University of Idaho

INTEGRATED RESEARCH & INNOVATION CENTER

Team 3

What we will cover...

- Site Context
- Climate
- Structural Systems
- Envelope
- Building Materials
- Mechanical & Electrical Systems
- ADA Accessibility
- Water Use
- Renewable Energy Potential
- Site
- Building Images

Concept

- Technology and nature come together in the state-of-the-art design of the University of Idaho's Integrated Research & Innovation Center. Features such as onsite energy generation, rainwater harvesting and smart facades allow this building to "walk the walk" in terms of attaining the goal of a net-zero energy building.

Goals

- Increase the daylighting levels in the building
- Minimize heat gain while allowing for exterior views
- Lower the amount of energy the building consumes
- Generate energy on site for building use

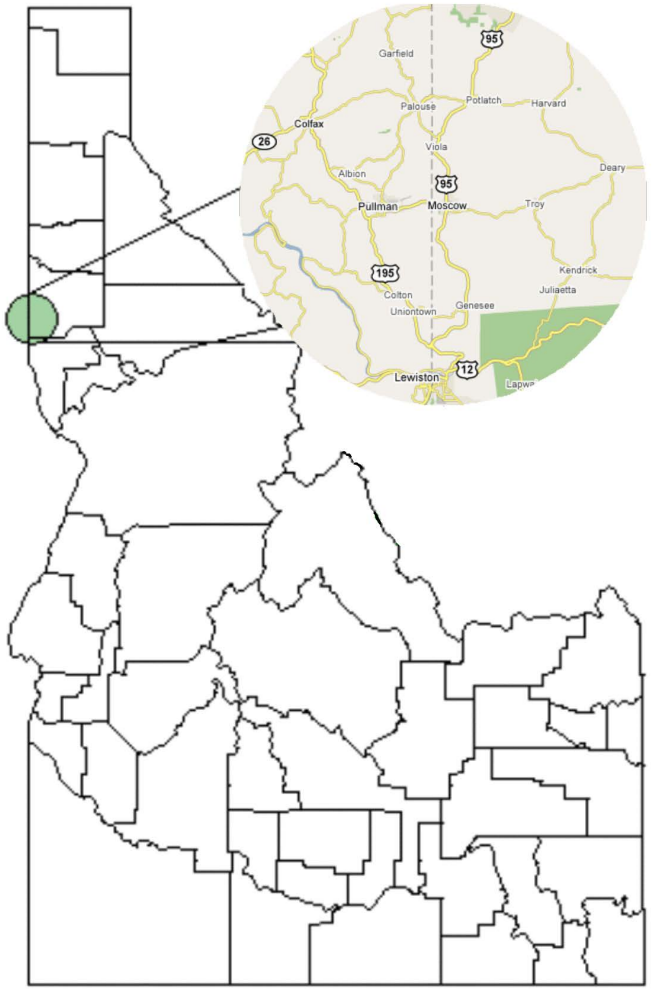
Objectives

- Enlarge windows on North facade to increase daylight penetration and incorporate light shelves into South facade
- Integrate operable shading devices into South, West, and East facades while allowing for exterior views
- Lower lighting power density (LPD) throughout building and incorporate occupancy sensors and daylight controls into lighting fixtures
- Incorporate high efficiency photovoltaic panels into South facade and roof

Site Context

Physical Location, Site Images

Where in Idaho?

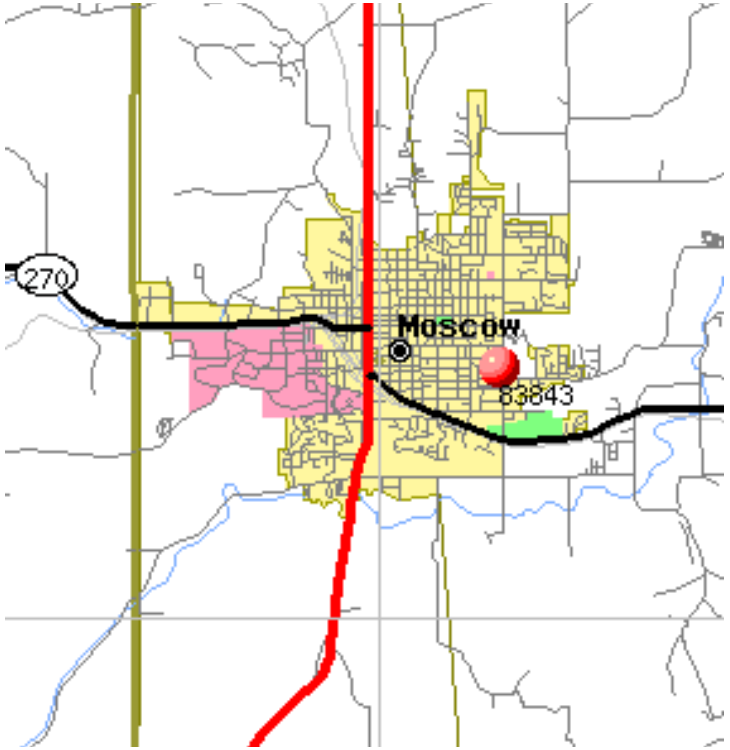


http://en.wikipedia.org/wiki/File:Moscow-id-map-w-inset.PNG

http://moscowchamber.com/

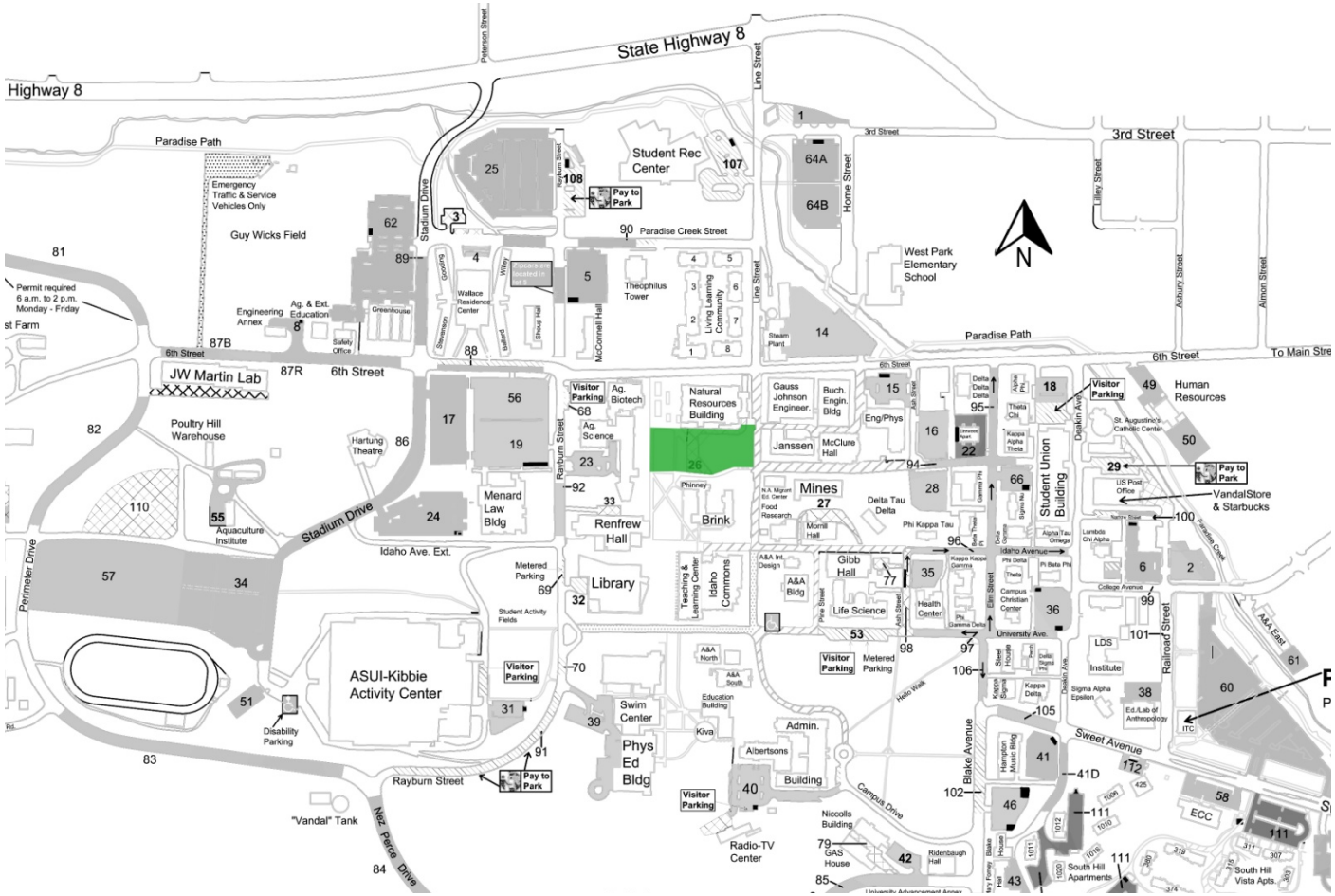
Where in Moscow?

http://todayscampus.com/featured_employers/360/detail



http://www.city-data.com/zips/83843.html

Where on U of I Campus?



