Hydro-Logical Architecture for the Urban Watershed (Syllabus)

Winter 2017 University of Oregon ARCH 4/584 Intermediate Architectural Design Studio
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> "If a measure of caring is the degree to which society organizes its thinking and allocates resources to the future, then on this score there is no contest: in Oregon, roads trump water any day." - Rick Basatch, *The Oregon Water Handbook: A Guide to Water Management*

Description

This studio endeavors to expand commitments to sustainability by exploring the architectural ramifications of decentralized, site scale approaches to water infrastructure in urban environments. Focusing on the design of a mixed-use building in Portland, OR, this studio will examine the inseparability of water and energy related concerns (the "**energy-water nexus**"). This effort is predicated upon the conviction that the redesign and retrofitting of water infrastructures in urban environments can help us to achieve zero total global GHG emissions between 2060 and 2080 (while also delivering important human health and ecosystem function benefits).

Learning Outcomes

At the final studio review, participants will demonstrate understanding of:

- Larger contextual circumstances - including the energy-water nexus - that warrant investment in decentralized water supply and treatment in urban environments
- Basics of decentralized, site scale water systems as demonstrated through the development of water schematics and budgets that define systems parameters
- Ways site scale design interventions can support broader scale (urban) ecosystem and hydrological function
- Means of evaluating the performance of a project's water systems in relation to a comparable baseline project
- The tremendous design opportunities associated with a water-centric approach to architecture

Background: Multiple Water Crises Facing Cities in the American West

David Sedlak, author of *Water 4.0*, encourages, "to wean cities from centralized systems and all their associated problems, we might simply have to find a way to make decentralized water supply and treatment practical at higher population densities." The transition to decentralized water systems, fundamental to a 'portfolio' (diversified) approach to water management, will bring about significant energy conservation, human health and environmental quality benefits. Consider for example:

The energy-water nexus
Centralized water systems conjoined with centralized energy infrastructures compound resource inefficiencies and climate vulnerabilities. Simply put, we consume great quantities of energy to move water and great volumes of water to produce energy:

- The California Energy Commission reported in 2005 that water related energy uses

account for 19% of all electrical and 30% of non-power plant natural gas consumption in the State
- About 85 percent of the electricity consumed by modern water and wastewater systems is associated with the need to lift and move water and sewage
- In 2000 generation of electricity ranked first in total water withdrawals in the United States (fresh plus saline), as incredibly large volumes are needed to providing cooling to dissipate rejected heat
- The EPA reports that reducing [municipal] potable water demand by 10 percent could save 300 billion kilowatt-hours of energy each year in the U.S. alone

Over-allocation of supply combined and reduced snowpack
As with many parts of the world, the American West has a water supply problem that is being exacerbated by a growing population, expanding cities, and climate change. We have over-allocated our water sources, the Colorado River being the most celebrated example. In addition, water supply infrastructures are aging and out of step with changing hydrological regimes, for example reduced snowpack in the mountains (historically the great natural storage reservoir) that is causing summer shortages

Threats to water quality: contaminants of emerging concern
Millions of urban dwellers in the US rely on drinking water supplies that contain large quantities of treated effluent from those living upstream. Of particular concern are "contaminants of emerging concern," pharmaceuticals and personal care products for example, that are not regulated through the National Pollution Discharge Elimination System, the regulatory structure set up with the passage of the Clean Water Act in 1972.

Downstream ecological impacts
In addition to problems of supply and quality, we witness detrimental ecological problems associated with "ultra urban pollutants" of non-point load sources in combination with prolonged periods of drought punctuated by increasingly severe storm events. Motor oils, heavy metals and a suite of other toxics that collect on roadways and other urban surfaces during the dry summer months are conveyed in minutes to urban water bodies during the first fall rains with devastating impacts on aquatic life.

Strategies Driving Design Studio Investigations

1. Explore 2030 Palette Synergies
Studio speculations will focus on water as a connective medium between urban buildings and landscapes. Such an emphasis will foster **exploration of synergies of 2030 Palette elements, for instance "vegetative cooling," "water catchment and storage," "constructed wetland," "green roof," and "thermal storage."**

Teams of students will be asked to devise alternative water schematics and water budgets through consideration of questions such as:

- What are the optimal scales for various systems, and to what extent are net zero water buildings the most efficient and most desirable solution?
- What are the architectural implications of storing the amount of water necessary to meet a significant portion – if not all - of overall annual building water demand?
- What efficiencies might be derived in combining functions, for example filtration of water in a matrix of storage or incorporation of wetland roofs that provide habitat

while reducing cooling loads?
- What are a range of design expressions associated with a water-centric approach to architectural design?

2. Create explicit linkages between alternative supply and downstream effects

A focus on water systems at the urban site scale prompts design explorations at the intersection of the Living Building Challenge's two Water 'Petals':

> Net Zero Water Imperative: One hundred percent of occupants' water use must come from captured precipitation or closed-loop water systems that account for downstream ecosystem impacts and that are appropriately purified without the use of chemicals.
>
> Ecological Water Flow: One hundred percent of storm water and building water discharge must be managed on-site to feed the project's internal water demands or released onto adjacent sites for management through acceptable natural time-scale surface flow, groundwater recharge, agricultural use or adjacent building needs.

How might a project collect rainwater during storm events, put that water to work in myriad ways (everyday use by occupants and as thermal mass, seismic dampening, sound attenuation, fire suppression, etc.), recycle it for reuse, and release it in an 'intelligent' manner based on an understanding of local seasonal hydrological needs, for example river or wetland patterns and fluctuations?

3. Utilize the expertise of an interdisciplinary team of consultants

Students groups will work with a team of experts that has been enlisted to serve as consultants and critics. This team includes:

Brent Bucknum, Principal and Environmental Engineer, and Megan Prier, Project Designer, Hyphae Design Laboratory http://www.hyphae.net/journal/

Josh Cerra, Assistant Professor of Landscape Architecture, Cornell University https://landscape.cals.cornell.edu/people/josh

Heather Flint Chatto, Project Manager for the New Zero Initiative, New Buildings Institute http://newbuildings.org/team/heather-flint-chatto/

Kirk Davis, Principal and Regional Director, Glumac Engineers ("engineers for a sustainable future" http://www.glumac.com

Kory Russell, Assistant Professor of Landscape Architecture and Environmental Studies, University of Oregon, whose research focuses on energy and resource recovery from waste streams https://landarch.uoregon.edu/kory-russel

Ellen K. Southard, Hon. AIA Seattle, Site Story and Salmon Safe www.sitestorynw.com www.salmonsafe.org

A January 2017 design charrette, involving the individuals listed above, will precede a "Salmon in the City" public outreach event sponsored by the nonprofit Salmon Safe: https://www.salmonsafe.org

Resources

Primary

Architecture 2030. *2030 Palette: A Resource for the Design of Low-Carbon and Adaptable Built Environments Worldwide* http://2030palette.org

Bastach, Rick (2006). *The Oregon Water Handbook: A Guide to Water and Water Management Revised Edition.* Corvallis, OR: Oregon State University Press. (originally published 1998)

Cascadia Green Building Council (March 2011). *Toward Net Zero Water: Best Management Practices for Decentralized Sourcing and Treatment* (primary authors: Joel Sisolak, Kate Spataro

Goldberg, Landon (2016). *Buildings as Functional Elements of Hydrological Systems: A Resource for Designers Striving for Net-Zero Water* (Independent study report, University of Oregon)

Ingram, L., and Malamud-Roam, F. (2013). *The West Without Water: What Past Floods, Droughts, and Other Climatic Clues Tell Us About Tomorrow.* Berkeley, CA: University of California Press.

Rodale Institute (2013). *Water Purification: Innovative On-site Wastewater Treatment.*

Salmon Safe (2016). *Model Stormwater Management Guidelines for Ultra-Urban Development.*

Sedlak, David (2014). *Water 4.0: The Past, Present, and Future of the World's Most Vital Resource.* New Haven, CT: Yale University Press.

