Missoula International Airport has been experiencing year-over-year record growth in enplanements for nearly a decade. This is causing significant stress on their existing terminal. It is antiquated, has inadequacies in handling the travel demands of the peak seasons, and struggles to keep up with the flexibility of modern technology.

The new Passenger Terminal Building for the Missoula International Airport is planned to be a state-of-the-art facility for the traveling public. The new facility will address critical concerns of the terminal that are vital to safer, healthier travel, and airport operations – all of which will ultimately enhance the experience of the public traveling by commercial air.

The Morrison-Maierle led design team, comprised of A&E Architects, Price Studios and the KPA Group, utilized an integrated design process which successfully engaged stakeholders who are invested in the development of the terminal facility. This process created a consensus that informed the programming and schematic design of this diverse project. Some of those stakeholders included Airport Administration, Federal Aviation Administration, Transportation Security Administration, commercial airline users, and tenants operating within the terminal today.

### Scope

**Terminal Building (Phase I & II)**

- **205,694 sf**
- **Site Work**
- **# of Gates = 8**
- **# of Jet Bridges = 6**

**Phase I**

- **Terminal Building  180,615 sf**
- **Site Work**
- **# of Gates = 4**
- **# of Jet Bridges = 4 (capable of ground loading 3 additional gates)**

**Phase II**

- **Terminal Building  25,079 sf**
- **# of Gates = 4**
- **# of Jet Bridges = 2**

### Timeline

- **06.27.2017 - Preliminary, Probable Cost to MSO Board, Missoula, MT**
- **06.30.2017 - Round Meeting, Schematic Design Deliverable**
- **09.26.2017 - Preliminary Pricing Package to MSO Board Meeting**
- **10.21.2017 - Exterior Design Workshop, Missoula, MT**
- **12.22.2017 - MJM Board Meeting, Task Order 10 & Pre-Construction Services**
- **03.22.2018 - Round Meeting, Schematic Design Deliverable**
- **05.21.2018 - MJM Board Meeting, Approval of Task Order 1 & Pre-Construction Services**
- **06.07.2018 - MJM Board Meeting, Approval of Task Order 2 & Pre-Construction Services**
- **09.26.2018 - MJM Board Meeting, Approval of Task Order 3 & Pre-Construction Services**
- **10.30.2018 - MJM Board Meeting, Approval of Task Order 4 & Pre-Construction Services**
- **12.11.2018 - MJM Board Meeting, Approval of Task Order 5 & Pre-Construction Services**
- **01.07.2019 - MJM Board Meeting, Approval of Task Order 6 & Pre-Construction Services**
- **03.14.2019 - MJM Board Meeting, Approval of Task Order 7 & Pre-Construction Services**
- **05.08.2019 - MJM Board Meeting, Approval of Task Order 8 & Pre-Construction Services**
- **07.05.2019 - MJM Board Meeting, Approval of Task Order 9 & Pre-Construction Services**
- **09.19.2019 - MJM Board Meeting, Approval of Task Order 10 & Pre-Construction Services**
- **11.07.2019 - MJM Board Meeting, Approval of Task Order 11 & Pre-Construction Services**
- **01.23.2020 - MJM Board Meeting, Approval of Task Order 12 & Pre-Construction Services**
- **03.12.2020 - MJM Board Meeting, Approval of Task Order 13 & Pre-Construction Services**
- **05.14.2020 - MJM Board Meeting, Approval of Task Order 14 & Pre-Construction Services**
- **07.28.2020 - MJM Board Meeting, Approval of Task Order 15 & Pre-Construction Services**
- **09.29.2020 - MJM Board Meeting, Approval of Task Order 16 & Pre-Construction Services**
- **12.18.2020 - MJM Board Meeting, Approval of Task Order 17 & Pre-Construction Services**
- **02.17.2021 - MJM Board Meeting, Approval of Task Order 18 & Pre-Construction Services**
- **04.28.2021 - MJM Board Meeting, Approval of Task Order 19 & Pre-Construction Services**
- **06.29.2021 - MJM Board Meeting, Approval of Task Order 20 & Pre-Construction Services**
- **08.30.2021 - MJM Board Meeting, Approval of Task Order 21 & Pre-Construction Services**
- **10.22.2021 - MJM Board Meeting, Approval of Task Order 22 & Pre-Construction Services**
- **12.09.2021 - MJM Board Meeting, Approval of Task Order 23 & Pre-Construction Services**
- **02.10.2022 - MJM Board Meeting, Approval of Task Order 24 & Pre-Construction Services**
- **04.21.2022 - MJM Board Meeting, Approval of Task Order 25 & Pre-Construction Services**
- **06.16.2022 - MJM Board Meeting, Approval of Task Order 26 & Pre-Construction Services**
- **08.18.2022 - MJM Board Meeting, Approval of Task Order 27 & Pre-Construction Services**
- **10.20.2022 - MJM Board Meeting, Approval of Task Order 28 & Pre-Construction Services**
- **12.21.2022 - MJM Board Meeting, Approval of Task Order 29 & Pre-Construction Services**
- **02.22.2023 - MJM Board Meeting, Approval of Task Order 30 & Pre-Construction Services**
- **04.25.2023 - MJM Board Meeting, Approval of Task Order 31 & Pre-Construction Services**
- **06.27.2023 - MJM Board Meeting, Approval of Task Order 32 & Pre-Construction Services**
- **08.28.2023 - MJM Board Meeting, Approval of Task Order 33 & Pre-Construction Services**
- **10.30.2023 - MJM Board Meeting, Approval of Task Order 34 & Pre-Construction Services**
- **12.18.2023 - MJM Board Meeting, Approval of Task Order 35 & Pre-Construction Services**
- **02.19.2024 - MJM Board Meeting, Approval of Task Order 36 & Pre-Construction Services**
- **04.21.2024 - MJM Board Meeting, Approval of Task Order 37 & Pre-Construction Services**
- **06.27.2024 - MJM Board Meeting, Approval of Task Order 38 & Pre-Construction Services**
- **08.29.2024 - MJM Board Meeting, Approval of Task Order 39 & Pre-Construction Services**
- **10.30.2024 - MJM Board Meeting, Approval of Task Order 40 & Pre-Construction Services**
- **12.18.2024 - MJM Board Meeting, Approval of Task Order 41 & Pre-Construction Services**
- **02.19.2025 - MJM Board Meeting, Approval of Task Order 42 & Pre-Construction Services**
- **04.21.2025 - MJM Board Meeting, Approval of Task Order 43 & Pre-Construction Services**
- **06.27.2025 - MJM Board Meeting, Approval of Task Order 44 & Pre-Construction Services**
- **08.29.2025 - MJM Board Meeting, Approval of Task Order 45 & Pre-Construction Services**
- **10.30.2025 - MJM Board Meeting, Approval of Task Order 46 & Pre-Construction Services**
- **12.18.2025 - MJM Board Meeting, Approval of Task Order 47 & Pre-Construction Services**
- **02.19.2026 - MJM Board Meeting, Approval of Task Order 48 & Pre-Construction Services**
- **04.21.2026 - MJM Board Meeting, Approval of Task Order 49 & Pre-Construction Services**
- **06.27.2026 - MJM Board Meeting, Approval of Task Order 50 & Pre-Construction Services**
- **08.29.2026 - MJM Board Meeting, Approval of Task Order 51 & Pre-Construction Services**
- **10.30.2026 - MJM Board Meeting, Approval of Task Order 52 & Pre-Construction Services**
- **12.18.2026 - MJM Board Meeting, Approval of Task Order 53 & Pre-Construction Services**
Renderings

6
8
10
12
14
16
18
20
22

exterior, departures
parking, day
parking, night
exterior, arrivals
interior, bar commons
interior, observation area
interior, holdroom
materials / building section perspectives
Exterior Rendering
View from Parking at Dusk
Interior Rendering

View at bar common
Interior Rendering

View of bar common
Interior Rendering

View from 3rd floor observation area
Interior Rendering

view at holdroom
Materials

view at baggage claim / ticketing / holdrooms

board-formed concrete, 6" horizontal

curtainwall system, butt-glazed

clerestory feature ceiling

wood feature wall

composite panel rainscreen system, Trespa Meteon

sunshade

Support

Screening

Ticketing

Bag Claim

Ticketing

Holdrooms

Support

Screening

Ticketing

Bag Claim
With the five valleys of Western Montana converging here, Missoula has always been—and will continue to be—a place that has a lively exchange of ideas, goods and people. Given the multiple mountain ranges and rivers that surround this terminal, it is positioned to be an environmentally responsible and breathtaking gateway to the circuit unique land and cultural treasures. This facility will serve Missoulians and tourists alike for generations by being adaptable, timeless, authentic to place and innovative in building technology.

Design Statement

1. Design for the user (traveling public, community airlines)
2. Intuitive way-finding (without the overuse of signage)
3. Design a flexible and expandable facility to meet future accommodations
4. Environmentally responsible design (lower operational + maintenance costs)
5. Be a warm, inviting and enhanced travel experience
6. Take advantage of the breathtaking views that occur in the Missoula Valley, specifically views to the north & southeast
7. Reflect the local geography, landscape and beauty of Western Montana and its valleys, rivers and mountains.
8. Reflect the diverse culture of Missoula and Western Montana by bringing local art, food, and community into the design to enhance its overall impact as an important civic building.
Our Process

Listening
Understanding the communityairport needs
Looking to the existing and natural landscape
Hearing the hopes and fears of our client

Collaboration
Take what we learned from listening, and then start
to create design parameters.

Applying
Start to create design decisions that reflect all of
the preceding work.

Hopes

Fears

Terminology

- Terminal
  - Warm gateway to Western Montana
  - Happy, enjoyable experience
  - Natural light
  - Mountain views
  - Identified as “Missoula”, not generic
  - Open and clean floor plan
  - New, modern
  - A place for history and art
  - Iconic
  - Balanced look and feel

- Terminal
  - Warm and inviting
  - Natural light
  - Low cost maintenance
  - Sustainable
  - Ground source heating and cooling

- MAINTENANCE & OPERATIONS
  - LED lights
  - Functional
  - Low cost maintenance
  - Sustainable
  - Ground source heating and cooling

- SAFETY & SECURITY
  - Security system too slow
  - Changes in TSA operations

- Flight + Motion
  - Connection exterior wayfinding
  - Intuitive – No need for signs
  - Adaptable to future technology
  - Future-proof
  - Handles oversized/special baggage
  - Functional

- Anchor
  - Integrated

- Transparency
  - Integrated

- Where we are today

- It all starts with a sketch
Past / Present / Future
The form of the building responds to the existing runway flight path. It provides new easily accessible gates for present needs, while allowing for future expansion.

Function / Context
Facade Articulation: Defined by the function & landscape
Flight (Function): relating to the roof articulation
Carving (landscape): relating to the articulation of the base of the building, as the river carves the valley

People / Movement
Organization of Spaces: Defined by Views, Transparency, and Movement through space

Design Diagrams
These design diagrams help illustrate certain design decisions and demonstrate why we made certain choices. They are meant to supplement the following design material: floor plans, area plans, exterior design, narratives.
PLANS

site development
floor plans
program area plans

keynotes
1. proposed passenger terminal building
2. proposed layout for aircraft parking apron
3. proposed terminal access road
4. proposed east general aviation ramp
Phasing

During all phases of the construction of the new airport and the demolition of the existing, the airport will remain operational.

Phase 1A
- Demolition of Existing TSA Screening and Baggage Handling
- New Construction of Main Terminal & South Concourse

Phase 1B
- Demolition of West Portion of Existing Holdrooms and Concessions
- New Construction / Demolition
- Construct Connector
- Demolish Remainder of Existing Holdrooms and Concessions
- Construct New Bag Claim

Phase 1C
- Demolition
- Construct Main Terminal & South Concourse
- Demolish West Portion of Existing Holdrooms and Concessions
- Construct Connector
- Demolish Remaining of Existing Holdrooms and Concessions
- Construct New Bag Claim

Phase 2
- New Construction
- Construct East Concourse

New Terminal
The following images act as a visual guide to the aspirations of the design team and MSO staff. These images - while not specifically the actual design - perform as precedent images for what the new terminal might look and feel like from a material standpoint.
environmental graphics

→ THE NOODLE BAR
→ THE COFFEE LOFT
→ WASHROOMS

revolving door, exit

sunshade
monument stair

cross-laminated timber (CLT) stair

steel framed / glass stair

cast-in-place concrete stair
wood ceiling, holdrooms

clerestory / feature ceiling
curtainwall system, butt-glazed

storefront system
board-formed concrete, 6" horizontal metal panel rainscreen system
metal panel screenwall metal panel rainscreen system

panel panel screenwall
panel panel system
NARRATIVES

44 mechanical
46 electrical
50 fire protection
52 plumbing
72 HVAC system energy comparison
Codes, Standards and Recommended Environmental Conditions for Human Acceptable Indoor Air Quality

- 2010 ASHRAE Standard 62.1 – Ventilation for Acceptable Indoor Air Quality
- 2012 International Mechanical Code (IMC)

Effect and include but are not limited to the following:

- All design and construction work shall comply with all applicable building codes, standards, and ordinances.

- **HEATING, VENTILATION & AIR CONDITIONING**

  **Mechanical**

  **Heating Hot Water**

  Heating hot water shall be circulated through the building by redundant circulation pumps located in the mechanical room. The heating plant will consist of three (3) gas fired, dual fuel, high efficiency, condensing, stainless steel fire tube, heating water boilers. Each boiler shall be sized for 50% of the building load. Basis of design for the boiler shall be Lochinvar “Crest” FBN5000. The boilers shall be capable of running on natural gas and propane.

  Each boiler will be equipped with a condensation pump that will circulate water between the building hot water circulation system and the boiler. Basis of design for the condensation pump shall be Alpin-Flo A-2000.

  Each boiler will vent through the roof via an independent flue. The flue shall be constructed from listed stainless steel using listed (UL) galvanized sheet metal. The flue shall be supported every 6 ft. to 10 ft. or less of the building base line of design for the boiler shall be Lochinvar “Crest” FBN5000. The boilers shall be neither a substitute for normal air and propane.

  Each boiler will be equipped with a condensation pump that will circulate water between the boiler hot water circulation system and the heating water system. The basis of design for the condensation pump shall be Alpin-Flo A-2000. The heating water system will be equipped with insulated PVC jacket.

  All valves in the heating water system that are 1-1/2" and smaller shall be Type L bronze with sweat fittings and shall be insulated with 1-1/2" thick preformed mineral fiber insulation. The pipe insulation shall include an all service jacket (ASJ) and the easiest means of ASJ-F.

  Each boiler will be equipped with an air handling unit for heating and cooling purposes. The air handling unit shall include a variable speed fan, energy management controls and will be 150 psi rated. All valves in the heating water system that are 1-1/2" and smaller will have bronze body with sweat connections and will be made with dielectric nipples or PEX separator.

  Isolation valves will be installed throughout the building. Isolation valves, y-strainer, flow control device (automatic or manually), drain connection and an air vent.

  The heating hot water system will be equipped with Kynar coated stainless steel piping, Insulation Jackets (www.ThermaxxJackets.com). Each boiler will be equipped with a circulation pump that will circulate water between the boiler hot water circulation system and the heating water system. Basis of design for the condensation pump shall be Alpin-Flo A-2000. The heating water system will be equipped with insulated PVC jacket.

  All valves in the heating water system that are 2" and smaller shall be Type L bronze with sweat fittings and shall be insulated with 2" thick preformed mineral fiber insulation. The pipe insulation shall include an all service jacket (ASJ) and the easiest means of ASJ-F. The flow rate of water from the ground water wells will be varied to maintain a chilled water supply temperature of 52°F.

  Chilled Water piping 1-1/2" and smaller shall be Type L bronze with sweat fittings and shall be insulated with 1-1/2" thick preformed mineral fiber insulation. The pipe insulation shall include an all service jacket (ASJ) and the easiest means of ASJ-F.

  Chilled Water piping 2" NPS and larger shall be schedule 40 black steel (ASTM A53 Grade A) with grooved mechanical fittings and shall be insulated with 2" thick preformed mineral fiber insulation. The pipe insulation shall include an all service jacket (ASJ) and the easiest means of ASJ-F.

  All valves in the chilled water system that are 1-1/2" and smaller will have bronze body with grooved mechanical fittings and will be 150 psi rated. All valves in the chilled water system that are 2" and smaller will have bronze body with grooved mechanical fittings and will be made with dielectric nipples or PEX separator.

  Isolation valves will be installed throughout the chilled water system to allow shutdown or small portions of the building for maintenance.

  Each valve will be equipped with isolation valves, y-strainer, flow control device (automatic or manual), drain connection and an air vent.

  The heating hot water system and the chilled water system will be equipped with Kynar coated stainless steel piping, Insulation Jackets (www.ThermaxxJackets.com).

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  The flow rate of water from the ground water wells will be varied to maintain a chilled water supply temperature of 52°F.
All unit serving the 2nd and 3rd floor will be located in mechanical spaces on the 3rd floor. These units will supply directly to a zone. Terminals re-heat coils will be equipped with hot water cabinet heaters. The loading ramp to the basement will also include a hot water radiant snow melt system to prevent snow and ice buildup on the ramp. Sensors detect moisture on the surface. Temperature is below freezing, and the snowmelt systems are graphically presented at the web browser, allowing flexible administration of access and equipment scheduling. The NAC acts as a web server that integrates with the building management system (BMS). The HVAC system shall be controlled by a building management system (BMS). The building management system shall have sufficient memory capacity to maintain a back-up of all database data for up to 3 months. Acceptable temperature center systems and control equipment shall be furnished and installed by Delta Controls by Electro Controls. Approved commissioning professionals are: Elkhorn Engineering or Highlands Balancing. Approved test and balance contractors are: RGO Inc or Highlands Balancing.

Controls & Instrumentation

The HVAC system shall be achieved by building management system (BMS). The building management system shall be comprised of distributed stand-alone controller networks (LON, BACnet). Third party devices can achieve access with a standard web browser. Security is achieved with secure passwords (PC) on the site's network, without any additional protocol devices. The NAC also performs alarm integration in to the building management system (BMS). The NAC shall utilize the Triton All platform.

Distribution Systems

A variety of systems will be used to distribute stormwater to an outside outlet. Interimeter piping system will drain to a trench drain to remove excess water from the site. Drainage from snow-melt systems is directed to a cold water main above the slab, circulating hot water when the outdoor air temperature is above freezing. The loading ramp to the basement will also include a hot water radiant snow melt system to prevent snow and ice buildup on the ramp. Sensors detect moisture on the surface. Temperature is below freezing, and the snowmelt systems are graphically presented at the web browser, allowing flexible administration of access and equipment scheduling. The NAC acts as a web server that integrates with the building management system (BMS). The HVAC system shall be controlled by a building management system (BMS). The building management system shall have sufficient memory capacity to maintain a back-up of all database data for up to 3 months. Acceptable temperature center systems and control equipment shall be furnished and installed by Delta Controls by Electro Controls. Approved commissioning professionals are: Elkhorn Engineering or Highlands Balancing. Approved test and balance contractors are: RGO Inc or Highlands Balancing.

Terminal Units

The front entry sidewalks and pedestrian areas will be equipped with hot water cabinet heaters. The loading ramp to the basement will include a hot water radiant snow melt system to prevent snow and ice buildup on the ramp. Sensors detect moisture on the surface. Temperature is below freezing, and the snowmelt systems are graphically presented at the web browser, allowing flexible administration of access and equipment scheduling. The NAC acts as a web server that integrates with the building management system (BMS). The HVAC system shall be controlled by a building management system (BMS). The building management system shall have sufficient memory capacity to maintain a back-up of all database data for up to 3 months. Acceptable temperature center systems and control equipment shall be furnished and installed by Delta Controls by Electro Controls. Approved commissioning professionals are: Elkhorn Engineering or Highlands Balancing. Approved test and balance contractors are: RGO Inc or Highlands Balancing.

Commissioning of HVAC Systems

The HVAC system shall be commissioned in accordance with the provisions of Code of the Florida Building Code and by a Registered Professional Engineer. Approved Commissioning Professionals are Elkhorn Engineering or Highlands Balancing.

Building Management System

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Electrical System

Power Distribution System

The existing electrical service will supply temporary power to the new building during construction. A separate emergency power system will be installed during construction and the service will be commissioned and maintained by the installer.

The new facility will be supplied by a new electrical service consisting of a new pad-mount transformer at a location to be determined by the installer. The transformer will supply power to the new utility service loop, supplying the new utility service that will be extended to the new building. The existing electrical service will supply temporary power to the new building during construction. A separate emergency power system will be installed during construction and the service will be commissioned and maintained by the installer.

The interior lighting control system will be integrated into the building management system. The lighting control system will provide lighting control, energy conservation, and occupant comfort. The lighting control system will be able to control lighting in individual rooms and areas, as well as in larger spaces such as corridors and lobbies.

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**Fire Protection**

Automatic Fire Sprinkler System

The building will be protected throughout by an automatic fire sprinkler system. The fire protection water service will be 6”.

A wet pipe sprinkler system will be used to protect all building areas, except areas exposed to freezing.

Drip spray sprinkler heads will be used in mechanical spaces, and vehicle recessed and chrome.

All fixtures shall be fully recessed.

Courtrooms, Community Room and Training Room Sprinkler heads in the Public Lobbies, Public Corridors, will be used to protect the IT and Data Rooms.

Clean agent fire protection system (FM200 or similar) such as entry vestibules and loading docks.

**Water Distribution**

Based on the current architectural drawings, ¾” domestic water service will be located to the main water meter as required by Appendix A of the 2007 Uniform Plumbing Code. The domestic water service will be 2½” NPS (hubbled) and be fully recessed.

Sprinklers heads in all other areas shall be exterior mounted and chrome.

Brass heads shall be 1½” in mechanical spaces, and vehicle areas shall have protection provision.

A wet pipe sprinkler system will be used to protect all water service shall be 8”.

The building will be protected throughout by an automatic fire sprinkler system. The fire protection service will be required to protect all the building operation.

Domestic water service entrance risers shall include insulated piping to protect the fire department connection.

A 5” galvanized steel riser, 6½” galvanized steel service will be required.

The pressure shall be maintained at 150 p.s.i. – 250 p.s.i. at the fire department connection.

All above grade roof drain piping shall be insulated with 1” insulation. All above grade roof drain piping shall be fully recessed.

All below grade sanitary waste and entry piping shall be insulated with a 2” stainless steel pipe that matches the fixture connections. All below grade water piping shall be insulated with a 2” stainless steel pipe that matches the fixture connections.

All domestic hot, cold and recirculation water valves shall be Type L hard copper (ASTM B88 & ANSI/NSF 61) with sweat fittings and joints. All domestic hot, cold and recirculation water valves shall be Type L hard copper (ASTM B88 & ANSI/NSF 61) with sweat fittings and joints.

All fixture connections shall be non-ferrous and lead free. All domestic water valves shall be non-ferrous and lead free. All above grade roof drain piping shall be insulated with 1” insulation. All above grade roof drain piping shall be fully recessed.

**Plumbing**

PLUMBING:

All planning fixtures shall be determined grade and shall be equal to the building drawings.

All fixtures shall be provided with commercial grade ¼” drain and vent piping that is necessary and required for under fixture piping runs.

Domestic hot water is to be protected by a gas fired, hot water boiler. All fixtures shall be made of Stainless Steel – Type 304.

Locknut Shall be Hardware 304-3000X200. The water heater shall be located in the laundry, boiler and equipment room.

Domestic hot water shall be protected by a gas fired boiler. The boiler shall be located in the boiler and equipment room. The boiler shall be fully recessed.

A 3,000 gallon concrete sand/oil interceptor will be installed to collect sand, oil, and other contaminants from the loading ramp and incoming baggage areas.

**Domestic Sanitary Waste**

The building sanitary system shall be designed in accordance with the City of Missoula requirements, to the building, inlet pressure gauge, pressure reducing valve and primary backflow preventer without interruption of potable water use.

Domestic hot water recirculation pumps shall be installed to collect grease waste for the restaurants and concessions areas.

Domestic hot water recirculation pumps shall be installed to collect grease waste for the restaurants and concessions areas.

All plumbing piping and equipment shall be seismically braced per the 2012 International Building Code and the owner’s insurance.

Fire Protection system, designed and installed per the 2007 Uniform Plumbing Code.

Floor sinks shall be installed in all mechanical spaces, and full-port ball type valves with stainless steel dome strainers and ¾ grate or approved equal.

Floor sinks shall be installed in all mechanical spaces, and full-port ball type valves with stainless steel dome strainers and ¾ grate or approved equal.

A new gas meter, regulator, shutoff and earthquake secure area.

A new gas meter, regulator, shutoff and earthquake secure area.

**Sanitary Waste**

The sanitary waste system shall include 6” sanitary waste and vent piping with heavy duty no-hub cast iron pipe and fittings that conform to CSIPI 301 and ASTM A888 with heavy duty no-hub couplings that conform to CSIPI 310, ASTM C 1277, ASTM C 1540 and FM 1680 Class 1.

A new gas meter, regulator, shutoff and earthquake secure area.

A new gas meter, regulator, shutoff and earthquake secure area.

**Sanitary Waste**

The waste and vent system shall be designed and installed per the 2007 Uniform Plumbing Code. The building shall be equipped with primary roof drain and primary overflow drains. The secondary roof drain and secondary overflow drains shall be piped to a 12” underground, liquefied propane gas tank will be installed to collect grease waste for the restaurants and concessions areas.

All below grade sanitary waste and entry piping shall be insulated with a 2” stainless steel pipe that matches the fixture connections. All below grade water piping shall be insulated with a 2” stainless steel pipe that matches the fixture connections.

1.5” above grade valve and piping assembly or prior approved equal.

1.5” above grade valve and piping assembly or prior approved equal.

A new gas meter, regulator, shutoff and earthquake secure area.

A new gas meter, regulator, shutoff and earthquake secure area.

Fire Protection

**Sanitary Waste**

The waste and vent system shall include 6” sanitary waste and vent piping with heavy duty no-hub cast iron pipe and fittings that conform to CSIPI 301 and ASTM A888 with heavy duty no-hub couplings that conform to CSIPI 310, ASTM C 1277, ASTM C 1540 and FM 1680 Class 1.

**Plumbing**

All plumbing piping and equipment shall be seismically braced per the 2012 International Building Code and the owner’s insurance.

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All plumbing piping and equipment shall be seismically braced per the 2012 International Building Code and the owner’s insurance.
Alternative #2: Water Source Variable Refrigerant Flow

This system uses central heat pumps to supply refrigerant to fan coils that heat and cool the rooms or spaces. Hot water boilers provide heat to the heat pumps and ground water is used to reject heat from the heat pumps. Dedicated return air with cold VRF heating coils and makeup air in return mains provide ventilation to the building.

The following table and chart show that the baseline system “Variable Air Volume with Hot Water Boiler and Ground Water Cooling” uses the least energy of the three (3) systems in our analysis. We feel the superior energy performance, coupled with this technology, would lead the building owners towards this system.

New Missoula Airport Terminal HVAC System Energy Comparison

The following document and attached system comparison is an analysis for the new Missoula Airport Terminal building. The analysis was intended to provide a comparison of the different energy options for several systems to each other. While the modeling of all the systems was quite detailed, the modeling of each system was handled differently. The modeling of the baseline model utilized the engineering program for each building, the building arrangement, i.e. the general shape, size and number of floors, but used IECC minimums for structural and fenestrations.

The results of this analysis do predict the operation of each building with different systems, but give the percent difference in annual cost for the different systems. The systems were modeled area as follows:

BASELINE: Variable Air Volume with Hot Water Boiler and Ground Water Cooling

This system uses central air handlers equipped with hot water heating coils and cooling coils and VAV boxes with hot water re-heat coils to allow for zone level control. Heating water will be generated by gas fired high efficiency hot water boilers and chilled water will be generated by a ground water loop in conjunction with flat plate heat exchangers.

Alternative #1: Variable Air Volume with Hot Water Boiler and Air Cooled Direct Expansion Cooling

This system uses central air handlers equipped with hot water heating coils and direct expansion (DX) cooling coils and VAV boxes with hot water re-heat coils to allow for zone level control. Heating water will be generated by gas fired high efficiency hot water boilers.

Alternative #2: Water Source Variable Refrigerant Flow

This system uses central heat pumps to supply refrigerant to fan coils that heat and cool the rooms or spaces. Hot water boilers provide heat to the heat pumps and ground water is used to reject heat from the heat pumps. Dedicated return air with cold VRF heating coils and makeup air in return mains provide ventilation to the building.

Currently, the New Missoula Airport Terminal Base case analysis uses the following equipment:

- **Cooling Plant**
  - VAV w/ HW Reheat and Ground Water Cooling
  - VAV w/ HW Reheat and DX Cooling
  - Water Source VRF Sensible Wheel

- **Heating Plant**
  - Ground Water Cooling High Eff. Condensing Boiler

- **Total Energy (kbtu)**
  - VAV w/ HW Reheat and Ground Water Cooling: 10,116,749
  - VAV w/ HW Reheat and DX Cooling: 12,596,168
  - Water Source VRF: 13,144,608

- **% Diff From Baseline**
  - VAV w/ HW Reheat and Ground Water Cooling: 100.0%
  - VAV w/ HW Reheat and DX Cooling: 124.5%
  - Water Source VRF: 129.9%

The following bar chart and chart show that the baseline system “Variable Air Volume with Hot Water Boiler and Ground Water Cooling” uses the least energy of the three (3) systems in our analysis. We feel the superior energy performance coupled with the technology would lead the building owners towards this system.
PROBABLE PROJECT COSTS
## Probable Project Costs

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<th>Item</th>
<th>Phase I Range (low)</th>
<th>Phase I Range (high)</th>
<th>Phase II Range (low)</th>
<th>Phase II Range (high)</th>
<th>Phase I + Phase II Total Range (low)</th>
<th>Phase I + Phase II Total Range (high)</th>
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