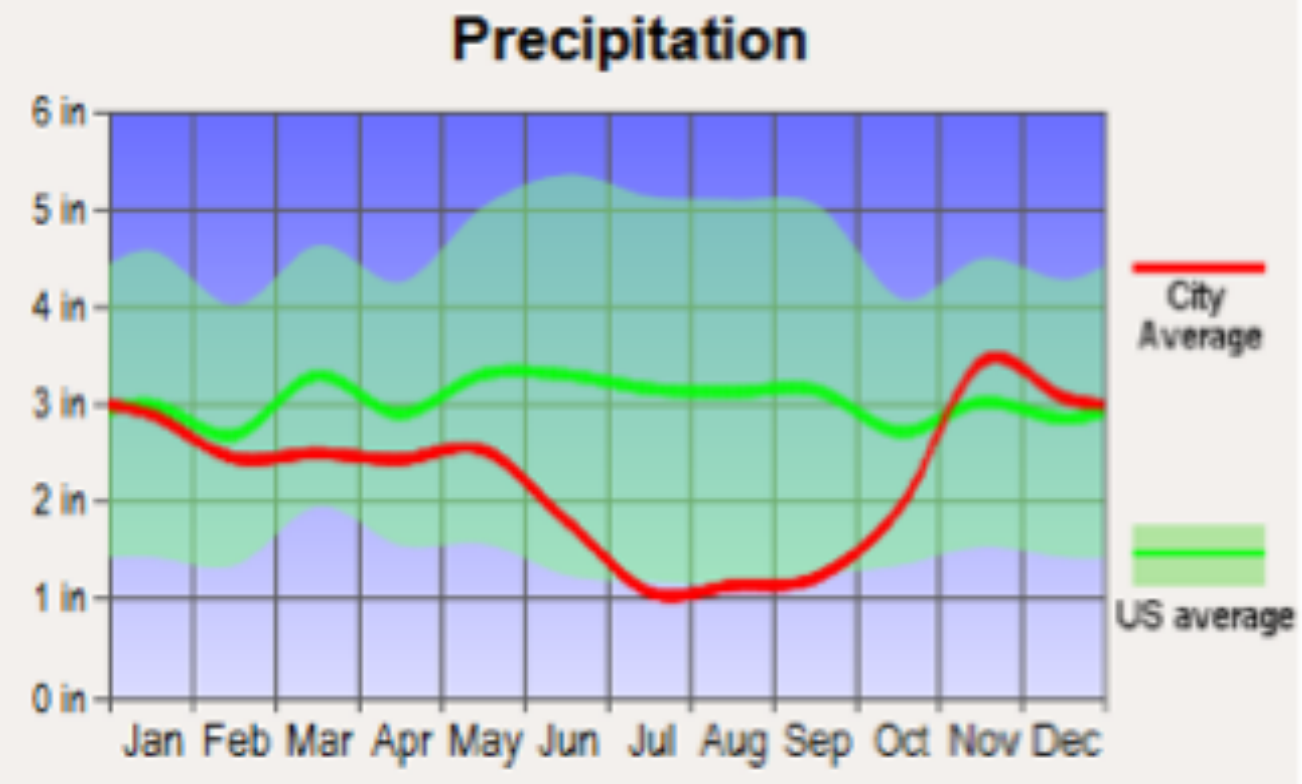
Site Photos

Building Site

Climate

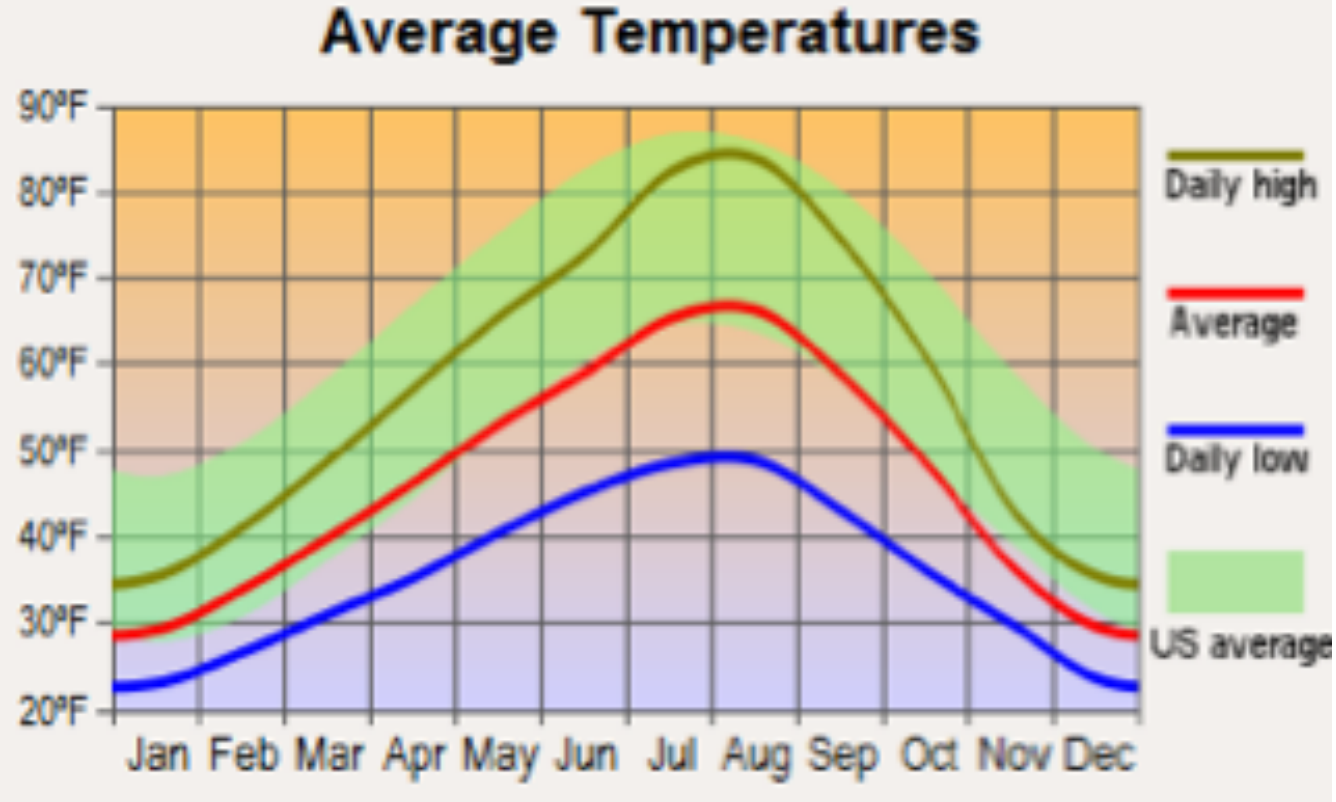
Precipitation, Degree Days, Temperature

Precipitation



Moscow gets about 27 inches of rain annually

Temperature



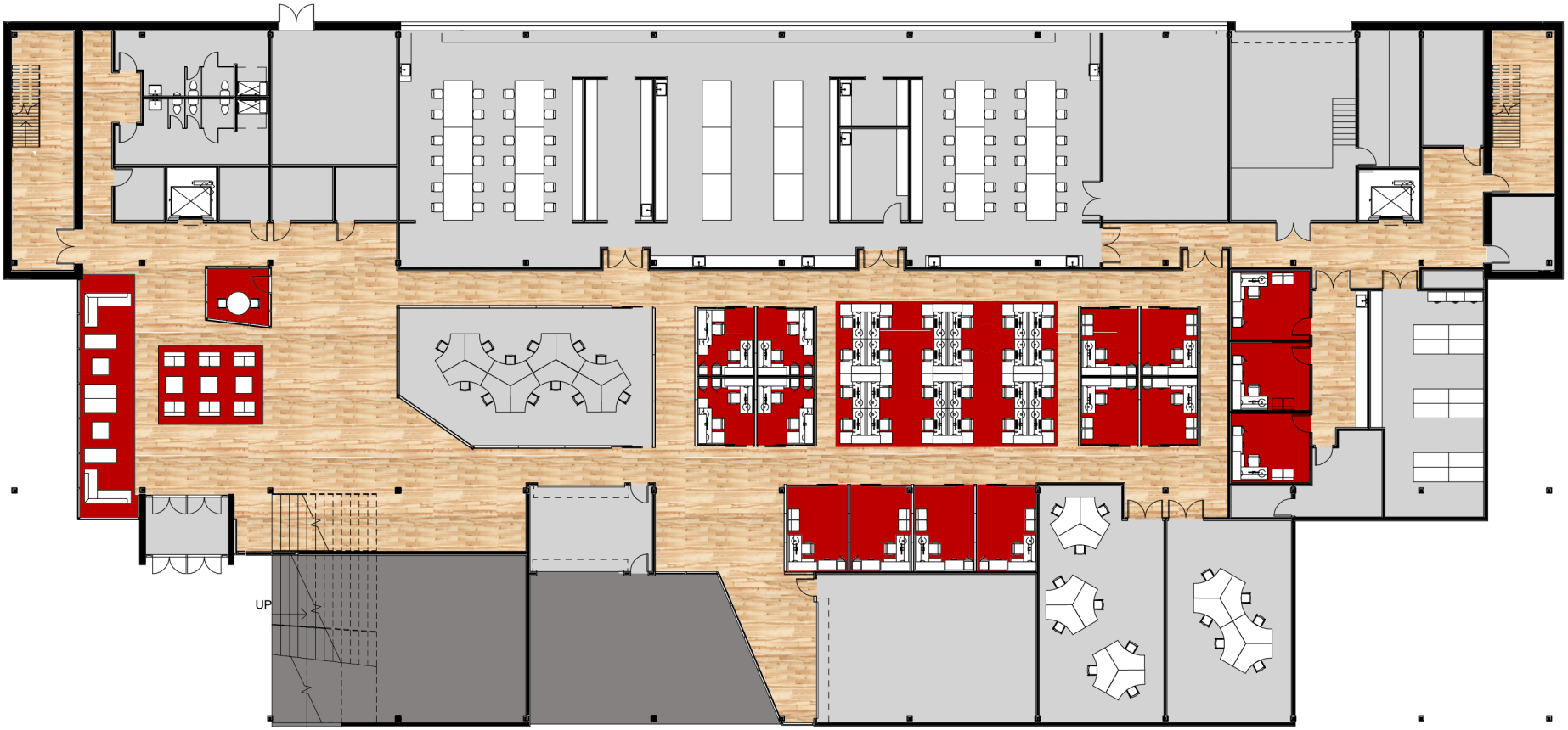
Winter: 28-37°F

Summer: 55-77°F

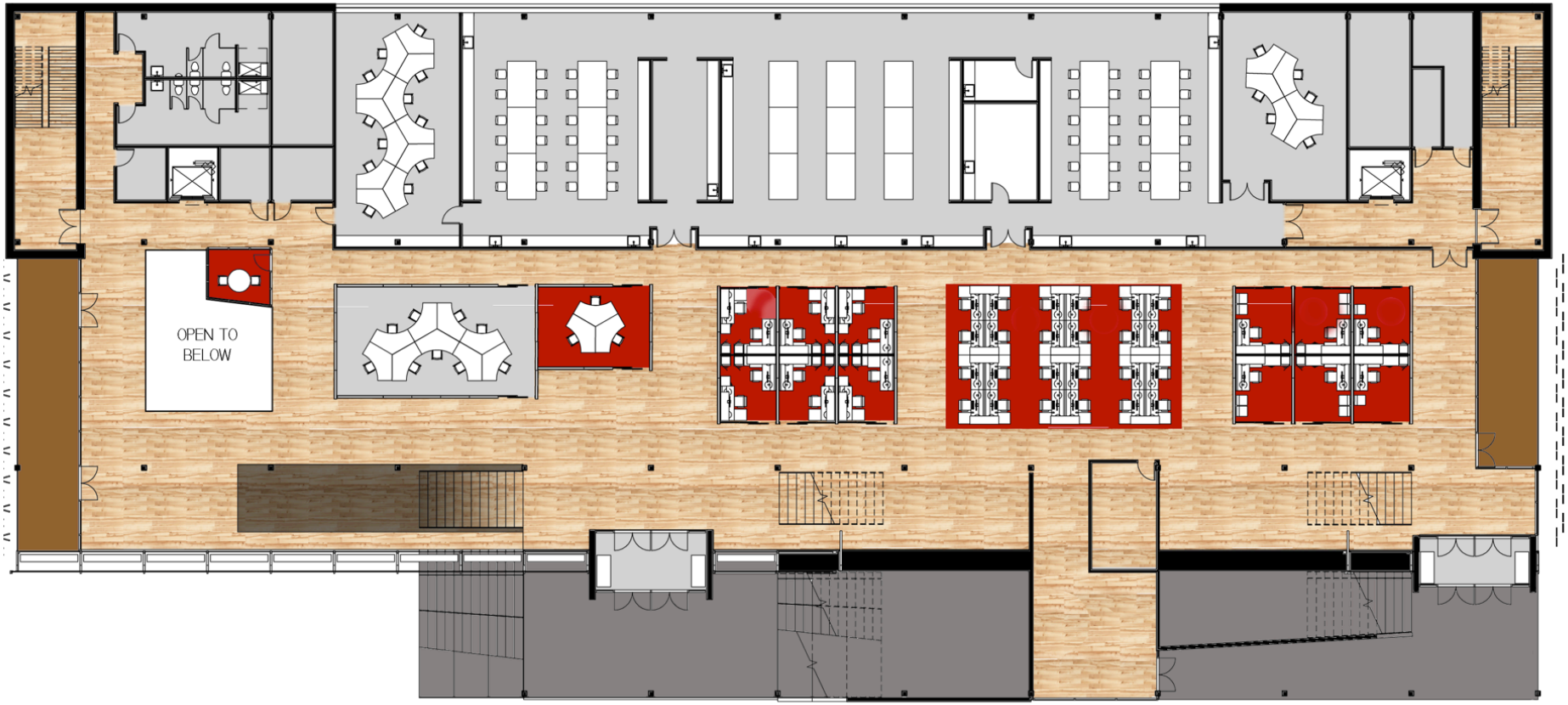
Floor Plans

Levels 1-3

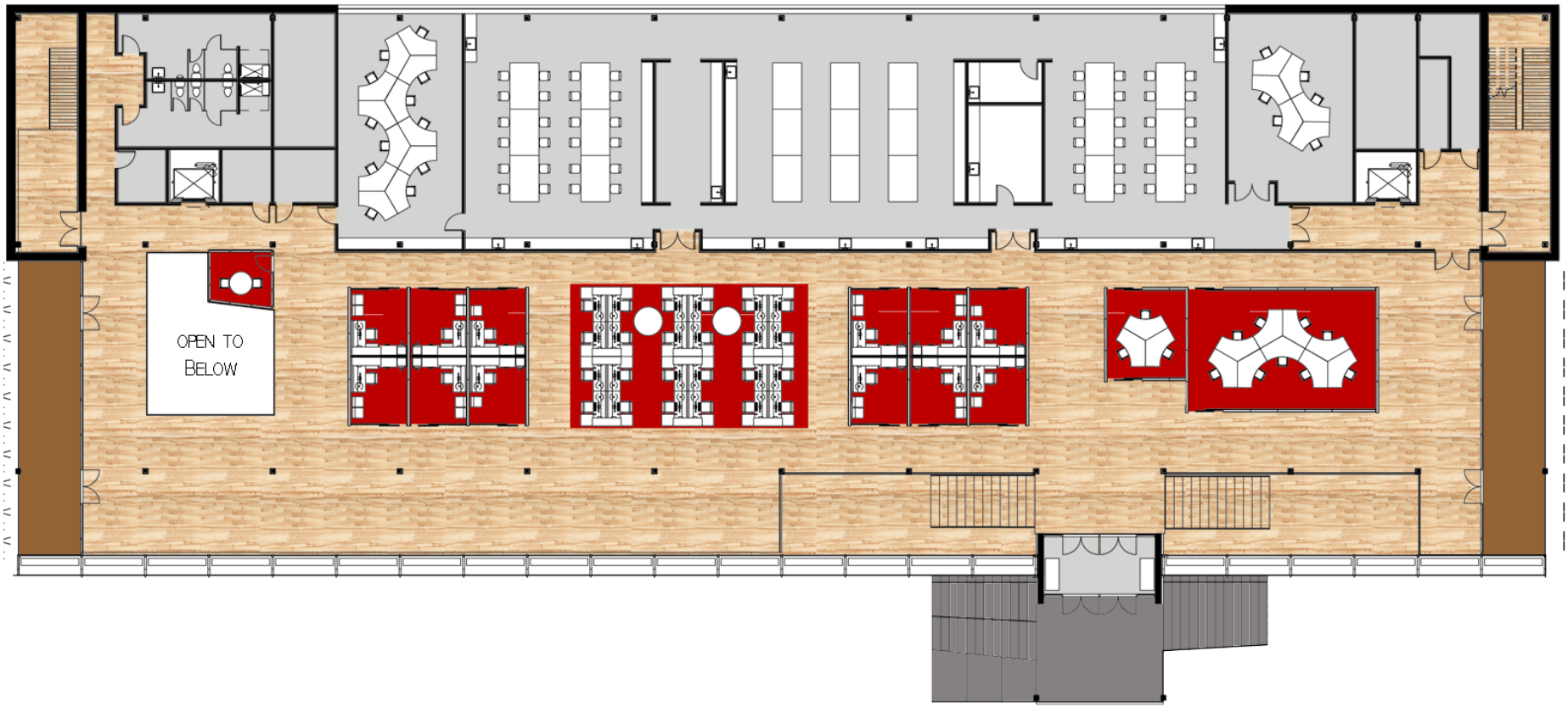
Level 1



Level 2



Level 3



Structural Systems

Why Wood?

- Wood stores carbon which is removed from the atmosphere
- It is renewable when responsibly sourced
- It has a lower carbon footprint as it takes much less energy to produce
- Wood is durable and can last hundreds of years if properly maintained