Wodder, Rebecca, Senior Advisor, US Department of Interior (2016). *Reflections on Water Wrongs* http://www.humansandnature.org/reflections-on-water-wrongs

Worster, Donald (1985). *Rivers of Empire: Water, Aridity, and the Growth of the American West.* Oxford, UK: Oxford University Press.

Additional Resources

Beechie, Tim, and Bolton, Susan. 1999. "An Approach to Restoring Salmonid Habitat-Forming Processes in Pacific Northwest Watersheds." *Fisheries* Volume 44, No. 4.

'Brockovich' Carcinogen Found in the Drinking Water of More than 75% of Americans — Is Your Water Toxic? See: https://foodrevolution.org/blog/food-and-health/chromium-6-in-drinking-water

Cerra, Josh, and Brook Muller (2014). "Adaptive Architectures and Dynamic Urban Ecologies," *The Environmental Design Research Association (EDRA) 45 "Building With Change" Conference,* New Orleans.

Dalton, M., Mote, P., and Snover, A. (2013). *Climate Change in the Pacific Northwest: Implications for Our Landscapes, Waters, and Communities.* Washington, D.C.: Island Press.

Dreiseitl, Herbert. 2014. "Thinking Fluid." In *Design in the Terrain of Water* edited by Anuradha Mathur and Dilip Da Cunha. Philadelphia: Applied Research and Design Publishing with the University of Pennsylvania School of Design.

Hester, Randolph. 2006. *Design for Ecological Democracy.* Cambridge, MA: The MIT Press.

Hobbs, R., Higgs, E., & Hall, C. 2013. "Introduction: Why Novel Ecosystems?" In R. Hobbs, E. Higgs, & C. Hall (eds.), *Novel Ecosystems: Intervening in the New Ecological World Order* (ch. 1). West Sussex, UK: John Wiley & Sons.

Muller, Brook (2014). *Ecology and the Architectural Imagination*. London: Routledge Press.

Theen, Andrew, "Audit: Oregon's water watchdog agency is understaffed, overworked, has no plan for future" See: http://www.oregonlive.com/environment/index.ssf/2016/12/audit_oregons_water_watchdog_a.html

Viessman Jr., W., Hammer, M., Perez, E., and Chadik, P. (2015). *Water Supply and Pollution Control, 8th Edition.* Noida, India: Pearson India Education. (originally published 2013).

Vigil, Kenneth M. (2003). *Clean Water: An Introduction to Water Quality and Water Pollution Control.* Corvallis, OR: Oregon State University Press. (originally published 1996)

Week 1 *Monday, January 9*
- Studio Introduction; **Introduce EX01A Opportunistic Research and EX01B Atmospheres**

Wednesday, January 11
- Work Day; Research Team Check In

Friday, January 13
- **Field Trip: Hassolo and Eighth On Site Wastewater System**

Week 2 *Monday, January 16*
- **Martin Luther King Jr. Day – No Class**

Wednesday, January 18
- **Review of EX01A and EX01B; Introduce EX02 Water Schematic**

Friday, January 20
- Work Day

Week 3 *Monday, January 23*
- Work Day

Wednesday, January 25
- **Salmon in the City Public Outreach Event and Associated Design Charrette**

Friday, January 27
- Water Schematic Workshop

Week 4 *Monday, January 30*
- **Review EX02; Introduce Mid-Term Requirements**

Wednesday, February 1
- Work Day

Friday, February 3
- Work Day

Week 5 *Monday, February 6*
- Work Day

Wednesday, February 8
- Work Day

Friday, February 10
- **Mid-Term Review**

Week 6 *Monday, February 13*
- **Introduce EX03 Spatiality of Water**

Wednesday, February 15
- Work Day

Friday, February 17
- **Review Spatiality of Water; Introduce Final Requirements**

Week 7 *Monday, February 20*
- Work Day

Wednesday, February 22
- Work Day: Evaluating Project Performance

Friday, February 24
- Work Day: Evaluating Project Performance

Week 8 *Monday, February 27*
- Work Day

Wednesday, March 1
- **90% Set Pin Up LA 206**

Friday, March 3
- Work Day

Week 9 *Monday, March 6, Wednesday March 8, Friday March 10: Production*

Week 10 **Wednesday, March 15 or Thursday, March 16: Final Review**

Hydro-Logical Architectures for the Urban Watershed (Program)
Winter 2017 ARCH 4/584 Intermediate Level Architectural Design Studio
Brook Muller (bmuller@uoregon.edu) and Friends

The block our site occupies in the inner side of SE Portland is bounded by SE Ankeny and Ash to the north and south and SE 7th and 6th to the east and west. Our project will occupy the southwestern quadrant of the site; it is therefore 100' east to west and 100' feet north to south.

Program Assumptions

Element	#	*Avg. per element*	*Notes*
Site footprint	1	10,000 SF	
Residential units*	51	533 SF	Unit size can vary from team to team as per demographic assumptions
Circulation and egress			
Production space**	?	3,000 SF	Generates revenue, consumes water, is part of bldg. hydro system, requires service access
Service access			
Parking	12		
Water infrastructure	?	?	As per team's schematic

*We have to discuss and make assumptions about the demographics of the population(s) we are serving. We have an affordable housing crisis in the city that is gaining in severity every day.

My assumptions in terms of location and number of units and their sizes are:

- No ground floor residential; this is reserved for production space(s), service access, parking spaces, and site landscape features possibly including wastewater treatment
- 3 stories of construction above ground floor 'platform'
- A mix of unit types. In the version I came up with, there are (3) larger suites at 900SF/suite, (6) smaller suites and 600 SF/suite, and (18) studios at 450/studio…meaning perhaps 46-50 occupants total

**We need to brainstorm options. There is a rich history of production in this area: machine shops, furniture makers, leathersmiths, etc., etc. Although they use water, we may just have enough breweries on our hands!

Hydro-Logical Architectures (Assignments)

Winter 2017 ARCH 4/584 Intermediate Level Architectural Design Studio
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EX01A Opportunistic Research
EX01B Atmospheres

Schedule Summary

Monday, January 9	Introduce EX01A Opportunistic Research and EX01B Atmospheres
Wednesday, January 11	Work day; Brook checks in with teams
Friday, January 13	Field trip to Hassalo on Eighth
Monday, January 16	**Martin Luther King Jr. Day – No Class**
Wednesday, January 18	Review of EX01A and EX01B; introduce EX02

EX01A Opportunistic Research

Assignment Goals

Given the studio emphasis on building water systems synchronized with the surrounding urban landscape, we will begin by researching a select set of issues that will be key to the design process moving forward. Keeping the "water-energy nexus" in mind, the emphasis will be on passive approaches to the collection, conveyance, treatment and storage of water. Each team is to respond to the questions related to their assigned category through a combination of diagrams, rules-of-thumb, case study examples and short narrative statements.

Resources

Please review:

Cascadia Green Building Council (March 2011). *Toward Net Zero Water: Best Management Practices for Decentralized Sourcing and Treatment* (primary authors: Joel Sisolak, Kate Spataro

Goldberg, Landon (2016). *Buildings as Functional Elements of Hydrological Systems: A Resource for Designers Striving for Net-Zero Water* (Independent study report, University of Oregon):

Also highly recommended (particularly with regard to the chemistry of water born pathogens and pollutants and thoughts on the next generation of urban water systems):

Sedlak, David (2014). *Water 4.0: The Past, Present, and Future of the World's Most Vital Resource.* New Haven, CT: Yale University Press.

With respect to non-point source pollutants and impacts on urban waterways see:

Walsh, Christopher, et al. (2005). "The Urban Stream Syndrome: Current Knowledge and the Search for a Cure." *Journal of the North American Benthological Society*.

With respect to emerging waste treatment and recovery systems, see:

Codiga Resource Recovery Center Stanford University https://cee.stanford.edu/labs-centers/codiga-resource-recovery-center-cr2c

EAWAG Swiss Federal Institute of Aquatic Science and Technology http://www.eawag.ch/en/

Project Team Categories

Teams of 2-3 will investigate the following categories.
Note it is critical to recognize the significant overlap in categories as befits the topic of water and healthy hydrological cycles (water is the very medium that encourages us to think synergistically!). To that end there will be need to communicate regularly with members of other teams. Our ultimate design goal of course is to achieve a high level of systems synthesis.

