Integrated Research and Innovation Center (IRIC)

ECS LAB#2 SITE & BUILDING WATER USE

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Building Description

This building located at the University of Idaho (UI) in Moscow, Idaho. The new 78,500 SF Integrated Research and Innovation Center (IRIC) is an academic hub, where grant-funded faculty, graduate and undergraduate teams work together on cross-department research projects, from the hard sciences, social sciences and even humanities fields. The building is used for Research, meeting and experiment. Building Type is Educational without café, gym or typical shower. The peak hours is M-F 9:00am-5pm, with the max 120 people.

Zone 1: Each of three public floors contains both men's and women's bathroom. Women's bathroom contain 3 toilets and 2 sinks. Men's bathroom contain 2 toilets, 2 urinals and 2 sinks. There are also family restroom in each floor with 1 toilet and 1 sink. There are 6 drink fountains for all three floors.
Zone 2: There are sprinklers for every floor with a total number of 240.
Zone 3: The total number of service sink in laboratory in three floors are 40.

Question A—Water Conservation

A(1) C4.1 Minimum required plumbing fixture

TABLE 20.3 Minimum Number of Plumbing Facilities[a]

Occupancy	Water Closets Urinals[b] Male	Female	Lavatories	Bathtubs/ Showers	Drinking Fountains[c]	Others
Educational	1 per 50		1 per 50	—	1 per 100	1 service sink

Based on MEEB Table 22.1

Water Fixture Inventory				
Fixture Type	Men	Women	Either	Recyclable
Toilet	6	9	3	No/Blackwater
Urinal	6	0		No/Blackwater
Drinking Fountain			6	Yes/Greywater
Lavatory Sink	6	6	3	Yes/Greywater
Bathroom Shower	3	3		Yes/Greywater
Sprinkler Inside			240	Yes/Greywater
Service Sink in Lab			40	Yes/Greywater

A(1) C4.2 Conventional Water Supply

TABLE 20.2 Planning Guide for Water Supply[a]

Building Usage	Per Capita (as Listed) Daily Usage – Gallons	Liters
Schools		
Boarding (per pupil)	75–100	284–378
Day, with cafeteria, gymnasium, and showers (per pupil)	25	95
Day, with cafeteria but no gymnasiums or showers (per pupil)	20	76
Day, without cafeteria, gymnasiums, or showers (per pupil)	15	57

MEEB P.872

Water Use Estimate			
Space	Per Capita Use(gallons/day)	#People	Total(gallons/day)
Restroom	15	40	600
Circulation	15	30	450
Laboratory	15	50	750
Total		120	1800

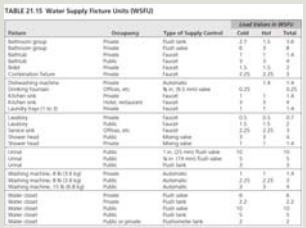
Per Capita Use: 15 gallons/day

Peak Hourly Occupancy Load :120

Total Gallons/day: (WU) (15*120)=**1800 gal/day**

A(2) D4.2 CONVENTIONAL WATER SYSTEM

Fixture	Occupancy	Type of Supply Control	Cold	Hot	WSFU	Number	Total FU
Toilet	Public	Flush Tank	5		5	18	90
Urinal	Public	3/4in. (19mm)Flush Valve	3		3	6	18
Drinking Fountain	Office,etc	3/8in. (9.5mm)Valve	0.25		0.25	6	1.5
Lavatory Sink	Public	Faucet	1.5	1.5	2	15	30
Bathroom Shower	Public	Faucet	3	3	4	6	24
Sprinkler Inside	Public	Mixing Valve	0.001	0	0.001	240	0.24
Service Sink in Lab	Private	Faucet	2.25	2.25	3	40	120
Total						331	283.74



GPFU = (WU) / (fu)

WU = total conventional water use (gallons/day)

