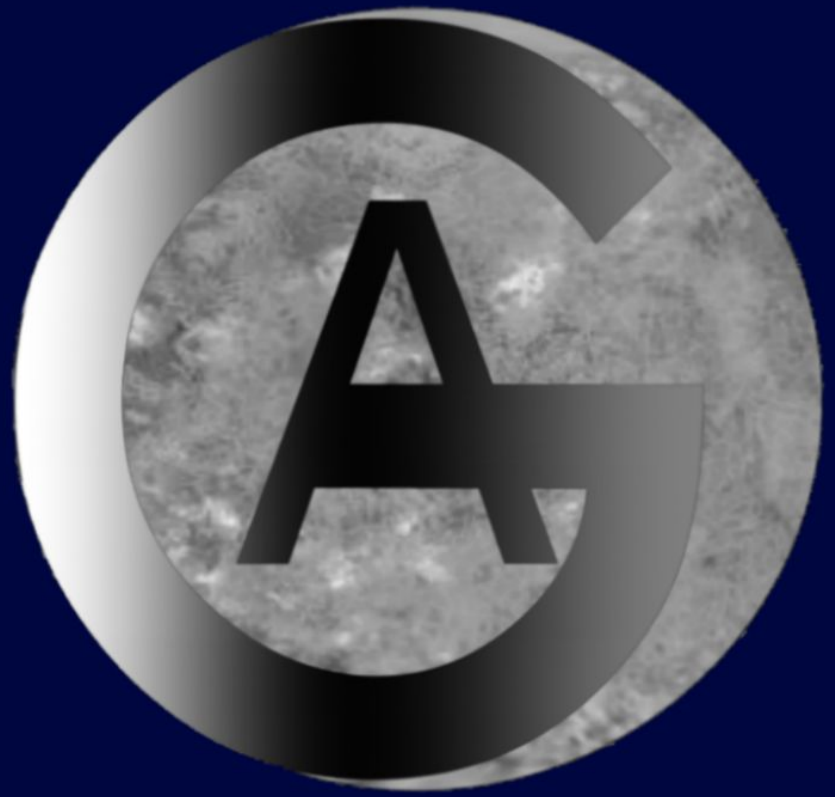
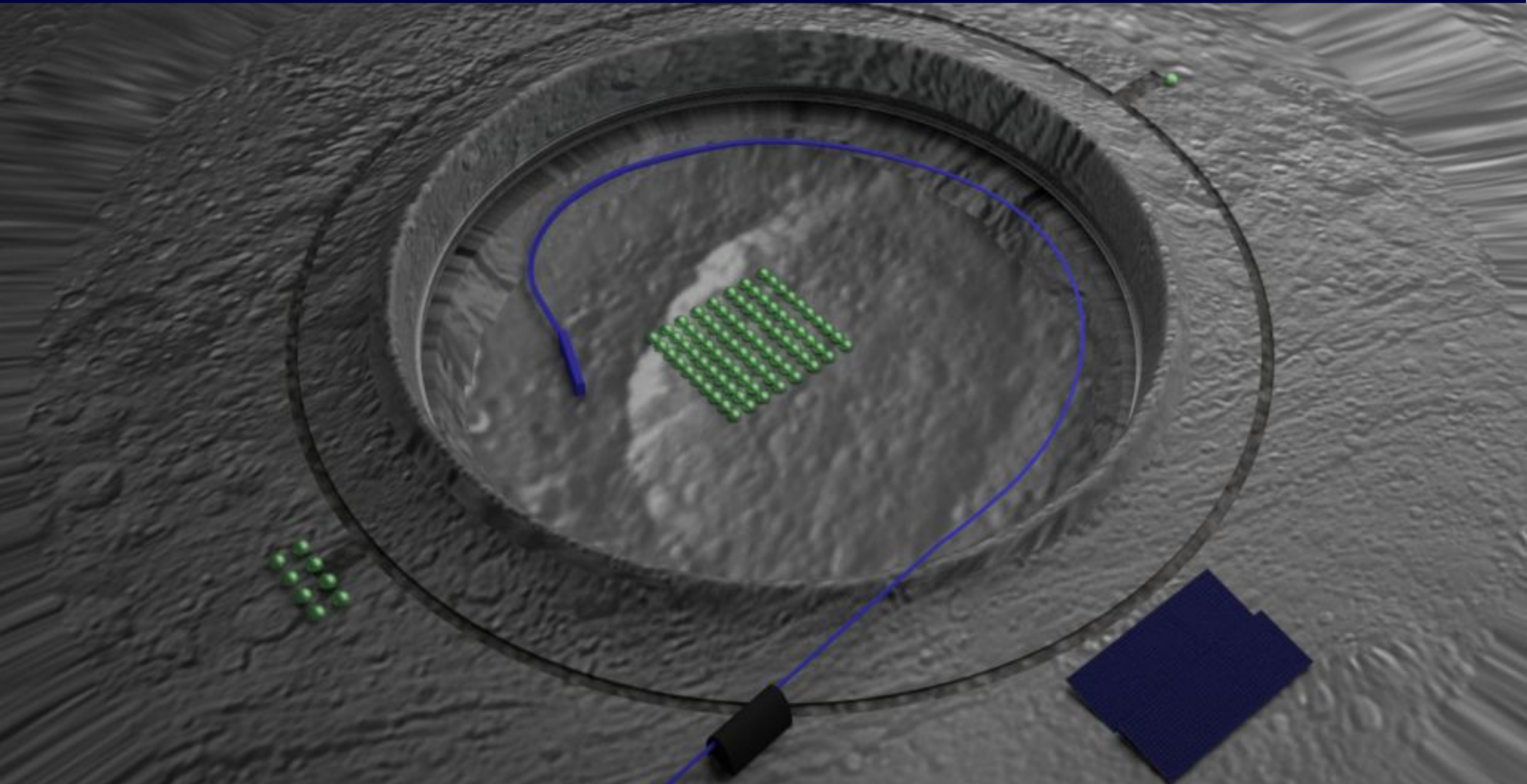
ALASKOL 2043



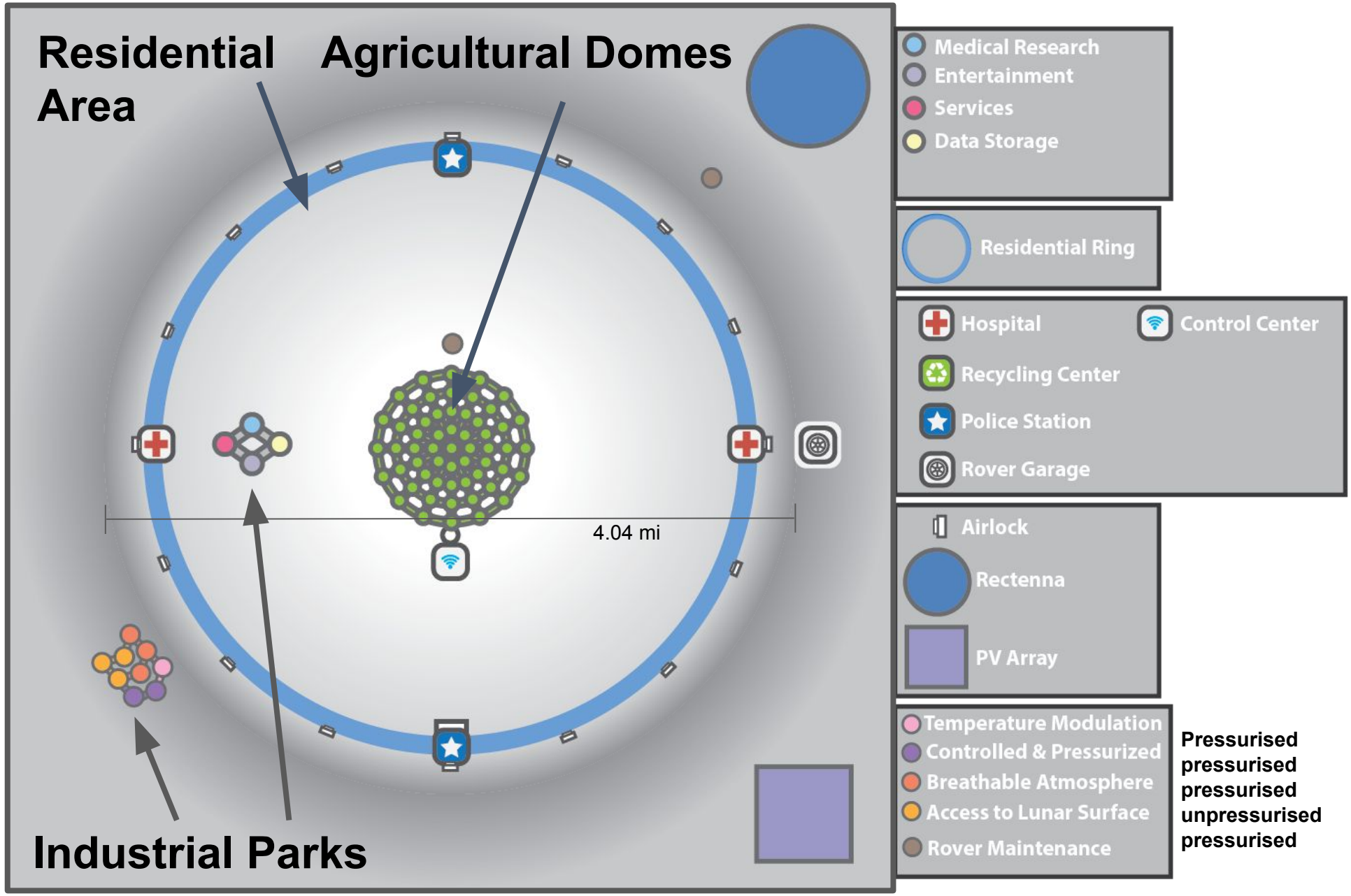
GRUMBO AEROSPACE

"Established to become the first Big City on Luna, Alaskol embodies the principle of an uncompromising city-like feel through industrial parks and a spacious structural design"

Alaskol



Overall Exterior View

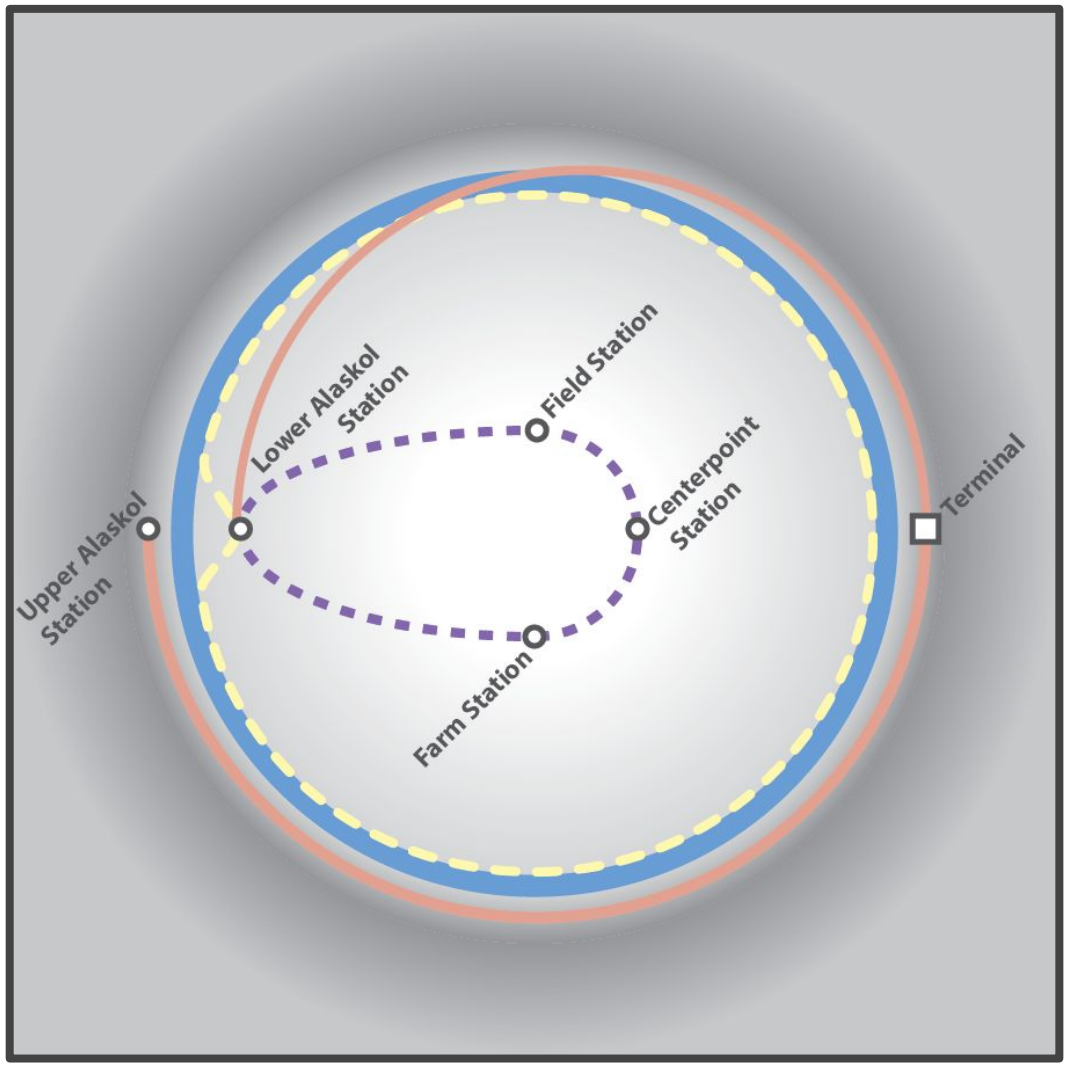


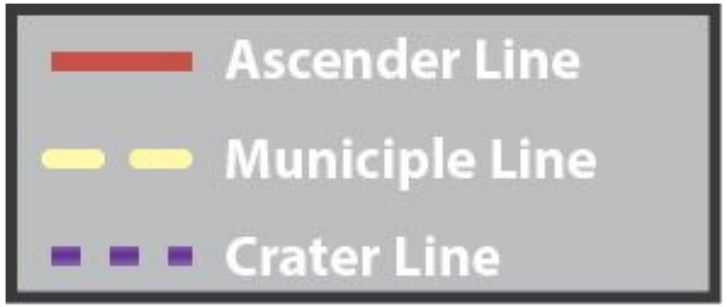
- Residential and service facilities embedded in hillside near top of crater.
- Light Rail lines will connect the residential areas
- 4 industrial parks in the crater & 7 on the surface
- 4 Rover maintenance modules
- 220 farming domes in center of crater

RFP 2.1

Map of Light Rail

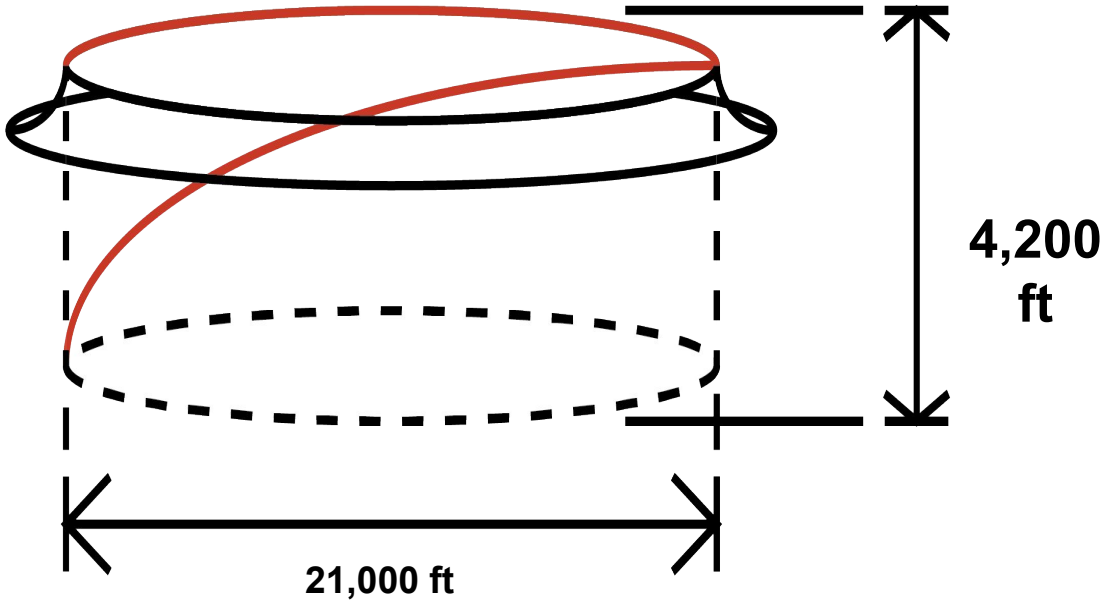
Top down view of crater





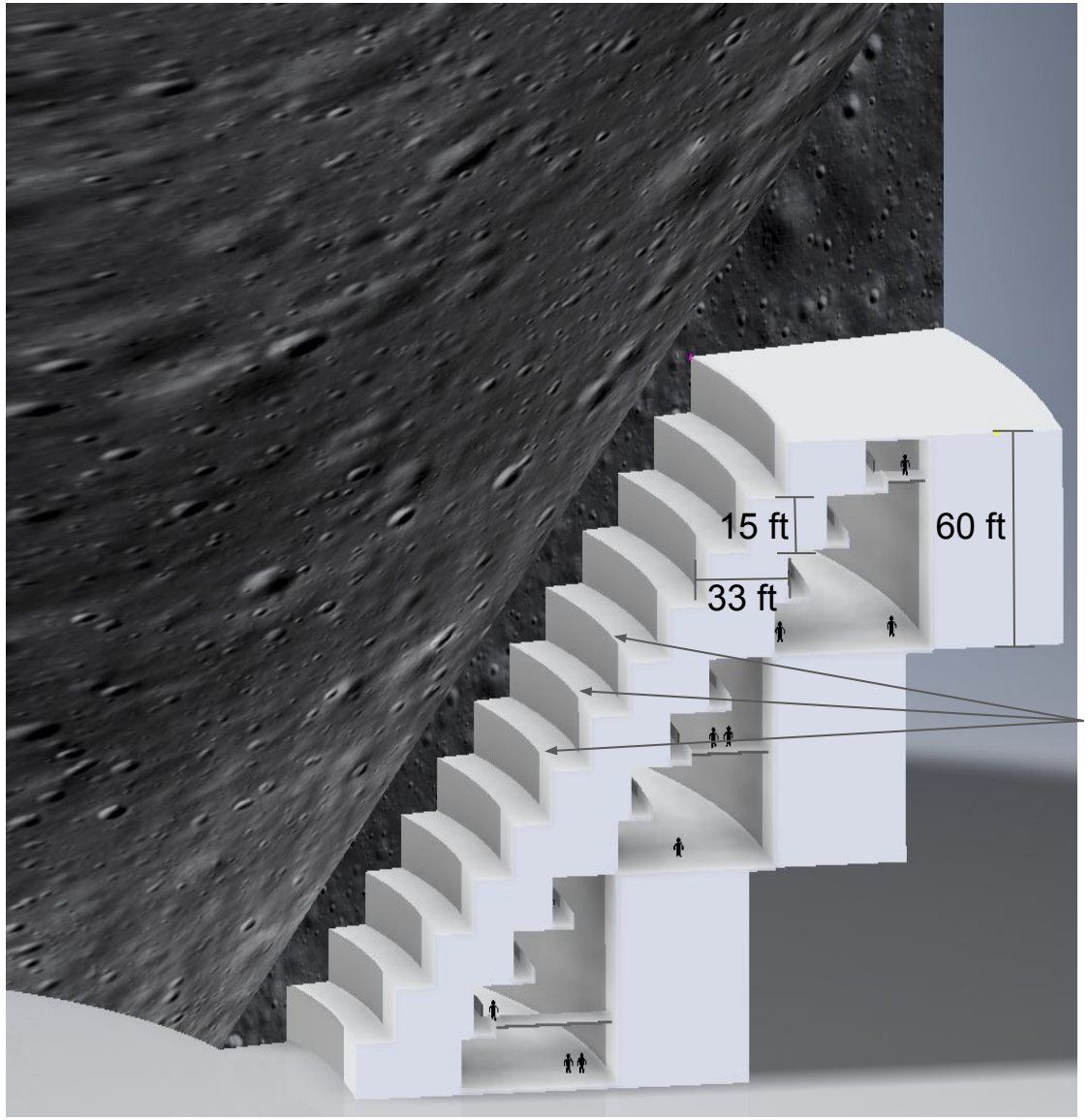
- Holey Moley adapted tunnelling technologies and equipment used to bore channel for Ascender line