1. Downstream Effects (blue green)

Of concern are the impacts of stormwater run off and non-point load pollutants on urban water bodies – most notably rivers, streams and wetland complexes – and aquatic, amphibious and avian species that rely on healthy urban waters. We are interested in honoring to the extent achievable this Living Building Challenge Petal:

> One hundred percent of storm water and building water discharge must be managed on-site to feed the project's internal water demands or released onto adjacent sites for management through acceptable natural time-scale surface flow, groundwater recharge, agricultural use or adjacent building needs.
>
> (Also: "For a net zero water project, the amount of water entering and leaving a site should ideally reflect the natural hydrology of the site." -Cascadia Green Building Council 2011, 31)

Questions

- What were the likely pre-development ecological and hydrological conditions of the site (east side south of Burnside) and its surroundings? What might the pre-urban journey of water have been?
- How would you assess current conditions? How have ecological and hydrological conditions changed?
- What are the discharges or releases to the environment? What are the downstream effects (what is the receiving environment and/or routes of exposure?). What are the primary environmental problems associated with the way water is moving to, through and off the site?
- How might we begin to think about site and building organization such that there are resulting ecological benefits? What functional attributes might we reintroduce? What should key project goals be from the standpoint of broader ecosystem processes?

2. Collection and Storage (dark blue)

With an overall goal of diversifying our water sources, of concern is the maximization of rainwater catchment and a corresponding goal of meeting as much of the water needs of building occupants in this way. We are interested in honoring to the extent achievable this Living Building Challenge Petal:

> One hundred percent of occupants' water use must come from captured precipitation or closed-loop water systems that account for downstream ecosystem impacts and that are

appropriately purified without the use of chemicals.

Questions

- Assuming a 100'x200' site footprint, what it the total amount of water we might be able to harvest for an average year in Portland?
- Assuming 125 building occupants, what is an estimate of annual water demand in gallons/pp and for the project in its entirety? (please make explicit your assumptions)
- What are the design implications of storing the amount of water necessary to meet a significant portion – if not all - of overall annual building water demand? There are costs implications to be sure (Brent Bucknum of Hyphae Design Laboratory claims: "above 100,000 gallons and storage gets expensive"); what about impacts on structure, spatial organization, other?
- What does a passive approach and minimization of the need to lift water imply for water storage (and conveyance)? (see structural Cook and Fox's One Bryant Park project in New York as an example of localized storage and the formation of water precincts).
- In addition to everyday use, are there other ways we might put stored water to work during its time in the building? How might it be used as thermal mass, fire suppression, seismic dampening, or other and what would the impact be on building design? (see for example GBD Architects OHSU Center for Health and Healing that has a 22,000-gallon cistern below the building that doubles as a source for fire suppression).

Note you will want to work with the Treatment team as many collection and storage strategies combine with filtration (green roofs for example…or passive sand filtration in a matrix of storage). You should also check in with the wastewater team as method of treatment will impact greatly water demand.

3. Treatment: Rainwater and Greywater (grey blue)

With an overall goal of using water supplies as resourcefully as possible and with a necessary commitment to occupant health and safety, of concern are treatment of rainwater and recycling of greywater.

Questions

- What are ways of treating contaminants that have accumulated on the roof between rain events?
- What are the implications of treatment from the standpoint use, energy, cost and health? (Does it warrant treating harvested water to the point where it is drinkable/potable? What are the implications as far as levels of filtration and disinfection necessary to bring this about?)
- What are the design synergies you might be able to achieve by combining filtration with other functions? What for example is the potential of slow sand filtration in a matrix of storage?
- What are appropriate greywater (re)uses and what are the necessary methods of filtration and disinfection necessary to achieve desired water quality levels? Does it warrant treating greywater to the point where it is drinkable/potable? (For a

thorough catalog of filter systems and their performance in removing specific elements from greywater, see Murthy and Murthy: *Greywater Treatment & Reuse: A Technological Review*).

- With an interest in passive approaches and the minimization of the need to lift water, how localized/decentralized might greywater systems be?

4. Wastewater Treatment (yellowish green or grello)

With an overall goal of more localized, passive and environmentally responsive approaches to water and waste systems, of concern are the types of wastewater treatment systems that would be appropriate in a multi-unit, multi-family urban context.

Questions

- What are the range of potential wastewater systems (from simple, passive systems that mimic the biological, chemical and physical processes occurring in natural systems to more energy-intensive, activated technologies)?
- Which systems do you consider the most appropriate for a multi-family project and why?
- What are the spatial implications of choice of system? Which systems do you consider the most appropriate for a constrained urban site and why?
- What are the health and safety risks and perceptions of risks that need to be addressed?
- What are some of the other implications of choice of system? Thinking once more of the “water-energy nexus,” which systems are the most energy intensive?
- What of social concerns and cultural resistance to on-site treatment and what are ways of overcoming these?

5. Ecological Envelopes (dark green)

With overall goal of using water supplies as resourcefully as possible and deriving synergies amongst systems, of concern is the potential of deploying ecological envelopes as part of the overall building organization.

Questions

- What are ecological envelopes? (my definition: matrices of vegetation and water features operating in tandem with facades, roofs and other building elements and systems)
- What benefits might ecological envelopes deliver?
- How might we use available (and when possible) recycled water supplies to help improve the performance of building skin(s)?
- What is the potential and what are the implications (structural, other) of incorporating green and/or wetland roofs that provide cooling while also providing habitat?
- What is the potential and what are the implications of incorporating living walls that provide cooling while also pretreating air? Note given the energy inputs and maintenance implications necessary to keep living walls thriving, Hyphae Design Lab’s Brent Bucknum describes them “ICU’s” and tends to prefer extensive trellises

with vegetation planted at grade. Perhaps that is the route we go as well (?). And yet perhaps if we can get more work out of living walls they would become a more attractive strategy. With the Bertschi Living Building Science Wing in Seattle for example, graywater is used to irrigate the plants of the living wall; the wall in turn provides a first level of filtration. We could also look into Alexander Felson's research at the Urban Ecology and Design Laboratory at Yale University, where living walls are being studied as a substitute for building cooling towers)

- What is the potential of shower towers and related (and largely passive) technologies deployed on the skins of buildings to reduce cooling loads for a temperate climate like Portland's? (see Mick Pearce's Council House 2 project in Melbourne, Australia for an effective use of shower towers)
- What other ecological envelope strategies might be worth exploring?

Form and Content

For each topic, teams are to prepare a 36"W X 24"H (landscape format) board. In the upper right of the board you are asked to include the category title (108 point type), the title of the studio (72), the assignment name and date (72) and the names of the team members (48).

Font choice should be reflective of the category.

All images should be black and white plus one additional color (those written next to the categories above should be the additional colors teams should use: Ecological Envelope team uses dark green, Downstream Effects team uses blue green, etc.).

Diagrams and analytical drawings (sections showing components or subcomponents of water systems for example) are vastly preferred over pretty pictures (photos).

Original drawings are preferred over pirated ones.

Please consider a hierarchical coding or display of information: slogan-like subheadings and diagram titles should be bold and large with more detailed information in smaller type below ("you have piqued my curiosity…and now I want to read more" instead of all content being equal)

When in doubt please include information vs. leaving it out - these boards need to serve as stand alone resources for the other teams!

EX01B Atmospheres

Project Goals
To develop a preliminary (initial response) image/composition that is suggestive of the atmosphere and character you intuit for the urban project we are to design. The focus should be on the/a commons space that might ultimately find its way into your project, perhaps a courtyard or atrium space. You should also provide some indication of the relationship between a public/shared realm and dwelling units (private realm) not to mention the outdoors (what time of day and year is it?)

A section or section perspective is preferred. With respect to media, you are encouraged to use a combination of media types (a collage for instance that combines original and borrowed imagery and a balancing of repetitive elements and unique ones). What is most critical is that there is a compositional intent as well as a spirit or "feel," where the type(s) of media corresponds to the architectural atmosphere you envision. If space age is the architectural feel, you need to deploy space age graphics. If an earthy feel, choice of media will be very different. If aqueous…

Please use an 18" x 18" board (the image need not be so big) and include a title with the appropriate font that captures intended atmospheric effects.

