

SUTTON MECHANICAL & ENVIRONMENTAL

Mechanical Engineering Design Services

30% BASIC DESIGN REVIEW

FarmWild Orangery

Project No. 2026-12

Client: FarmWild

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Hamilton MT

2026-10-01

Purpose & Agenda

The orangery is a 30 x 60 ft glass event hall for 99 guests with a 16 ft service wing (three toilet rooms, a janitor and mechanical room, and caterer staging). The design keeps the hall lean: two propane infrared tube heaters for winter, natural ventilation through the ridge lantern plus ceiling fans and one evaporative cooler with a spiral supply duct for summer, and no refrigerated cooling. The wing gets electric heat, toilet and staging exhaust, and full plumbing on farm well water and septic. The Class 3 opinion of probable cost for mechanical, plumbing and electrical is \$156,788, about \$70 per square foot.

PURPOSE OF THIS REVIEW

- Present the 30% Basic Design Review design basis for owner review and comment.
- Confirm the design criteria, code basis, and system selections before further development.
- Surface open items and decisions needed to advance to the next milestone.
- Review the preliminary construction cost estimate and its accuracy band.

AGENDA

- Project overview
- Codes & design criteria
- Zone load summary
- Mechanical systems
- Equipment schedule
- Plumbing, gas & compressed air
- Electrical service & distribution
- Load calculation summary
- Preliminary cost estimate
- Drawing list & status
- +2 more (*see the source noted below*)

Preliminary design -- for coordination and budgeting. PE review and stamped documents required before construction.

Project Overview

BUILDING AREA

2,250 ft²

THERMAL ZONES

6

SYSTEMS

3

SITE ELEVATION

3,570 ft

BUILDING

- MAIN: 76 x 30 ft, 2,280 ft² footprint, 12.0 ft floor-to-floor
 - HALL -- 1,800 ft², multiuse_assembly, served by IR-1/2
 - TR1 -- 50 ft², toilet_room, served by EWH
 - TR2 -- 50 ft², toilet_room, served by EWH
 - TR3 -- 50 ft², toilet_room, served by EWH
 - MECH-JAN -- 45 ft², janitor, served by EWH
 - STAGING -- 255 ft², kitchen_commercial, served by EUH-1

SITE & DESIGN CONDITIONS

- Location: Hamilton, MT (lat 46.25, lon -114.16)
- Site elevation: 3,570 ft (air density corrected)
- Summer design day: 92.0 F DB / 62.0 F WB
- Winter design day: -4.0 F DB
- Envelope: wall R-17.0, roof R-30.0, window U-0.29 / SHGC 0.27
- Window-to-wall ratio: 0.0

Source: 04-Calcs\building.yaml (the same model inputs the EnergyPlus load calculation runs on).

Codes & Design Criteria

ADOPTED CODES

- IBC 2021
- IRC 2021
- IMC 2021
- IFGC 2021
- IECC 2021
- UPC 2021
- NEC 2020
- ARM Title 24, Chapter 301 amendments

DESIGN CRITERIA (DESIGN.XLSX)

- Indoor Design Temp Summer (F): 80
- Indoor Design Temp Winter (F): 60
- Outdoor Design Temp Summer (F): 92
- Outdoor Design Temp Winter (F): -4
- Ventilation Standard: ASHRAE 62.1
- Cooling Safety Factor: 1.15
- Heating Safety Factor: 1.25
- Elevation (ft): 3570
- Location/City: Hamilton, MT
- *Not yet set: Electrical Service Spare Capacity (%), Electrical Feeder VD Limit (%), Roof Live Load (psf), Snow Exposure Factor Ce*

Jurisdiction: Montana Dept. of Labor & Industry, Building Codes Bureau (state program -- unincorporated / non-certified areas, incl. unincorporated Ravalli County). Permit authority: Montana Building Codes Bureau -- (406) 841-2056. Adopted codes per design-tools\rules\permit_requirements.yaml -- confirm with the AHJ before submittal.

Zone Load Summary

CONDITIONED AREA 2,250 ft2	PEAK COOLING (SUM OF ZONES) 5.5 ton	PEAK HEATING 108.0 MBH	DESIGN OUTDOOR AIR 941 cfm
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Zone	Name	Area (ft2)	Cooling (MBH)	Heating (MBH)	Supply CFM	OA CFM	System
Z01	HALL	1,800	42.5	92.6	1,325	850	IR-1/2
Z02	TR1	50	0.7	1.6	46	0	EWB
Z03	TR2	50	0.7	1.6	46	0	EWB
Z04	TR3	50	0.7	1.6	46	0	EWB
Z05	MECH-JAN	45	0.8	1.1	34	0	EWB
Z06	STAGING	255	20.3	9.3	808	91	EUH-1
BUILDING TOTAL		2,250	65.8	108.0	2,305	941	

Loads are EnergyPlus design-day peaks including outdoor-air conditioning; outdoor air per the Ventilation tab (ASHRAE 62.1 breathing-zone basis). Restroom/space exhaust: EF-1 70 cfm, EF-2 70 cfm, EF-3 70 cfm, EF-4 50 cfm.

Mechanical Systems

SYSTEMS 3	COOLING LOAD 5.5 ton	HEATING LOAD 107.9 MBH	TOTAL AIRFLOW 2,304 cfm
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Hall heating peaks at 92.6 MBH at -4 F; with the 1.25 safety factor that is 115.8 MBH of output, met by IR-1 and IR-2, two 75 MBH input LP tube heaters on the eaves (about 128 MBH out). The EnergyPlus cooling peak of 42.5 MBH in the hall is handled without refrigeration: 850 cfm of outdoor air arrives naturally through doors and the lantern, with ceiling fans CF-1 to CF-4 (8 ft off center, zig-zag) and one evaporative cooler EC-1. EC-1 is about 12,000 cfm, 2 hp, 230 V single phase, on a steel stand on the flat service wing roof. It discharges west through a solid insulated panel in the hall east gable with a motorized insulated damper, into a spiral round supply duct on the hall centerline at 13 ft: 36 in for 20 ft, 30 in to 40 ft, 24 in to an end cap, with six pairs of side registers at about 1,000 cfm each (top velocity about 1,650 fpm). It is drained and covered October to May. Cooler size is preliminary by air change: 23,400 ft3 at 30 ACH is about 11,700 cfm. The wing is heated by four 1.9 MBH electric wall heaters and staging unit heater EUH-1. Toilet exhaust fans EF-1 to EF-3 are 70 cfm (IMC Table 403.3.1.1 public rate, switched), EF-4 runs the janitor room continuously at 50 cfm, and EF-5 is a 400 cfm wall fan for staging heat. The 5.5 ton figure is the summer cooling load, not installed equipment.

System	Type	Serves	Cooling (MBH)	Heating (MBH)	CFM
IR-1/2	Gas IR Tube Heater	HALL	42.5	92.6	1,325
EWH	Electric Wall...	TR1, TR2, TR3, MECH-JAN	3.0	6.0	171
+2 more rows -- see the source tab					

Source: DESIGN.xlsx Systems tab (rolled up from the zone loads on the previous slide).

Equipment Schedule

UNITS SCHEDULED

9

VENDOR DATA PENDING

9 of 9

Tag	Type	Capacity	CFM	Electrical (V/Ph)	MCA	Basis of Design
EF-1	EF	70 CFM @ 0.5 in wg	70	120/1	1	
EF-2	EF	70 CFM @ 0.5 in wg	70	120/1	1	
EF-3	EF	70 CFM @ 0.5 in wg	70	120/1	1	
EF-4	EF	50 CFM @ 0.5 in wg	50	120/1	1	
EF-5	EF	400 CFM @ 0.1 in wg	400	120/1	2	
IR-1/2	Gas IR Tube Heater	2 x 57.9 MBH		120/1	5	
EWB	Electric Wall Heater	4 x 1.9 MBH		240/1	12	
EUH-1	Electric Unit Heater	11.7 MBH		240/1	18	
EC-1	Evaporative Cooler	12,000 CFM, 2 HP	12000	208-230/1	15	

Source: DESIGN.xlsx Equipment Schedule. 8 row(s) carry estimated values flagged '(est.)' -- replace with vendor submittal data. 9 basis-of-design selection(s) still TBD.

Plumbing, Gas & Compressed Air

WATER SERVICE 1"	BUILDING DRAIN 4"	GAS MAIN (2 OPTIONS) 3/4" / 1/2"
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Water comes from the farm well through a 1 in service with 1/2 in fixture branches (staging drawn at 3/4 in). Fixture units were checked against the 2021 UPC, the code Montana adopts: 35 DFU and 28.25 WSFU. The toilet-side building drain is drawn at 4 in with 2 in vents and a 3 in vent through the roof, and staging drains separately through grease interceptor GI-1. The propane header is 3/4 in on the LP basis. Where the drawn size differs from the pipeline size, the Pipe Sizing tab and P-601 show both with the reason.

System	Segment	Serves	Size	Notes
Domestic Water	DW-HW	Hot water branch (WH-1 to...	1"	4.1 fps actual
Domestic Water	DW-MAIN	Building water service (all...	1"	7.8 fps actual
Domestic Water	DW-MECH	MECH	3/4"	4.4 fps actual
Domestic Water	DW-STAGING	STAGING	3/4"	DRAWN 3/4", engineer...
Domestic Water	DW-TR1	TR1	1/2"	6.9 fps actual
Domestic Water	DW-TR2	TR2	1/2"	6.9 fps actual
Sanitary	SS-MAIN	Building drain (all groups)	4"	DRAWN 4", engineer...
Sanitary	SS-VENT	Building vent stack	2" + 3" VTR	DRAWN 2" + 3" VTR...
Gas	GAS-MAIN (2 psi)	All gas appliances (longest run)	1/2"	cap 451 CFH (200% spare)...
Gas	GAS-MAIN (7" wg)	All gas appliances (longest run)	3/4"	DRAWN 3/4", engineer...

Source: DESIGN.xlsx Pipe Sizing tab (IPC/IFGC fixture-unit and Spitzglass basis; every row cites its rule key). Gas main is carried at two utility delivery pressures -- confirm available pressure with the utility to fix the size. Showing 10 of 16 sized segments -- mains and risers first.

Electrical Service & Distribution

SERVICE 400 A	VOLTAGE 240/120, 1 ph	CALCULATED LOAD 73.2 kVA	DEMAND CURRENT 305.2 A
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[Narrative pending -- edit 04-Calcs\bdr_notes.yaml and re-run]

Panel	Fed from	Voltage	Connected (kVA)	Demand (kVA)	Main OCPD (A)	Feeder	VD
MDP	SERVICE	240/120	75.6	73.2	400	(3) 600 Cu + 3 EGC	0.2%
LP-1	MDP	240/120	75.6	73.2	350	(3) 500 Cu + 3 EGC	0.1%

Source: 04-Calcs\electrical_sizes.yaml + DESIGN.xlsx Electrical / Panel Schedules tabs. Includes a 25% spare-capacity design allowance. Code basis: NEC 2020 (NFPA 70-2020) -- verify against the AHJ-adopted edition. 1 flag(s) raised for review -- see the Electrical tab FLAGS section.

Load Calculation Summary

Zone and system peak heating and cooling loads were computed using EnergyPlus 26.1.0 design-day (ASHRAE-style) sizing simulations, run without a weather file (design-day-only mode).

Item	Basis / value
Load calculation engine	EnergyPlus 26.1.0 design-day (ASHRAE-style) sizing run, one ideal-loads system per zone
Zones modeled	6
Modeled floor area	2,250 ft2
Building peak cooling	65.8 MBH (5.5 ton)
Building peak heating	108.0 MBH
Design supply airflow	2,305 cfm (current-density, altitude corrected)
Design outdoor air	941 cfm
Safety factors applied	cooling 1.15 / heating 1.25 (Design Criteria tab)
Report of record	04-Calcs\Load_Calc_Report.docx (dated 2026-09-30)

Source: 04-Calcs\Load_Calc_Report.docx (python-docx read of the issued report). Loads include outdoor-air conditioning; they are not a substitute for a full annual energy model.

Preliminary Cost Estimate

ESTIMATED CONSTRUCTION COST	ACCURACY RANGE LOW	ACCURACY RANGE HIGH	UNIT COST
\$156,788	\$125,430	\$203,824	\$69.68/ft2

Cost group / factor	Amount
HVAC Equipment	\$30,296
Ductwork	\$6,298
Plumbing	\$31,474
Electrical	\$51,250
Direct cost buildup (sum of all group subtotals)	\$119,318
x Location Factor (MT) 0.92 -> factors.location_factors	\$109,772
x (1 + General Conditions 8%) -> factors.general_conditions_pct	\$118,554
x (1 + Overhead & Profit 15%) -> factors.overhead_profit_pct	\$136,337
x (1 + Contingency 15%, AACE Class 3) -> factors.contingency_by_class.3	\$156,788
x (1 + Escalation 0.0% = 0 yr x 4.0%/yr) -> factors.escalation_pct_per_yr	\$156,788
TOTAL (Class 3)	\$156,788

Class 3 -- accuracy range -20% / +30%. Basis date 2026-08-10. Location factor 0.92 (MT, from register Project Info State). Benchmark check: benchmarks.mech_cost_per_ft2.assembly_heat_only = \$15-35/ft2 -- Buildup: \$156,788 / 2250 ft2 = \$69.68/ft2 -- ABOVE band -- investigate (NOTE: the band is MECHANICAL \$/ft2 only; this buildup also carries the Division 26 Electrical group, so a reading above the band is expected and is not by itself a defect). Reference unit costs for preliminary estimating -- not bid data.

Drawing List & Status

SHEETS IN SET

8

DISCIPLINES

E 2 / M 3 / P 3

MOST COMMON STATUS

DEMO - NOT FOR
CONSTRUCTION (6)

Sheet	Title	Rev	Rev Date	Status
M-101	HVAC PLANS	A	2026-09-30	DEMO - NOT FOR CONSTRUCTION
M-601	MECHANICAL SCHEDULES	A	2026-09-30	DEMO - NOT FOR CONSTRUCTION
M-701	MEP 3D VIEW	A	2026-09-30	DEMO - NOT FOR CONSTRUCTION
P-101	PLUMBING PLANS	A	2026-09-30	DEMO - NOT FOR CONSTRUCTION
P-501	PLUMBING RISER DIAGRAMS	A	2026-09-30	DEMO - NOT FOR CONSTRUCTION
P-601	PLUMBING SCHEDULES	A	2026-09-30	DEMO - NOT FOR CONSTRUCTION
E-601	ELECTRICAL PANEL SCHEDULES	A	2026-09-30	DRAFT - NOT FOR CONSTRUCTION
E-701	ELECTRICAL SINGLE-LINE DIAGRAM	A	2026-09-30	DRAFT - NOT FOR CONSTRUCTION

Source: PROJECT.xlsx Drawing List. Sheet status is maintained in the register and updated at each issue.

Open Items & Decisions Needed

OPEN ITEMS FROM THIS REVIEW

- Pipe tool still uses IPC-style fixture units (27.5 DFU, 31.95 WSFU). The UPC hand check gives 35 DFU and 28.25 WSFU.
- Ravalli County EH plan review of caterer staging: 3-compartment sink, S-1 direct per UPC 704.3, listed ventless oven (UL 710B).
- Wing ceiling: water at 8.5 ft and ducts at 8.6 ft sit below the 9 ft ceiling. Raise it, add a soffit, or route above.
- Owner accepts no refrigeration in summer (natural air, fans, one evaporative cooler with supply duct) up to the 80 F indoor design.
- Propane tank siting, regulator and yard line. Not in the estimate, nor are WH-1, GI-1, well, septic or electrical.
- Evaporative cooler size is by air change. Confirm with a wet-bulb check at the Missoula 0.4% design.
- Wing roof structure: EC-1 and its stand put about 1,000 lb operating on the wing roof. Check the joists and stand footprint.
- EC-1 service access is by ladder to the wing roof. Confirm a fixed ladder or roof hatch and fall protection.
- Basis-of-design selections for all eight scheduled units, with MCA data for the electrician.

AUTOMATED FLAGS & REGISTER ACTION ITEMS

- [ELEC] Fault current: TX-2 data is ASSUMED: REC has not sized pad TX-2; 100 kVA 1-ph, 1.5%Z, infinite-bus primary. Get kVA, %Z and primary fault MVA from the...

Open items are tracked in PROJECT.xlsx Action Items; review-specific items live in 04-Calcs\bdr_notes.yaml.

Next Steps to 60%

Path from this 30% Basic Design Review to 60% design.

- Owner review of this 30% package and answers on the open items.
- Pre-application call with Ravalli County EH on the caterer staging layout.
- Commissioning plan and recommended maintenance plan on the same equipment list.
- Advance the sheets to 60 percent: architectural backbone, detailed risers, 0.1 in minimum text.

Source: 04-Calcs\bdr_notes.yaml next_steps. Preliminary design -- for coordination and budgeting. PE review and stamped documents required before construction.