- Some wood species have a strength to weight ratio 20% higher than structural steel
- Wood is a natural insulator with air pockets in its cellular structure
- Wood is beautiful and less expensive than other building materials

Carbon Estimator

How much carbon will our building store?

WOW!

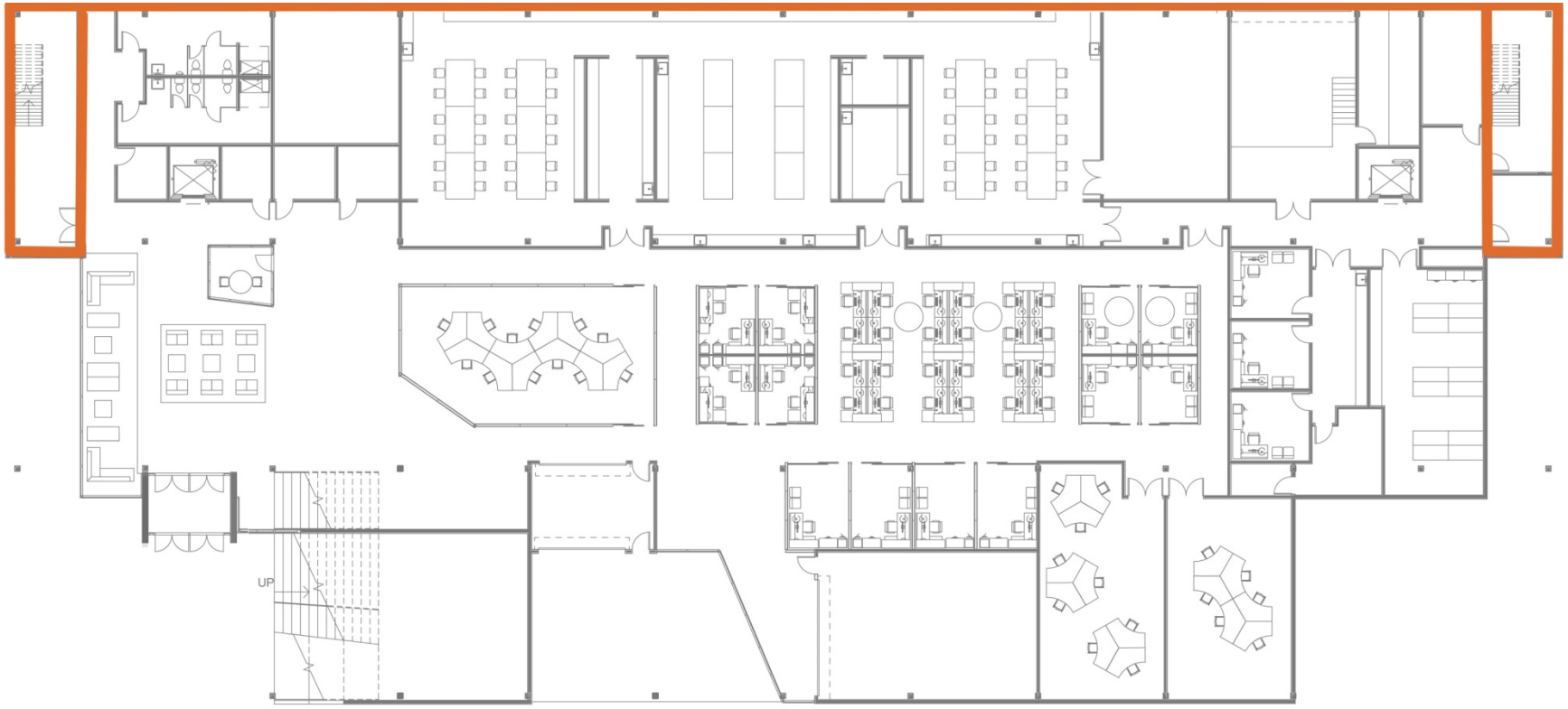
Cross-Laminated Timber (CLT) Panels

- Excellent fire protection
- Ductile in earthquakes
- High strength and dimensional stability
- Prefabricated
- Accelerated construction speeds

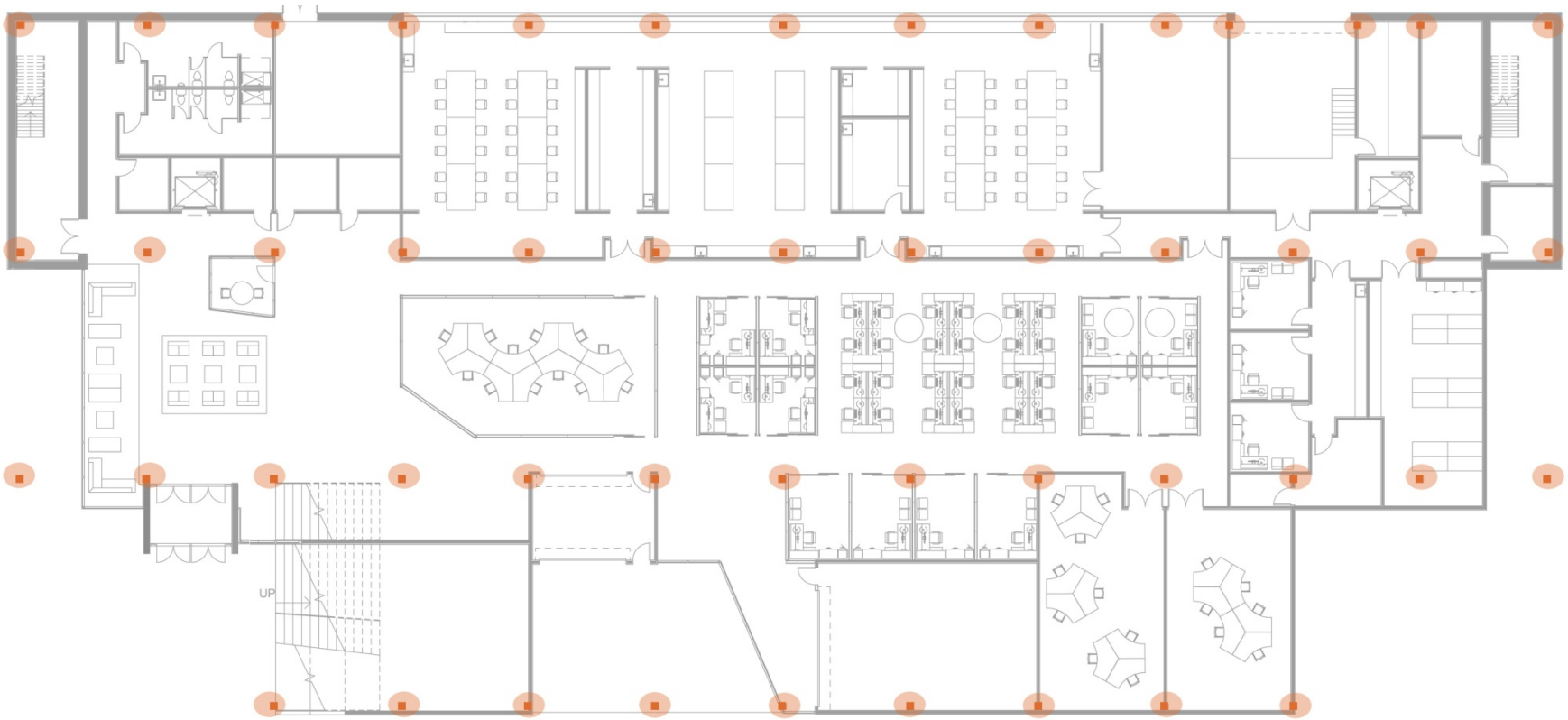
Glue-Laminated Timber

- Versatile
  - Can be used for roof/ floor beams, columns, decking
  - Many sizes and shapes
- High strength to weight ratio
- Economical
- Fire resistant
- Durable
- Warm, natural beauty