EX02A Water Budget Narrative + Schematics
EX02B 3D Massing Studies+

Wednesday, January 18	Introduce EX02
Friday, January 20	Work Day; conversation with Professor Josh Cerra
Monday, January 23	Work Day
Wednesday, January 25	Design Charrette and associated Salmon in the City Public Outreach Event
Thursday, January 26	Drop in day with Hyphae Design Laboratory
Friday, January 27	Field Trip to Hassalo on Eighth
Monday, January 30	Review EX02; introduce Mid-Term Requirements

EX02A Water Budget Narrative + Schematics
Assignment Goals
Each team will develop a preliminary water budget narrative for the project that considers supplies/sources, uses, means of storage, filtration, recycling, wastewater treatment and re/discharge. In essence this is a bulleted sequence of steps that outlines the journey of water through the project and the quantities involved. Teams will develop (2) corresponding water schematics for the project: one (micro) that offers a preliminary, more detailed depiction of water systems at the building scale, and one (macro) that illustrates the role of the project in the urban watershed.

Teams will have to thoughtfully reconcile goals of an aggressively resourceful use of water with the desire to avoid energy inputs or overly complex and expensive technologies. And as Landon Goldberg encourages in his *Buildings as Functional Elements of Hydrological Systems: A Resource for Designers Striving for Net-Zero Water*, "creative multiple functions for water filtration and storage are strongly encouraged."

Resources

Same as for EX01A. In addition, please review from front to back:

Hyphae Design Lab (2016). *Living Building Challenge Research Document – Coliseum Place*.

Grondzik, Walter, Kwok, Alison, Stein, Benjamin, and Reynolds, John (2015). *Mechanical and Electrical Equipment for Buildings 12th Edition.* Hoboken, NJ: John Wiley & Sons.

Bernard, and Mooij, Harald. *Housing Design Manual* (note this will be extremely helpful in considering massing in relationship to housing type, egress, structure, etc.)

Water Budget Narrative

Please create a bulleted narrative that outlines the steps in the process of harvesting, storage, use, recycling, and treatment. Provide an indication of supply (amount that can be harvested in a typical year) assuming a 100'x100' site and using an educated guess as to the % that is lost in the process of capturing rainwater. Correlate this with a preliminary indication of demand (average per person, total building) based on 50 residents as well as assumptions of use, types of fixtures, whether some activities are shared (clothes washing, other?), the extent to which water is recycled, etc. (note *MEEB* will be a useful resource for baseline water demand).

Also indicate assumptions about treatment of wastewater (type and rough size of the system). Note you can also make a very preliminary best guess estimate of the quantity of water that will consumed by the ground level production space.

Consider how best to represent and communicate this information hierarchically. For example, the primary steps in the system could be indicated with a larger, bolder type, with the details and sub-functions listed in smaller type underneath.

The Cascadia Green Building Council's *Toward Net Zero Water: Best Management Practices for Decentralized Sourcing and Treatment* is a useful source for this exercise in its entirety (please see in particular p. 38). Also: **please include elements in the Architecture 2030 Palette (**http://www.2030palette.org), for example: "green roof," "water catchment and storage," "thermal storage," "vegetative cooling," and "constructed wetland" (maybe even in that order!)**.**

Water Schematics

These (2) schematic views are intended to illustrate the building organizational and contextual implications of the assumptions articulated in the budget narrative.

Micro View

Please develop a diagrammatic section perspective with overlays showing water systems function in relationship to a preliminary spatial organization. The section should be 1/8" = 1'-0" in scale; choose the cut so as to be able to describe relationships between residential units and common space(s), and also extend the ground plane line and describe context (buildings across the street, other). I am guessing this is a N/S cut.

How much is water captured and where is it stored (centralized or decentralized? above ground or below ground or both?). How does the greywater system work (how centralized or decentralized?) and what is it used for? How does treatment work for both harvested rainwater and greywater? What is the nature and location of the wastewater system? What other features do you propose? (living roofs or other ecological envelope elements, other)

This should be developed in close association with the Water Budget Narrative (place them side-by-side).

In addition, please include thumbnails of system components and their spatial implications so as to enrich one's understanding of the direction the project may be headed in.

Macro View
Aerial perspective (see example by Hyphae Design Lab below) or similar that describes the project in relation to a broader urban hydrological condition. This should depict where the flows (supplies) are coming from and how water – and how much water - is moving to and from the site (this is essentially a Sankey diagram that depicts relative flows that is superimposed over the site and that is also indicative of surrounding conditions)

Format
Teams are to prepare a 36"W X 24"H (landscape format) board that includes the water budget narrative, micro and macro views, and thumbnails. On the upper right of the board you are asked to include the category title, the title of the studio, the assignment date and the names of the team members.

EX02B Schematics, 3D Massing Studies+

Assignment Goals
In parallel with the Water Budget Narrative and Schematics investigations, teams are asked to devise a corresponding set of 3D massing studies (models) and associated plan and section diagrams for the site. The water schematics and massing studies need not be in sync in this early phase of the design process. Our ultimate goal of course will be to align these agendas and choreograph water systems with others (spatial, structural, circulatory, etc.).

Please generate a total of 4 massing studies at 1/32" = 1'-0" that drop into a larger site model that encompasses approximately 400' square feet (that includes the block the site is on and portions of adjoining blocks). Please indicate those water systems that have significant spatial presence (storage, wastewater treatment, etc.).

For each 3D study please generate a corresponding plan diagram and section diagram at 1/16" = 1'-0" that describe the organizational basics: unit type (please refer to Leupen and Mooiji's *Housing Design Manual*!), circulation, relationship of private to public and semi-public space, other. Please give each diagram a title.

EX03 Water Integrated Architecture

Landscape Architect Herbert Dreiseitl on designing with water:
"The main challenge, in my view, is *not* a lack of technical know-how, but a lack of integration between technology and design, and a shortage of multi-functional design strategies that can address a variety of conflicting requirements."

Monday, February 13	Post midterm discussion and recap; introduce EX03
Wednesday, February 15	"MEP 101" at Glumac ("engineers for a sustainable future")
Friday, February 17	Work day; teams check in with Hyphae from 3-5
Monday, February 20	Work day
Wednesday, February 22	EX03 pin up; introduce final requirements

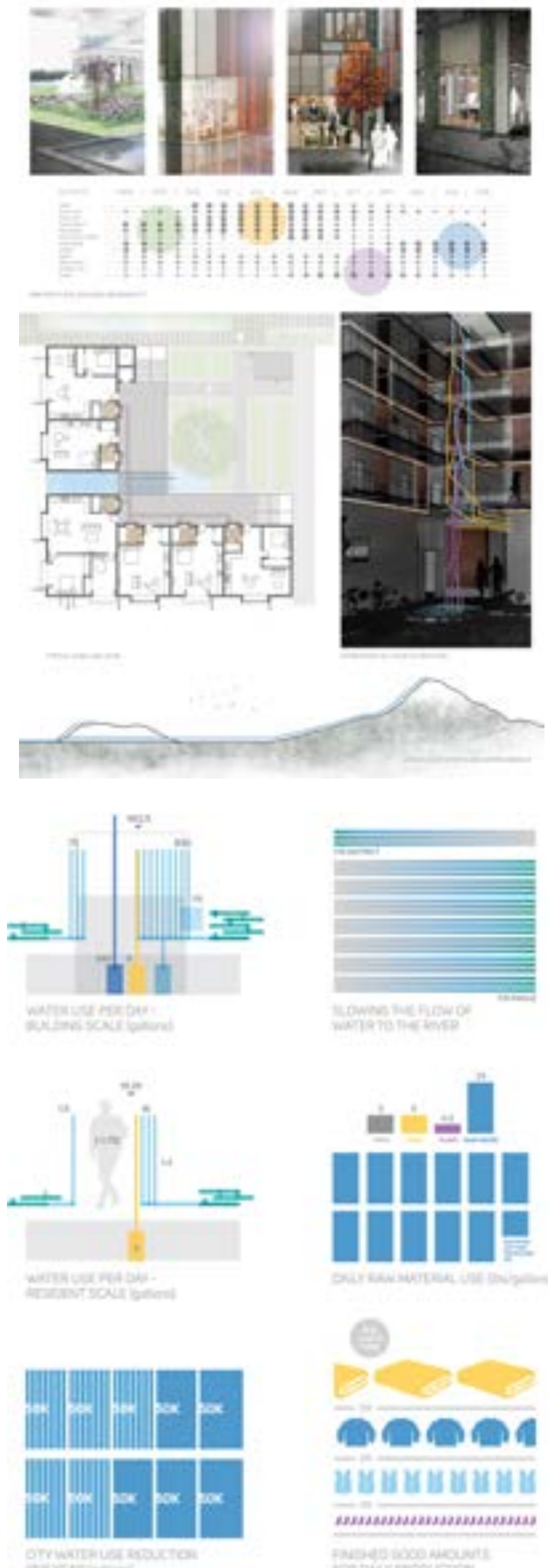
Assignment Goals
Based on thoughtful reflections on the feedback you received at the midterm as well as articulations of individual roles and overall goals moving forward, teams are encouraged to embark on a series of interconnected studies pertaining to the syncing up of architectural intention and building and landscape water systems design.