- Hard Roll used to fabricate rail infrastructure

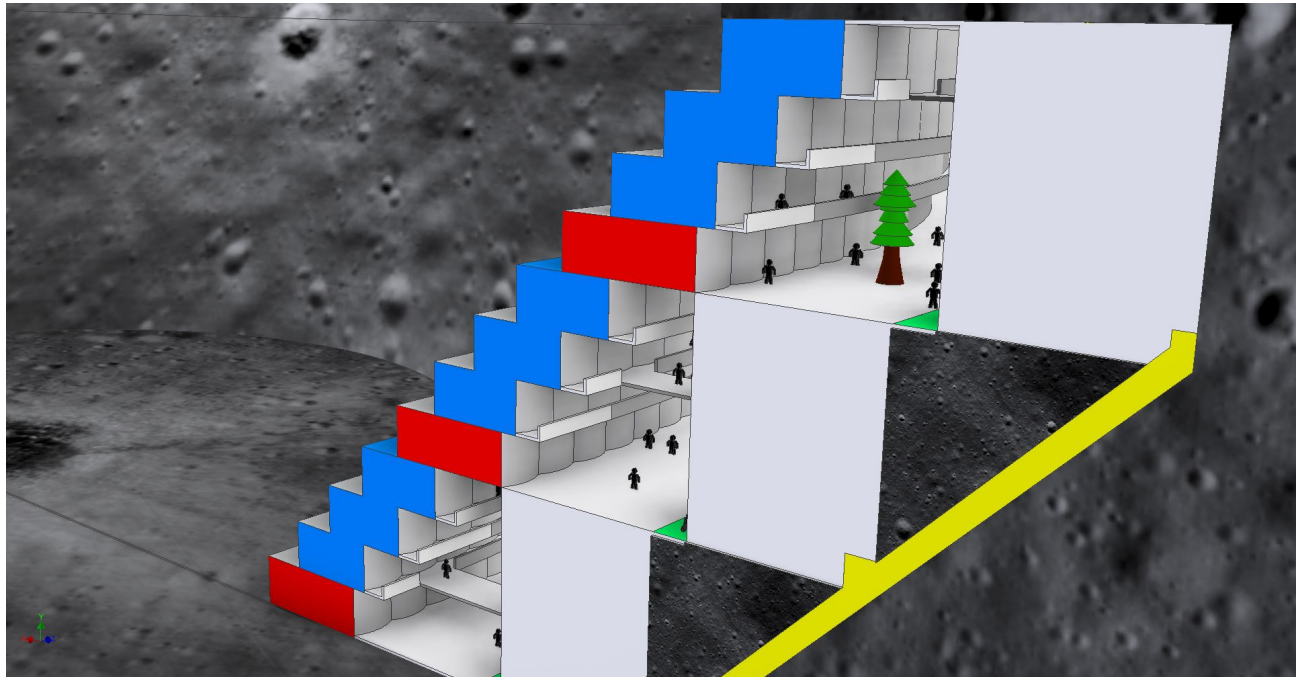


RFP 3.3

Interior View



Recessed Windows



= Housing

= Shops & Restaurants

= Bike Paths

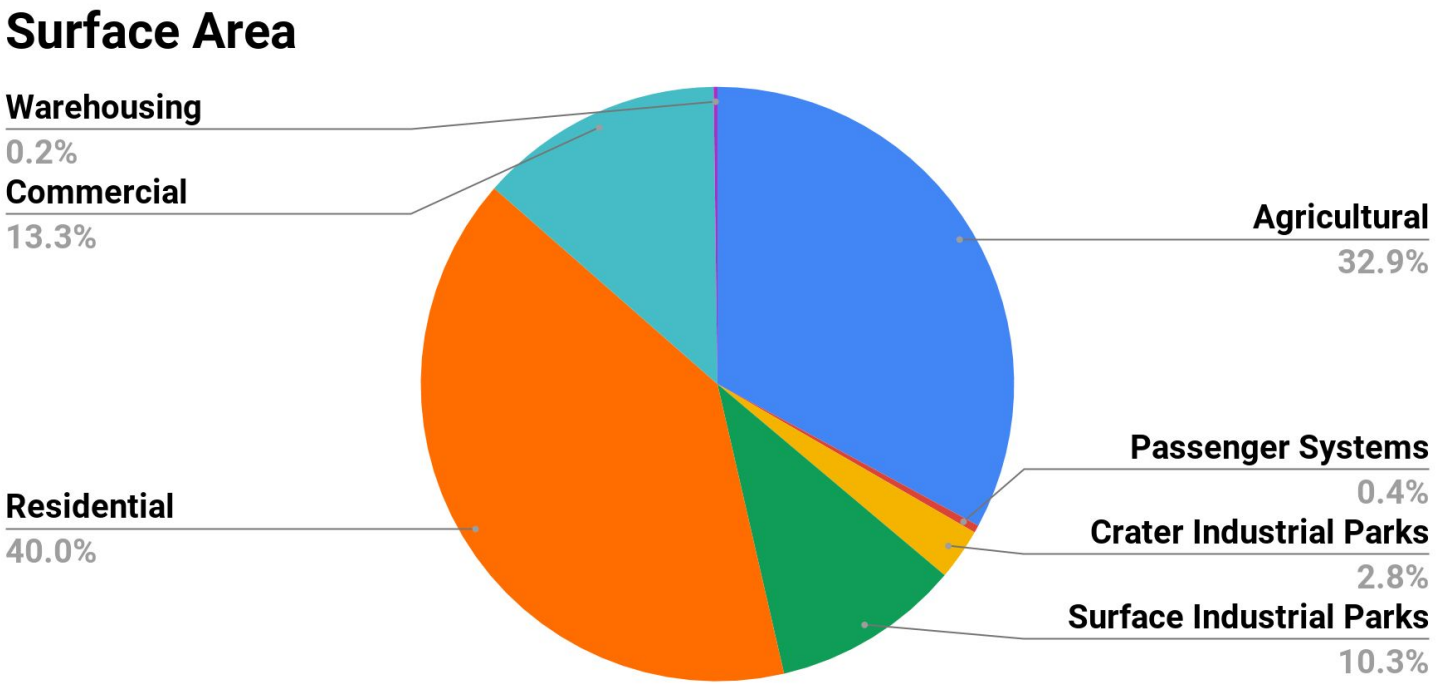
= Elevators

= Mixed Use Amenities

RFP 2.2

Alaskol Area Breakdown

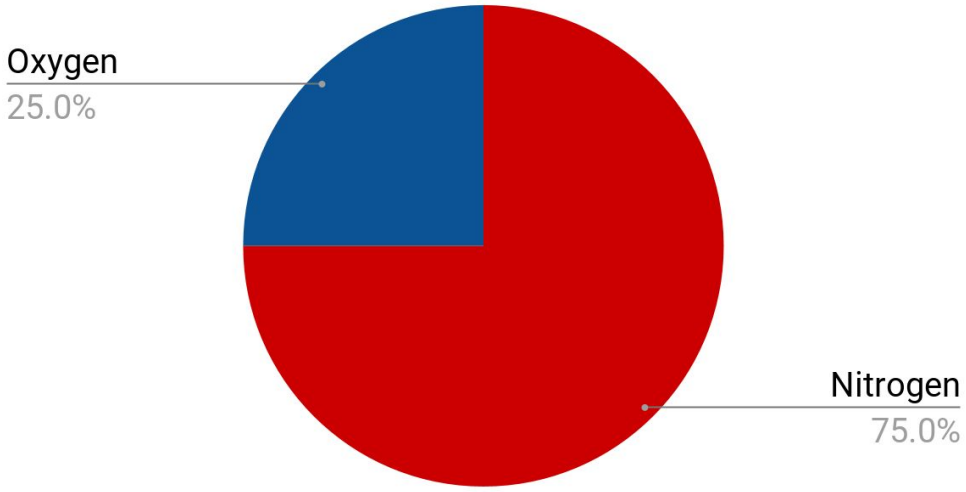
Structure	Surface Area (sq ft.)	Volume (cu ft.)
Agricultural	8,000,000	64,000,000
Passenger Systems	100,000	250,000
Crater Industrial Parks	681,800	2,727,000
Surface Industrial Parks	2,500,000	30,000,000
Residential	9,737,000	146,041,000
Commercial	3,246,000	48,680,000
Warehousing	51,000	3,797,000



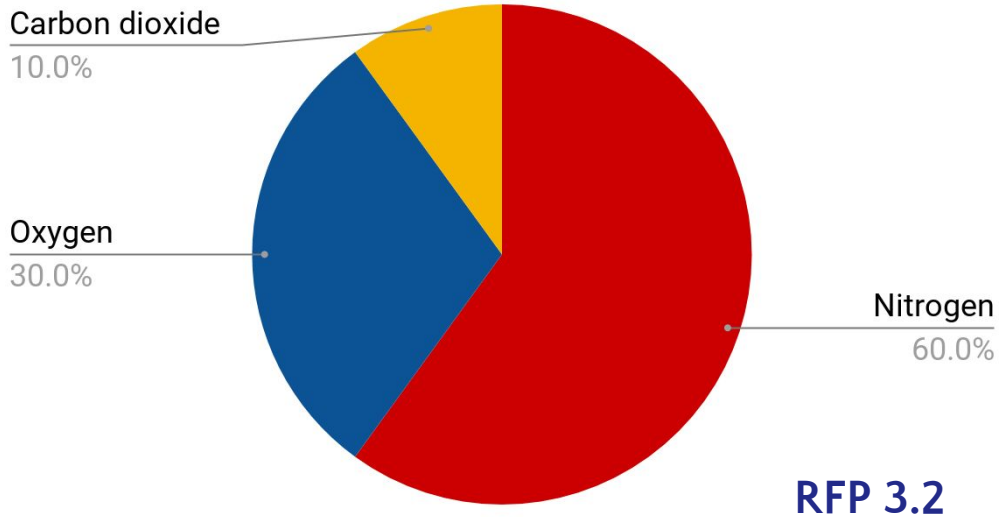
Atmospheric Composition

- CO_2 will be restricted to 0.02% using **Clean Up Your Act** in habitable areas.
- Quantities of air subcontracted by **Stuff Of Life.**
- Higher oxygen content than earth due to low pressure because of 11 psi pressure.
- Increased CO_2 in farms to promote plant growth, but limited as excess CO2 content in farms impedes nitrogen absorption.
- Workers in farms use breathing masks in case of hazardous agri volumes.

Habitable Atmospheric Composition



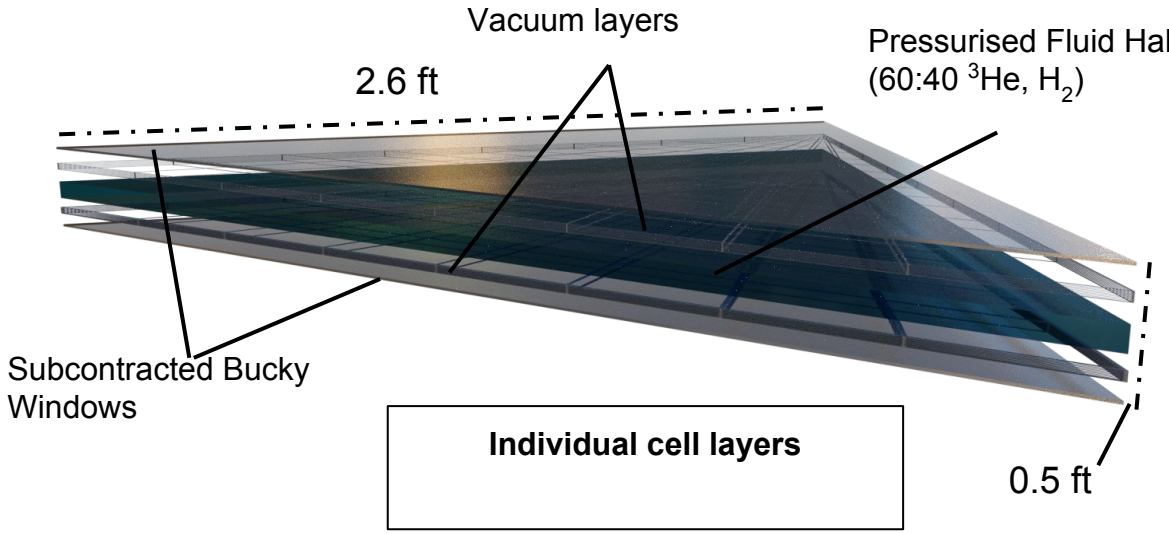
Agricultural Atmospheric Composition

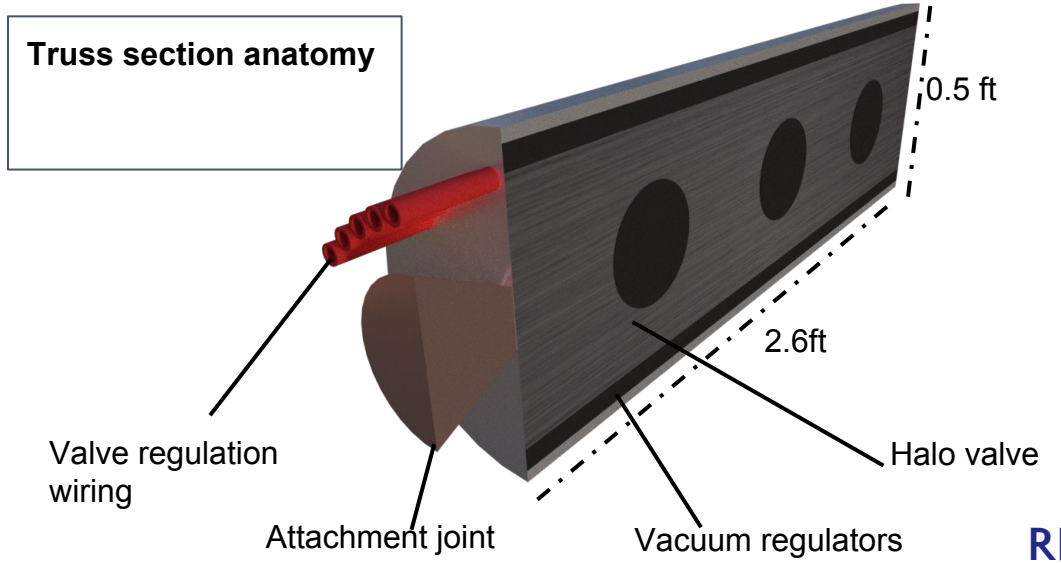


RFP 3.2

DOME RADIATION SHIELDING (FLUID HALO)

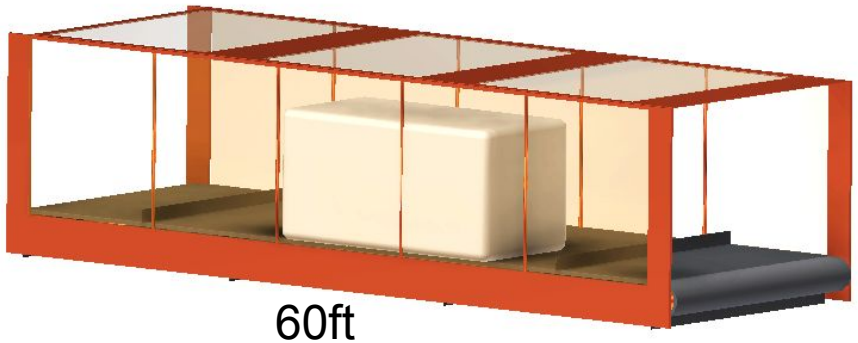
- 60:40 mixture of gaseous ^{3}He and H_2, pressurized in a series of sectioned pockets.
- Mixture will become gaseous in sunlight. Overpressure is avoided through the establishment of convection currents between cells.
- Helium-3 is fire retardant and individual cells can be sectioned off using truss valves.
- Convection current system enables phase fluctuations and helps mitigate temperature effects.





RFP 3.2

Vehicle Dust Mitigation



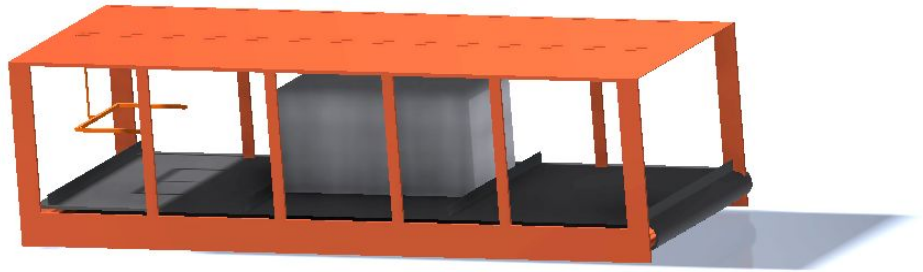


Fig x. Dust Removing "Car Washer"

- CASSSC's loaded onto the conveyor belt where coarse material is brushed off
- Compressed air blows off fine substrate and is vented back to moon
- CASSSC's indexed into the warehouse
- Robot control room monitors imports & exports
- *CASSSC's move out of settlement using same ports in reverse order
- *Cargo delivered to remote communities using the Magnetic Propulsion Co mass driver

RFP 5.4, 3.2

Materials

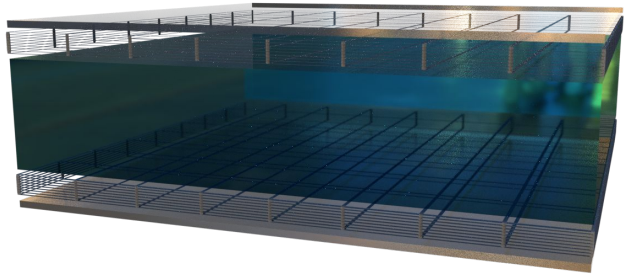
Material	Purpose	Properties	Source
Titanium Aluminide	• Heavy Base Framework • α-ray radiation protection	• Lightweight • Insulation • Good strength to weight ratio	Titanium: Lunar mares Aluminum: Anorthosite from lunar highlands
Silicon Bucky-structures	• Light base framework • Supplementation	• Can withstand high pressure • Provides structural integrity	Silicon: Lunar Surface as moon is about 20% silicon
Lunar Regolith	• Radiation protection	• Radiation protection	Lunar surface
Epoxy Adhesive	• Adhesion	• Corrosion resistant • Resists degradation	Earth
Metal Foam (High z steel-steel)	• Radiation Protection • Light base framework	• High tensile strength • Radiation Protection	Iron: Lunar mare plains Carbon: Carbon creations

Note: The subcontractor Seal-It will be used for additional protection against Lunar Dust

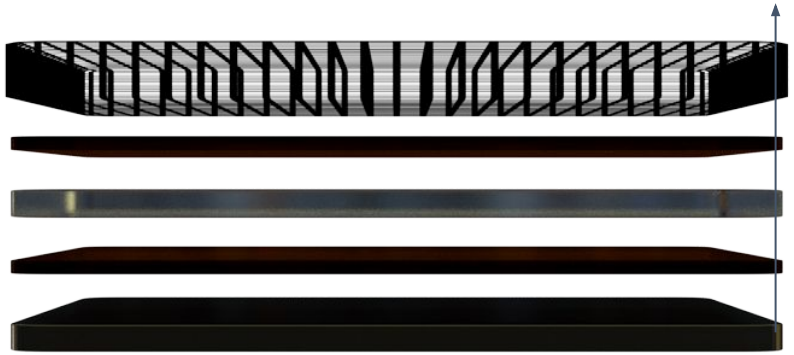
Materials

Material	Quantity (cu ft)
Silicon Bucky-structures	806,000
Epoxy Adhesives	395,400
Metal foam	410,300
Titanium aluminide	410,300
Lunar Regolith	As needed

WINDOW



Halo Fluid



Silicon Bucky-structures : 6 inches

Epoxy adhesive : 1.5 inches

Metal Foam : 3 inches

Epoxy adhesive : 1.5 inches

Titanium Aluminide : 3 inches

HULL

Lunar Regolith

Materials and Equipment

- For Sources of materials - Refer 2.1
- The **excavation equipment** subcontracted from **Holey Moley**
- **industrial processing tools and extraction** can be asked to provide from Sub contractor Holey Moley