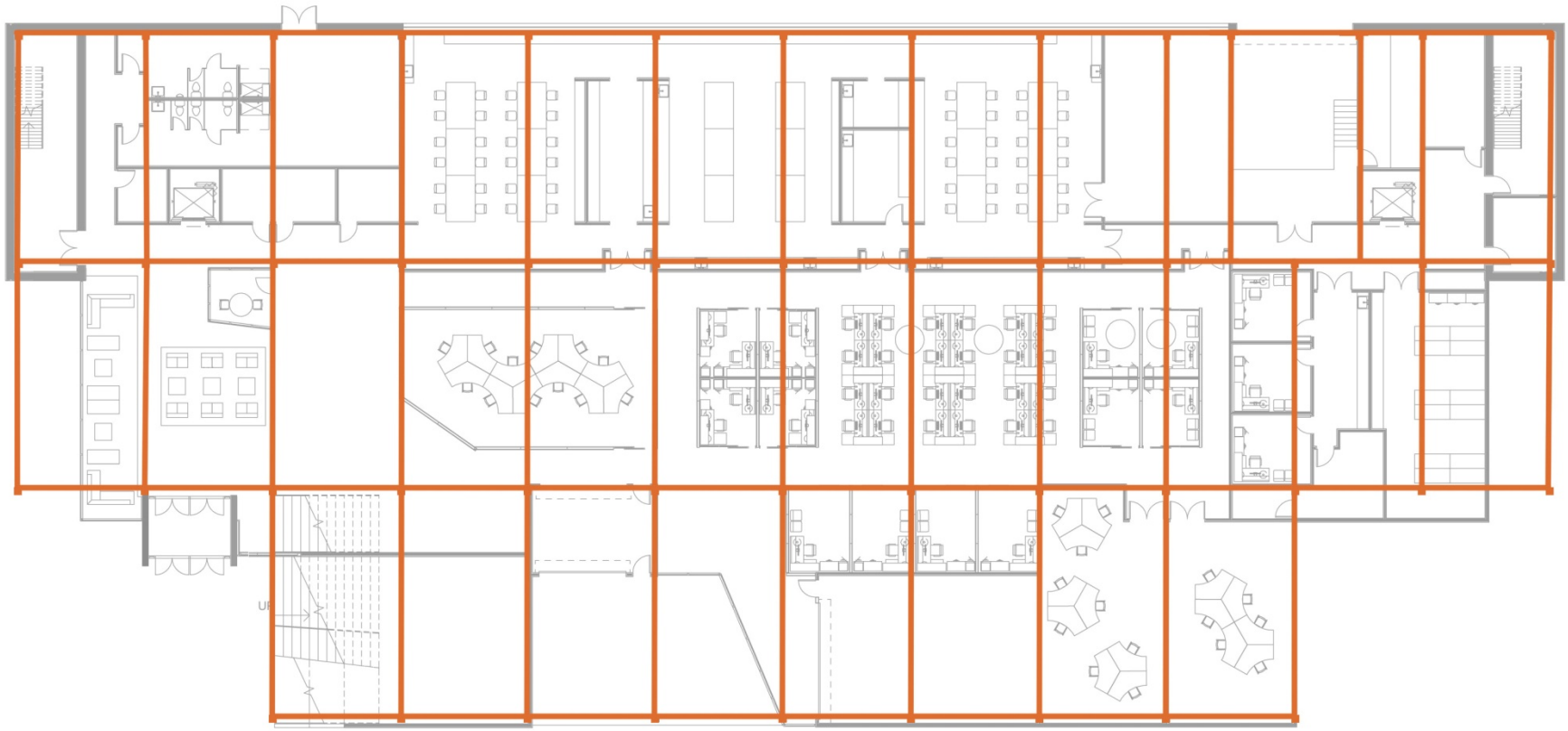
CLT Panel Layout



Column Layout

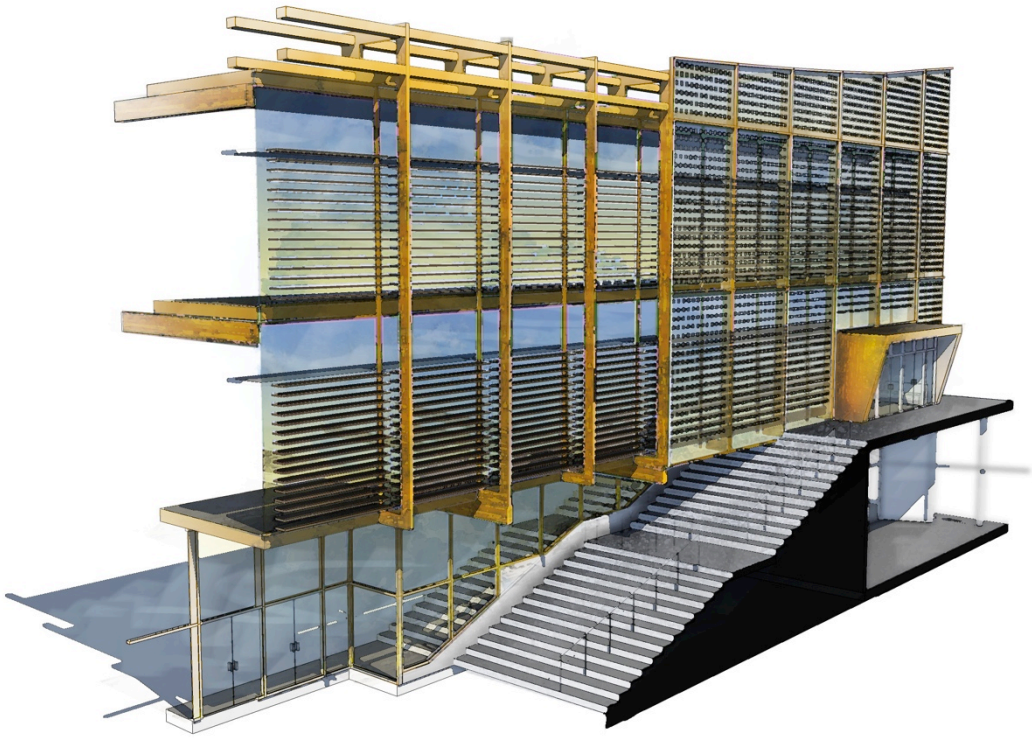


Beam Layout



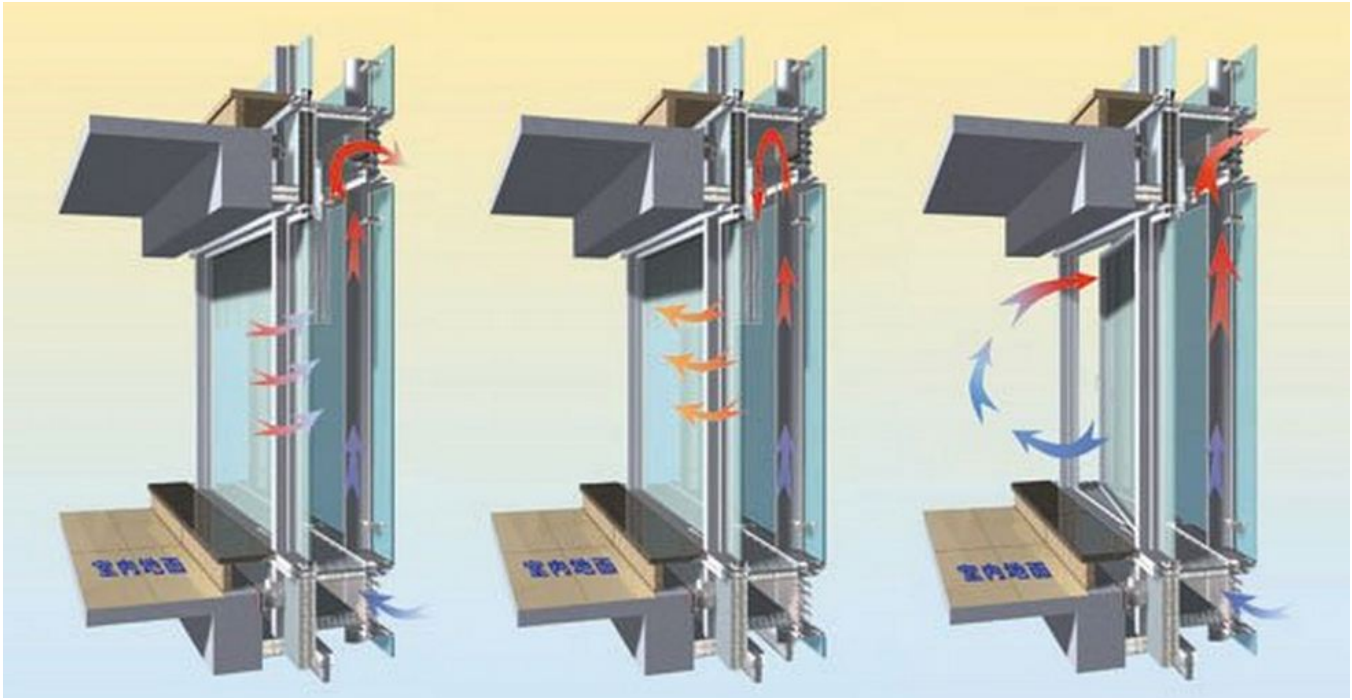
Envelope

Double-Skin Facade



- Glulam structure supporting facade
- 2'-0" air cavity for insulation and louvers
- Wood louvers to control lighting levels
- Building-integrated photovoltaic panels in glass generates energy for building
- Light shelves allow light to penetrate deep into the space

Double-Skin Facade

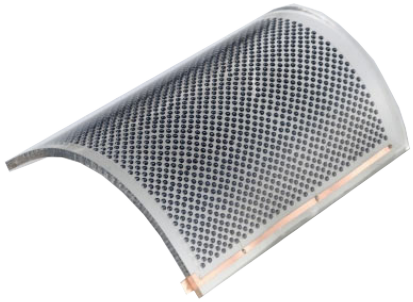


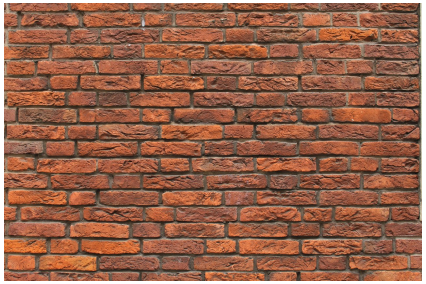
- Summer: hot air will be removed from spaces through stack effect and fresh, cool air can be drawn in
- Winter: insulated cavity provides a thermal barrier

Building Materials

Exterior Materials, Interior Materials

Exterior Materials

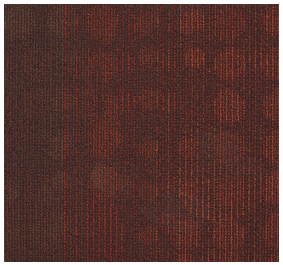


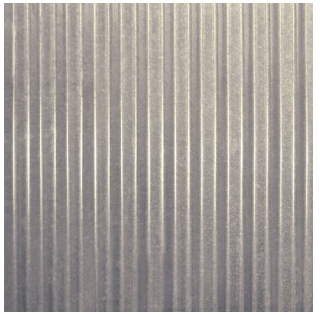


- Building integrated PV Panels
- Red brick veneer
- Parklex rainscreen wood panel

Interior Materials

- FSC Certified Maple wood flooring
- Shaw Ecoworx recyclable modular carpet tile
- Steelcase privacy walls
- Corrugated metal panels