For **Friday**: you are asked to prepare a 5-6 sentence narrative of project intent and a revised/updated water budget and system diagram. Please assemble this along with the most critical and explanatory midterm drawings as a 1-page 200 dpi (legible) 24"H x 36"w PDF and send to Hyphae at the very beginning of Friday's class (no later than 1:30p). PDF's will serve as the basis of our Skype conversations with Hyphae that begin at 3:00p

For **Monday**: you are asked to prepare a revised building section at 1/8 = 1'-0" as well as south and west elevation drawings of your project set into context (also at 1/8 = 1'-0"). These should provide clear indications of the relationship between the project, the street, and neighboring buildings. You are also asked to develop a plan diagram at 1/32" = 1'-0" that shows the relationship of the project and site to the block in its entirety (that indicates anticipated build out) as well as to neighboring buildings and streets (if the project is connected to the green loop, please show the loop…this should not be just a green fill but should indicate diagrammatic design intent). If you have parking at grade, please indicate. Lastly, please develop ¼" = 1'-0" plan and section drawings of a key element/joint/feature/space in the scheme.

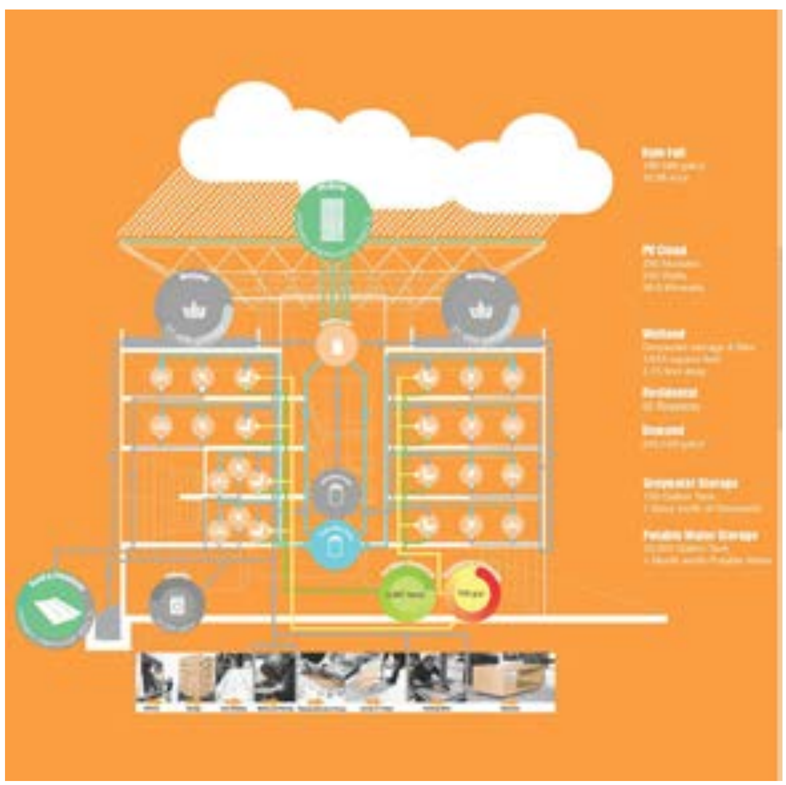
For **Wednesday**: In addition to updates to what is listed above (based on feedback on Minday), please prepare for pin up and review a ¼" = 1'-0" fragment model study of a key element/joint/feature/space in the scheme. Note "fragment" means the model begins to indicate its relationship to the larger architectural setting. Choice of material(s) is key and should correspond to the atmosphere of the architecture as it is unfolding. A recommended rough area or 'spatial frame' for the model is 20'x20'x20' (although it may be far preferable to not build a model in a cubic frame but one that is long and skinny or some other well considered shape)

Rachel Hall, Gretchen Leary, Sumana Raghavendra: *Residential units sit above ground level wool dying and spinning spaces. Borrowing from a age-old process, urine collected from composting toilets in the residential spaces above is treated and used to fix dye in the wool.*



Rachel Hall, Gretchen Leary, Sumana Raghavendra

Hydro-Logical Architecture for the Urban Watershed
Examples of Student Work



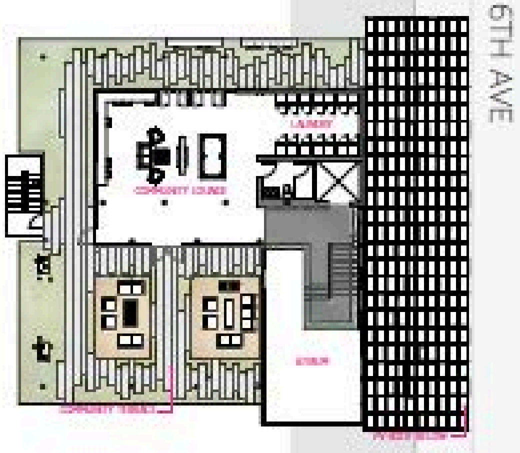
Josh Mehrer, Andrew Milner, Bill Sandstrom: *Residential units sit above a production space dedicated to making prefabricated, biocompatible concrete furnishings. Greywater from residential units is pumped up the south façade to rooftop wetlands where it is diluted with rainwater that is collected by PV "cloud" (diluted to the point where it is of acceptable quality for use in the production space)*

Joel Bohlmeyer, Amy Santimauro, Katelynn Smith: *Residential units sit above a production space dedicated to making bamboo flooring, cabinetry and other products. Non-invasive bamboo is planted underneath a nearby highway to improve air quality. The bamboo is harvested for use in the production space. Greywater from residential units is treated by wetland planters that descend in tandem with an atrium stairway. It is then directed to a second-floor pond above the production space that serves as thermal mass and an acoustic barrier. A bamboo forest that grows in the pond is interspersed by wellness spaces (for massage, yoga and fitness). Bamboo sawdust from production space is used to heat residential units and for composting toilets of residential units above.*

7 Design For Wellness

The design of this building is intended to flip the negative connotation of production to something that improves and benefits the lives of the people in and around the building. The 2nd level wellness space and bamboo garden benefit from improved air quality. In addition it creating a nexus of health and wellness services including a gym, spa, Juice bar and yoga studio. The emphasis on renewable energy sources, natural ventilation and sustainable materials create a healthy living environment for residents.

Level 2 - Wellness Sanctuary



Level 6

Levels 3-5

Ground Level

5 Design For Economy

Using the constraints of the industrial sanctuary in Portland's central eastside as a way to create a relationship between production and ecology allowed the building and its program to beneficially serve the district and local economy. The production space uses the locally grown bamboo to produce goods within the woodshop that are sold through a small business which supports the local economy. Additionally, the 2nd level wellness space brings in health and wellness businesses to the community and promotes a healthy lifestyle.

