.2..2.3. All drop safe locations

10.1.2..2.4. Queue lines

10.1.2..2.5. All CCTV cameras shall be monitored in the security office. Queue line cameras to be viewed in kitchen area for staffing purposes.

#### 10.1.3. Access Control System:

10.1.3.1. Access to all Back of House (BOH) areas and rooms shall be controlled. Multiple BOH rooms in one common BOH area shall be controlled from the centrally located access door or primary access point.

10.1.3.2. The local access control devices shall be connected to the parkwide access control system.

10.1.3.3. Access to the following Back of House (BOH) areas shall be controlled:

10.1.3.3.1. All cash handling, counting and storage locations

10.1.3.3.2. Service entrances

10.1.3.3.3. Restricted utility areas

### 10.2. Restrooms

#### 10.2.1. Voice and Data System

10.2.1.1. A PSER room shall be provided to house the incoming telecommunications service, telecommunications equipment backboard, and telecommunications equipment racks. Room size shall be as indicated on the Technology Design (TD) floor plans.

10.2.1.2. Voice horizontal cables shall be connected to the parkwide communications network.

10.2.1.3. Voice and Data outlets shall be located as follows:

10.2.1.3.1. General back of house areas: Voice outlets for wall phones

#### 10.2.2. Surveillance System

10.2.2.1. Closed Circuit Television (CCTV) equipment shall be housed in the telecommunications equipment rack and mounted to the telecommunications equipment backboard as required. All CCTV camera power supplies shall be mounted to the telecommunications equipment backboard.

10.2.2.2. CCTV Cameras shall be located as follows:

10.2.2.2.1. General area coverage

10.2.2.2.2. Facing guests at area entry



10.2.2.2.3. Facing guests at area exit

10.2.2.2.4. All CCTV cameras shall be monitored in the security office.

10.2.3. Access Control System:

10.2.3.1. Access to all Back of House (BOH) areas and rooms shall be controlled. Multiple BOH rooms in one common BOH area shall be controlled from the centrally located access door or primary access point.

10.2.3.2. The local access control devices shall be connected to the parkwide access control system.

10.2.3.3. Access to the following Back of House (BOH) areas shall be controlled:

10.2.3.3.1. Service entrances

10.2.3.3.2. Restricted utility areas

### 10.3. Retail

10.3.1. Voice and Data System

10.3.1.1. A PSER room shall be provided to house the incoming telecommunications service, telecommunications equipment backboard, and telecommunications equipment racks. Room size shall be as indicated on the Technology Design (TD) floor plans.

10.3.1.2. Voice horizontal cables shall be connected to the parkwide communications network.

10.3.1.3. Voice and Data outlets shall be located as follows:

10.3.1.3.1. Office Space: Voice and Data connections at each work station / desk

10.3.1.3.2. POS Station: Voice and Data outlet for Phone and POS

10.3.1.3.3. General kitchen areas: Voice outlets for wall phones

10.3.1.3.4. General back of house areas: Voice outlets for wall phones

10.3.2. Surveillance System

10.3.2.1. Closed Circuit Television (CCTV) equipment shall be housed in the telecommunications equipment rack and mounted to the telecommunications equipment backboard as required. All CCTV camera power supplies shall be mounted to the telecommunications equipment backboard.

10.3.2.2. CCTV Cameras shall be located as follows:

10.3.2.2.1. General area coverage

10.3.2.2.2. Facing guests at area entry

10.3.2.2.3. Facing guests at area exit

10.3.2.2.4. All CCTV cameras shall be monitored in the security office.

10.3.3. Access Control System:

10.3.3.1.1. Access to all Back of House (BOH) areas and rooms shall be controlled. Multiple BOH rooms in one common BOH area shall be controlled from the centrally located access door or primary access point.

10.3.3.1.2. The local access control devices shall be connected to the parkwide access control system.

10.3.3.2. Access to the following Back of House (BOH) areas shall be controlled:

10.3.3.2.1. All cash handling, counting and storage locations

10.3.3.2.2. Service entrances

10.3.3.2.3. Restricted utility areas

### 10.4. Animal Holding

10.4.1. Voice and Data System

10.4.1.1. An IDF or PSER room shall be provided to house the incoming telecommunications service, telecommunications equipment backboard, and telecommunications equipment racks. Room size shall be as indicated on the Technology Design (TD) floor plans.