fu = total number of conventional supply fixture units

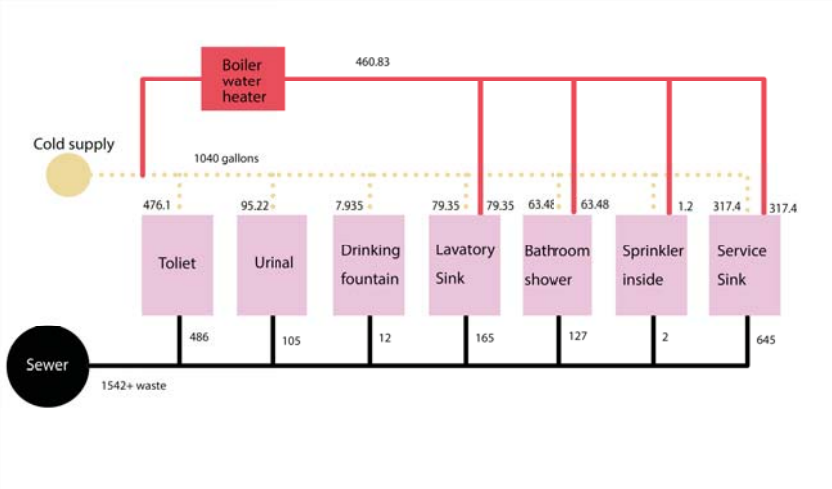
(1800)/283.74=5.29 gallons/fixture (MEEB TABLE 21.15)

A(2) D4.2 Conventional Water Supply Fixtures Estimates

Fixture	FU_conv	GPF_conv
Toilet	90	476.1
Urinal	18	95.22
Drinking Fountain	1.5	7.935
Lavatory Sink	30	158.7
Bathroom Shower	24	126.96
Sprinkler Inside	0.24	1.2696
Service Sink in Lab	120	634.8
Total:		1500.9846

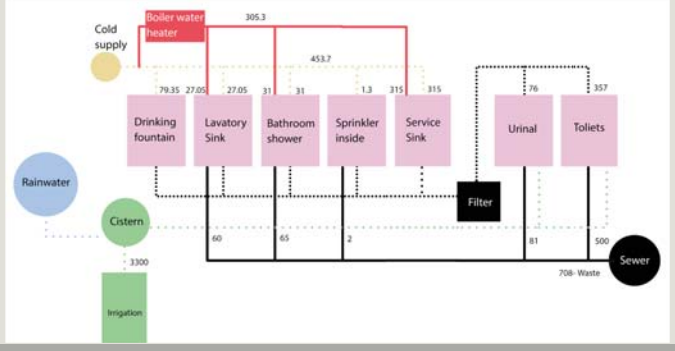
GPF = (GPFU) (FU)
GPFU = gallons/day/supply fixture unit
FU = weight in supply fixture units

Total: 1500 gallons/day



A(3) D4.3 WATER CONSERVATION SYSTEM

Fixture	FU_conv	USE_cons	USE_conv	FU_cons	GPFU	GPF_cons
Toilet	90	1.2	1.6	67.5	27	357.075
Urinal	18	0.8	1	14.4	40	76.176
Drinking Fountain	1.5	0.5	0.5	1.5	3.5	7.935
Lavatory Sink	30	0.75	2.2	10.2272727	14	54.1022727
Bathroom Shower	24	1.2	2.5	11.52	54	60.9408
Sprinkler Inside	0.24	1.5	1.5	0.24	0.9	1.2696
Service Sink in Lab	120	2.2	2.2	120	11	634.8
Total:						1192.299

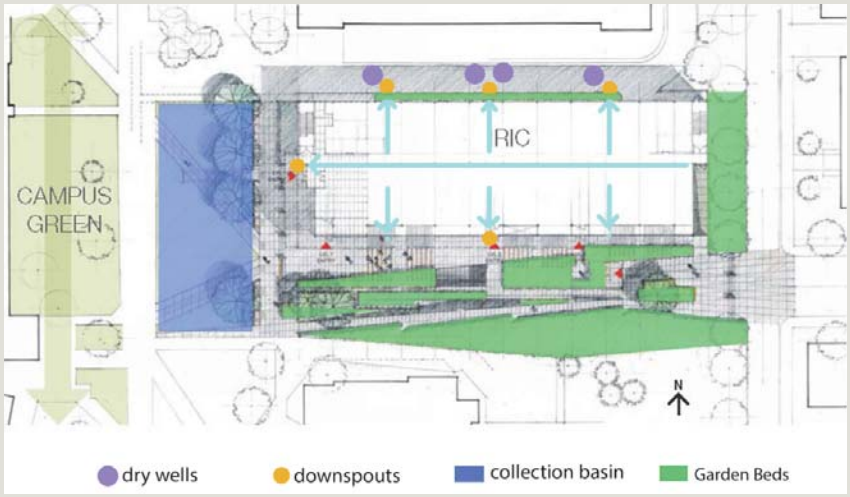


FUcons = (FUconv) [(usecons) / (useconv)]
where:
FUcons = weight in conservation fixture units for the fixture
FUconv = weight in conventional fixture units for the fixture
usecons = water use by conserving fixture (gallons)
useconv = water use by conventional fixture (gallons)

Conventional Total GPF: 1500.985
Conservational Total GPF : 1192.299
Savings:308.686 GPF

Question B — Storm Water

B(1) Inventory of the storm water control device



The original design is a LEED Gold award design with a 3300cuft collection basin on the west side of the building. There are 4 downspouts, 4 drywells and a series of garden bed around.