WATER BUDGET

USE

BATHROOM SINK: 1.02
KITCHEN SINK: 7.5
SHOWER: 11.8
DRINKING WATER: 1.75
LAUNDRY: 1.56

TOTAL: 23.63
[Gallons/Person/Day]

23.63 x 50 x 365

431,248
[Gallons/yr]

HARVESTNG

x .85

(7246SF x 42" x .85)

258,682
[Gallons/yr]

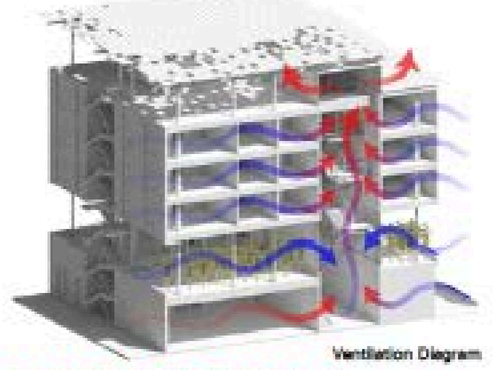
258,682 x 4 Buildings
1,034,728
[Gallons/yr]

STORAGE

1,182 x 90days= 106,380
106,380 x 4 Buildings

-425,520 Gallon Tank

Cistern= 56,887ft³



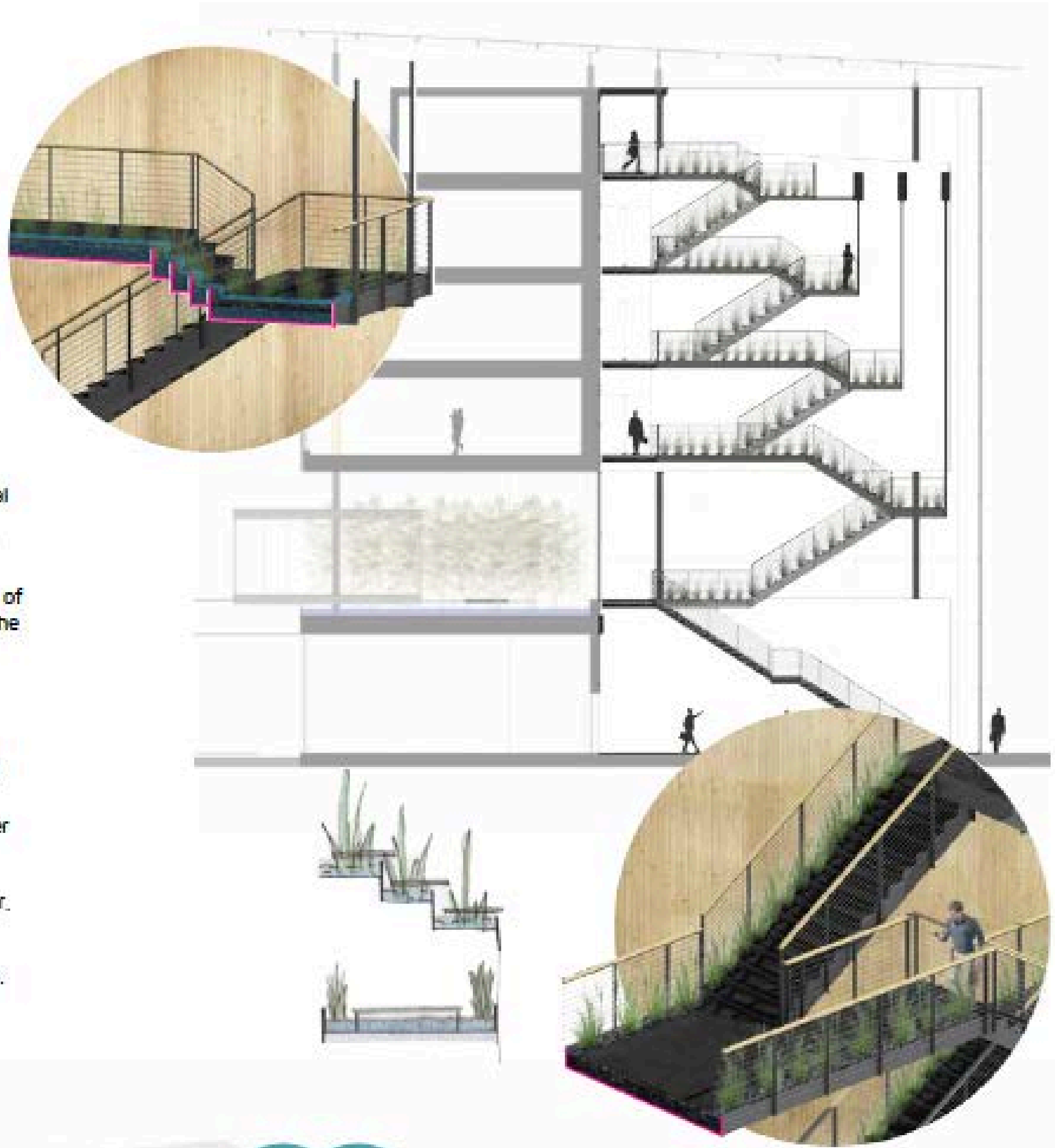
Ventilation Diagram

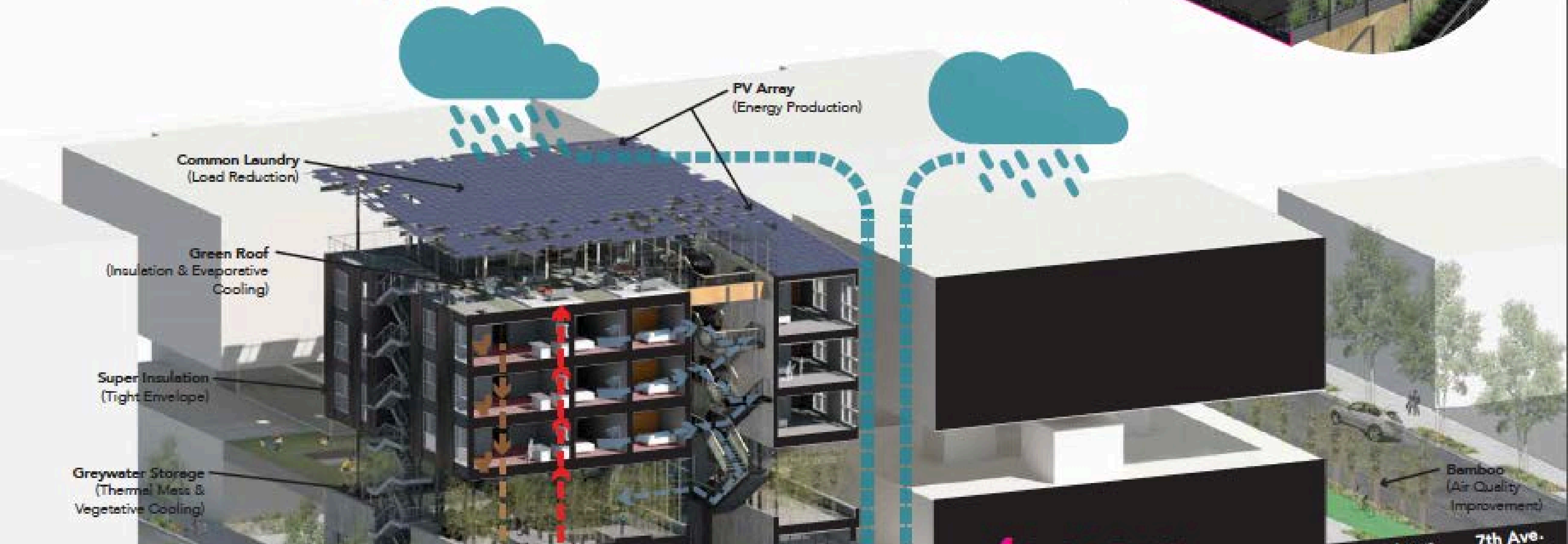
9 Design For Change

Resiliency is a key characteristic of the building design. A net positive energy rating paired with a decentralized water system ensures safety and comfort in case of natural disaster. Furthermore, the design of passive systems, such as stack ventilation, and stepped-filtration lower the building's reliance on mechanical systems for operation. Lastly, while the prescribed use of the second level is that of a bamboo garden, the project can be easily modified for the production of food in response to a crisis.