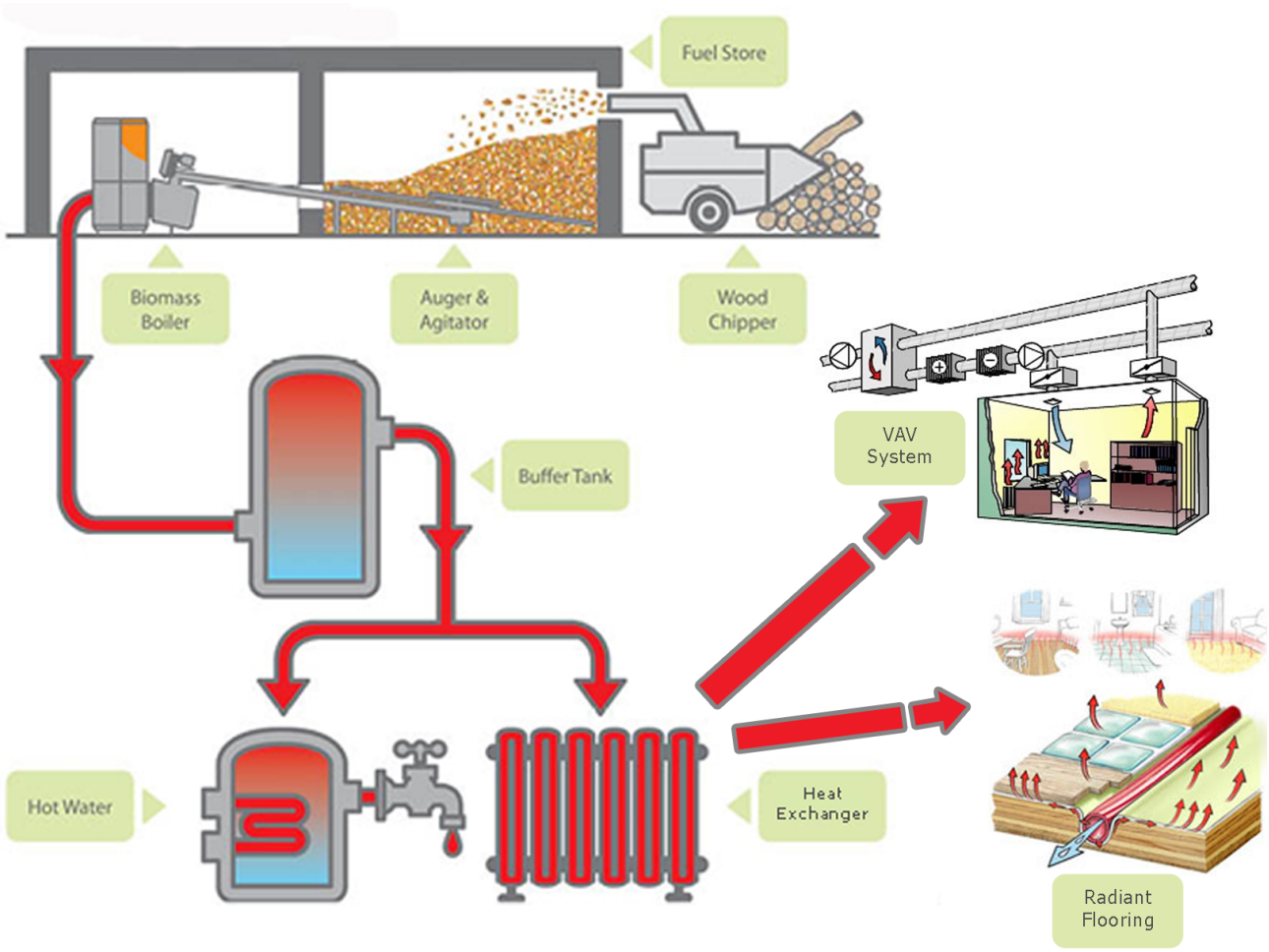




Mechanical & Electrical Systems

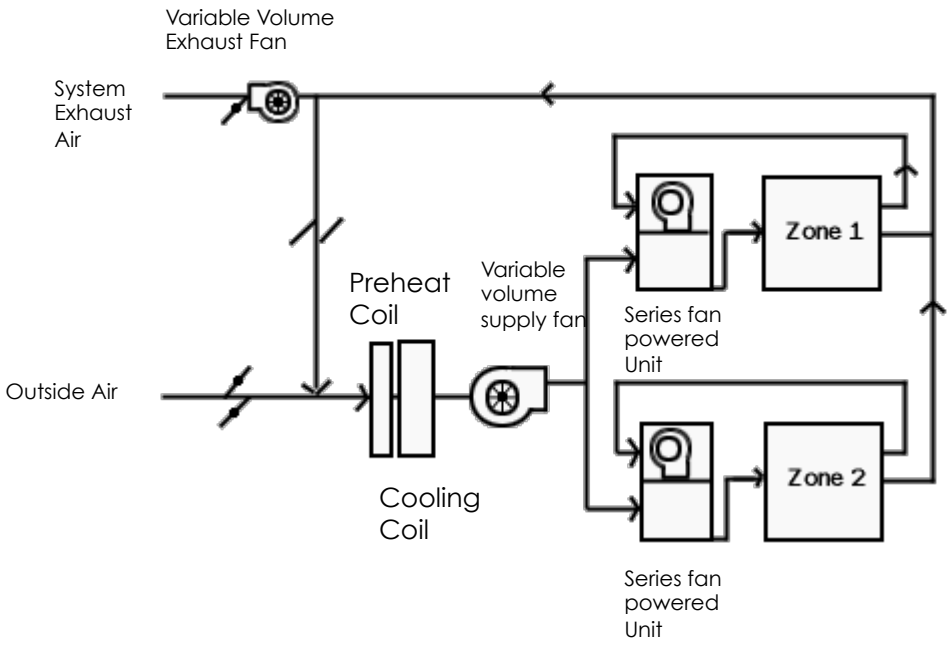
Biomass Boiler, HVAC, Lighting

Biomass Boiler



- Cedar chips, a by-product of local saw mills, are used for fuel
  - The boiler produces 90% of the steam needed for hot water and space heating/ cooling
- Heat exchanger allows the steam to be used for radiant floor heating system as well as VAV air handling units

Heating/Cooling - Labs

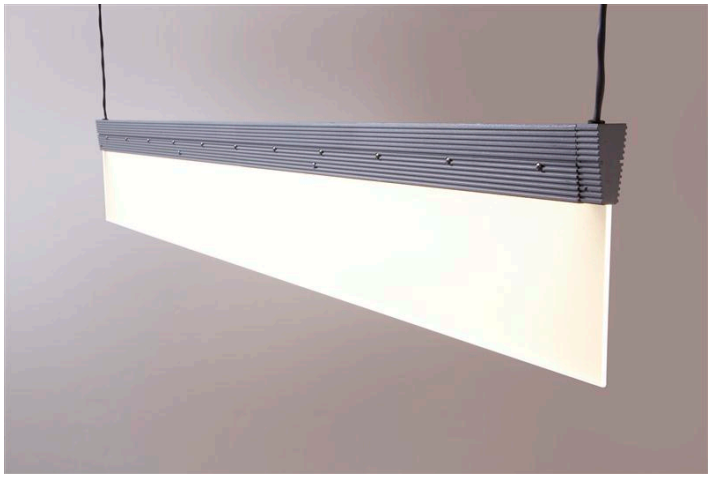


- VAV Air Handling Unit
  - 100% outside air used
  - All heating, cooling, and humidification supplied to space by air
  - Single duct system: Multi-zone, variable-air valve

Heating/Cooling Other Zones

- Warmboard Radiant floor heating
  - Integrated with subflooring
  - Heat is more evenly distributed across floor
    - PEX tubing lays on layer of aluminum
  - Better indoor air quality
  - Heat is in comfort zone

Lighting



- GE Lumination EP and EL Series LED luminaires lower LPD (Lighting Power Density) in the spaces
- Provide more light with less energy
- Occupancy sensors and daylight controls integrated

ADA Accessibility

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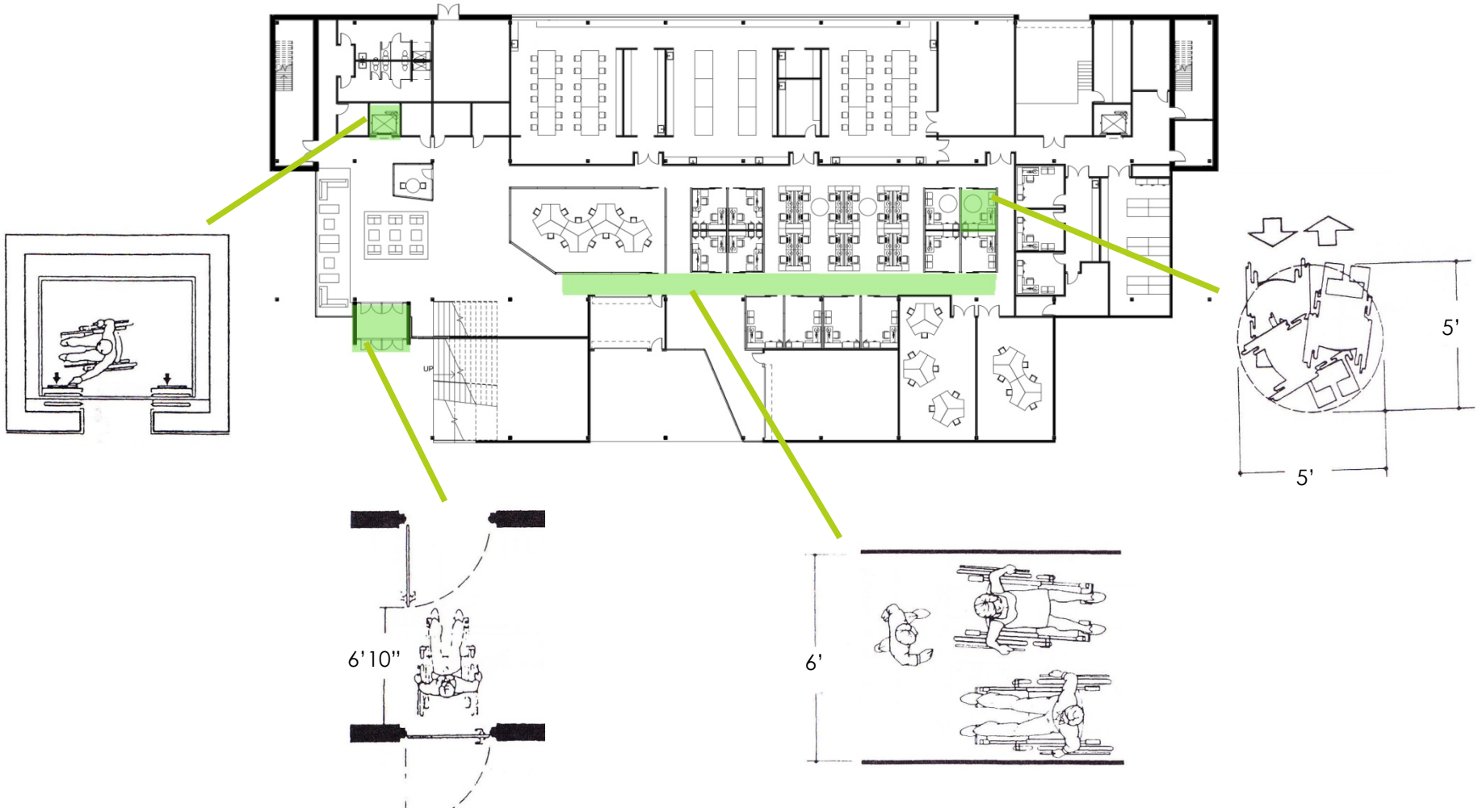


Water Use

Harvesting Potential, Cisterns, Low-flow Fixtures, Xeriscaping

Low-Flow Water Fixtures

Indoor Water Use

- **1,342,612 Gal/year**

- Use of low-flow fixtures saves **308,516 Gal/year**
  - (18.7% savings!)

Xeriscaping

- **Idaho Native** plant species used in tiered planter areas
- **Saves water**
  - Can reduce landscape water by 50-75%
- **No fertilizers or pesticides needed**
  - Nutrients supplied by healthy, organic soil
- **Minimal maintenance**

Water Harvesting Potential

- Potential Amount Harvested
  - 375,352 Gal/year
- Xeriscaping
  - 1,523 Gal/year
- Greywater Reclamation
  - 2,779 Gal/year

Amount produced on site – **29.5%**

Cistern Sizing

1,342,612 Gal/year / 260 (days in school year)

= 5,163 gal/day

(2/3) x 27" = 18" Design Precipitation

18 x 0.62 = 11.16 Gal/sq. ft.