B(2) Use GAISMA to determine monthly rainfall.

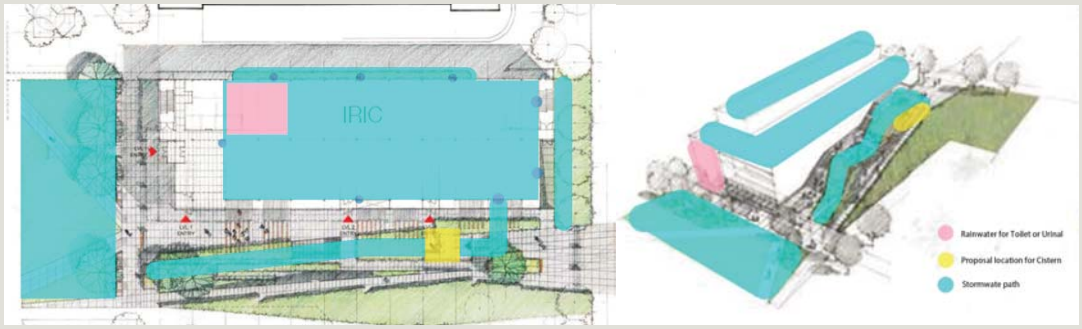
Variable	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Insolation, kWh/m²/day	1.25	2.12	3.37	4.6	5.47	6.09	6.44	5.54	4.04	2.49	1.4	1.06
Clearness, 0 - 1	0.42	0.47	0.5	0.51	0.51	0.53	0.58	0.57	0.53	0.47	0.41	0.42
Temperature, °C	-4.86	-3.43	0.75	5.24	9.93	14.03	17.93	17.51	11.76	5.22	-0.69	-5.37
Wind speed, m/s	4.25	4.08	3.76	3.83	3.73	3.84	3.86	3.88	4.13	4.13	4.27	4.23
Precipitation, mm	83	60	61	56	56	48	22	28	31	52	84	82
Wet days, d	12.6	10.8	12	10.2	9.7	8.6	5.3	5.8	6.6	7.5	12.1	13.3
Wet day average perception, mm	6.587302	5.555556	5.083333	5.490196	5.773196	5.581395	4.150943	4.827586	4.69697	6.933333	6.942149	6.165414

Note: The Chart circled with red rectangle shows the precipitation monthly. The last row shows the average perception each wet day in each month.

Average monthly precipitation=55.25

This shows we have good amount of rainwater throughout the year and it will be a good design decision to collect the rainwater.

B(3) Stromwater management strategies and problem



In order to improve the usage of the rainwater, we decided to add a cistern for collecting rainwater from roof. And add the downspout for irrigation the garden in the east and south. The pink shows that we could add water pipes to toilet that uses the rainwater to flush the toilets and urinals. Yellow shows the potential space for water cistern.

Question C—Water Use Redesign

C(1) Water Conservation Strategies

Strategies: Using Composing Toilet and Waterless Urinal. Improved the Faucet of the Lavatory Sink. Also, because the bath shower is not for daily use, so we changed it using recycle water.

Fixture	Occupancy	Type of Supply Control	Cold	Hot	WSFU	Number	Total FU
Toilet	Public	Composting Toilets	0		0	18	0
Urinal	Public	Waterless	0		0	6	0
Drinking Fountain	Office,etc	3/8in. (9.5mm)Valve	0.25		0.25	6	1.5
Lavatory Sink	Public	Better Faucet	0.5	0.5	0.7	15	10.5
Bathroom Shower	Public	Faucet	1	2	2	6	12
Sprinkler Inside	Public	Mixing Valve	0.001	0	0.001	240	0.24
Service Sink in Lab	Private	Faucet	2.25	2.25	3	40	120
Total						331	144.24

Conventional: Total FU 283.74
Redesign: Total FU 144.24

Saving: 139.5

C(2) D4.5 and E 4.8 Sizing cisterns

rain collected = (A) (R) (7.48 gal/ft3)
where:
A = catchment area (three-fourths of roof area) (ft2)
R = monthly rainfall (inches) [B4.2]

Average monthly precipitation=55.25mm
Roof catchment area=19200 sqft
G= (2.18)(19200)/(2.15)
Average Monthly Rainfall Catchment=19467.907