10 Design For Discovery

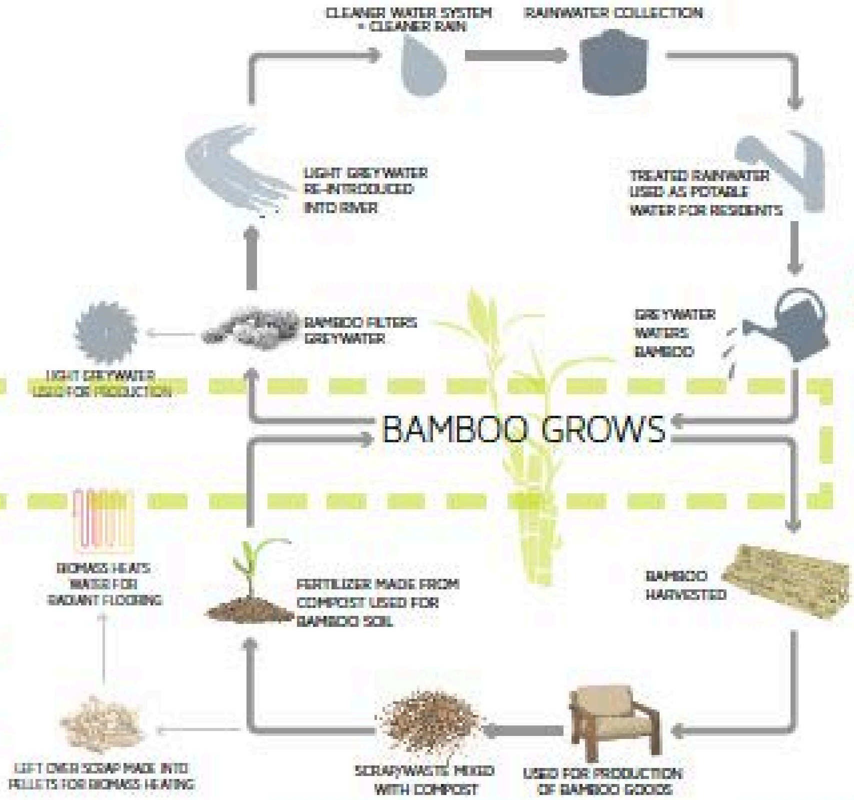
Transparency and highlighting of systems plays an integral role in the design. Housed within a six-story atrium, the staircase is a series of cascading planters, designed to filter residents' greywater while providing lush greenery that serves as a source of wayfinding throughout the building. Metal grates protect residents from contact with greywater, but affords them connection and understanding of the system's environmental benefits. At the second level, water transfers to an open-air bamboo garden for storage. The garden is open to the public and encourages users to meander its series of elevated walkways and decks to explore public services.





4 Design For Water

Utilization of composting toilets, shared laundry services, and efficient fixtures aid in a 70% water usage reduction. 60% of the building's needs are offset through the use of on-site rainwater catchment and treatment. Greywater is UV treated and step-filtered through an interior, planter staircase before arriving at the second level for storage in the bamboo garden. After filtering, the light-greywater is utilized in the building's radiant floor system and in the ground level woodshop's water jet. Once filtered, excess greywater is released into a series of bioswales to be step filtered before returning to the Willamette River.



BAMBOO BUDGET

USE
12,000 Board ft/yr
(Estimated)

NEED
12,000/1594=7.75 Acres/yr
(Usable Board ft/acre)
7.75 x 5yr (Harvesting Rate)
38.75 Acres

3 Design For Ecology

The regenerative looped system of resources creates an ecological system that benefits the environment, economy, and people. The bamboo is harvested for production and wastes from that process are then used to feed the bamboo growth. The building's light-greywater is utilized by the bamboo planters located throughout the building. The excess light-greywater that isn't used in the production shop is released and filtered through a series of bioswales finally arriving at the river. This slow release of filtered greywater and storm runoff help the river's ecosystems to thrive in clean water and improves the health of the overall water system.

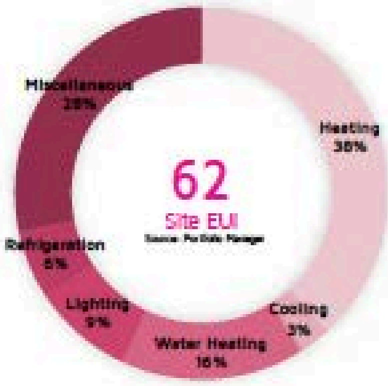
ENERGY GENERATED

8598 SF /17.9 = 480 Solar panels
480 x 345 watts
165.6 kW

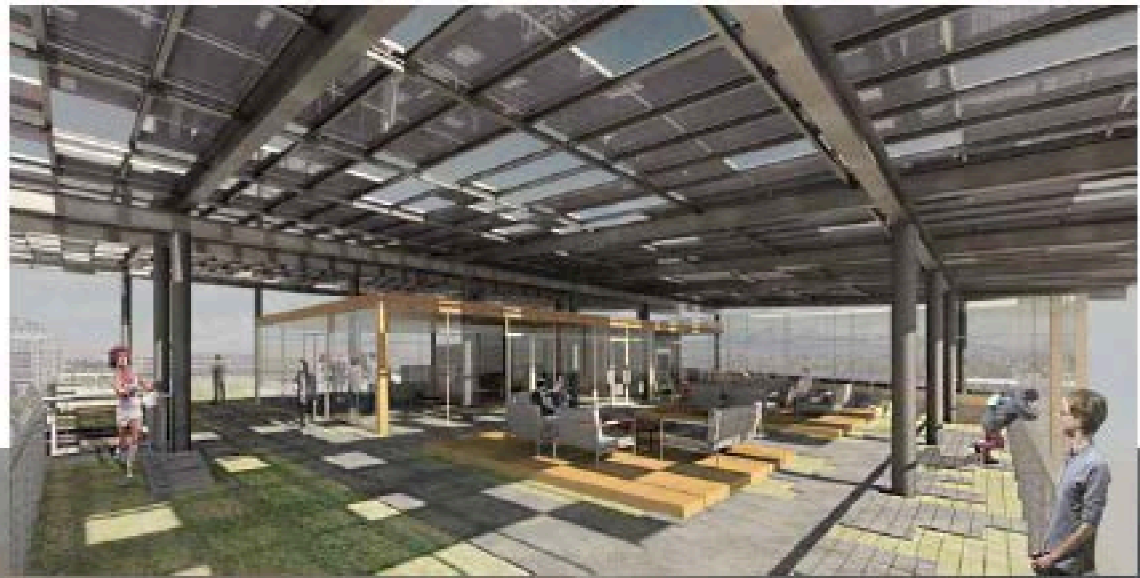
PVWatts Inputs:

DC System Size	165.6 kW
Module Type	Premium
Array Type	Fixed Roof
Array Tilt	3°
Array Azimuth	180°
System Losses	14%