11.16 x 21,186 (roof area) = 236,435

236,435 / (1/3) = **78,811 Gal Tank**

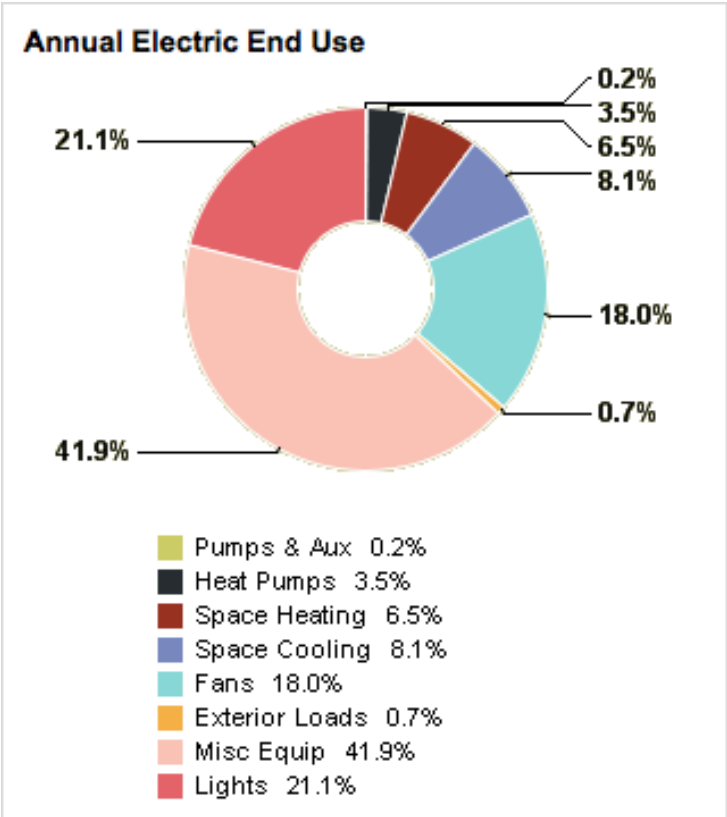
or 3 tanks that hold 26,700 Gallons

Renewable Energy Potential

Photovoltaic Panels

Electricity Demands

Annual Energy	
Energy Use Intensity (EUI)	35 kBtu / ft² / year
Electric	662,635 kWh
Fuel	1,747 Therms
Annual Peak Demand	656.8 kW



662,635 kWh/year

(heating/cooling) -96,744 kWh/year

(natural ventilation) -87,801 kWh/year

= **478,090 kWh/year**

Building Integrated PV Panels

- Allow views to the exterior while generating electricity for the building

Potential Energy Generated

- **82,220 kWh/year**
- 17.2% of total need
- $5,755 in savings

Roof PV Panels

- 46.7° tilt at 180° azimuth and 1-axis rotation with 77% AC-DC factor
- 11,679 sq. ft. array

Potential Energy Generated:

- **436,359 kWh/year**
- 91% of total need
- $30,545 in savings

Total Onsite PV Generation

Roof	436,359 kWh/year
Facade	82,220 kWh/year
Total	**518,759 kWh/year***

*This amount takes into account a 7% difference in usage for plug loads

Installation Costs & Payback Period

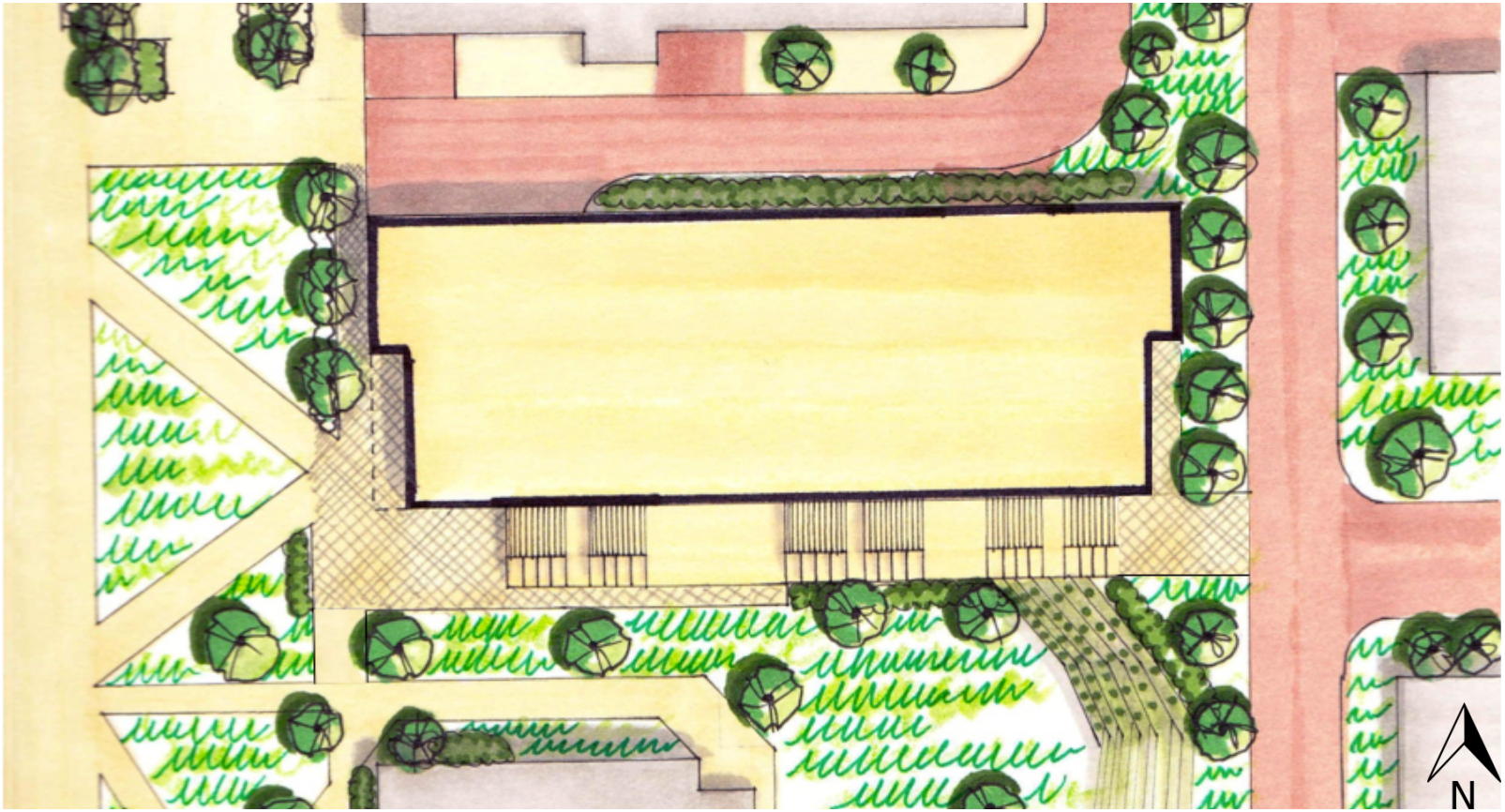
Installation Cost	$910,420
PV Savings/year	$36,300

$910,420 / $36,300 = **25 year payback period**

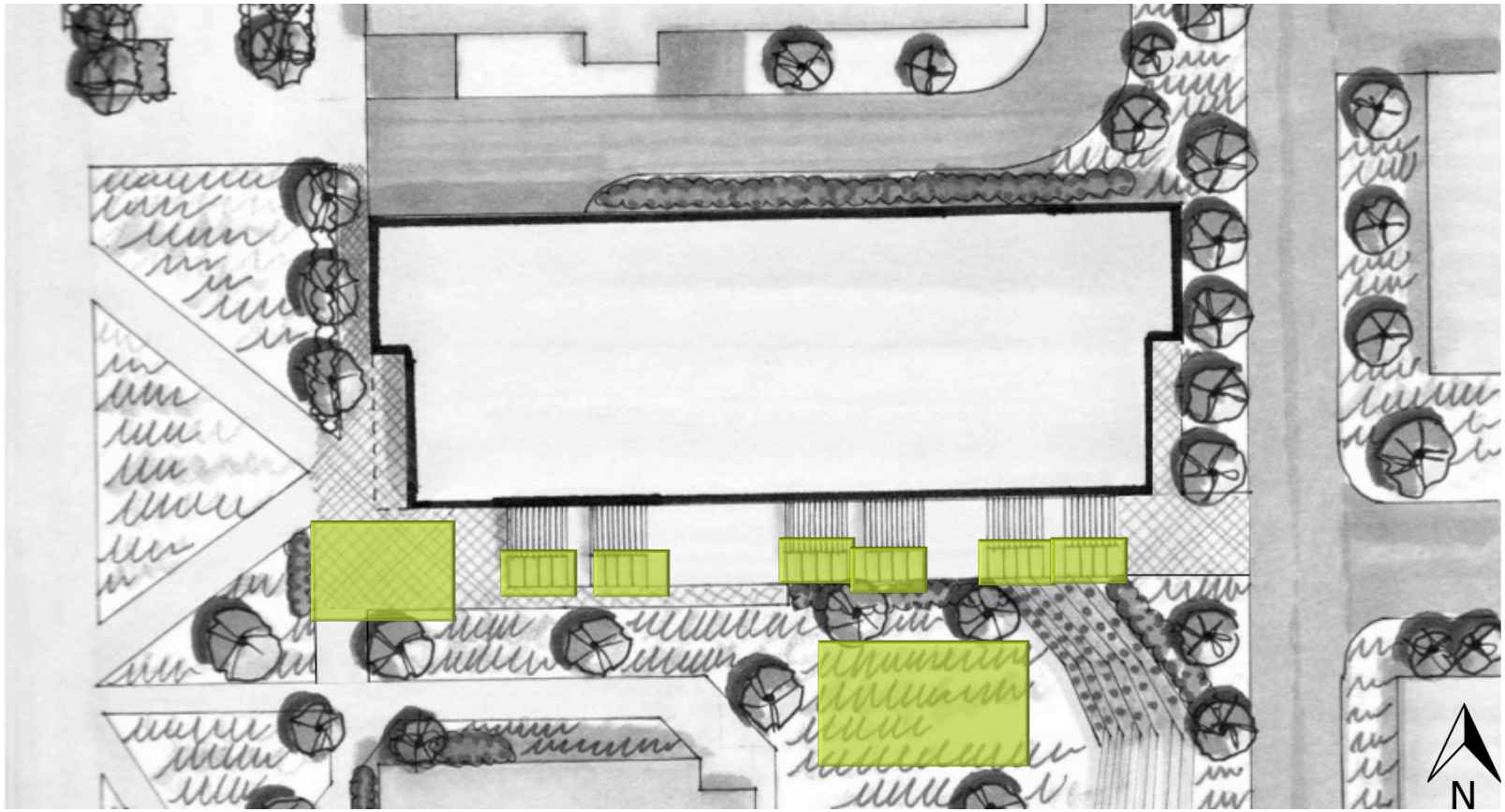
Site Integration

Public Spaces, Landscaping, Connections, Storm-water, Bicycle Accommodation

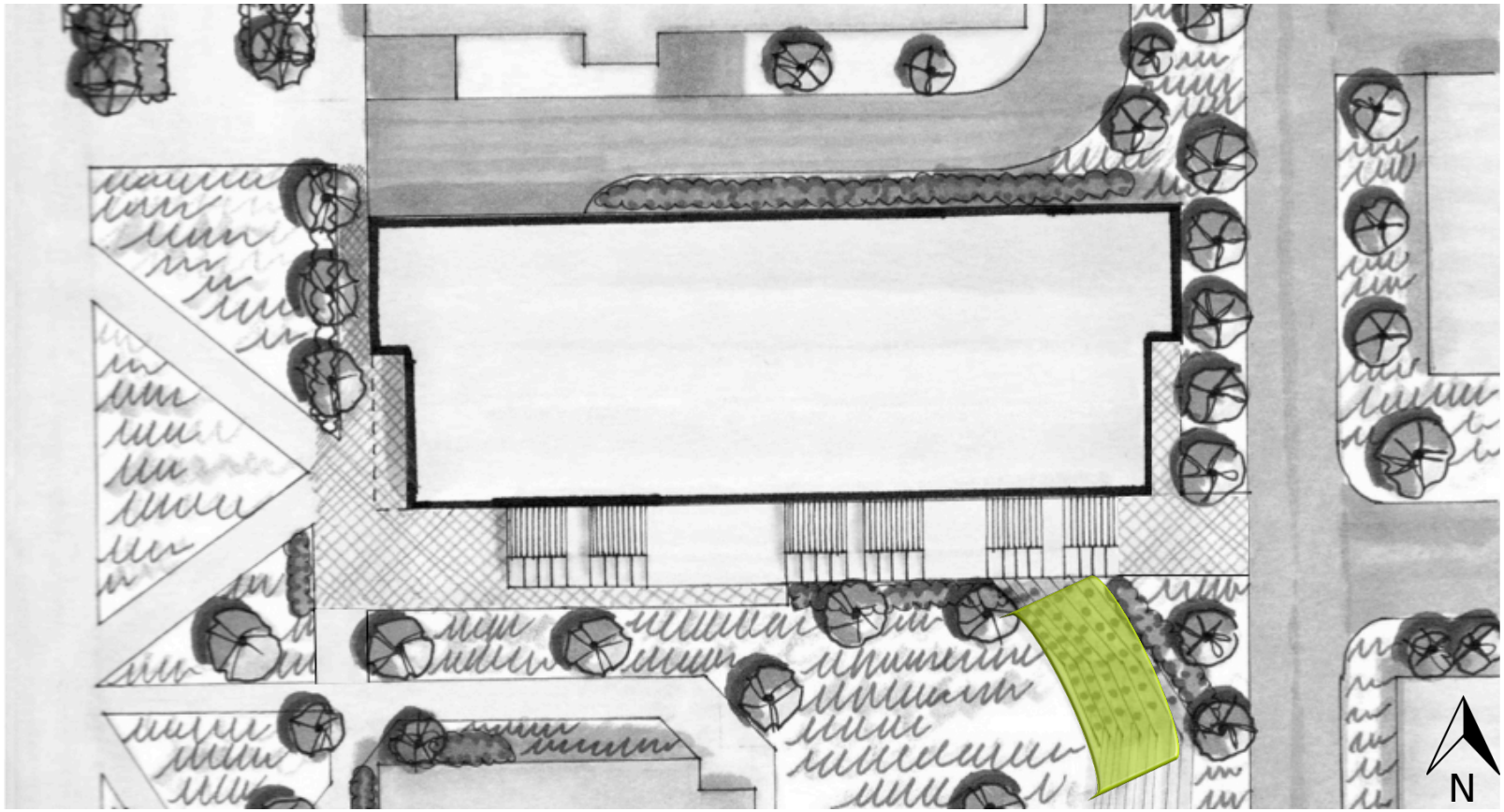
Site



Public Spaces

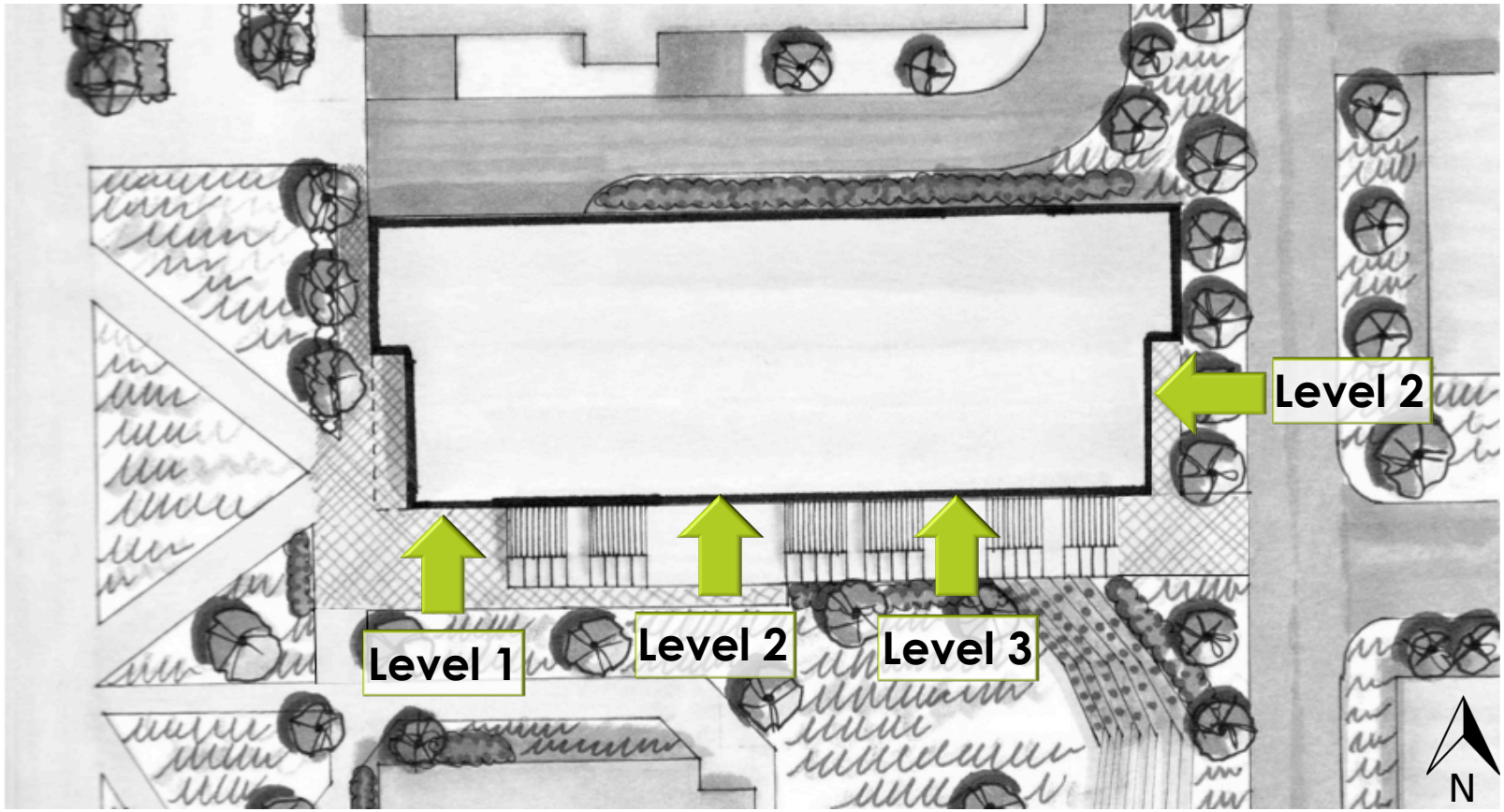


Landscaping

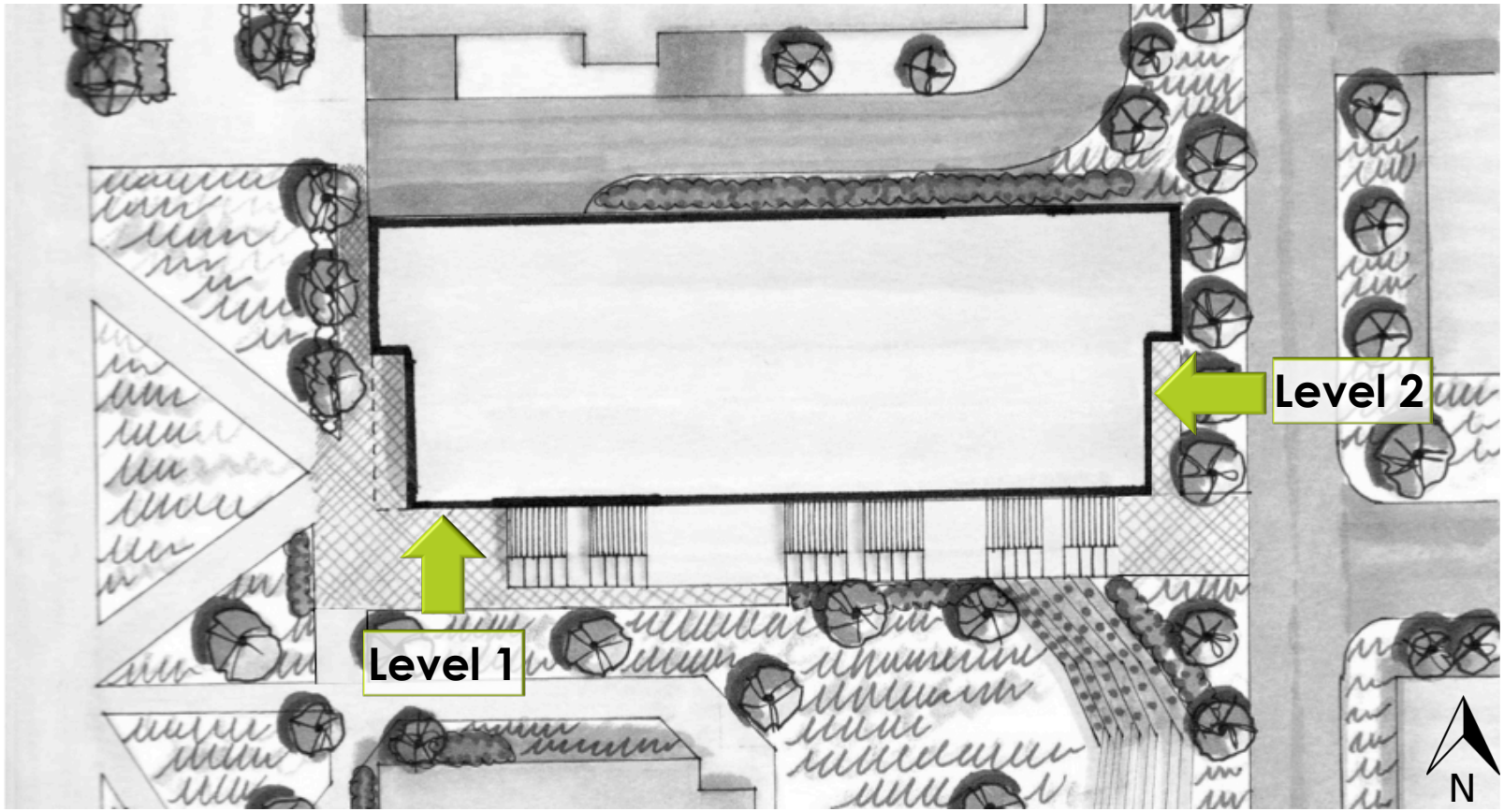


- Tiered landscaping to the SE allows for the steep change in grade

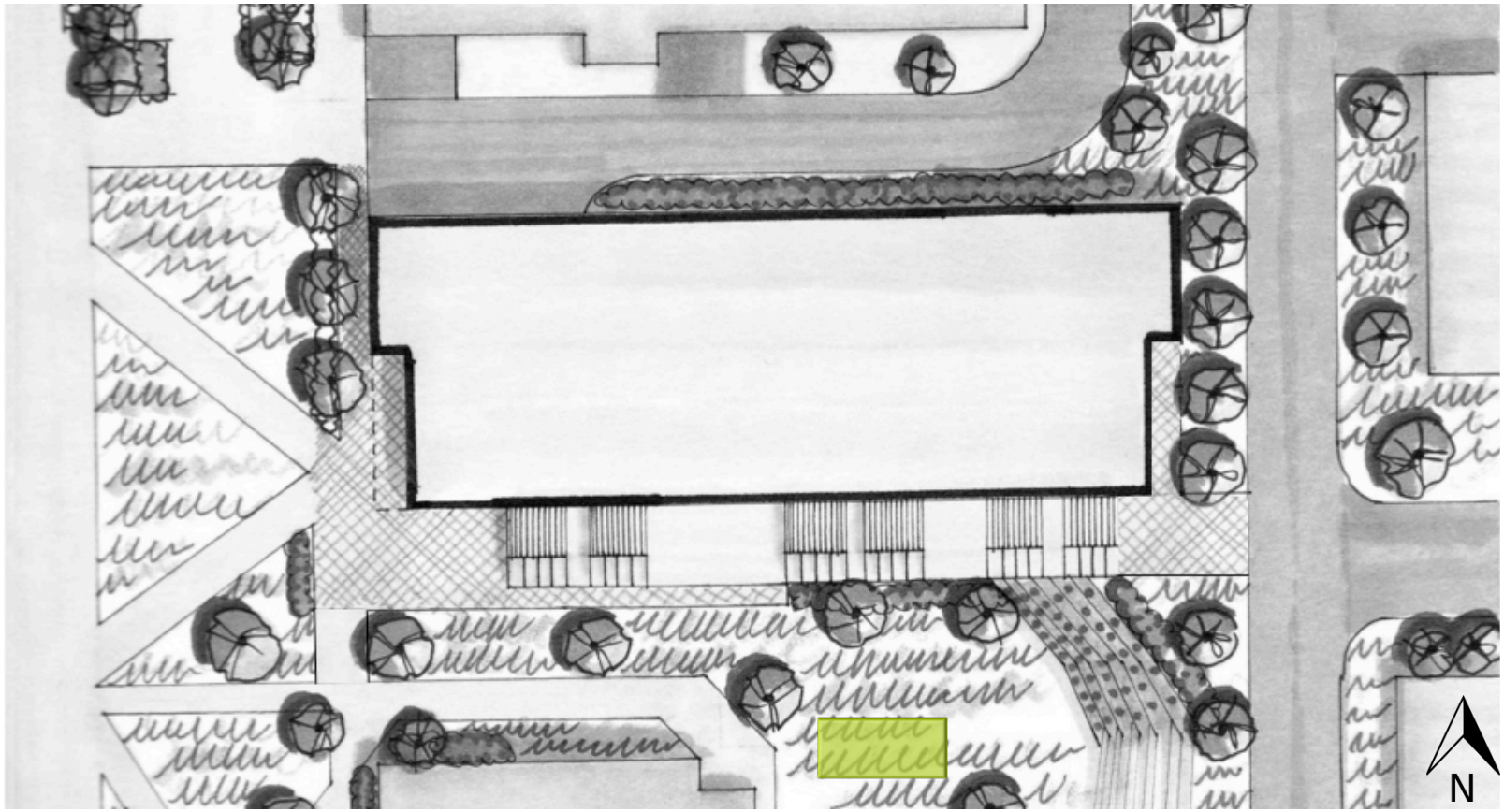
Entry Locations



ADA Accessible Locations

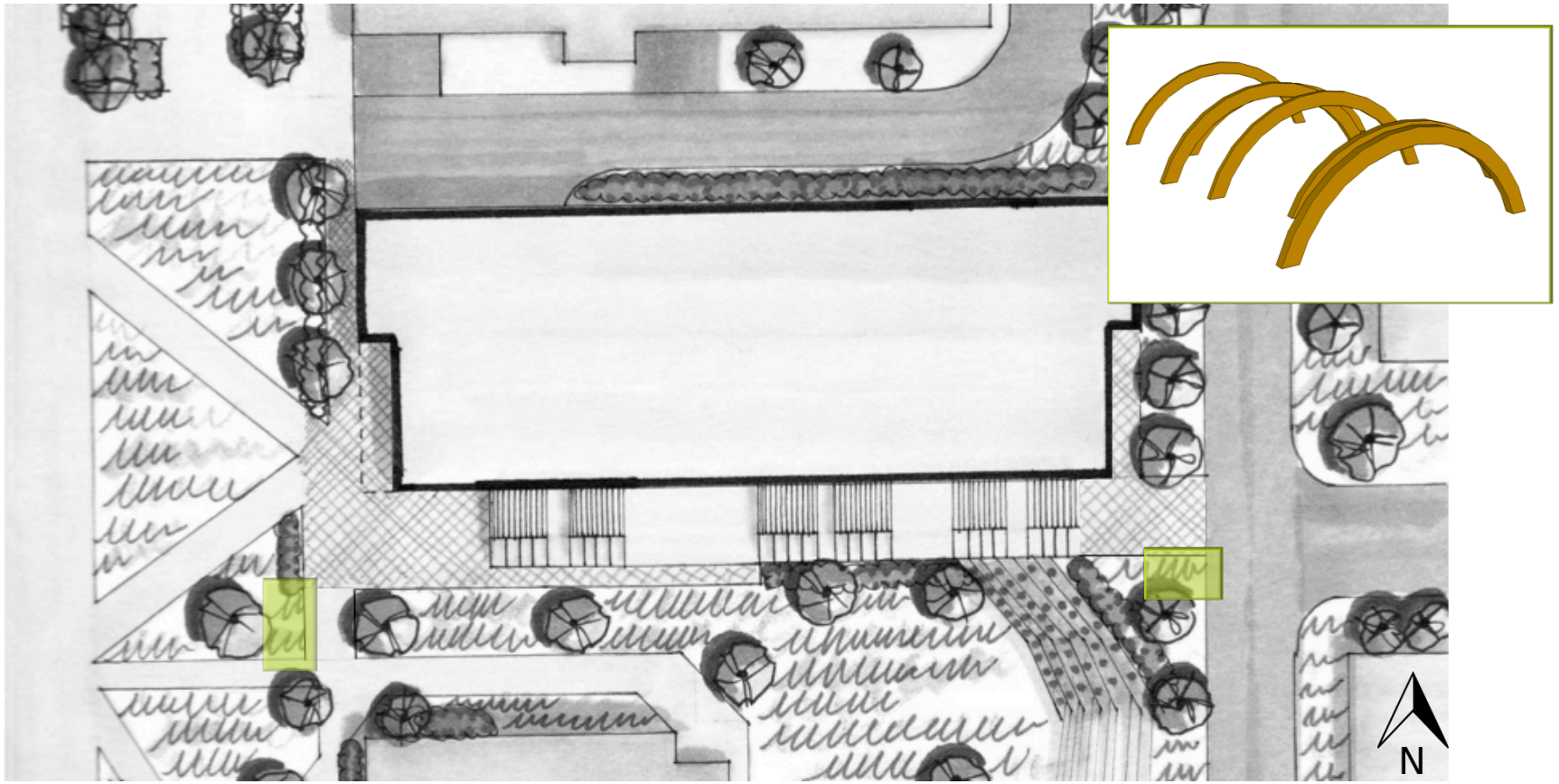


Storm-Water Retention



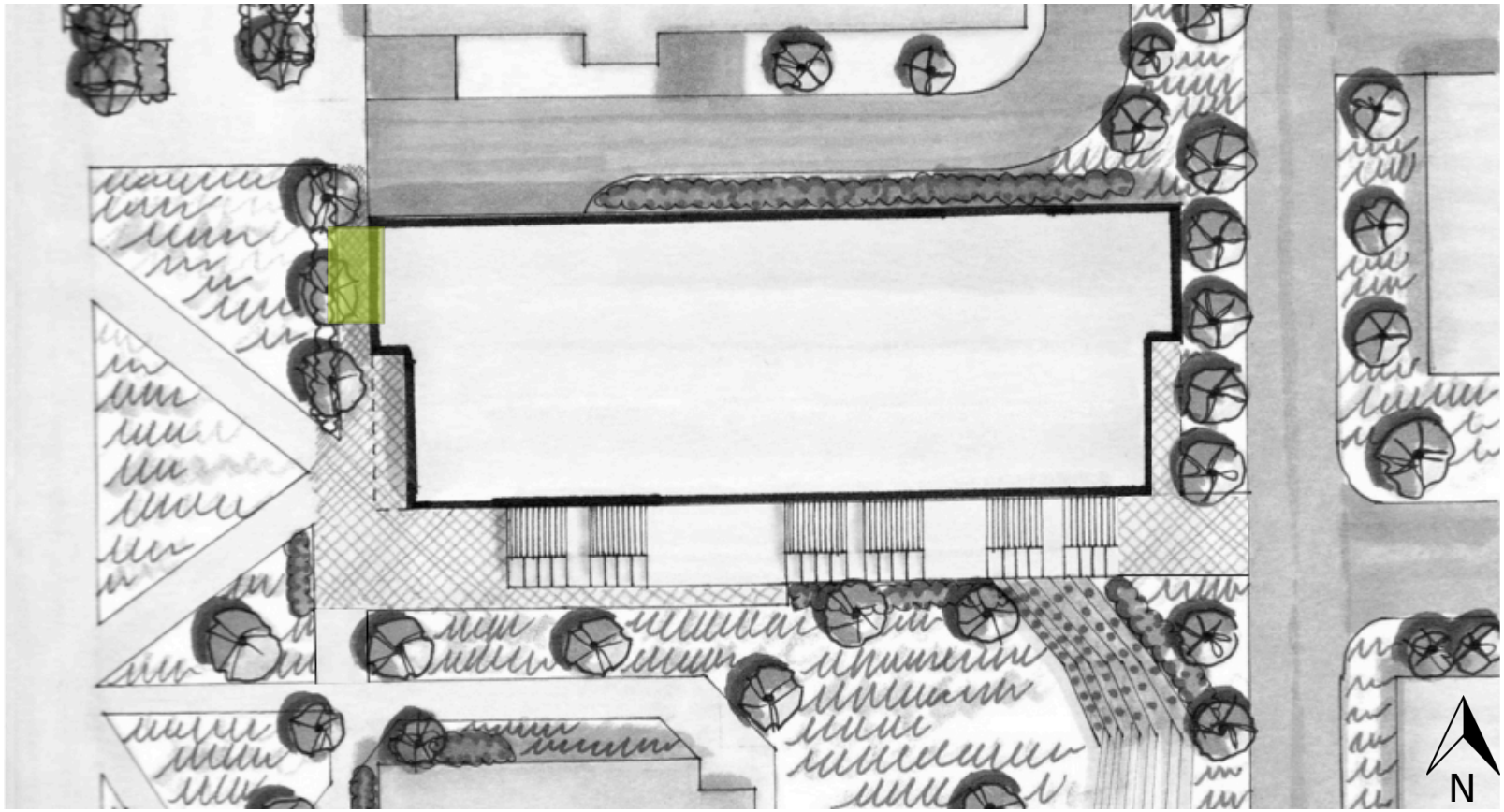
- Bioswale allows for excess storm-water drainage on site

Bicycle Accommodations



- Custom glulam bicycle racks integrate seamlessly into the site