10.4.1.2. Voice and data horizontal cables shall be connected to the parkwide communications network.

10.4.1.3. Voice and Data outlets shall be located as follows:

10.4.1.3.1. General phone in holding areas

10.4.1.3.2. Safety phone at designated holding areas.

10.4.1.3.3. General outlets provided at workstations and specialized equipment locations as required.

10.4.2. Surveillance System

10.4.2.1. Closed Circuit Television (CCTV) equipment shall be housed in the telecommunications equipment rack and mounted to the telecommunications equipment backboard as required. All CCTV camera power supplies shall be mounted to the telecommunications equipment backboard.

10.4.2.2. CCTV Cameras shall be located as follows:

10.4.2.2.1. Animal holding areas.



10.4.2..2.2. Specialty holding areas including but not limited to indoor habitats, safety shelters and designated birthing locations.

10.4.2..2.3. On-Stage Performance Areas

10.4.2..2.4. All general space and back of house areas shall be monitored at the main security office. All onstage performance area cameras shall be monitored in the control room.

10.4.3. Access Control System:

10.4.3.1. Access to all Back of House (BOH) areas and rooms shall be controlled. Multiple BOH rooms in one common BOH area shall be controlled from the centrally located access door or primary access point.

10.4.3.2. The local access control devices shall be connected to the parkwide access control system.

## 10.5. Area Development

10.5.1. Voice and Data System

10.5.1.1. Area Development areas will be served by a PSER room in a building adjacent to the area to house the incoming telecommunications service, telecommunications equipment backboard, and telecommunications equipment racks. Room size shall be as indicated on the Technology Design (TD) floor plans.

10.5.1.2. Voice horizontal cables shall be connected to the parkwide communications network.

10.5.1.3. Voice and Data outlets shall be located as follows:

10.5.1..3.1. General back of house areas: Voice outlets for wall phones

10.5.2. Surveillance System

10.5.2.1. Closed Circuit Television (CCTV) equipment shall be housed in the telecommunications equipment rack and mounted to the telecommunications equipment backboard as required. All CCTV camera power supplies shall be mounted to the telecommunications equipment backboard.

10.5.2.2. CCTV Cameras shall be located as follows:

10.5.2..2.1. General area coverage

10.5.2..2.2. Facing guests at area entry

10.5.2..2.3. Facing guests at area exit

10.5.2..2.4. All CCTV cameras shall be monitored in the security office.

10.5.3. Access Control System:

10.5.3.1. Access to all Back of House (BOH) areas and rooms shall be controlled. Multiple BOH rooms in one common BOH area shall be controlled from the centrally located access door or primary access point.

10.5.3.2. The local access control devices shall be connected to the parkwide access control system.

10.5.3.3. Access to the following Back of House (BOH) areas shall be controlled:

10.5.3..3.1. Service entrances

10.5.3..3.2. Restricted utility areas



11. Appendix

Appendix A: Low Voltage Total Fiber Optic Strand Count By Building – Phase 1a & 1b

BLDG #	BLDG Name	Telecom Strands
101	Guest Services/Restrooms/Ticketing	12
101	Retail	12
102	Education Entry Restrooms	0*
103	The Lodge	12
104	Events Pavilion	12
201	Dwarf Mongoose Care Quarters	12
202	Giraffe Feeding Shelter Canopy	0*
202	Giraffe Feeding Shelter Sales Room	12
203	Beer Garden Restrooms	0*
204	Beer Service	12
205	Beer Service	12
206	Cheetah Care Quarters	12
207	Cheetah View Shelter	0*
208	Fennec Fox Care Quarters	12
209	Lion View Shelter 1	0*
210	Lion View Shelter 2	0*
211	Meerkat Care Quarters	12
212	Rhino View Shelter 1	0*
213	Rhino View Shelter 2	0*
214	Rhino Encounter Shelter	0*
215	Overnight Guest Duplex	12
215	Overnight Guest Duplex	12
215	Overnight Guest Duplex	12
216	Lion Care Quarters	12
217	Rhino Care Quarters	12
218	Giraffe Care Quarters	12
218	Overnight Guest Suite	0*
219	Hoofstock Care Quarters	0*
220	Savanna LSS	0*
221	Walk In Browse Cooler	0*
222	Hay Storage	0*
223	Event Lawn Giraffe Feeding Shelter	0*
301	Flamingo LSS	12
302	Flamingo Care Quarters/Brooder	12
303	Africa Aviary Care Quarters	0*
304	Lvl 1: Vestibule	12
304	Lvl 2: Colobus Care Quarters	12
305	Okapi Care Quarters	12
306	Giant Tortoise Care Quarters	12