Transportation of Materials

- **Mass drivers** transports materials on luna, subcontracted from **Magnetic Propulsion Company**
- The mass drivers will be located at **all major export locations** on luna (Refer 2.1)
- The rest of the materials will be transported in CASSSCs using **Grumbo TransBot**

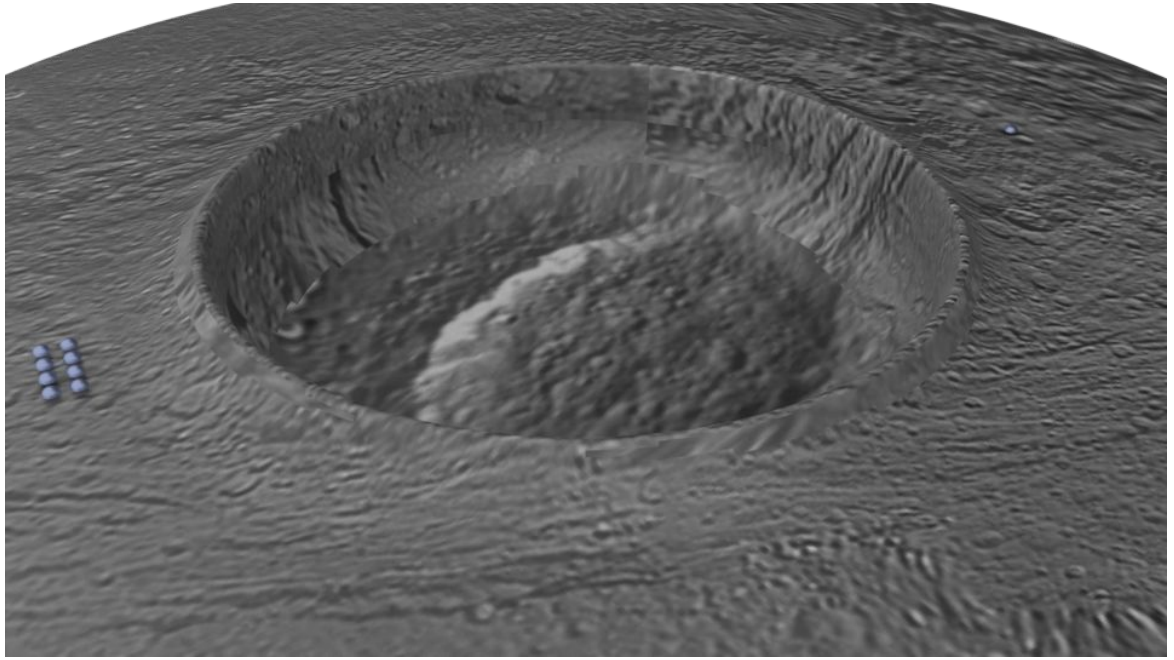
Sequence of Construction

Phase 1:

- Setting up temporary structures (Blown Away) for monitoring and a construction shack
- Place dome over Apollo 11 (blown-away sub contractor)
- Elapsed Time: 2 years (concurrent)

Phase 2:

- Receiving personnel, subcontractors, and robots needed for initial construction
- Elapsed Time: 1 month

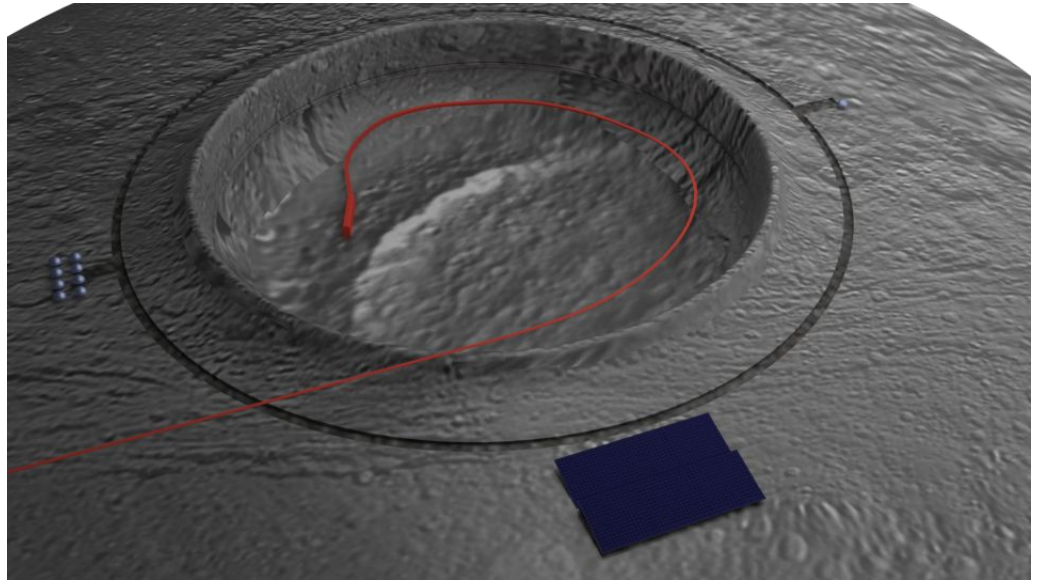


Structure	Key
Blown Away Inflatables	Light Blue Spheres
Monorail Track	Red Line
Solar Arrays	Dark Blue Boxes
External Domes	Green Spheres

Sequence of Construction

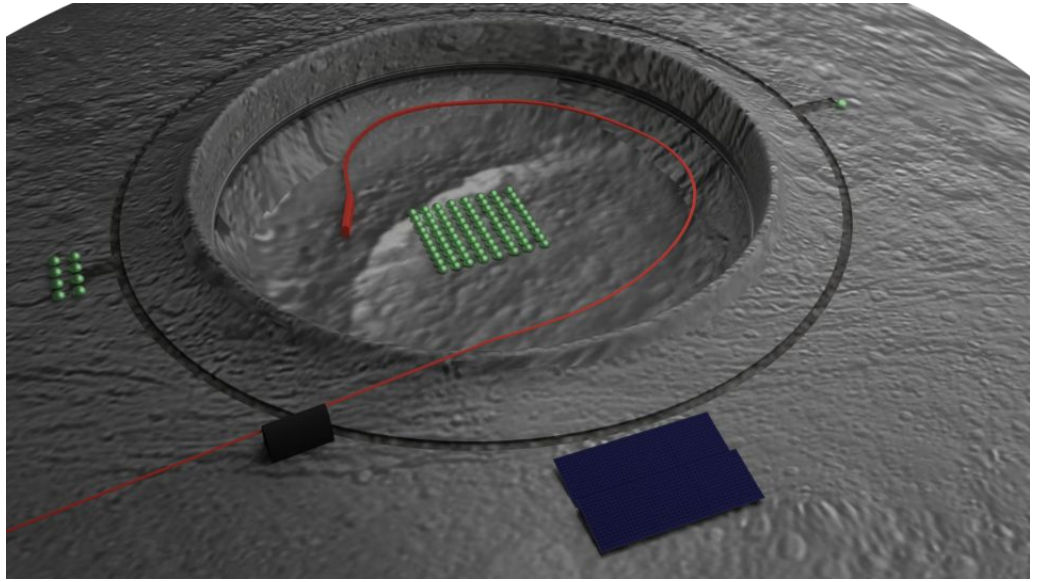
Phase 3:

- Planetary Pavers begin roads for CASSSC movement
- Multi-purpose F1M8's construct monorail
  - Hard Roll provides rails
  - Light Rail cars shipped from Earth
- Mass driver is installed
- CASSSCs repurposed into buildings
- Solar panels, Soletta and Rectenna installed
- Elapsed Time: 2 months



Phase 4:

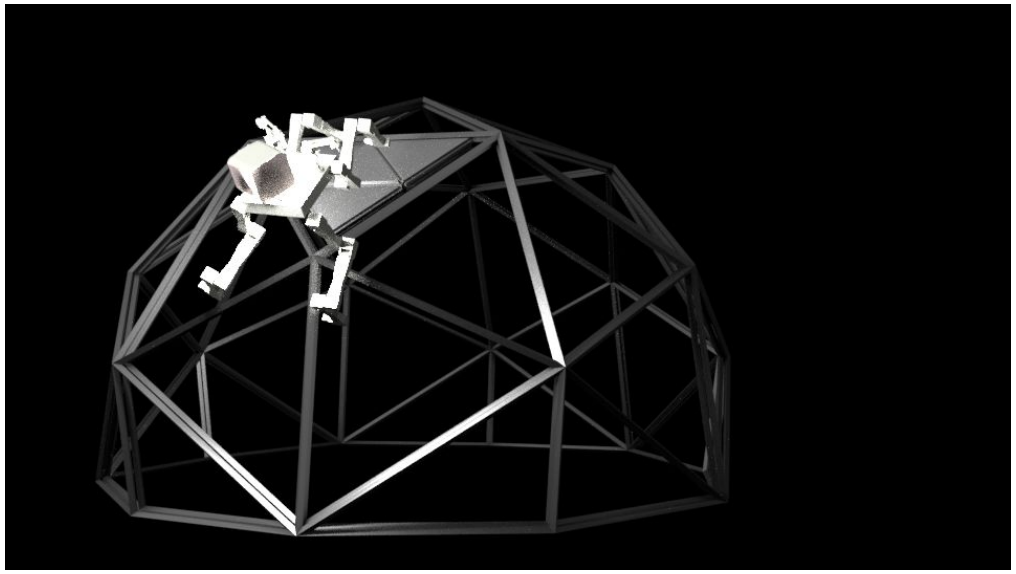
- Excavation and dome creation begins
  - Holey Moley (digging out area for housing)
  - Large Print (print dome parts)
- Other subcontractors begin misc work
  - Vulture Aviation (providers of window)
  - Rockdonnell (prepares interior parts)
- Elapsed Time: 16 months



Sequence of Construction

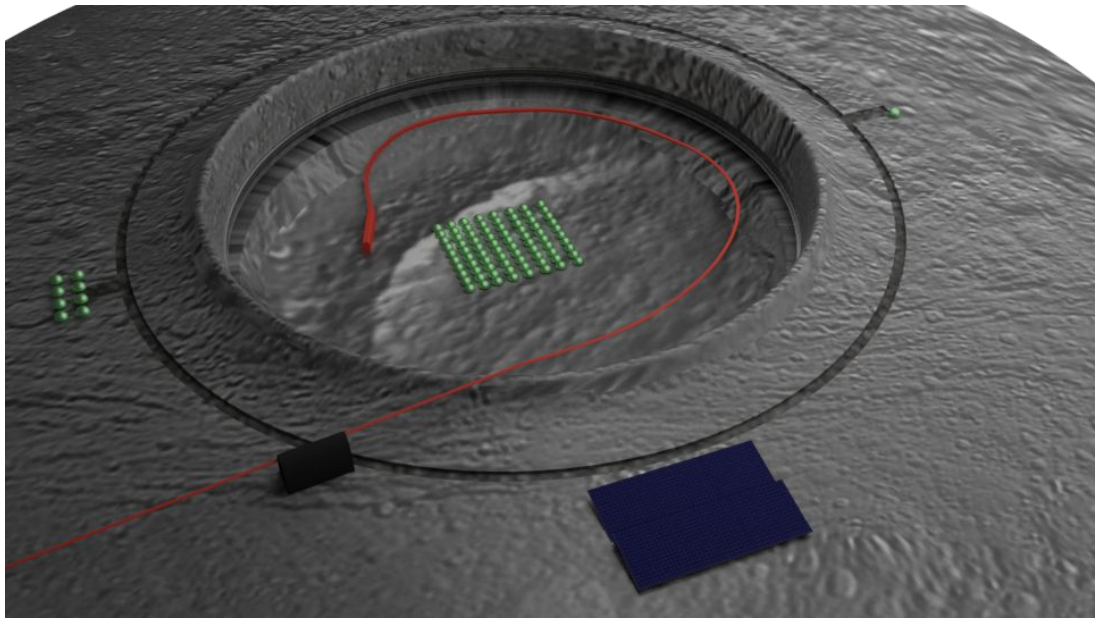
Phase 5:

- Domes finish
- Waste Products builds plumbing system
  Set up food production via Garden-a-go-go
- Interior furnishing of domes begins
  - F1M8 uses built-in 3D printer
- Glass dome over Apollo 11
- Elapsed Time: 4 months

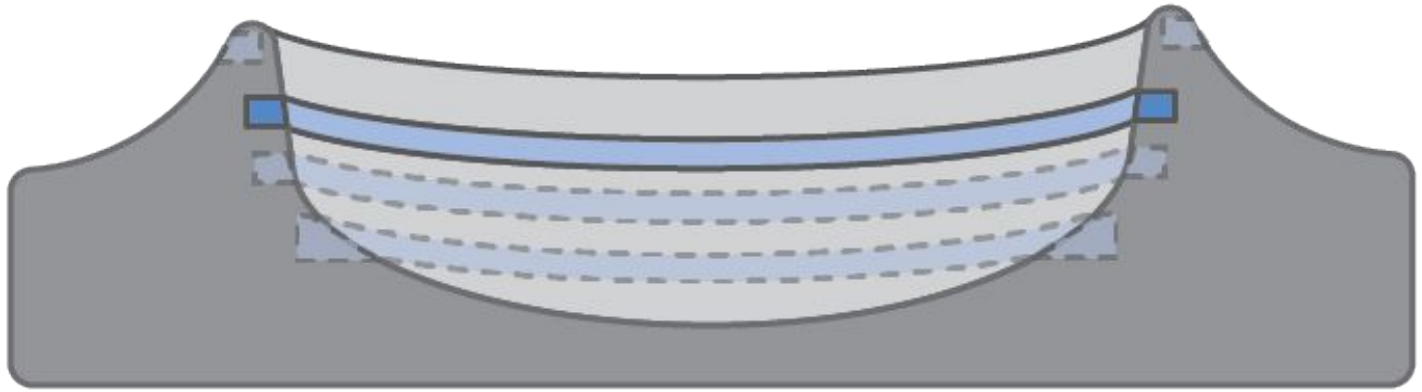


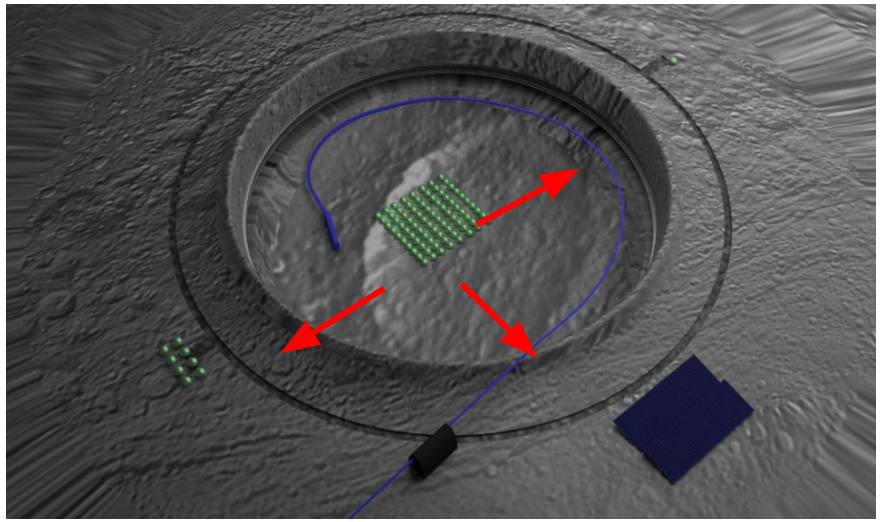
Phase 6:

- Assembly of interior out of CASSSCs moved via Light Rail
- Glass installed, construction is complete
- Industries move in
- Elapsed Time: 7 months



Future Expansion



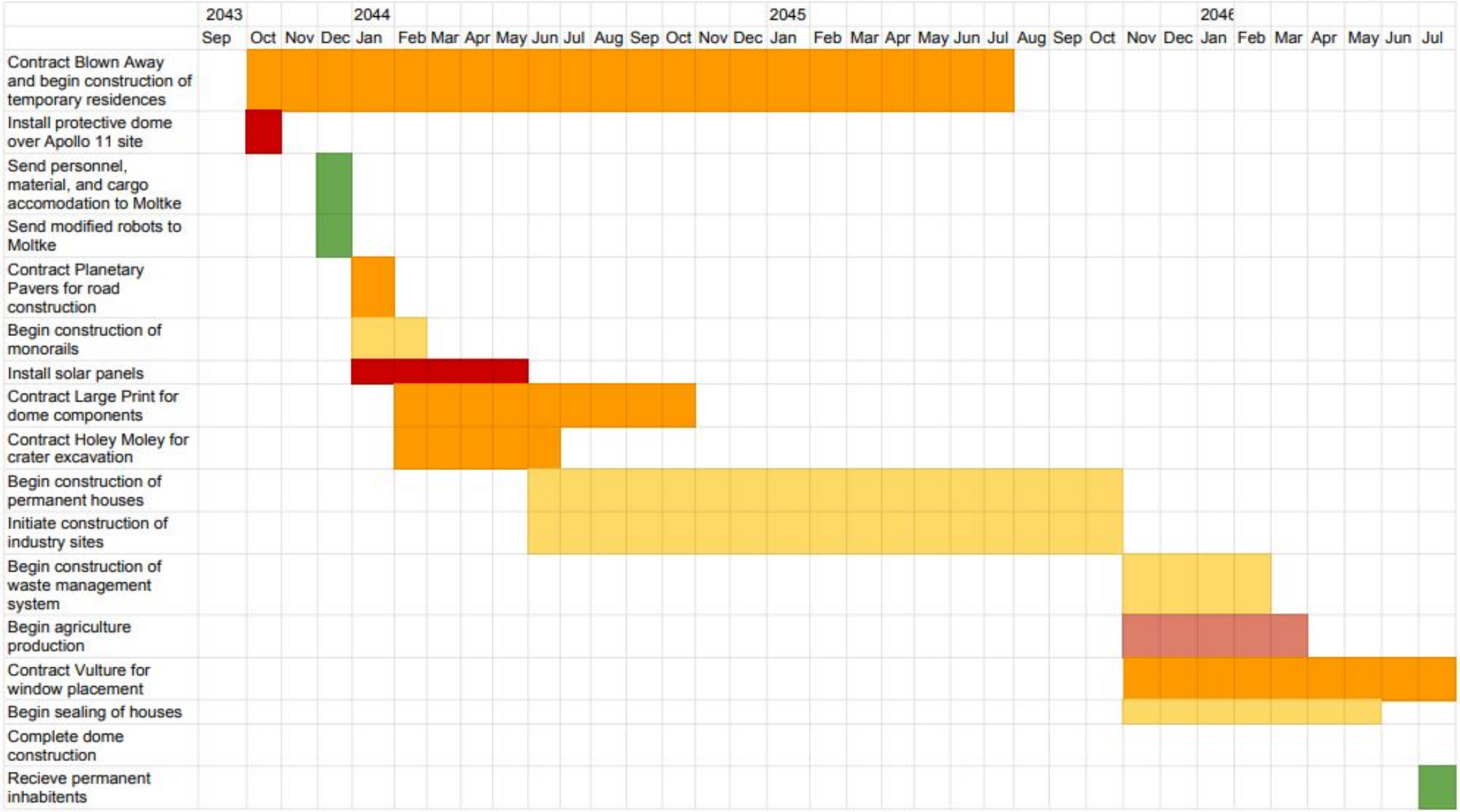


- Industrial parks in crater will expand outwards
- More levels will be added downwards to expand residential area

Trade study for choosing structure

Ring Layout	Vertical Layout
Pros:	***Pros:***
Structural Stability	Compact
Big city feel	Quicker transportation
Early shifting in of residents	
Easier transportation	
Cons:	***Cons:***
Longer Transportation time	Structural instability
More elevators need to be constructed	Haphazard transportation system
Therefore we have chosen the ring layout	Crater wall needs to be excavated in one go, which would take longer

Schedule



RFP 6.1

Automated Construction

- Robot Command Center allows interaction with construction process
- The Robotic Monitoring Control Panel allows monitoring and interaction
- Bi-monthly status reports to Foundation members provided by subcontractors
- Wheels of Fortune will be used when we are close enough to have roads
- Mass driver for further distances
  - 150 F1M8 based construction robots will assemble the station
  - Parts will be either 3D Printed or subcontracted
  - Storage and housing done in Blown Away shelters befo construction is finished

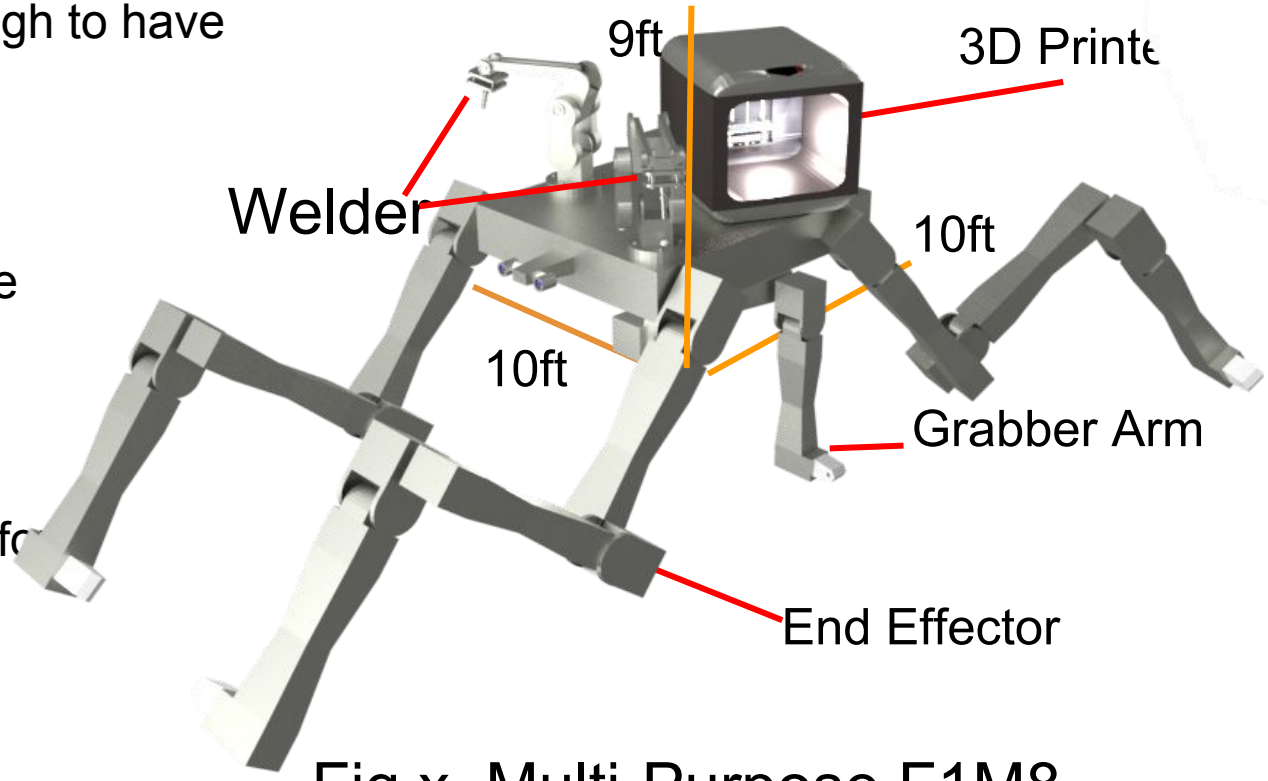


Fig x. Multi-Purpose F1M8

RFP 5.1, 5.2 & 5.4

Industrial Areas

Requirements in Industrial Parks	Types of industries
Access to lunar surface & Unenclosed vacuum (surface)	Electric management, vehicular research, lunar geology, etc
Breathable Atmosphere, pressurised (in crater)	Medical research, entertainment, service industries, data storage (subcontractors)
Enclosed vacuum (surface)	Waste management (subcontractors), materials science
Controlled & pressurized (surface)	3D printing (3D logistics) & manufacturing
Temperature Modulation (surface)	Metallurgy and materials research

The industrial parks will have showrooms that display the salient features of the that particular park

Types of Industry and other subcontractors

- 3D Printing & Manufacturing
- Aerospace & aviation
- Electrical & water management
- Entertainment Industry
- Medical research
- Materials Science & Metallurgy
- Research
- Vehicular Research
- Waste management

Dimensions & Numbers

- 275 domes
- Each dome has a radius of 50 ft
- 1,030,000 struts total from all domes
- 343,000 cells total from all domes

RFP 2.4

Passenger Terminal & Shipping Facility

CASSSC elevator

Multi-directional mover surface

Wheels of fortune rover berths (x40)

Commercial space

Mass driver

- Floor 1 will possess berthing for up to 40 rovers as well as CASSSC cleaning and train loading units.

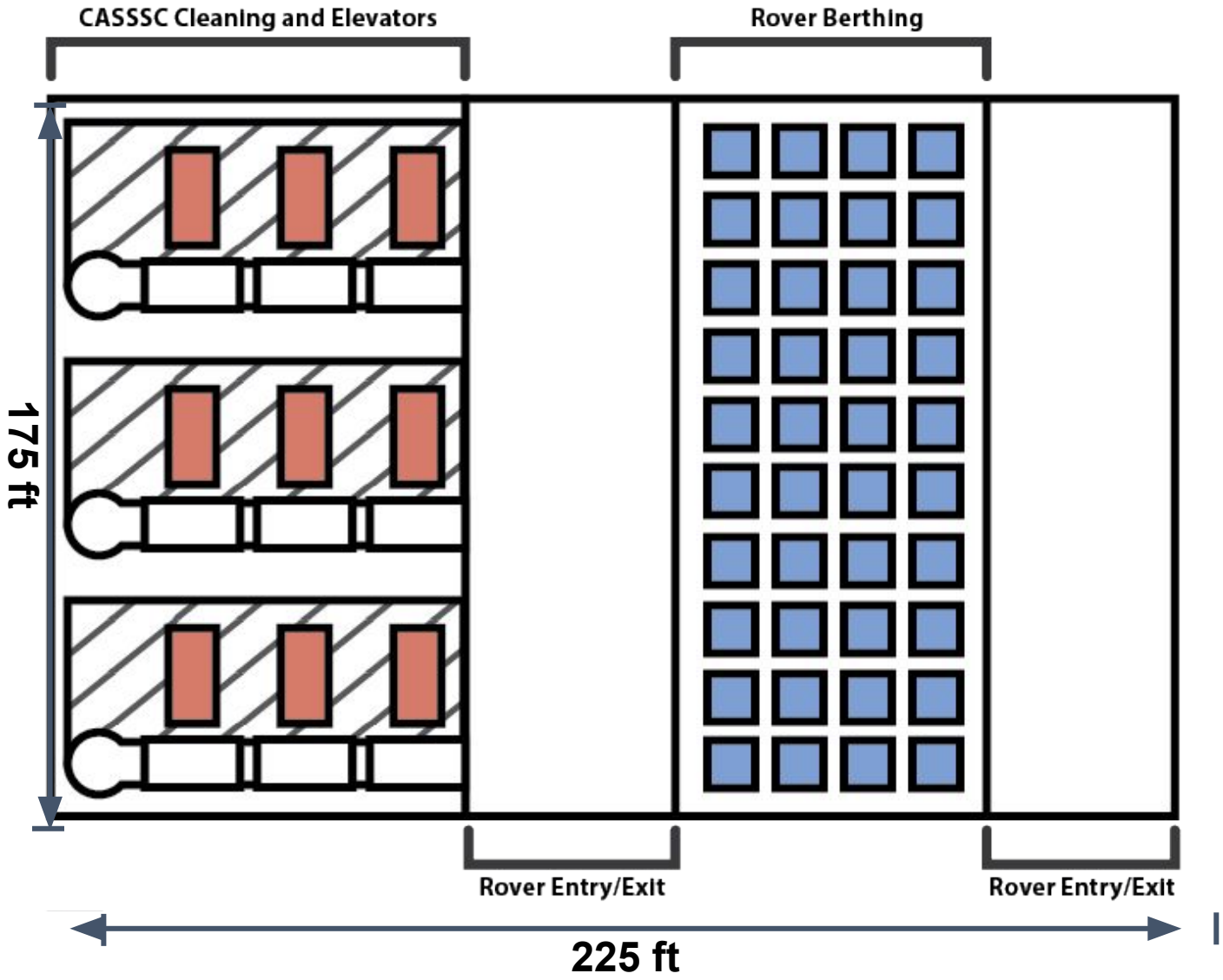


Fig 1. Floor 1: Vehicle Processing

RFP 3.3

Passenger Terminal & Shipping Facility

- **CASSSC elevator**
- **Multi-directional mover surface**
- **Wheels of fortune rover berths (x40)**
- **Commercial space**
- **Mass driver**

- Floor 2 will consist of light rail terminal for passenger & cargo and connecting monorail.
- Mass driver will be used for launching and receiving cargo from other lunar settlements.

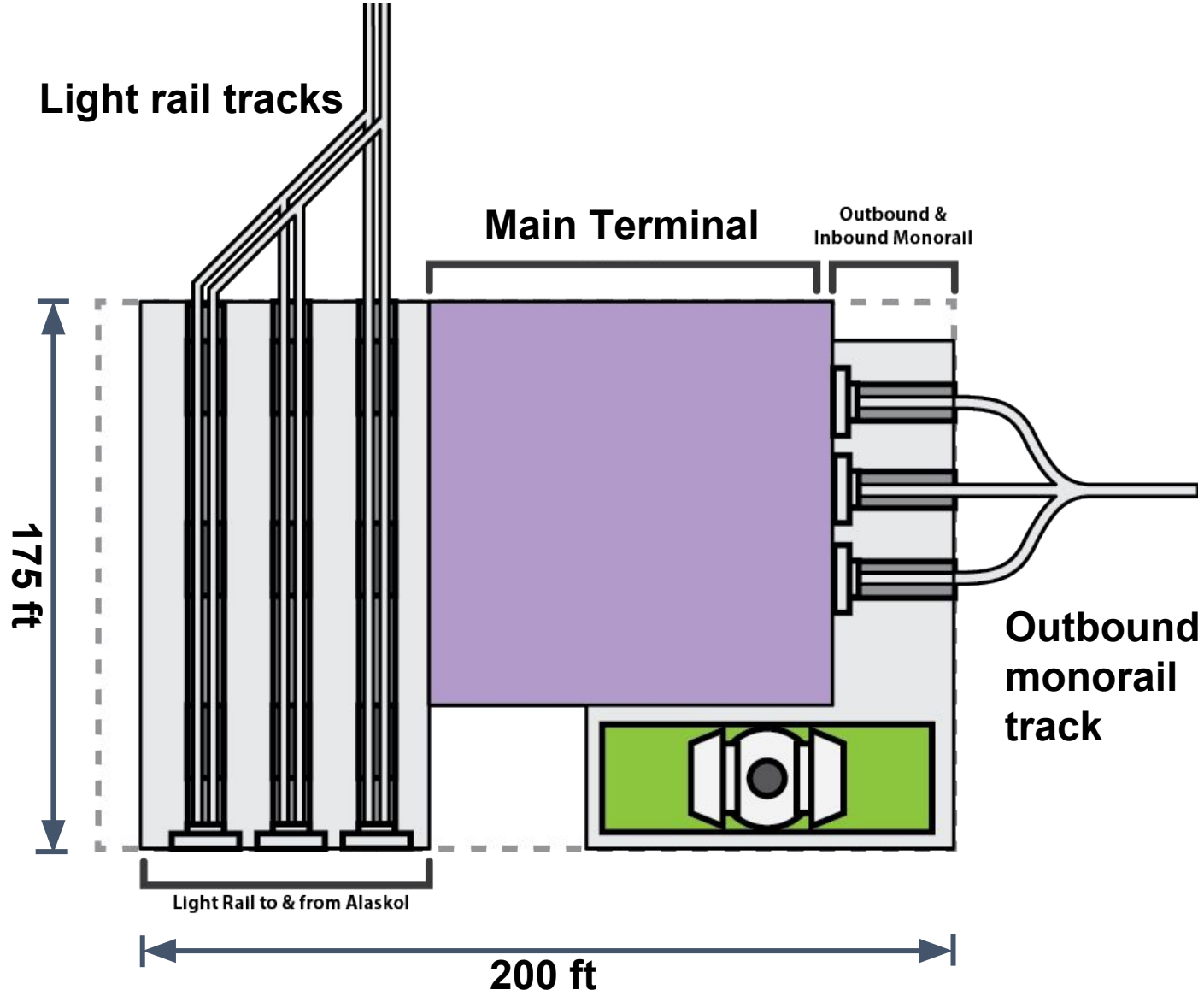
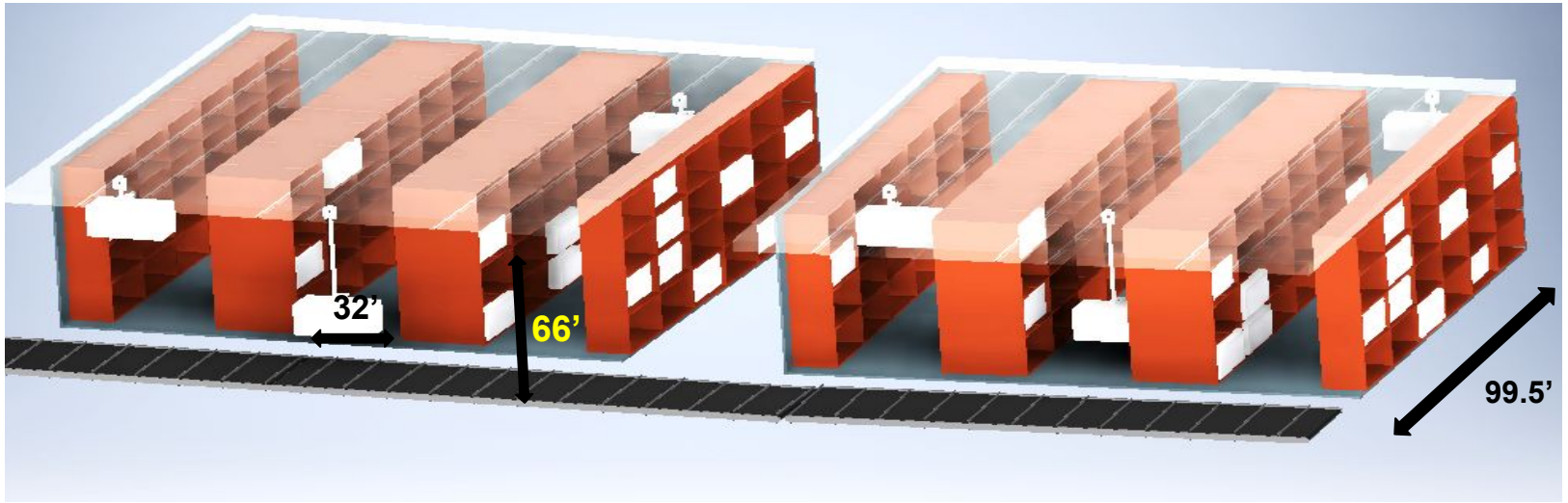


Fig 2. Floor 2: Monorail & Light Rail Terminal RFP 3.3

Retail Businesses and Industrial Parks

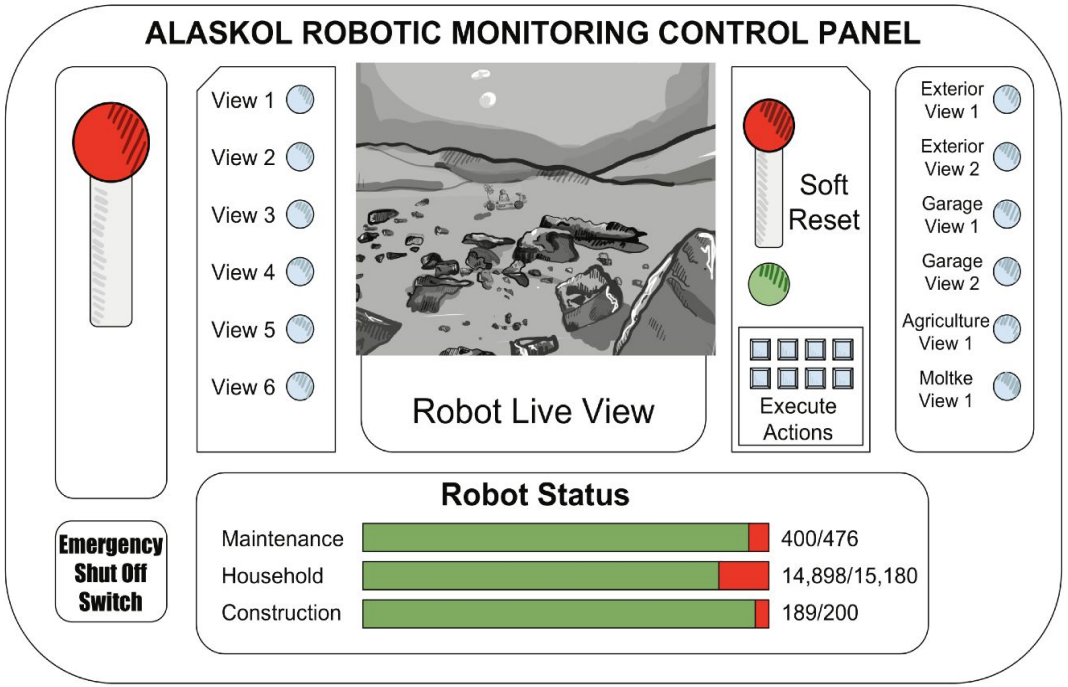
- Automated shops using personal computers
- Checkout-less “grab-and-go” retail shops
- Premium cargo imported from earth and delivered to automated vendors using CASSSC handling system
- Goods stored by vendors protected by state of the art alarm systems
- Bots4U keep commercial areas clean, make life easier



CASSSC shelves

Control Rooms and Human Interaction

- **All robots** in the settlement including contracted Bots4U and proprietary F1M8 will be monitored in the **Robot Control Room**
- **All Vital Systems** will be monitored in the **General Control Room**
- **All Cloud Storage and Software** will be hosted in the **Server Room**



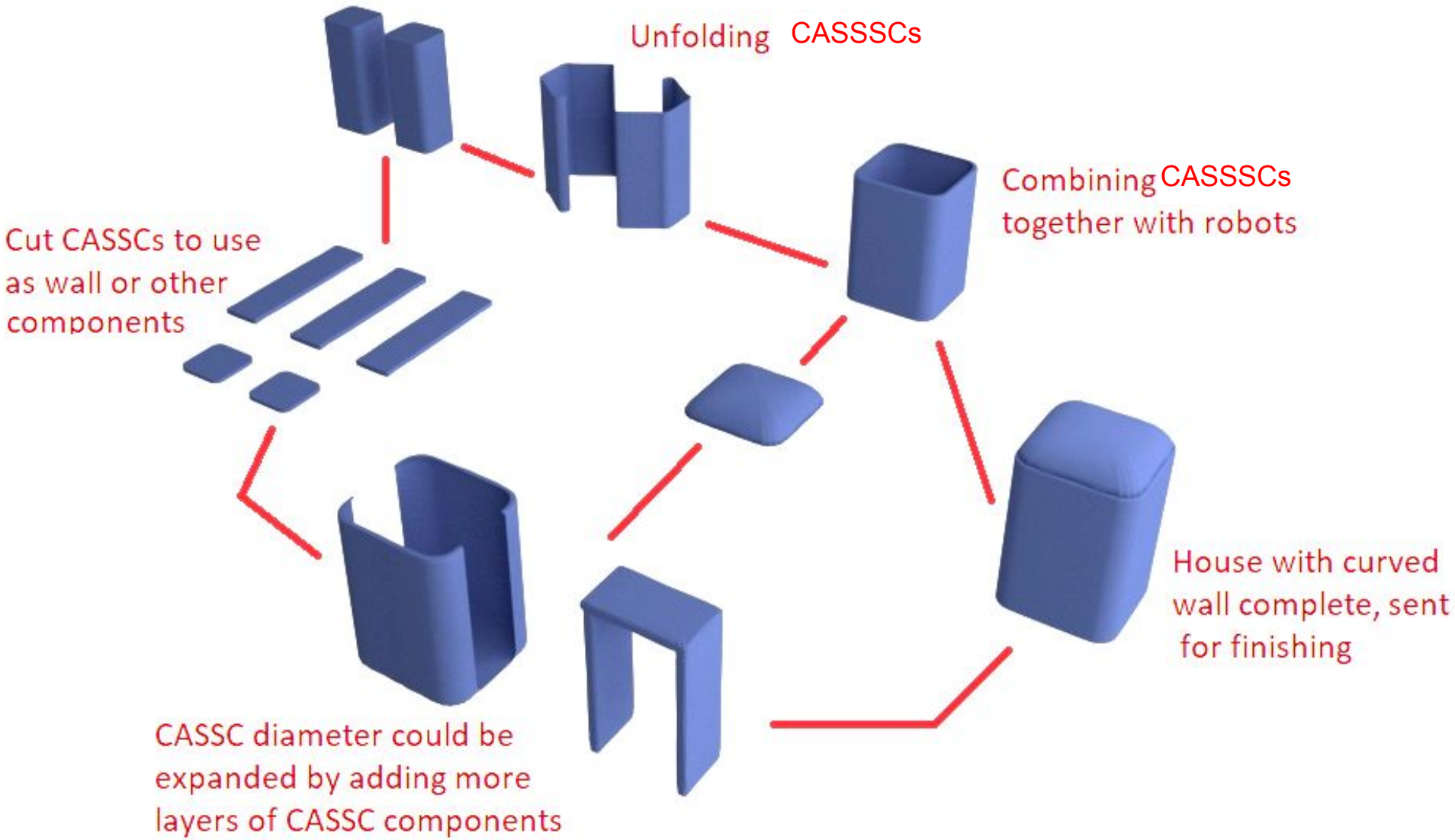
Robot Control Panel

Reboot	Manual Action	Visit Site
Attempt to reboot the robot remotely to solve the problem.	Take control of the robot and attempt to solve the problem.	If absolutely necessary, visit a site with a land vehicle and retrieve robot.

Human Intervention Protocol

RFP 5.1, 5.2 & 5.4

Repurposing CASSSCs



Representation of how CASSSCs will be remodeled to create several infrastructural facilities

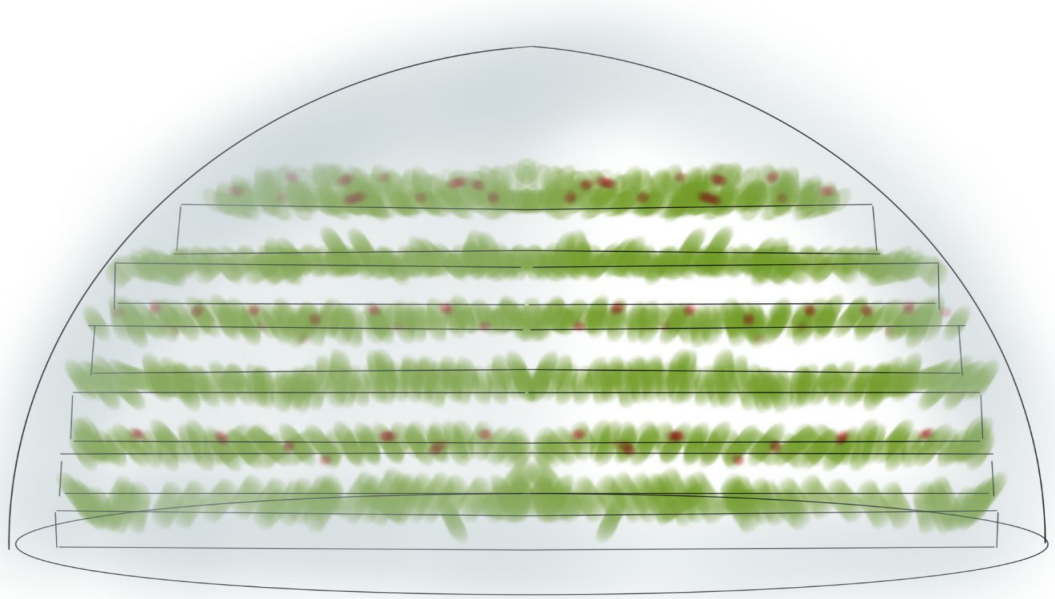
Inspired from original design used previously at ARSSDC 2018

Food Production

Storage under high pressure → Moisture removal → Packaging in Antibacterial paper

Dedicated Agriculture	Edible Landscaping
• Grown at the base of the lunar crater • 5,227,000 square feet - size of all the units • 80 people are required for harvesting; one hour per day • Refuel nutrients are automated	• Grown in the habitable volumes • Combines aesthetics with space utilisation, giving a city garden feel • We provide the customer with different choices including - orange trees, berry bushes, herbs, artichokes etc. • Watering systems will be automated

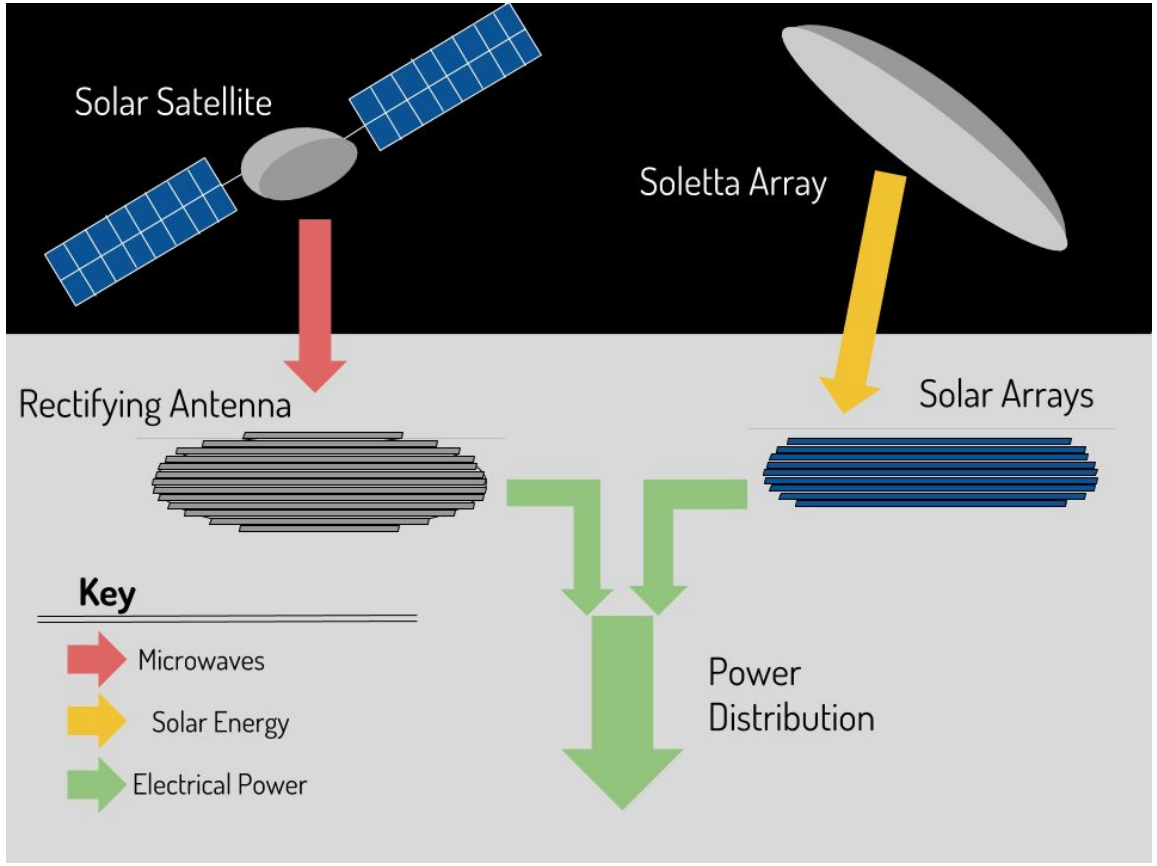
- **Food production** is sub contracted by **Garden-A-Go-Go.**
- **Food processing** involves the following process:



Garden -A-Go- Go Dome

RFP 3.2

Power Production



Area	Industrial	Domestic	Research and Recreation	Agriculture
Power Requirement	50 MW	40 MW	5 MW	5 MW

Solettas for ground Solar Panels

- Solar panels subcontracted by **Zap! Industries**
- 6 **Solettas** subcontracted from LightWorks
- Solar panels Installed away from the base of the crater
- 1.3 million solar panels
- **Solar Field Size = 2.6 Million square feet**

Solar Powered Satellites

- Subcontracted by **Dougledyne** using **Litigation Limiters**
- **Rectenna size = 3.5 Million square feet**

Total: 100 MW

RFP 3.2

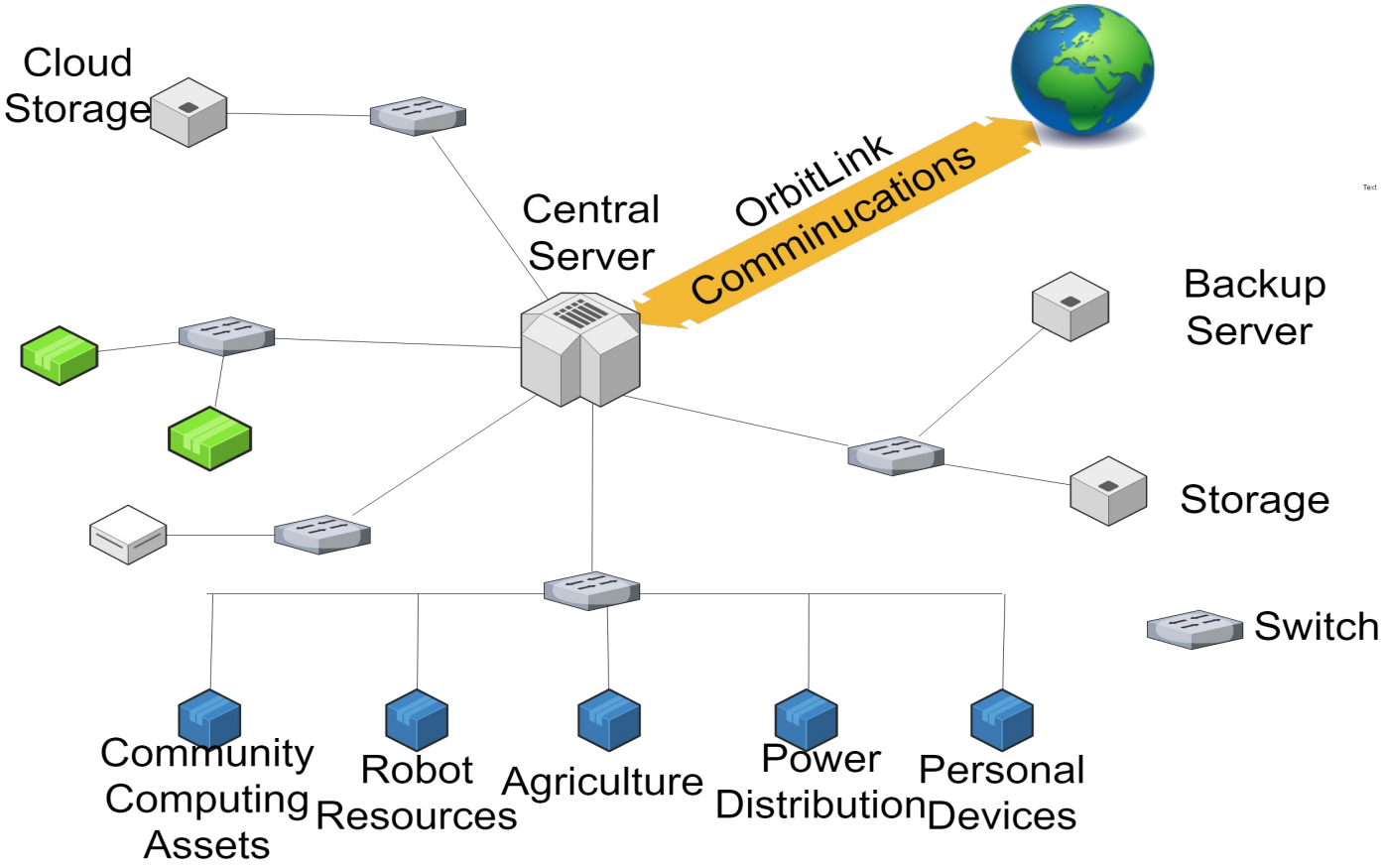
Waste Management

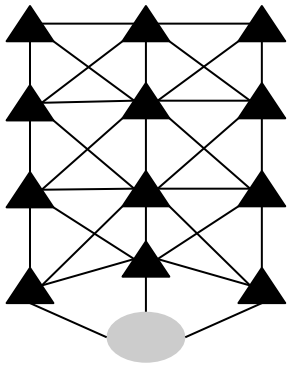
Distribution *- Subcontracted from* ***ZAP! Industries***

- Toilets, Waste Handling systems and Sewer systems Subcontracted from **Waste Products**.
- **1,600** toilets installed in the whole city.
- Sewer Lines will be subcontracted from **Clean Up Your Act**.
- Water recycling services subcontracted from **Toss It To Me**.

S.No	Type of waste	Quantity per person/day (in lbs)	Quantity per person/year (in lbs)	Total quantity per year (in lbs)
1	Biodegradable Organic	1.2	450	8,800,000
2	Biodegradable Inorganic	0.035	13	253,000
3	Non- biodegradable Organic	0.012	4.5	88,000
4	Non- biodegradable Inorganic	0.3	120	1,030,000
	Total	**1.547**	**587.5**	**10,171,000**

Communications and Network





Depiction of repeater network

Internal communication-
Uses star network topology- isolates problems and provides a secure network connected via fiber optic.

External communication-

- **OrbitLink Communications** are subcontracted for communication with earth.
- **Repeater network** of radio stations at the industrial parks and lunar outposts

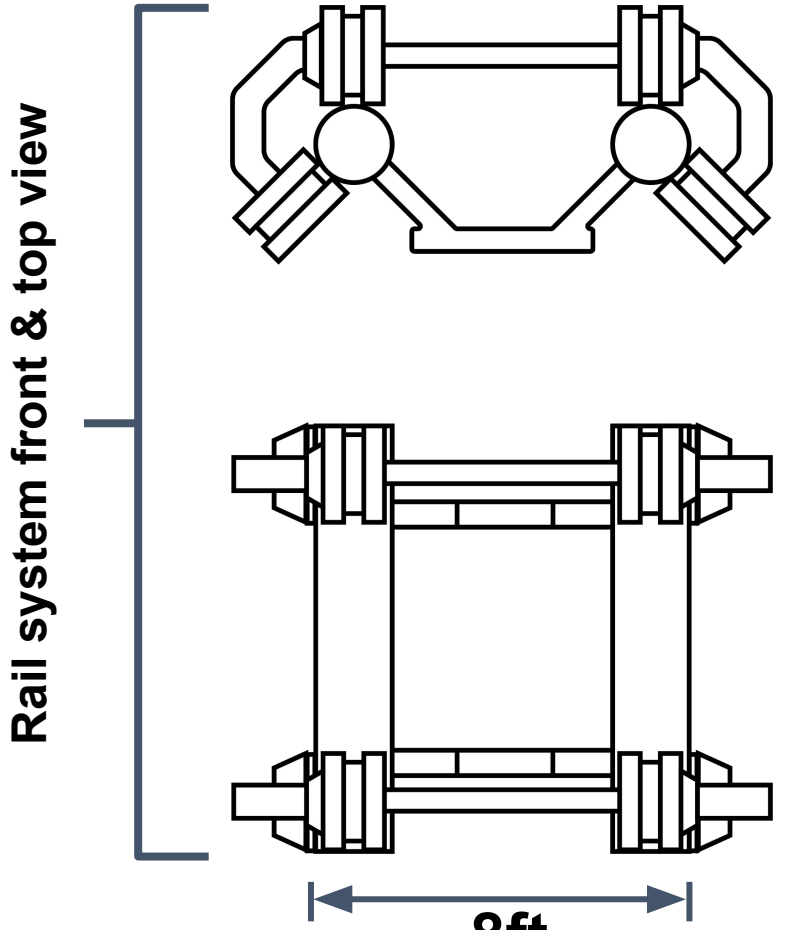
Data collection and storage - The Storage Server

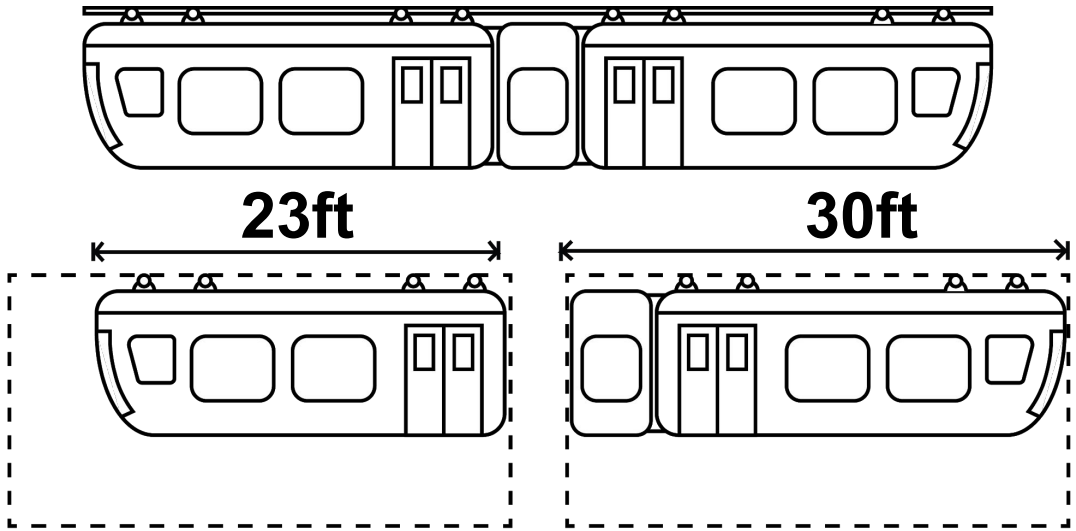
- Consists of 200 petabytes
- Each resident gets 5 terabytes of cloud storage (transients get 1TB each)
- Factors in growth - future inhabitants and businesses will have access to cloud storage.

RFP 3.2 & 3.4

Internal Transportation

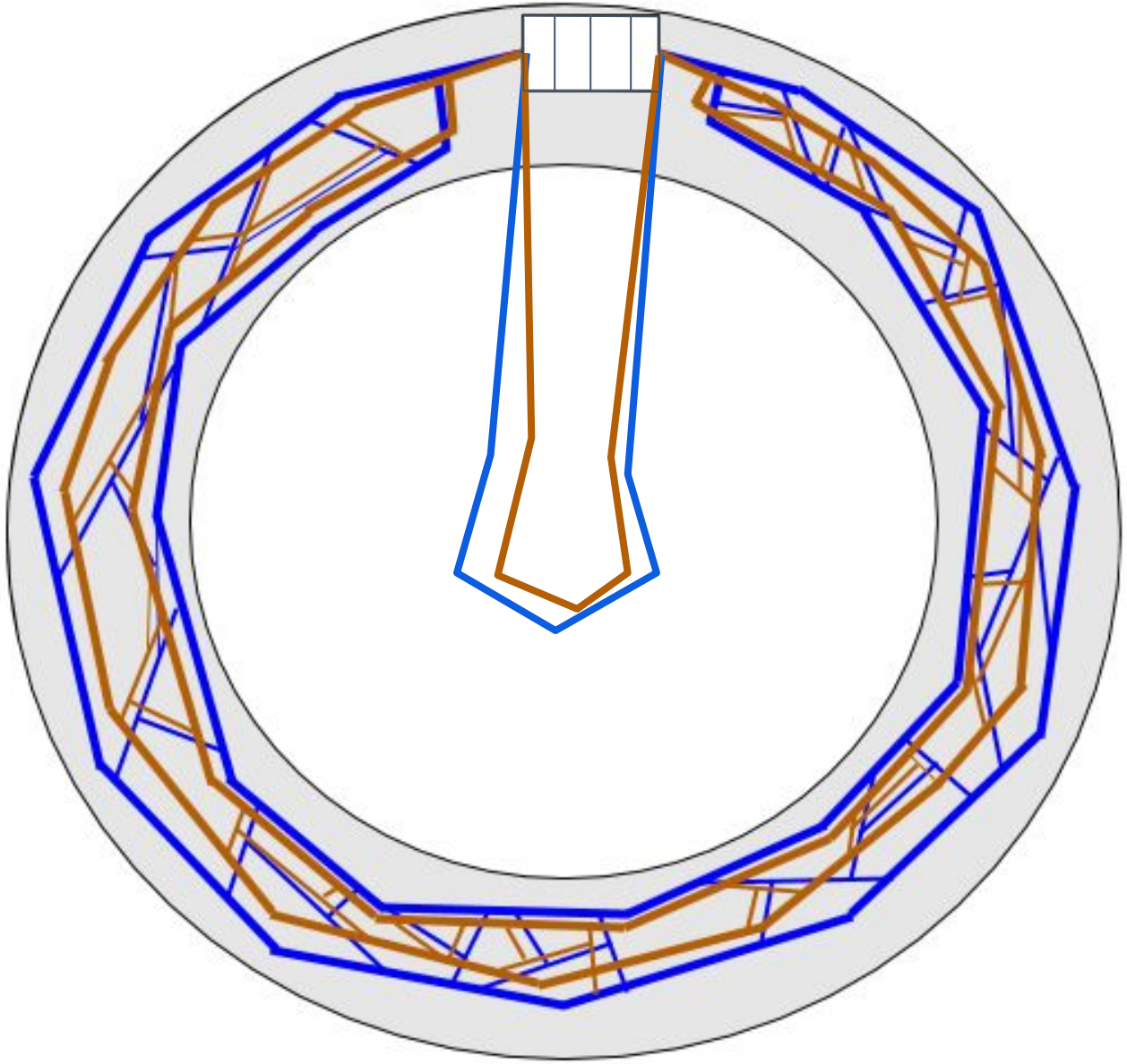
- **Light rail** will service residential ring of Alaskol and crater base.
- **Hard Roll subcontractor** fabricates rails and attachment components.
- The custom tracks compensate for weaker lunar gravity.
- Smaller scale travel:
  -bicycles (height - 3 ft, length - 5.5 ft, handlebar width - 2 ft),
  -walking,
  -elevators.
- Trains will fit in CASSSCs in case of transport or storage





RFP 3.2

Water Management



Type of Water Usage	Consumption per day (in litres)	Total Consumption per year (in litres)
Residential	25 (per person)	178,000,000
Agriculture	300	109,500
Industrial	14,400	5,256,000
Total	**14,725**	**183 Million**

Water Recycling will be subcontracted from **Clean Up Your Act**.

Tanks

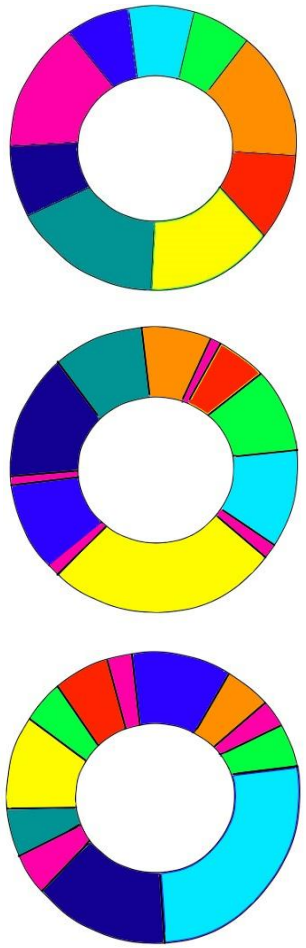
Sewage

Water

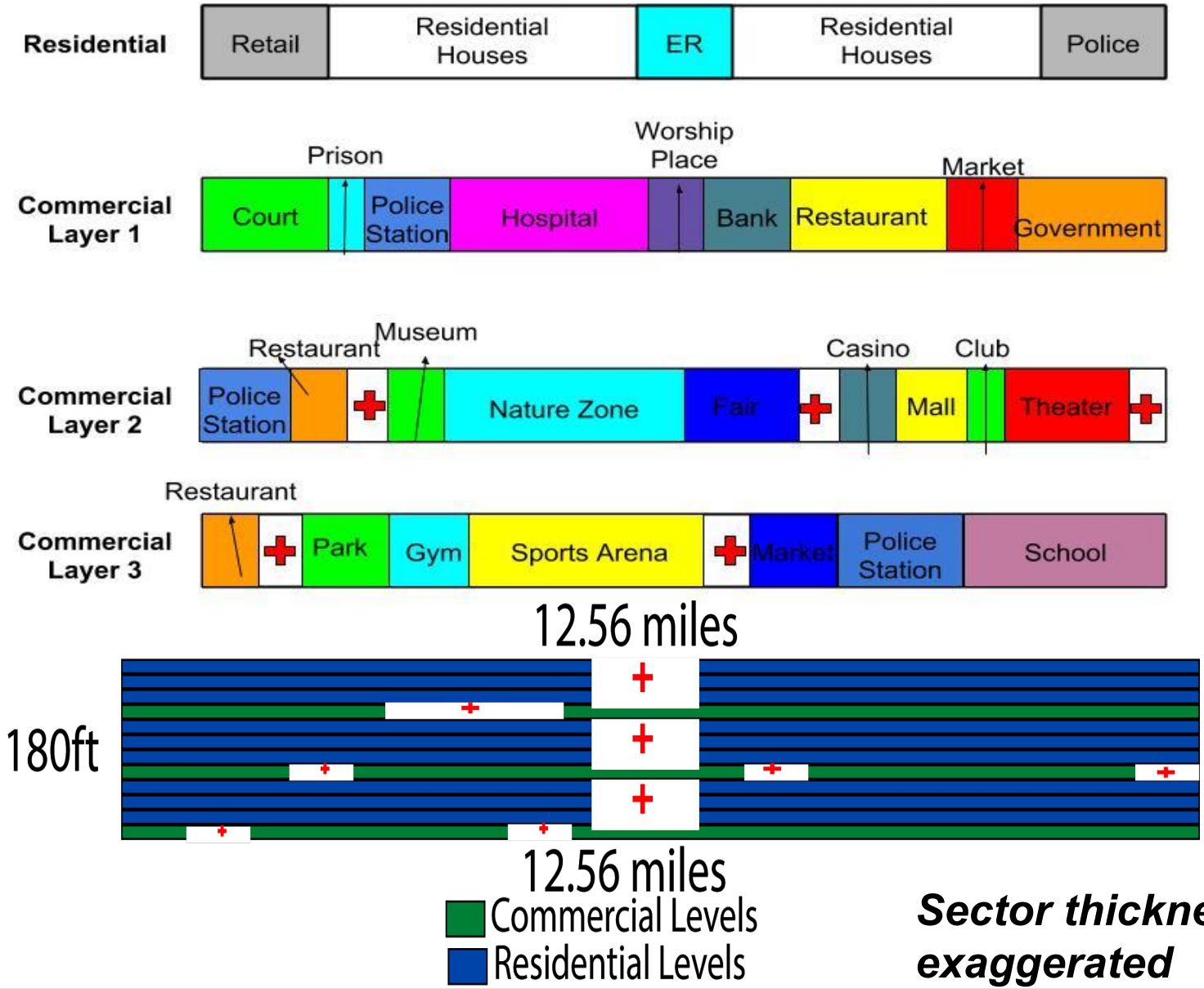
RFP 3.2

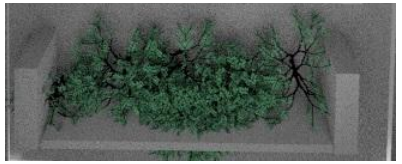
Community Layouts

Overhead Ring View



Expanded Ring View



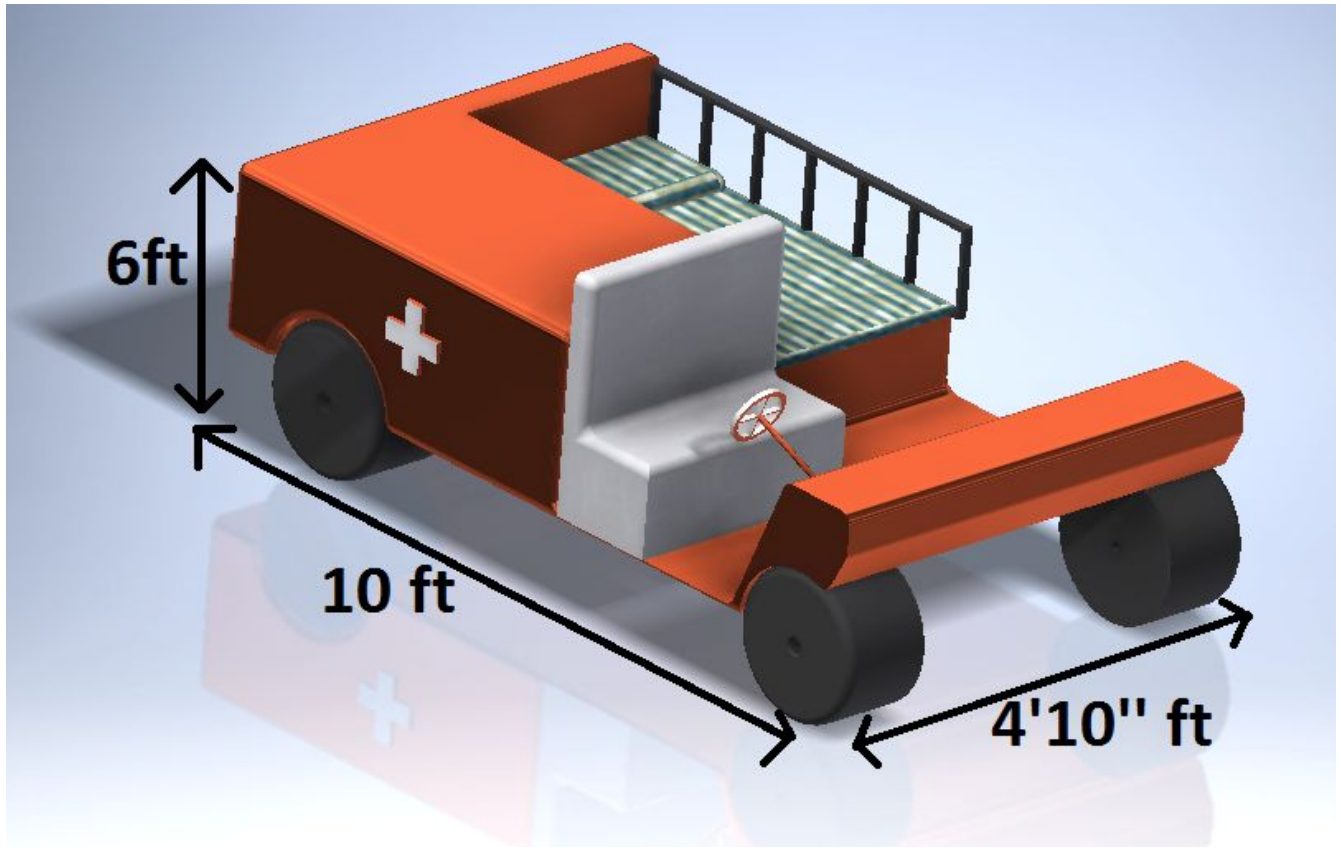


- Wall rings contain nine residential levels and three commercial levels
- Rooms may exist adjacent to or behind crater wall

Sector thickness exaggerated

RFP 4.1 & 4.4

Generic City Services



- Hospital available to serve the settlement in case of emergencies, and will function as an advanced treatment facility for other lunar operations.
- External EMS vehicles to reach remote settlements, recover disabled vehicles, enforce law, and bring injured patients to the hospital.
- In event of fire fire doors would seal and in public/dangerous areas automatic sprinklers would activate.

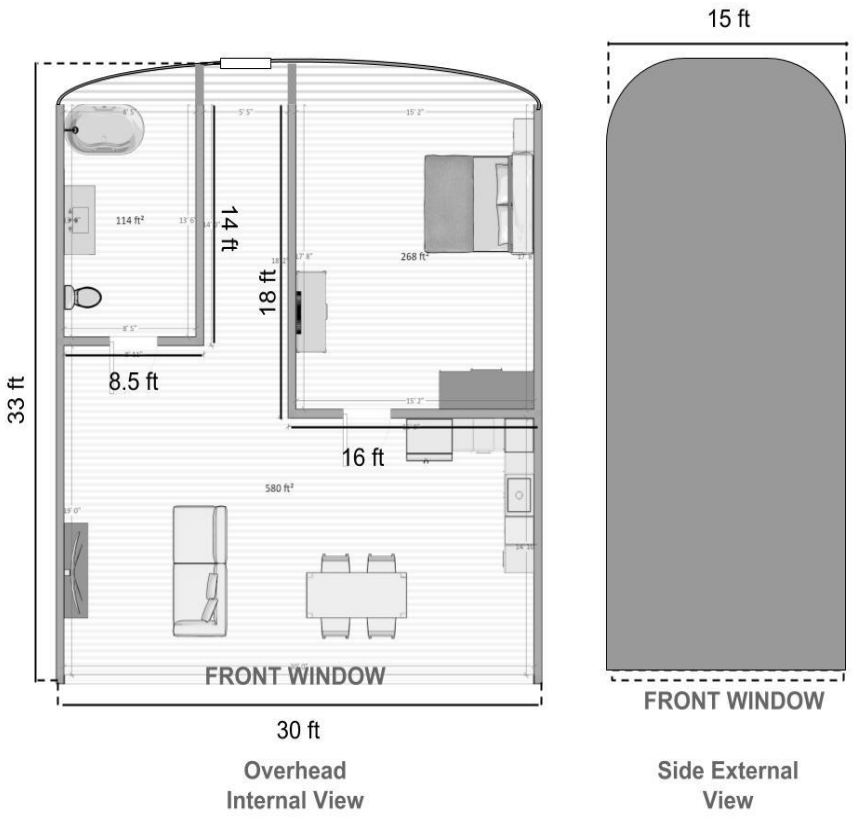
Vehicle Maintenance

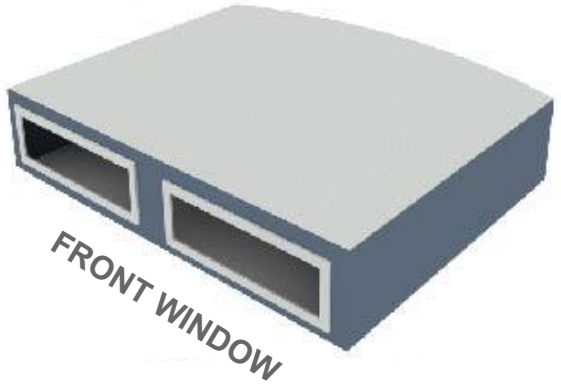
- All land vehicles docked outside of the city, residents board them via airlocks.
- External vehicles only require automatic maintenance and cleaning by designated F1M8 robots.
- If any significant problems arise, rovers can be taken apart and replaced with 3D printed parts produced by the **Large Print** subcontractor.

Name of Service	Quantity	Description
Hospital	1	1. Advanced treatment facilities for lunar settlements 2. 100 bed capacity each 3. 84 doctors and 250 support staff each
External Emergency Service Vehicles	6	1. Bring services to remote settlements 2. Recover disabled vehicles 3. Bring injured patients to the hospital 4. Tow trucks available for broken down vehicles
Intra-settlement vehicles	10	1. Bring services to residents quickly
Police Department	3	1. Enforce the law and resolve disputes in settled locations 2. 50 police officers and staff

Residential Design

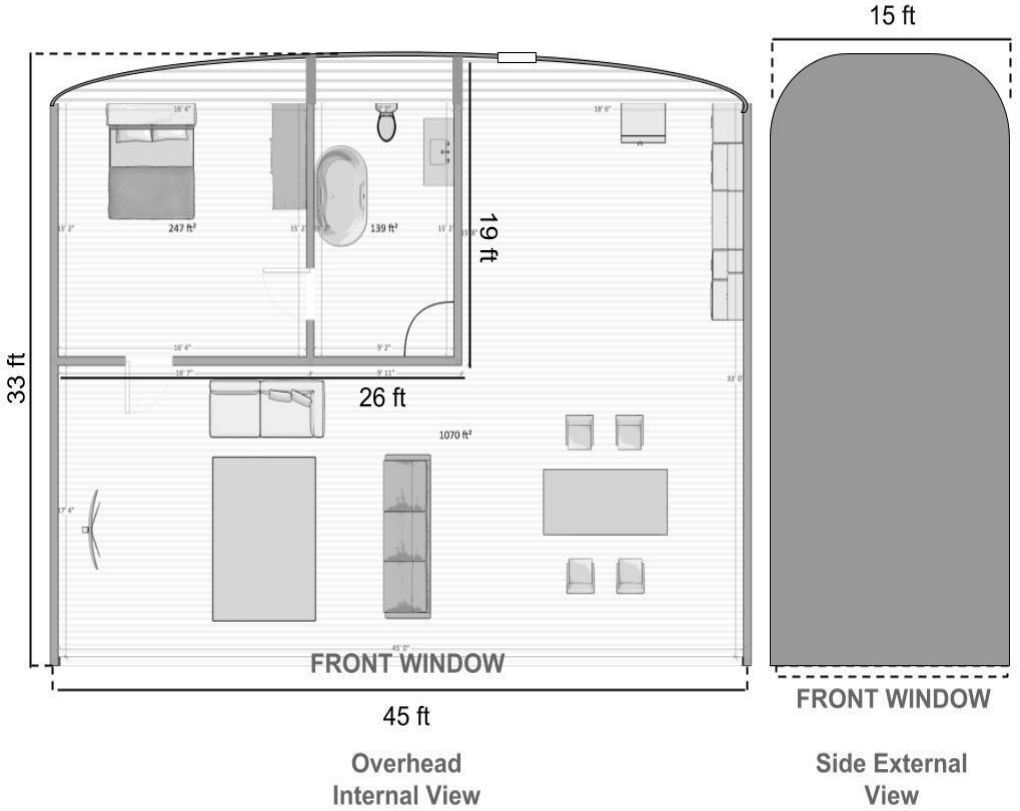
Single Housing





- 1,000 square feet
- Houses one occupant
- Clear lunar views

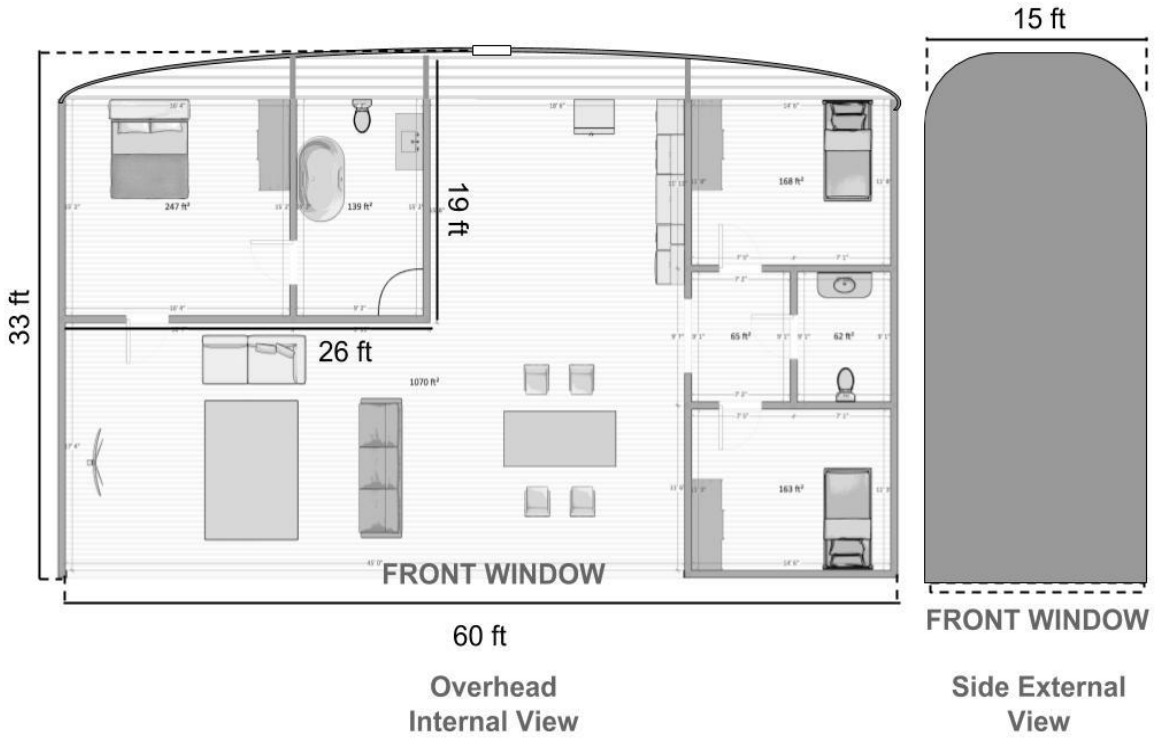
Married Housing



- 1,500 square feet
- Houses two occupants in shared room
- Improved kitchen and bathroom facilities

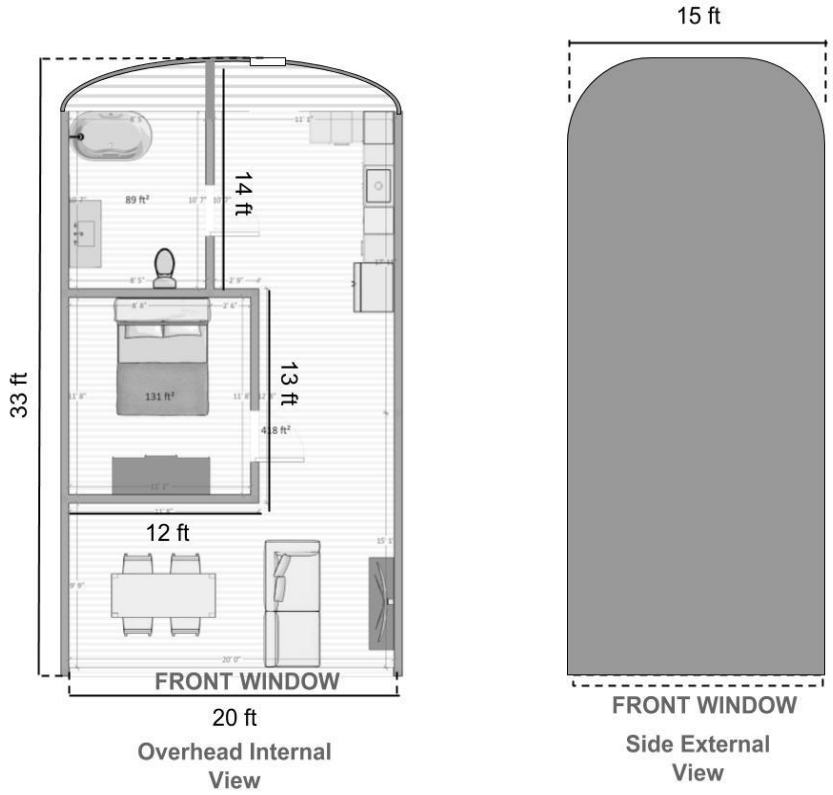
Residential Design

Family Housing



- 2,000 square feet
- Three bedrooms, four occupants
- Includes secondary bathroom facility

Transient Housing



- 750 square feet
- Houses one occupant
- Intended for short-term usage

Consumables

	Food type	Consumption PPPD	Consumption PPPY	Total consumption per day	Total consumption per year
1	Grains (Wheat and Rice)	0.66	241.4	1,897	4,707,420
2	Legumes	0.44	160.9	8,598	3,138,280
3	Fats and oils	0.11	40.2	2,150	784,570
4	Sugar	0.11	40.2	2,150	784,570
5	Salt	0.11	40.2	2,150	784,570
6	Vegetables	1.10	402.3	21,495	7,845,701
7	Fruits	0.44	160.9	8,598	3,138,280
9	Spices	0.04	16.1	860	313,828
10	Beverages	0.44	160.9	8,598	3,138,280
11	Milk	1.10	402.3	21,495	7,845,701
12	Milk products	0.66	241.4	12,897	4,707,420
13	Meat	0.88	321.9	17,196	6,276,561

PPPD: Per Person Per Day
PPPY: Per Person Per Year

All values are in lbs.

	Type	Mass of items per person	Total mass
1	Clothes	6.6	128,700
2	Shoes	2.2	42,900
3	Furniture	42.7	849,420
4	Office Supply	3.1	60,060
5	Toiletries	12.788	137,280

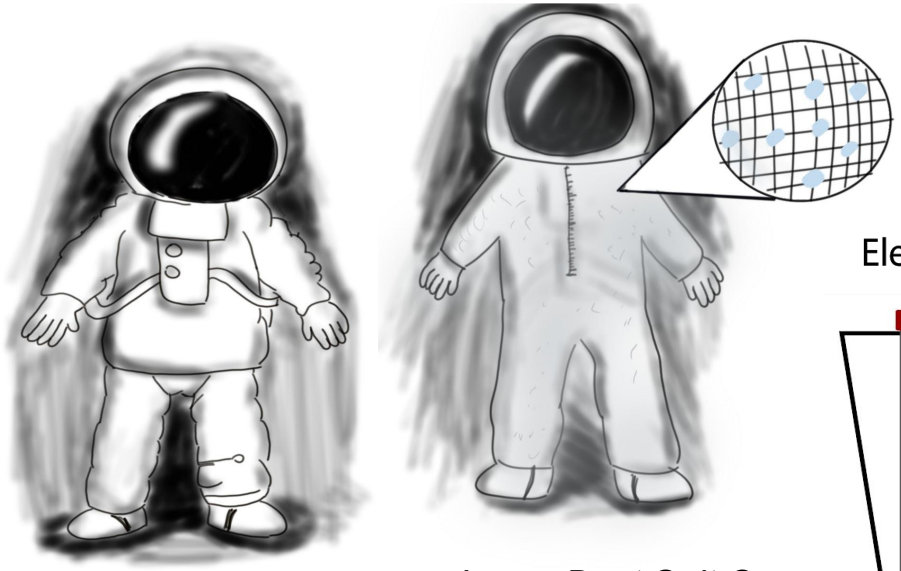
These non-edible consumables are subcontracted from Remotely Local Products

These will be bought in corner stores on residential floors as well as in the commercial levels.

Spacesuits

Space Suits

- General spacesuits can be ordered from EST
- 35 for children and 1200 for adults general space suits available for residents and transient visitors
- Located near every exit



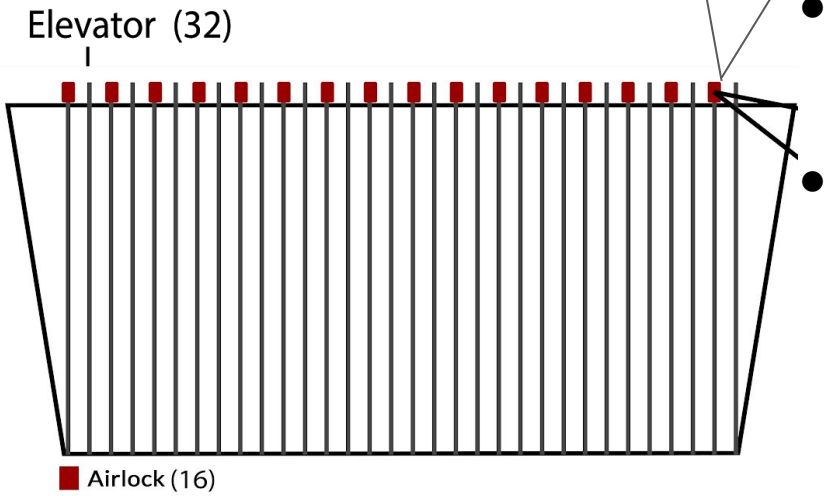
Subcontracted Spacesuit

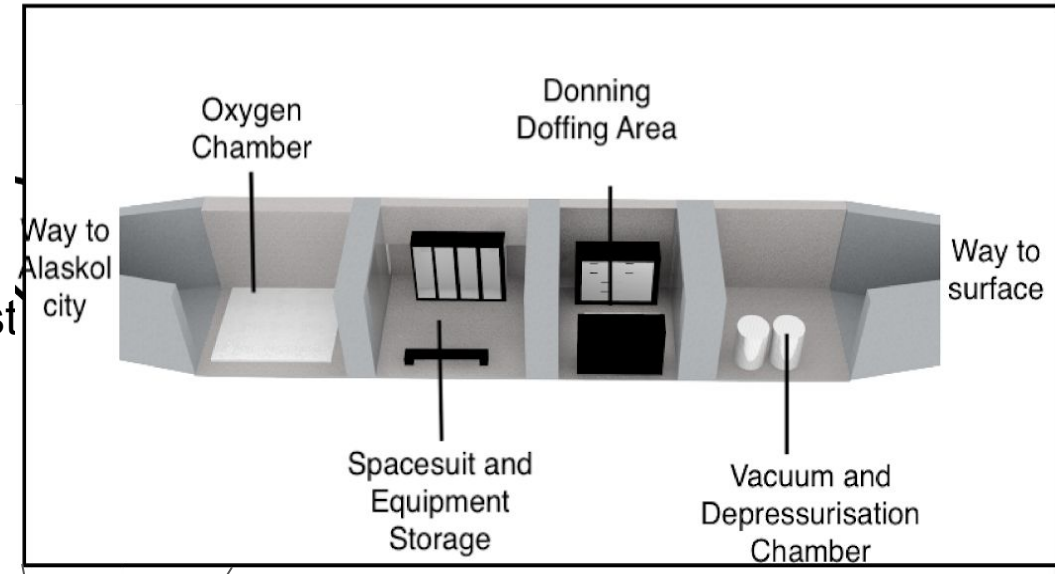
Disposable Space Suit Cover

- Overcoat for spacesuits to protect from lunar dust
- Electrostatically active polymer fiber mesh traps dust particles
- Stored in decontamination locks for easy disposal after use

Lunar Dust Suit Cover

Depiction of levels when opened up.





Spacesuit Storage Bays

- Upper ring features 16 airlocks for exterior access subcontracted from Lossless Airlocks
- Airlocks contain storage bays for spacesuits, as well as areas for suiting up/ down

RFP 4.3

Maintenance and Location

MONITORED PARAMETERS:

1. Atmospheric Composition
2. Humidity
3. Dust in air
4. Atmosphere pressure
5. pH levels of the water
6. Temperature
7. The watch will monitor (optional):
   a. Blood pressure
   b. Heart rate

- Real Time AI monitors well being of settlement and displays data in the General Control Room
- AI will analyse data and act upon it if it is out of range.
  - A human is always able to override any operation.
- General and Robot Control Rooms are located in a sphere in the middle of the settlement
- Personnel is able to act on data shown in a similar manner to the Robot Control Panel shown in 5.4
- When a problem is discovered, a maintenance robot can be dispatched

Safety and Security

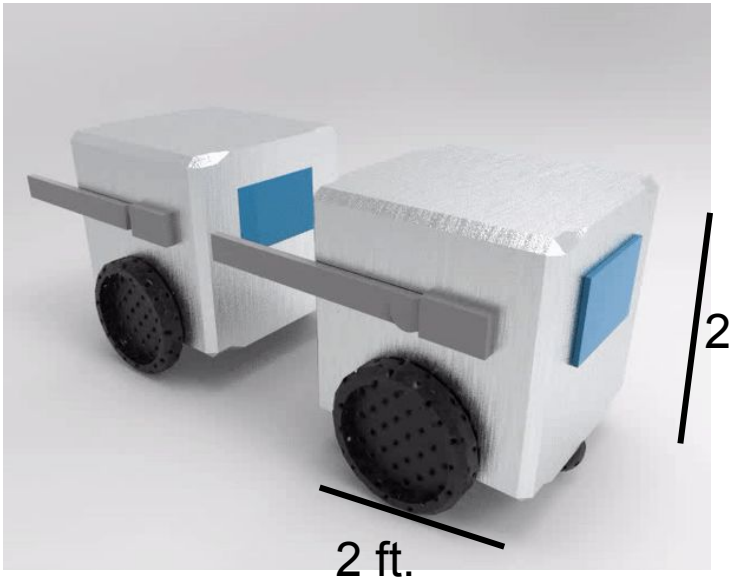
- **Firewall** to control the access to/from network
- Up to date patches to the operating system and antimalware software
- Critical systems will use real time operating system
- All access to bank accounts and businesses is restricted by deep packet inspection

Clearance Level	Security Measures	Location of use	Authorized Personnel
Low Level	Fingerprint and Palm scanner	Residential and Commercial	Residents
Medium Level	Above + Iris Recognition	Agriculture, Industrial, and Maintenance	Heads of departments
High Level	Above + DNA matching	Server and Control Rooms	Administration

Drawings of Robot Systems

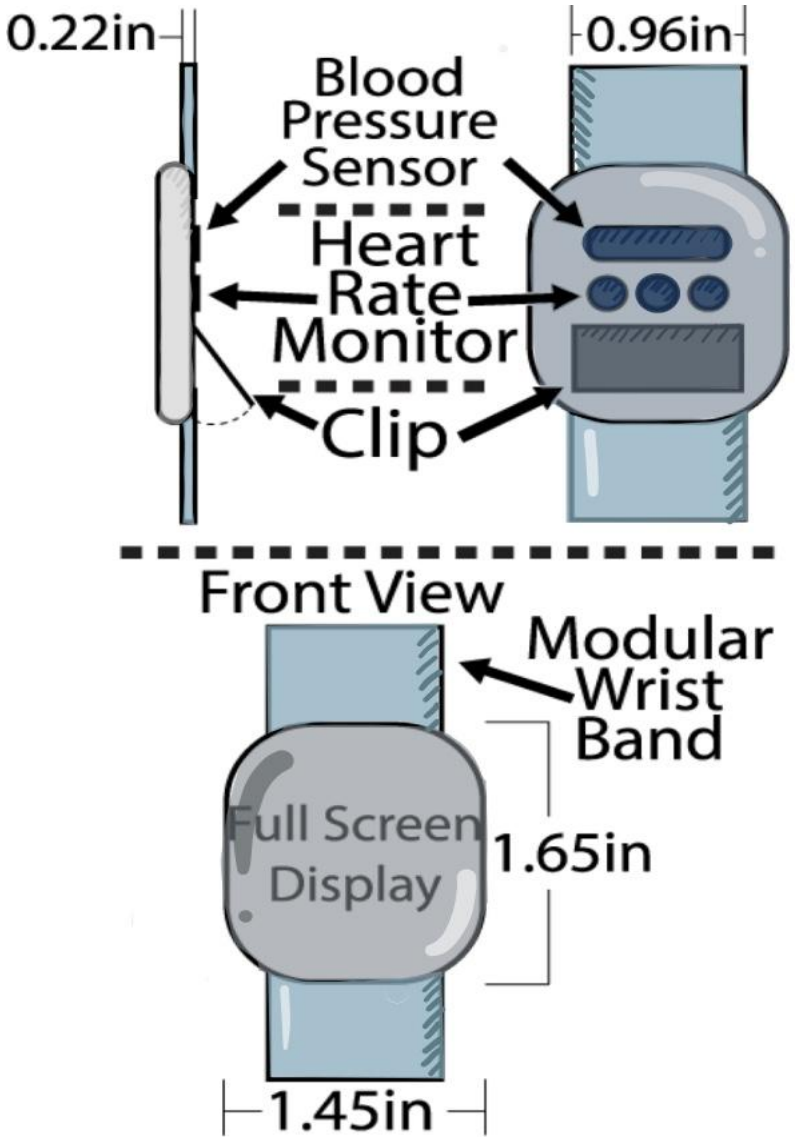
Types of Robots	Uses of Robots	Amount Needed
Bots4U personal robots	Lifting, cleaning, delivery, chores	15,180 (one per home)
Grumbo F1M8 robots	Heavy lifting, maintenance, laborious, and dangerous procedures	400 (100 per each robot bay in)

F1M8 Dust Cleaner



Animation of Bot4U lifting another Bot

- All adults, including transients, are provided with a **LunaWatch**
- Has a screen. Able to monitor heart rate & blood pressure
- Consists of modules for different functions and can call bots when needed
- Compatible with proximity sensors and all levels of security; can be used as a "key"
- Used for payment, Earth-based banking system
- Wearing it is optional; can be clipped onto clothing



Luna Watch

RFP 5.2 & 5.3

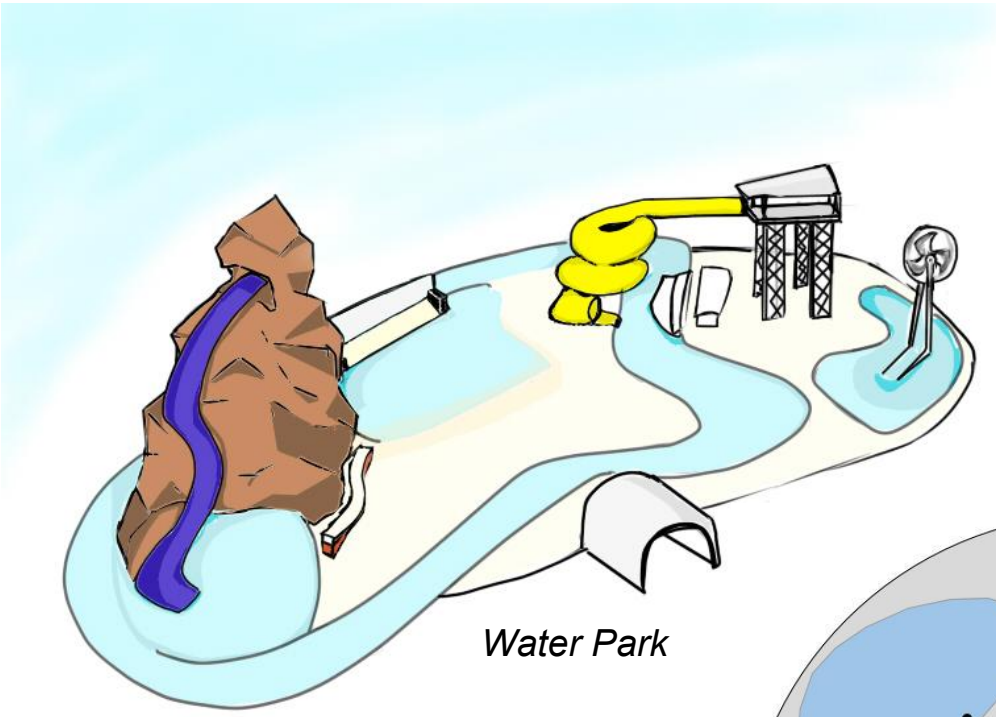
Indoor Entertainment

<u>In a Dome</u>

- Water Park - First Lunar Waterpark
- Parks
- Moon golf
- Parkour Park
- Earth Games, On the moon (Dodgeball)

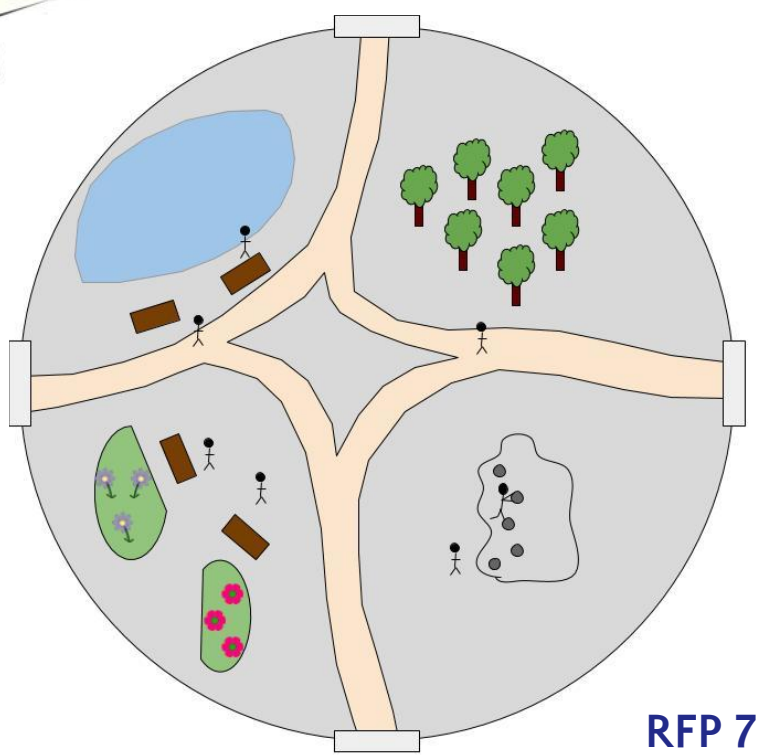
<u>In Commercial Area</u>

- Casino
- Theater
- Museum
- Virtual reality experience



Water Park

Park Dome



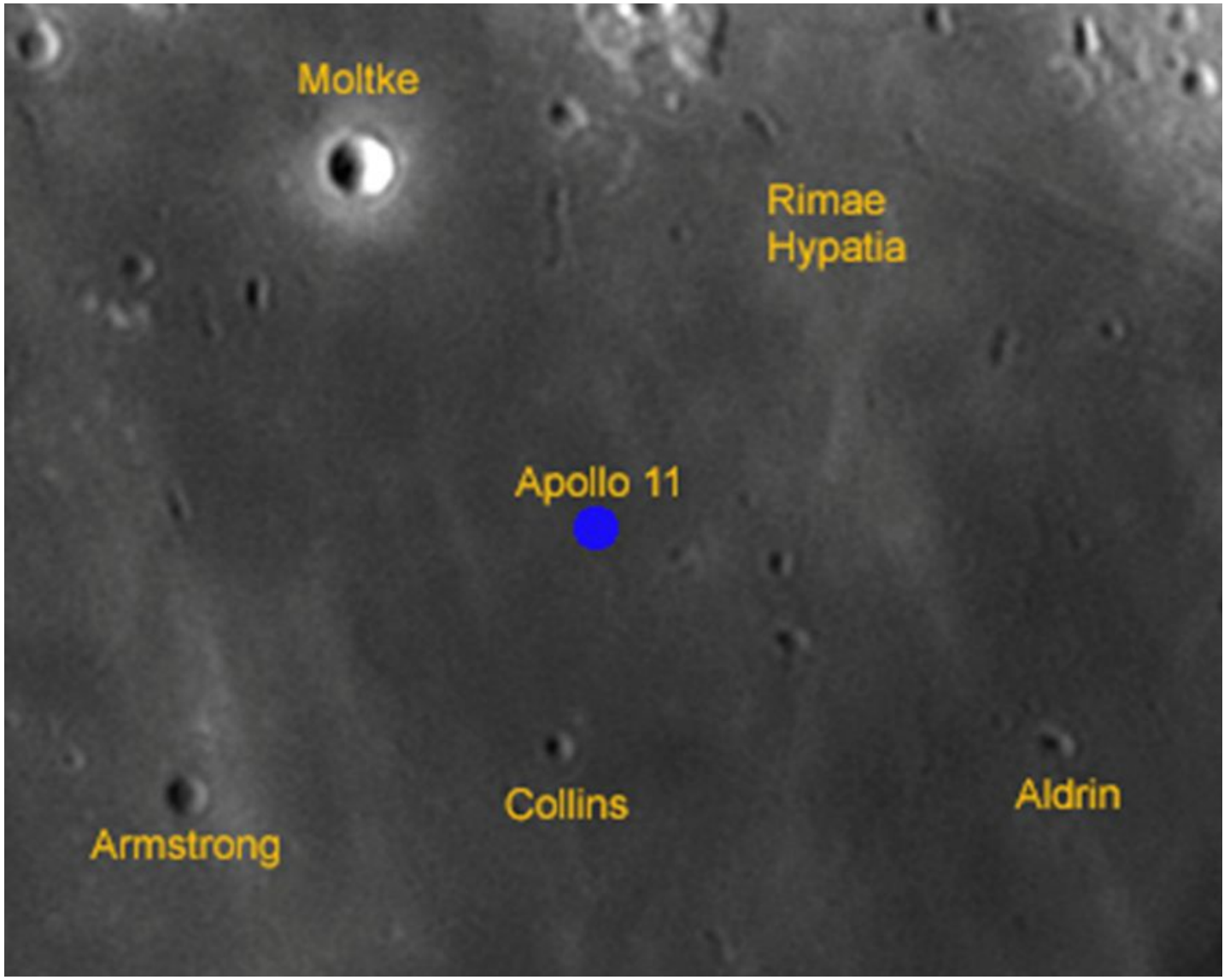
Outdoor Entertainment

Climb...

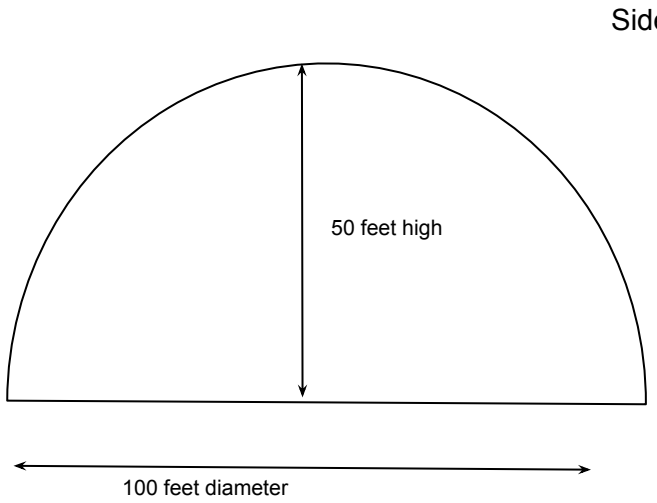
- The Ridges of the Rimae Hypatia

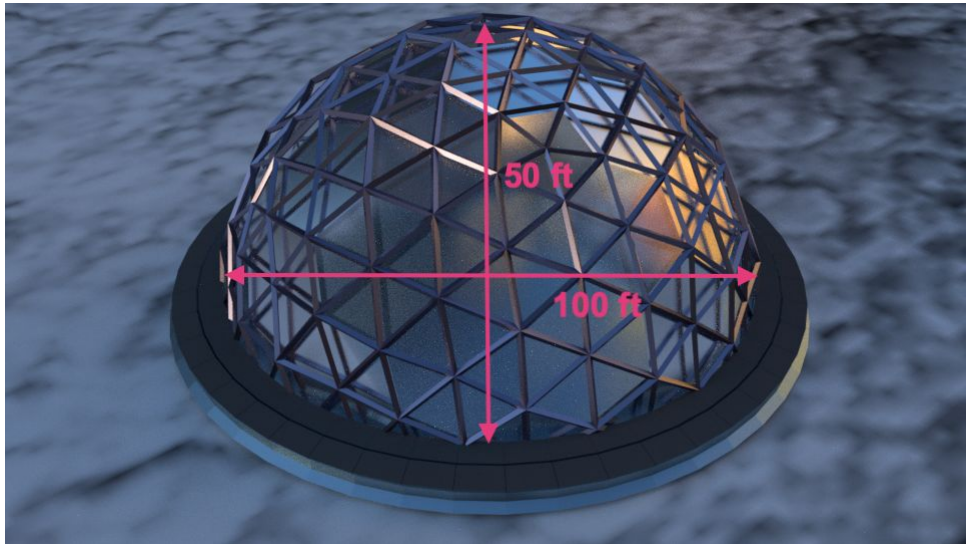
And Explore by Buggy...

- The Landing sight of Apollo 11
- The Craters named after Neil Armstrong, Michael Collins, and Buzz Aldrin



Apollo 11 landing site historical preservation





- First covered with temporary Blown Away modules
- Then covered with transparent dome for preservation
- Geodesic domes without radiation protection
- Unpressurised; spacesuits needed
- Cleaning robots from Bots4You to maintain outer area of dome from dust
- Transportation subcontracted through Lunar Adventures
- Material- transparent magnesium aluminate, only one material to avoid conflicting refractive indexes impacting visual clarity

Costs

Phase	Employees	Items	Subcontractor	Cost
Phase 1: Temporary Housing and Storage	20	Spacesuits	EST	8,000,000,000
		Hotel Furniture		5,502,000,000
		Transporting materials from earth		20,000,000,000
Phase 2: Initial Construction	20	F1M8		1,500,000
		Dust Removal Machines		135,000
		LunaWatch Display		1,932,000
		LunaWatch Modules		3,864,000
		Smartphones		5,346,000
		Laptops		26,730,000
		Shipping		162,191,000
		Shipping of Epoxy Adhesive		55,000,000,000.00
			Large Print	
			3D Logistics	
			Custom Cargo Accomodations	
			Blown Away	
			Planetary Pavers	
			Hard Roll	
			Holey Moley	

Costs

Phase 3: Construction of Infrastructure	20	Soletta		50,000,000
		Solar Panels		164,000,000
		Rectenna		105,260,000
		Power Grid	ZAP! Industries	
		Train Rails	Hard Roll	
		Trains	Large Print, Dirtbuilders. Seals-It-All	
		Shipping		5,200,000,000
Phase 4: Excavation and Dome Construction	20	Rovers	Grumbo	
Phase 5: Completion of Domes, Begin Food production and Waste plumbing	30	water distribution	Hard Roll	
		water recycler	Waste Products, Clean Up Your Act	
		food production	Garden-A-Go-Go	1,500,000,000
Phase 6: Interior construction and Industries move in	100			

TOTAL COSTS

$95,722,958,000

Note: All subcontractors that don't have a price listed will procure a direct contract with the Foundation Society.

Subcontractors

- 3D logistics: Smaller 3D parts for robots
- Blown Away: Temporary structures
- Clean up your act: Subcontractors given space in Industrial parks
- Custom Cargo Accommodations:
- Efficient Softwares: Subcontractors given space in Industrial parks
- F1M8 Robots: Construction of domes
- Large print: Construction materials
- Lossless Airlocks: Airlocks and pressurisation of Alaskol
- Planetary Pavers: Roads and surfacing
- Seals-it-all: Lunar dust mitigation
- Toss it to me: Subcontractors given space in Industrial parks
- Vulture Aviations: Windows
- Waste products: Subcontractors given space in Industrial parks
- Lunar Adventure
- EST
- Remotely Local Products

Compliance Matrix

Subteam	RFP	Work	Slide #
Basic Req	1	Alaskol will be the first Big City on Luna. It will provide a variety of basic services	2
Struct	2	Alaskol must provide a safe and pleasant living and working environment for 18,000 full-time residents, plus an additional transient population, not to exceed 1500.	3
Struct	2	Provide natural views of surrounding lunar terrain.	2
Struct	2.1	Identify uses of large enclosed volumes, and show dimensions of major components.	3
Struct	2.1	Show the local terrain and compatibility with it.	2
Struct	2.1	Identify construction materials used for major structural components.	10, 11
Struct	2.1	For protection from radiation and extreme thermal conditions, habitable volumes of the settlement will be built into walls of a lunar crater.	5
Struct	2.1	Excavation is expensive; designate functions for surface structures as much as possible.	3
Struct	2.1	CASSSCs may be repurposed as building components.	24
Struct	2.2	On interior design drawings, specify uses and dimensions of pressurized and unpressurized enclosed areas both built into crater walls and on the surface, with drawings clearly labeled to designate residential, commercial, warehousing, industrial, agricultural, and other uses. Overall map of enclosed land areas, showing usage and sizes of those areas.	5, 6
Struct	2.3	Describe the six step process to construct the settlement, by showing the sequence in which excavation will occur, major structural components will be assembled, and interior finishing will be conducted.	13, 14, 15
Struct	2.3	Identify population and business capabilities available at intermediate phases	17, 45, 46
Struct	2.3	Show how Alaskol can be expanded with future increases in population and business interests.	16
Struct	2.4	Identify locations and sizes of industrial parks that the Foundation Society will manage in/ around the city.	19
Struct	2.4	Identify which subcontractors or businesses are expected to operate in each industrial park.	19
Ops	3	Describe facilities and infrastructure necessary for building and operating the Alaskol lunar settlement.	12
Ops	3.1	Alaskol will be located in and around Moltke crater, to enable building habitable volumes into the steep crater walls.	2
Ops	3.1	Identify sources of materials and equipment that will be used in construction and operations, from where, and means for transporting those materials and equipment to the Alaskol location.	12
Ops	3.2	Food production and processing (describe dedicated agriculture and “edible landscaping”)	25
Ops	3.2	Electrical power distribution (specify kilowatts distributed to habitable areas)	26
Ops	3.2	Internal and external communication systems (specify devices and central equipment)	28
Ops	3.2	Intra-settlement transportation systems (show routes and vehicles, with dimensions),	29
Ops	3.2	Atmosphere (define air composition at 11 psi, and quantity)	7
Ops	3.2	Household and industrial solid waste management (trash and garbage)	27
Ops	3.2	Water management (including fresh water distribution)	30
Ops	3.2	Show methods for preventing surface dust from getting into interior volumes.	9
Ops	3.3	Provide illutstrations of shipping & receiving facility(ies), accommodating 30 visiting lunar vehicles simultaneously, where surface vehicles from other communities will deliver commodities, products, and raw materials.	4, 20, 21
Ops	3.3	Provide illustrations of a passenger terminal for a monorail that will transport people to and from remote launch / landing sites, and eventually will be expanded as a lunar transportation network.	4, 20, 21
Ops	3.4	Alaskol will provide generic services including medical care, emergency rescue, vehicle repair and maintenance, communication network(s), data collection and storage, and power distribution network.	28, 32, 33
Ops	3.4	Identify city services that will be extended to other lunar locations and, as appropriate, added infrastructure required to extend services to remote locations.	32
HF	4	Alaskol will offer attributes available to residents of Earth’s small cities in developed countries.	34, 35
HF	4	Provide natural views of the lunar surface for residents.	43
HF	4.1	Provide map(s) and/or illustrations (with a distance scale) of facilities for services that residents could expect in a comfortable modern community environment (e.g., medical, parks and recreation, access to fine food and entertainment), variety and quantity of consumables and other supplies, and public areas designed with open space.	31, 36
HF	4.2	Include designs of typical residential homes, clearly showing room sizes.	34, 35
HF	4.2	Homes will be excavated into the crater wall.	34, 35
HF	4.2	Every home will have windows overlooking the crater from at minimum kitchen, dining area, and daytime activity room(s).	34, 35
HF	4.2	The back wall for interior rooms will be curved, to enable easier excavation.	34, 35
HF	4.2	External drawing and interior floor plan for at least four types of home designs, and the area (preferably in square feet) for all residences.	34, 35
HF	4.3	Define types of spacesuits (to be acquired by the customer from a different vendor) for use within the settlement perimeter, numbers of each spacesuit type, and storage locations for spacesuits.	37
HF	4.3	Establish requirements for spacesuit features to mitigate degrading effects of lunar dust and prevent entry of dust into pressurized areas of the settlement.	37
HF	4.3	Show location(s) on community map for spacesuit donning / doffing.	37
HF	4.4	Alaskol will be the place where residents of other lunar communities come to the Big City for medical care, entertainment, and to acquire capital goods	31
HF	4.4	Describe how emergency medical care will be made available for all lunar residents.	31
HF	4.4	Show locations of Big City amenities on community map(s).	31
Auto	5.1	Chart or table describing automated construction and assembly devices.	18
Auto	5.2	Chart, table, or list(s) of settlement systems and parameters that must be monitored and controlled for safe operations of Alaskol	38
Auto	5.3	Dimensioned drawings of robots and computing systems that people will encounter in Alaskol.	40, 41
Auto	5.4	Show control room(s) for human monitoring of city operations, with examples of displays to inform and enable human intervention.	23

Compliance Matrix

Subteam	RFP	Work	Slide #
Auto	5	Describe types and capacities of data storage media, security, and access to networks.	28
Auto	5	Show robot and drone designs, clearly indicating their dimensions and illustrating how they perform.	40
Auto	5	Identify locations and sizes of repair, maintenance, and storage facilities for automation system	33, 38
Auto	5.1	Describe automation to aid construction, including monitoring of progress by subcontractors and scheduling transitions between tasks.	18
Auto	5.1	Describe how humans monitor automated construction processes and progress, and where/how human interaction is required during construction.	23
Auto	5.1	Consider automation for excavation, transport and delivery of materials and equipment, assembly of surface structures, and finishing the interior.	18
Auto	5.1	Chart or table describing automated construction and assembly devices.	18
Auto	5.2	Specify automation systems for settlement maintenance, repair, and safety functions	18, 38
Auto	5.2	Show the control center(s), and define numbers of display and control systems required.	23
Auto	5.2	Describe when and how human intervention in automated functions is required.	23, 38
Auto	5.2	Define physical locations of computers and robots for critical functions.	23, 41
Auto	5.2	Describe means to access critical data systems; include descriptions of security measures to assure that only authorized personnel have access, and only for authorized purposes.	23, 39
Auto	5.2	Chart, table, or list(s) of settlement systems and parameters that must be monitored	23
Auto	5.3	Show automation devices to enhance livability and productivity in the community,	40
Auto	5.3	Emphasize use of automation to perform maintenance and routine tasks	40
Auto	5.3	Provide for privacy of personal data and control of systems in private spaces.	39
Auto	5.3	Describe access to community computing assets and robot resources	28
Auto	5.3	Describe devices for personal delivery of information, communications, and entertainment	41
Auto	5.3	Robots used in homes and public areas will be no taller than 2.5 feet (76 cm) and not anthropomorphic, but may be designed to stack on top of each other	40
Auto	5.3	Dimensioned drawings of robots and computing systems that people will encounter	40
Auto	5.4	Provide appropriate automation for operations of retail businesses, industrial parks, shipping / receiving facility(ies), and delivery of city services to remote lunar communities.	9, 18, 22
Auto	5.4	With human monitoring, autonomous systems will unload and load CASSSCs on cargo hauling vehicles; warehouse operations and most manufacturing will be autonomous.	23
Auto	5.4	Some agricultural volumes will be hazardous to humans, and will require automated attention	38, 39
Auto	5.4	Show control room(s) for human monitoring of city operations, with examples of displays.	23
Biz Dev	7	Commercial center where residents of other communities come to buy goods and services	31
Biz Dev	7	Retail areas will be larger and more varied than usual for a community of this size	31
Biz Dev	7	Medical services will have regular (and emergency) customers from remote locations	31
Biz Dev	7	Showrooms will feature rovers and other equipment of interest	31
Biz Dev	7	Commercial center where residents of other communities come to buy goods and services	31
Biz Dev	7	Retail areas will be larger and more varied than usual for a community of this size	42
Biz Dev	7	Medical services will have regular (and emergency) customers from remote locations	31
Biz Dev	7	Showrooms will feature rovers and other equipment of interest	31
Biz Dev	7	Provide storage for CASSSCs loaded with commodities ready to ship to customers	3, 31
Biz Dev	7	Provide equipment for loading and unloading CASSSCs on cargo hauling vehicles	29
Biz Dev	7	Banking system must be robust and secure for handling large transactions	41
Biz Dev	7	Industrial Park and shipping / receiving center	9, 22
Biz Dev	7	Manufacturing and materials processing businesses will require additional power	26
Biz Dev	7	Valuable goods will require added security. Businesses are likely to create goods using proprietary processes; Intellectual Property must be protected	39
Biz Dev	7	Businesses will need vehicles for transporting parts between suppliers and assemblers	29
Biz Dev	7	Convenient transportation to/from residential areas must be provided for employees	29
Biz Dev	7	Manufacturing and materials processing businesses will require additional power	26
Biz Dev	7	Valuable goods will require added security. Intellectual Property must be protected	39
Biz Dev	7	Businesses will need vehicles for transporting parts between suppliers and assemblers	29
Biz Dev	7	Convenient transportation to/from residential areas must be provided for employees	29
Biz Dev	7	Major tourist destination	42
Biz Dev	7	Opportunities to see the Apollo 11 site; suggest methods for preservation of the site	43, 44
Biz Dev	7	Show examples of indoor and outdoor facilities within the Alaskol perimeter that offer sports and competitive opportunities uniquely suited to the lunar environment.	42
Biz Dev	7	Outfitting businesses will provide guide services and equipment for lunar activities	42
S&C	6	The proposal will include schedule and costs for development and occupation of Alaskol,	45
S&C	6.1	The schedule must describe contractor tasks from contract award (31 July 2043) until the customer assumes responsibility for operations of the completed settlement.	17
S&C	6.1	Show in the schedule when each subcontractor is starting and completing its tasks.	45, 46, 47
S&C	6.1	Durations and completion dates depicted in a Gantt chart with monthly or smaller increments.	17
S&C	6.2	Specify the costs associated with Alaskol design through construction in U.S. dollars	45, 46
S&C	6.2	Include estimates of numbers of employees associated with each phase of design and construction in the justification for contract costs to design and build Alaskol.	45, 46
S&C	6.2	Do not include costs of consumables shipped and delivered in CASSSCs; do specify number of CASSSC-loads of each commodity required to be shipped to the construction site.	45, 46
S&C	6.2	Spreadsheet(s) listing separate costs associated with different phases of construction, and clearly showing total costs that will be billed to the Foundation Society.	45, 46
Biz Dev	7	The basic design must include sufficient flexibility to accommodate development of additional compatible business types with little configuration change.	16