PVWatts Output:
(173,478/ 8,598) x 3.41
68.8 kBtu/SF/Yr



109%
of energy produced on site



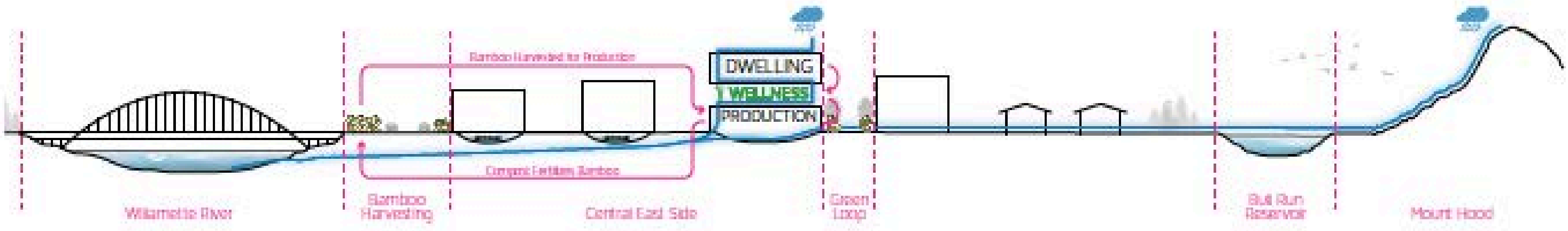
6 Design For Energy

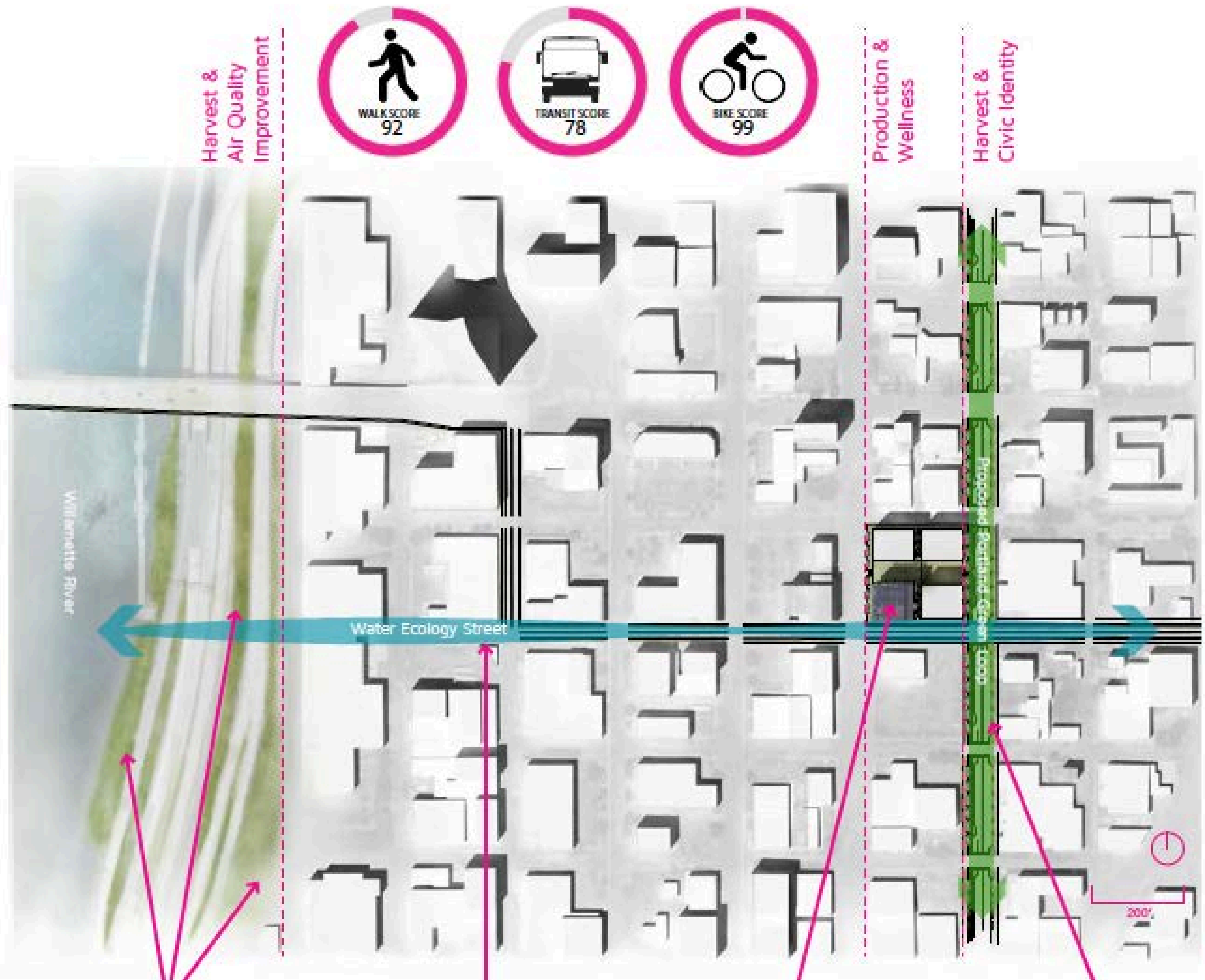
This building employs both active and passive strategies to maximize the use of energy. Orienting the building on an east/west axis maximizes daylighting and direct solar gain. The use of natural ventilation through operable windows and stack effect that pulls air up through the atrium reduce the energy load. The solar array generates power for the building on site and is net positive creating 109% of the energy that the building needs to operate. Furthermore, the building uses wood waste from production to power a biomass system, heating water for radiant floors in the residences.

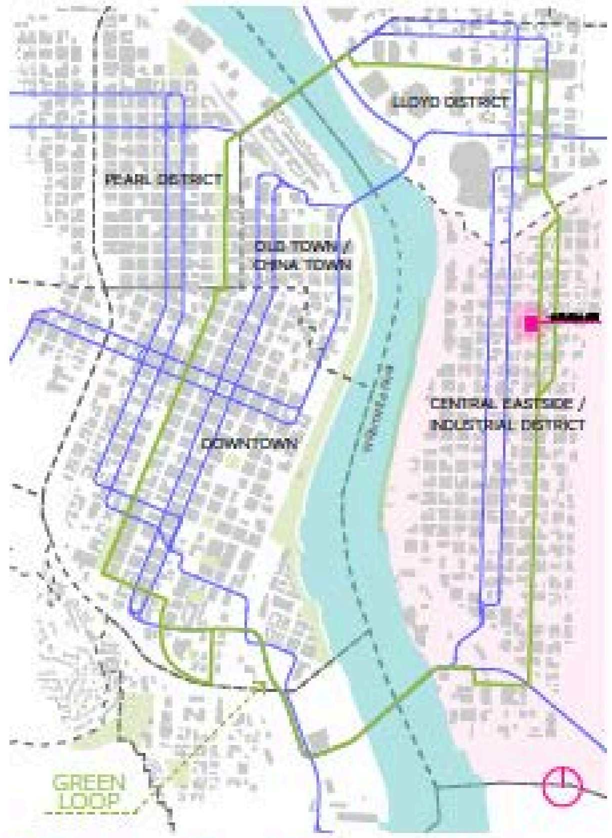
FABRICATING WELLNESS

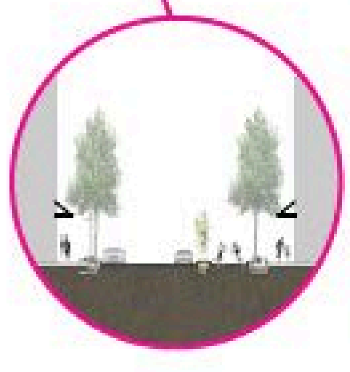
1 Design For Integration

The goal of the project was to place a building's water system at the forefront of design and rethink how water can be integrated into a community. At a large scale the building could become a catalyst to spur change within the city. At a smaller scale by creating a prototype that contains a regenerative looped system of resources and thinking about how to integrate water and energy into a building changes how buildings are designed and built.









2 Design For Community

This design seeks to foster the well being of the district and the people living there. Bamboo serves as the catalyst to improving the existing community and the creation of a wellness node within the industrial sanctuary. The building is located adjacent to the proposed portland green loop and only a few blocks from the riverfront. The integration of bamboo along the green loop, in the building, and along the highway creates a cycle of growth and production that improves the air and water quality in the surrounding area, as well as, enhancing the aesthetics through biophilia in the city.

8 Design For Resources

In order to reduce its environmental impact, the building is designed to utilize a podium-style, cross-laminated timber system. A CLT system holds less embodied energy than other conventional metal and concrete systems, and wood can be harvested and milled locally. Furthermore, the CLT system is thermally superior to most other systems, and is fabricated off-site, increasing precision and efficiency, thus reducing job site waste. The building is cladded in locally harvested, charred, larch wood. This ensures the longevity of the material, while maintaining a low embodied energy. Furthermore, the charred exterior filters external water as it moves down the building.