\*Building will be served by network rack in a nearby building

Low Voltage Total Fiber Optic Strand Count By Building – Phase 1a & 1b (Con'd)

BLDG #	BLDG Name	Telecom Strands
307	Multipurpose Room	12
307	Multipurpose Room	12
307	Multipurpose Room	12
308	Gelada LSS	12
309	Klipspringer/Hyax Holding	12
310	Gelada View Shelter 2	0*
311	Gelada View Shelter 1	0*
312	Gelada Care Quarters	12
313	Train Depot	0*
314	Alligator Viewing Shelter 1	0*
315	Alligator Viewing Shelter 2	0*
316	Alligator & Sq. Monkey Care Quarters	12
317	Squirrel Monkey Viewing Shelter	0*
318	Parrot Care Quarters	12
319	Play Area Restrooms & Lactation Room	0*
320	Carousel Pavilion	0*
321	Lemur View Shelter 1	0*
322	Lemur View Shelter 2	0*
323	Lemur Care Quarters	0*
324	Quarantine & Nutrition Center)	12
701	Maintenance Shed/Shops	12
703	Containerized Fodder System	0*
703	Walk In Browse Cooler	0*
703	Roof	0*
801	Admin Modular 1	12
801	Admin Modular 2	12
801	Admin Modular 3	12
801	Admin Modular 4	12
801	Admin Modular 5	12
801	Admin Modular 6	12
801	Restrooms - Prefabricated	0*
802	Animal Staff Modular 1	12
802	Animal Staff Modular 2	12

\*Building will be served by network rack in a nearby building



**Appendix B: Low Voltage Total Fiber Optic Strand Count By Building – Full Buildout**

BLDG #	BLDG Name	Telecom Strands
105	Administration / Staff Support & Offices (2-stories)	12
401	Changing Exhibits	0*
401	Otter Care Quarters & LSS	0*
401	California Fresh Waters Indoor Exhibits	12
401	Beaver Care Quarters	0*
402	Education & Classrooms	12
402	California Deserts Indoor Exhibits	12
403	Capybara Care Quarters	0*
404	Grizzly Bear View Shelter	0*
405	Bobcat Care Quarters	12
406	Restrooms - California	12
407	Food Kiosk	0*
408	Big Horned Sheep Care Quarters	12
409	Rescue & Rehab Facility	12
410	Grizzly Bear Care Quarters & LSS	12
501	African Ape Viewing	12
502	Hippo Springs View Shelter	0*
503	Hippo River View Shelter	0*
504	Food & Restroom Kiosk	0*
505	Overnight Arrival Building	12
505	Accomodation 1	0*
505	Accomodation 2	0*
505	Accomodation 3	0*
505	Accomodation 4	0*
505	Accomodation 5	0*
505	Accomodation 6	0*
505	Accomodation 7	0*
506	Hippo Care Quarters	12
507	Hippo+ Tiger Filtration	0*
508	African Ape CQ	12
509	Wild Dog / Hyena CQ	12

\*Building will be served by network rack in a nearby building

**Low Voltage Total Fiber Optic Strand Count By Building – Full Buildout (Con'd)**

BLDG #	BLDG Name	Telecom Strands
510	Rhino Breeding / Hoofstock CQ	0*
601	Wallace Line Gallery Indoor Exhibits	12
601	Komodo Dragon/Red Panda C.Q.	0*
602	Clouded Leopard Care Quarters	12
603	Tiger View Shelter	0*
604	Tiger Care Quarters	12
605	Aviary Care Quarters 1	12
606	Restrooms - Asia	0*
606	Aviary Viewing Shelters	0*
606	Food Kiosk	12
607	North Water Recovery	0*
608	Asian Ape View Shelter	0*
609	Asian Ape Care Quarters	12
610	Cassowary Care Quarters	0*
611	Australian Aviary Care Quarters	12
612	Clouded Leopard View Shelter	0*
702	Maintenance Shed/Shops	12
705	Greenhouse 2	0*
706	Greenhouse 1	0*
707	Event Storage	12