Rainwater Cistern Location



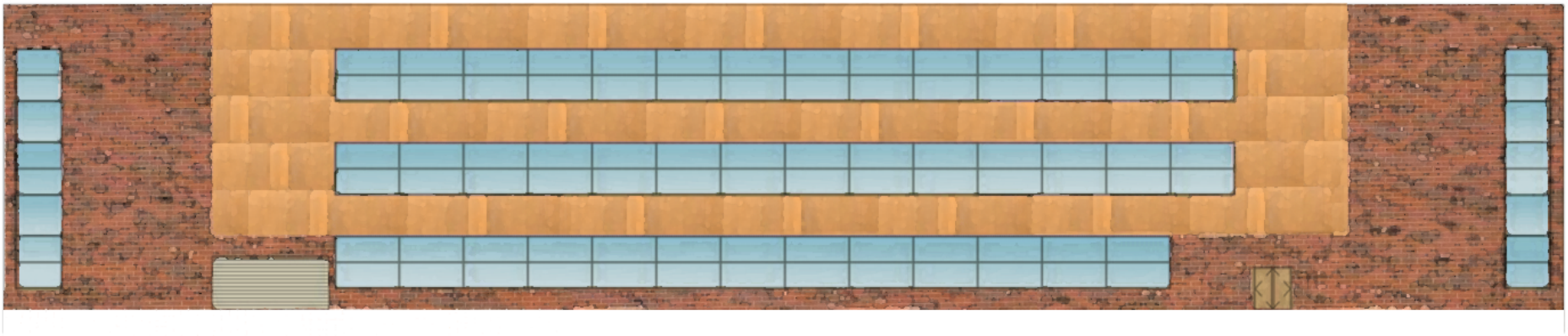
- 3 tanks located near the largest concentration of water fixtures

Building Images

Elevations, Sections, Perspectives

Exterior Perspective

North Elevation



West Elevation

Double Section

Lobby

Lab

Interior Stair – 3rd Floor

THANK YOU!

Works Cited

- http://dingo.care2.com/pictures/greenliving/1089/1088929.medium.jpg
- http://solarious.files.wordpress.com/2008/03/xeriscapeco.jpg
- http://eng.sfe-solar.com/wp-content/uploads/2012/08/CIMG4219.jpg
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- http://www.city-data.com/city/Moscow-Idaho.html
- http://www.chandlerdesignbuild.com/blog/warmboard2.jpg
- http://swegon.akcor.com.tr/publishDocument.php?id=401