G= [(P)(A)] / (2.15)
G= annual rainfall collected
P=total precipitation
A= roof catchment area

V= G/7.48
Where:
V= cistern volume
V=2602.7 cuft

Cistern Sizing Estimate=2602.7 cuft

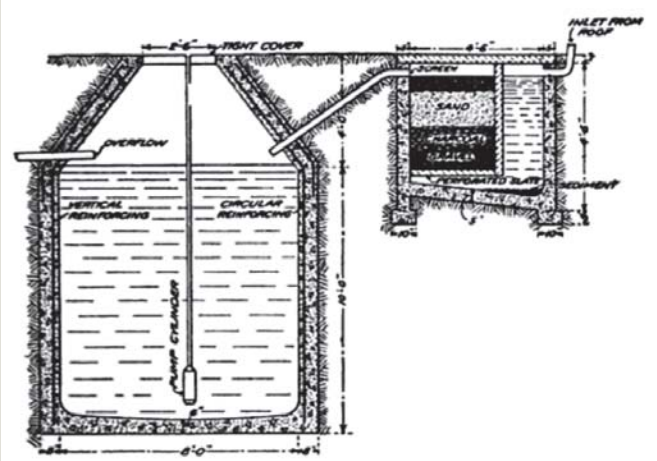


FIG. 3.—A common type of cistern and filter.

C(3) Design performance use method from D4.2-4.3

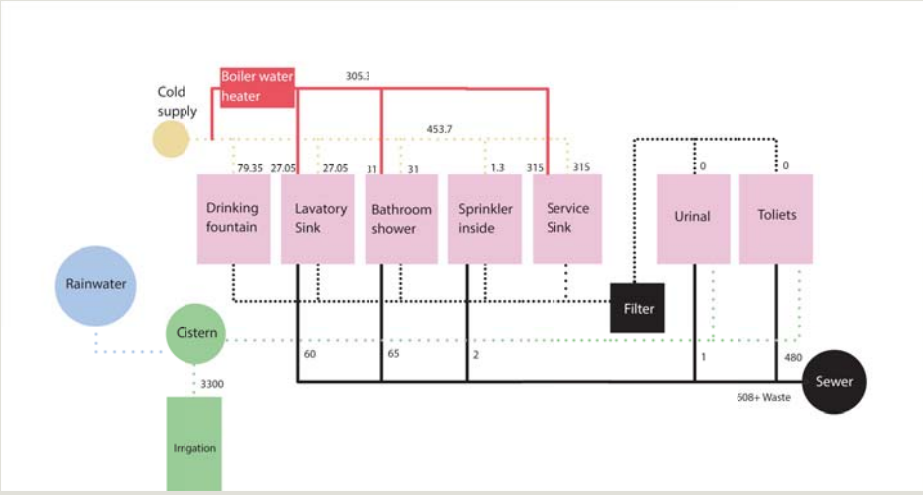
Fixture	FU_conv	USE_cons	USE_conv	FU_cons	GPFU	GPF_cons	GPF_conv
Toilet	90	0	1.6	0	27	0	476.1
Urinal	18	0	1	0	40	0	95.22
Drinking Fountain	1.5	0.5	0.5	1.5	3.5	7.935	7.935
Lavatory Sink	30	0.75	2.2	10.2272727	14	54.1022727	158.7
Bathroom Shower	24	1.2	2.5	11.52	54	60.9408	126.96
Sprinkler Inside	0.24	1.5	1.5	0.24	0.9	1.2696	1.2696
Service Sink in Lab	120	2.2	2.2	120	11	634.8	634.8
Total:						759.0477	1500.985

FUcons = (FUconv) [(usecons) / (useconv)]
where: FUcons = weight in conservation fixture units for the fixture
FUconv = weight in conventional fixture units for the fixture
usecons = water use by conserving fixture (gallons)
useconv = water use by conventional fixture (gallons)

Before Redesign: 1500.985 Total GPF
Redesign: 144.24 Total GPF

Savings=741.9 GPF

C(3) Design performance diagram use method from 4.3



Waterless Urinals and Composing Toilets in this diagram. As a result, the amount of water and waste goes to sewer in largely reduced.

Conclusion

The IRIC building is a good design with the water collection in basin that irrigates the gardens with the conservation water fixture. After design, we use the waterless toilets and urinals, we reduced the water usage. Even if the toilet and urinal have to use water, the rainwater collection in cistern can fulfill the needs, also function as the back up for sprinklers.

Conventional Water Usage per year=54,7859.379 gallons

Re-design Usage per year=27,7052.401 gallons

Saves 50.1% per year