\*Building will be served by network rack in a nearby building







**Appendix D: Low Voltage Responsibility Matrix**

Legend

- S = Specify
- D = Layout and Design
- F = Furnish
- I = Install
- P = Provide / Furnish & Install
- T = Terminate
- C = Coordinate

	exp	Architect	General Contractor	Electrical Contractor	Low-Voltage Contractor	Owner	AV Designer	Ride Vender	Ride Photo Vendor
<b>Supporting Systems</b>									
1. Back boxes	S/D			P					
2. Conduit	S/D			P					
3. Cable Tray / Ladder Rack	S/D			P					
4. Trenching	S/D			P					
5. Concrete Patching		S	P						
6. Painting of all exposed Conduit, Junction Boxes, Enclosures, Hardware and Brackets	S/D	C	P						
<b>Voice and Data System</b>									
1. Structured Cabling System (SCS) Permanent links (All Systems Listed Below)	S/D				P				
2. Patch Panels / Outlets	S/D				P				
3. Equipment Racks	S/D				P				
4. Terminations	S/D				P				
5. Patch Cables						P			
6. Station Cables						P			
7. Data Switches	D					S/P			
8. UPS	D					S/P			
9. Workstations	D					S/P			



10. IP Phones	S/D						p		
12. Point Of Sale Servers and Point Of Sale Stations / Equipment		D					S/P		
13. TimeClocks	S/D						P		
13. Wireless Intercom System	S/D					P			
13. Wireless Intercom Remote Antenna Locations	S/D					P			

**CCTV**

1. Structured Cabling System (SCS) Permanent links (All Systems Listed Below)	S/D					P			
	exp	Architect	General Contractor	Electrical Contractor	Low-Voltage Contractor	Owner	AV Designer	Ride Vender	Ride Photo Vendor
2. Patch Panels / Outlets									
3. Terminations									
4. Patch Cables									
5. CCTV Cameras									
6. CCTV Licenses									
7. Commissioning / Aiming / Programing	S					P	C		

**Electronic Access Control**

1. Access Control Panels / Power Supplies	S/D					P			
2. Network Connections	S/D					P			
3. Door Hardware Cabling	S/D				P				
4. Door Hardware	C	S/D	P						
5. Licenses	S					P	C		
6. Commissioning / Aiming / Programing	S					P	C		

**- Wireless Access Points (WAP)**



1. Structured Cabling System (SCS) Permanent links	S/D				P	C			
2. Electrical Connections	S/D			P		C			
3. Wireless Access Points (Active Equipment)	C	C				S/P			
4. Mounting hardware, External Antennas, Antenna cables, Enclosures and Accessories	C					S/P			
5. Commissioning / Programing / Aiming	€					S/P			
6. Headend Equipment						S/P			

	exp	Architect	General Contractor	Electrical Contractor	Low-Voltage Contractor	Owner	AV Designer	Ride Vender	Ride Photo Vendor
<b>Fiber Distribution and Racks</b>									
1. Fiber Termination/Testing									
2. Fiber Optic Cables									
1. MDF/IDF Equipment Racks									

<b>Audio Systems</b>									
1. Wire Management (Cable Tray, Vertical Wire Management)	s						S/D/P		
2. Equipment Racks							S/D/P		
3. Patch Panels / Outlets							S/D/P		
4. Data Switches							S/D/P		
5. UPS							S/D/P		
6. Digital Signal Processors							S/D/P		
7. Amplifiers							S/D/P		
8. Paging Stations							S/D/P		
9. Intercom Station				P			S/D/P		
10. Power Cables	S			P/T					



11. Audio Cables				P			S/D/T		
12. Raceway Systems (Power)				P			S/D/P		
13. Raceway Systems (Audio)				P			S/D/P		
14. Speakers							S/D/P		
15. Breakout Boxes							S/D/P		
16. Terminal Strips, Insert Panels							S/D/P		

	exp	Architect	General Contractor	Electrical Contractor	Low-Voltage Contractor	Owner	AV Designer	Ride Vender	Ride Photo Vendor
<b>Visual</b>									
1. Wire Management (Cable Tray, Vertical Wire Management)									
2. Equipment Racks									
3. Headend Equipment									
4. Video Monitors									
5. Power Cables	S				P/T				
6. Signal Cables					P		S/D/T		
7. Raceway Systems (Power)	S				P				
8. Raceway Systems (Signal)	S				P				
9. Breakout Boxes							S/D/P		
10. Terminal Strips, Insert Panels							S/D/P		

Lodge:



Gelada/Animal Care:



Entry:

