

**Digital Mass**

A Transparent E-Waste Infrastructure for Seattle

Amelia M Simoncelli

A thesis

submitted in partial fulfillment of the  
requirements for the degree of

Master of Architecture

University of Washington

2014

Committee:

Gundula Proksch

Anne Marie Borys

Rick Mohler

Program Authorized to Offer Degree:

Architecture

© Copyright 2014  
Amelia M Simoncelli

University of Washington

**Abstract**

**Digital Mass**

A Transparent E-Waste Infrastructure for Seattle

Amelia M Simoncelli

Chairs of the Supervisory Committee:

Gundula Proksch

Anne Marie Borys

Architecture

The production of consumer electronics has accelerated over the last several decades due to rapidly advancing technologies. As a result, new electronics become obsolete almost the moment they leave the shelf, creating a mounting global problem: electronic waste or e-waste. The local networks for handling obsolete electronics are young, often ad hoc and hidden from public view. Investigating the configuration of the current system in Seattle, this thesis proposes the creation of a more visible e-waste infrastructure. As a hub of technological innovation, Seattle is a fitting place for creating awareness of the mounting e-waste problem, positioning technology's end-of-life infrastructure adjacent to where its life begins.

### Acknowledgments

To my instructors for all of their counsel and inspiration.

To my family and friends for all of their love and support.

To my dad for his enduring guidance.

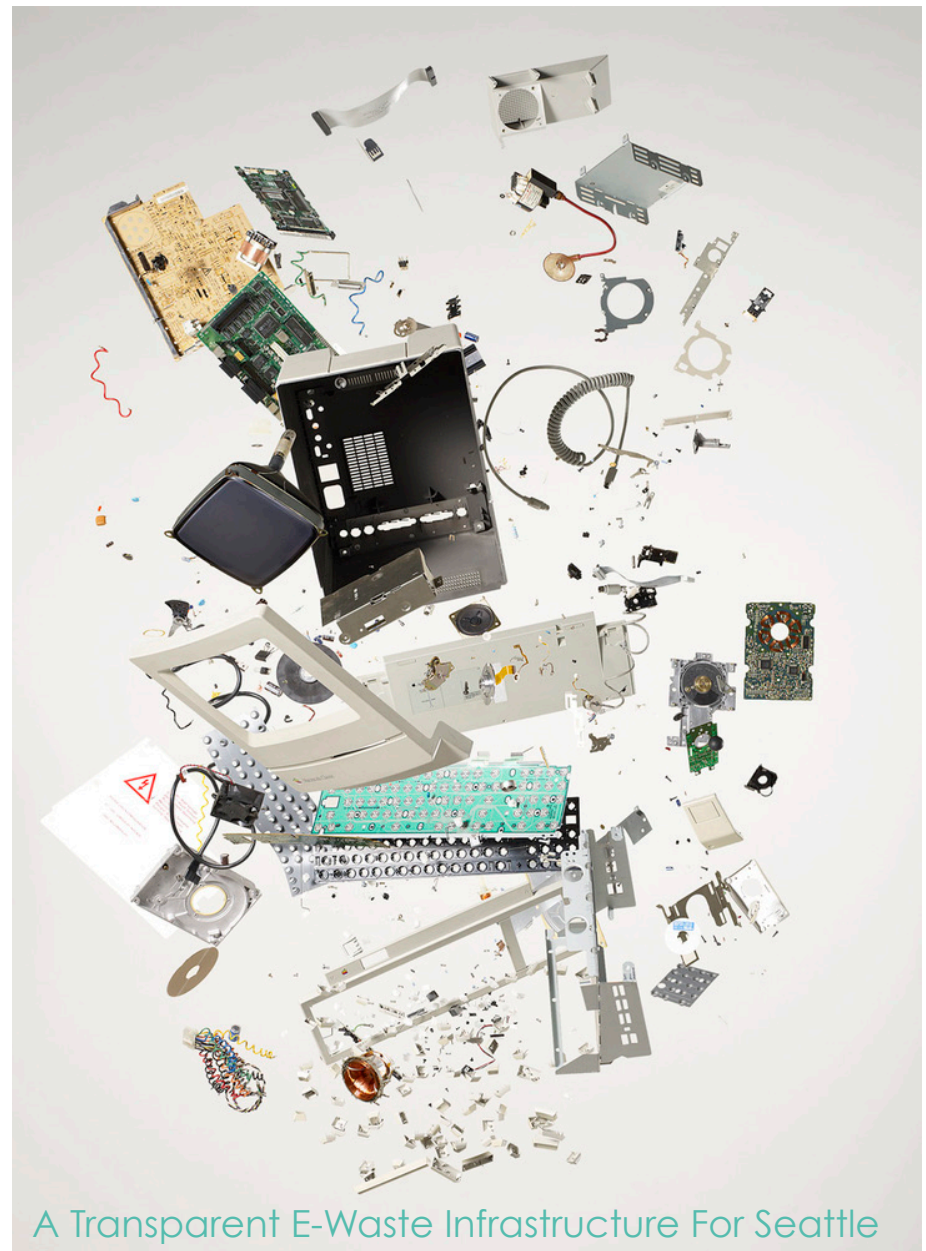


Figure 0.1 "Old Macintosh" & "Apart Macintosh" by Todd Mclellan from the photographic series *Things Come Apart*

# Contents

|   |   |           |
|---|---|-----------|
|   | <b>Introduction .....</b>                 | <b>4</b>  |
| 1 | <b>Electronic Waste .....</b>             | <b>5</b>  |
|   | A Toxic Global Network .....              | 6         |
| 2 | <b>Sublime Accumulation .....</b>         | <b>9</b>  |
|   | E-Waste as Technological Sublime .....    | 11        |
|   | Sublime Landscape of E-waste .....        | 12        |
| 3 | <b>Local E-Waste Infrastructure .....</b> | <b>17</b> |
|   | The Nodes in the Seattle Network .....    | 19        |
|   | The Collector and The Processor .....     | 21        |
| 4 | <b>Making the Process Visible .....</b>   | <b>26</b> |
|   | Site: Finding a Middle ground .....       | 32        |
|   | The Existing Condition .....              | 38        |
| 5 | <b>The Architectural Design .....</b>     | <b>45</b> |
|   | <br>List of Figures .....                 | <br>62    |
|   | <br>Bibliography .....                    | <br>65    |

## Introduction

While the mark of the Industrial Age was the proliferation of mass-manufactured goods, the legacy of the Digital Age will be its proliferation of information. However the Digital Age has also succeeded in increasing the pace of mass-production while building in an ever-increasing complexity to its products. The production of consumer electronics has accelerated over the last several decades due to rapidly advancing technologies. As a result, new electronics become obsolete almost the moment they leave the shelf, creating a mounting global problem: electronic waste or e-waste.

The end-of-life management of electronics is an expensive and hazardous process because of their complex and toxic material composition. It became common practice to export e-waste to developing countries, where unprotected workers perform unregulated, harmful recycling processes. As the dangers of this global problem have been exposed, local governments have begun to introduce regulations in order to create more formalized e-waste infrastructures.

Still in their infancy, these local networks for handling obsolete electronics are often ad hoc and hidden from public view. Investigating the configuration of the current system in Seattle, this thesis proposes the creation of a more visible and accessible e-waste infrastructure. As a hub of technological innovation, Seattle is a fitting place for creating awareness of the mounting e-waste problem, positioning technology's end-of-life infrastructure adjacent to where its life begins.

With the goal of increasing visibility and accessibility, this architectural intervention proposes a facility that functions both as a collector and demanufacturer, creating moments where the consumer can confront and engage with technological obsolescence. By repositioning and reprogramming e-waste facilities, the infrastructure as a whole becomes more integrated into the urban fabric.

## 1 Electronic Waste

Over the last several decades, the increasing popularity of consumer electronics has drastically transformed how we obtain information, entertain ourselves, and most importantly how we communicate with one another. The growth in demand for consumer electronics coupled with the rapid changes in technology has generated vast quantities of electronic equipment that include computers, hard-copy devices, keyboards, TVs and mobile devices. In 2010, the EPA estimated that 440 million new electronic products were sold in the United States, which is a significant increase compared to the 325 million products sold in 2000 and an even more dramatic one compared to the 75 million in 1990.<sup>1</sup> This high volume demand is only accelerated by the short lifespan built into these common electronic devices. The average lifespan of a laptop computer for example is two to three years and of a mobile device is one and a half to two and a half years.<sup>2</sup> The increasing demand combined with this planned obsolescence is creating a mounting global epidemic, which has manifested itself in a new waste stream, electronic waste.

1 EPA Report 530-R-11-002, p.9

2 EPA Report 530-R-07-004b, p. 22

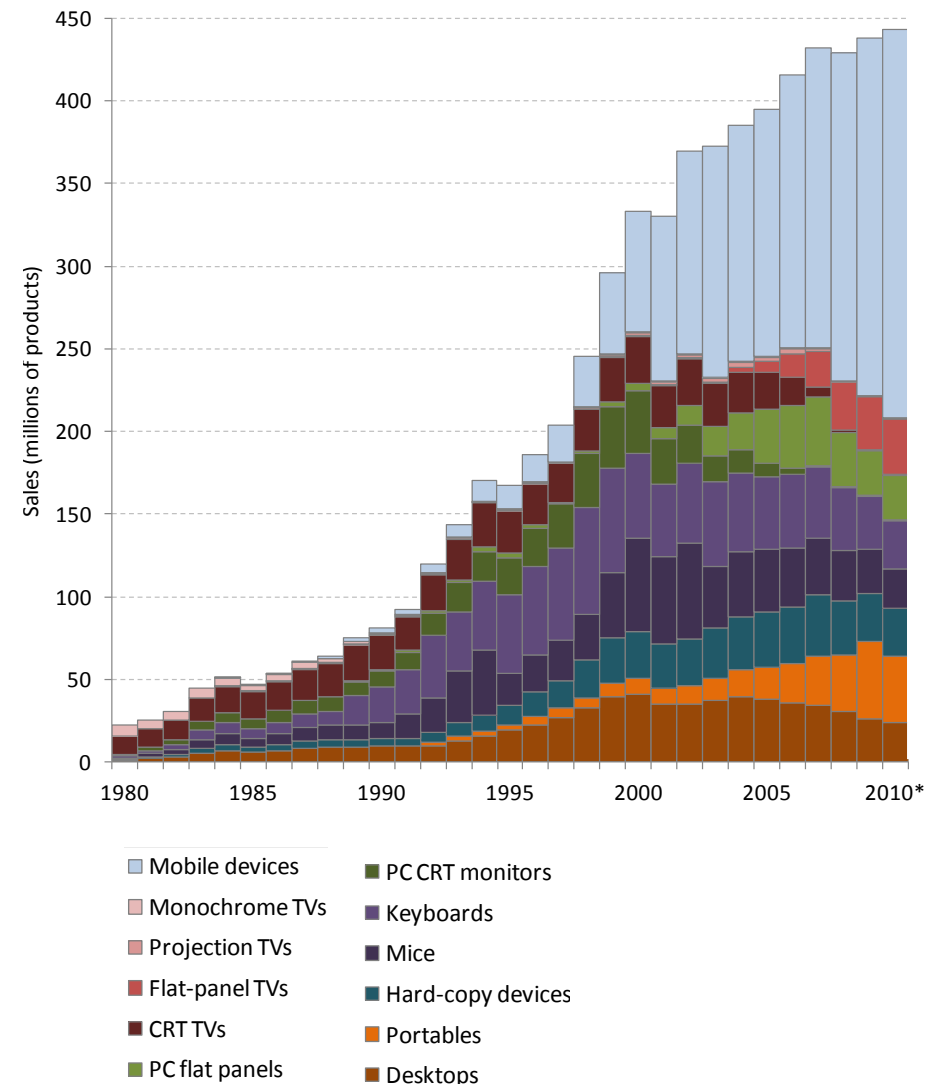


Figure 1.1 Escalating Sales of Electronics, EPA Report 2011

## A Toxic Global Network

E-waste is the fastest growing waste stream in many countries, expected to grow 8% a year, indefinitely.<sup>3</sup> In 2009, 2.37 million electronic devices were ready for end-of-life management in the United States, a 122% increase from 1999.<sup>4</sup> While this rapid increase in quantity is a concern on its own, it is the contents of this waste stream that is causing the most harm. Electronics are composed of diverse materials, some valuable, like gold and others extremely toxic, like mercury, lead, and arsenic. These technological devices are built of toxic substances, which are screwed, glued and soldered together, making them difficult to disassemble. Unfortunately, the manufacturers who design and produce these electronics spend far more capital on selling new products than dealing with the obsolete ones.

End-of-life management of electronics is an extremely hazardous process due to the complexities of their composition. Improper disposal can have severe environmental impacts because of the complex material composition of these items. In 2009, the EPA reported that 75% of the electronic waste generated in the United States ended up in landfills or incinerators, where harmful toxins could be released into the air

or leached into groundwater.<sup>5</sup> While laws are being passed to stop e-waste from entering landfills, it is still legal in many states to simply throw away electronics.

The remaining 25% of e-waste was presumably recycled. However a staggering percentage of what is reported to be recycled is often exported to developing countries to be processed in an unregulated environment with no protection for the workers. The Basel Action Network (BAN), an international agency fighting global toxic trade, estimated that 70 to 80% of e-waste that is given to recyclers is in fact exported to developing countries.<sup>6</sup> By exporting these products, recyclers are externalizing the true costs of managing this waste and burdening developing countries with a toxic legacy. Jim Puckett, a leading investigative journalist at BAN, writes that when “done properly, e-waste recyclers pay the higher costs of treating leaded glass, mercury lamps or toxic phosphors to minimize exposures to the environment and workers. When costs are internalized in this way, the costs often outweigh the material value of the metals.”<sup>7</sup> While recycling can be profitable, the complex material composition in electronics can drive up the cost of safe recycling, greatly reducing profits. In order to recycle

3 E-Stewards Website  
4 EPA Report 530-R-11-002, p.22

5 EPA Report 530-R-11-002, p.22  
6 E-Stewards Website  
7 Puckett, 3



Figure 1.2 "Waste Sorting" in Edward Burtynsky's Photo Project *China Recycling*, 2004

responsibly, expensive technology and intensive manual labor is necessary to safely process e-waste.

Separating toxic from non-toxic materials in a way to allow recovery of valuable materials is an extremely difficult part of electronic recycling. Documenting the dangerous practices of informal recycling in Guangdong, China, BAN reports that open air burning and riverside acid baths were common separation techniques. The toxic materials that are considered worthless are discarded into unlined and unmonitored dumps, exposing workers handling them to hazardous conditions.

Ultimately, the e-waste stream is both valuable and hazardous, a complex juxtaposition that is not being dealt with in a thoughtful manner. The mounting global problem of e-waste is extremely complex, with many parties involved in creating it. The consumer feeds the system by discarding functioning electronics, perpetuating planned obsolescence. The manufacturer produces complex products, with little thought to end-of-life management. The recycler exports the cost of processing discarded items to developing countries, creating hazardous environmental conditions. The regulatory governance of this process at all stages is inadequate or non-existent.

While intervention is needed throughout the supply and demand chain of consumer electronics, this thesis will address

the organization and accessibility of the architecture of e-waste facilities. The architecture of the proposed public utility will seek to address the physical and psychological distance that exists between the consumer and waste infrastructure. In order to understand this disassociation, the next chapter will explore the cultural perceptions of the waste landscape.

## 2 Sublime Accumulations

The passion caused by the great and sublime in nature, when those causes operate most powerfully, is Astonishment; and astonishment is that state of the soul, in which all its motions are suspended, with some degree of Horror.<sup>8</sup> *Edmund Burke, 1757*

The literary concept of the Sublime reemerged during the Industrial Revolution in England, in the mid-18<sup>th</sup> century. As philosophers contemplated the new relationship between machine and nature, the mass production of goods commenced. The concept of the Sublime has been considered by numerous philosophers, theorists, and artists in the past two centuries, from Edmund Burke to Immanuel Kant to Victor Hugo. The term can generally be defined as an aesthetic quality of greatness that goes beyond temporal understanding, which is incompatible with the human scale. This thesis makes use of the term to identify the psychological distancing of the human from the object, landscape or technology that is considered Sublime. This philosophical concept is used to define the current cultural perceptions of e-waste at two distinct scales. The first

permutation applies to the material scale, in this case, the obsolete electronic. The second view addresses the broader scale of the e-waste landscape.

The sublime was defined as an aesthetic quality found in nature that inspired awe through its great scale or dramatic appearance. These landscapes elicited “astonishment” and even “horror” in the viewer, slowing time and motion to provoke an almost spiritual moment. In 1757, Edmund Burke expounded upon this notion in seeking to distinguish the sublime from the beautiful. In his view the sublime evoked a similar transcendent response but went beyond the beautiful to be vast, dark, silent even terrifying.<sup>9</sup> The Grand Canyon has often been cited as an example of a natural sublime landscape. Difficult to fathom, in its massive scale and terrifying in its infinite depth, this natural site evokes an immeasurable grandeur that frames the insignificance of humans. Burke observes that, “Infinity has a tendency to fill the mind with that sort of delightful horror, which is the most genuine effect and truest test of the sublime.”<sup>10</sup> The idea that the sublime could be both attractive and repulsive is central to this thesis.

8 Burke, Part 2, Sect 1

9 Burke, Part 2, Sect 8: Vastness

10 Burke, Part 2, Sect 9: Infinity



Figure 2.1 A Sublime Landscape - "Wanderer Above the Sea of Fog" by Caspar David Friedrich 1818

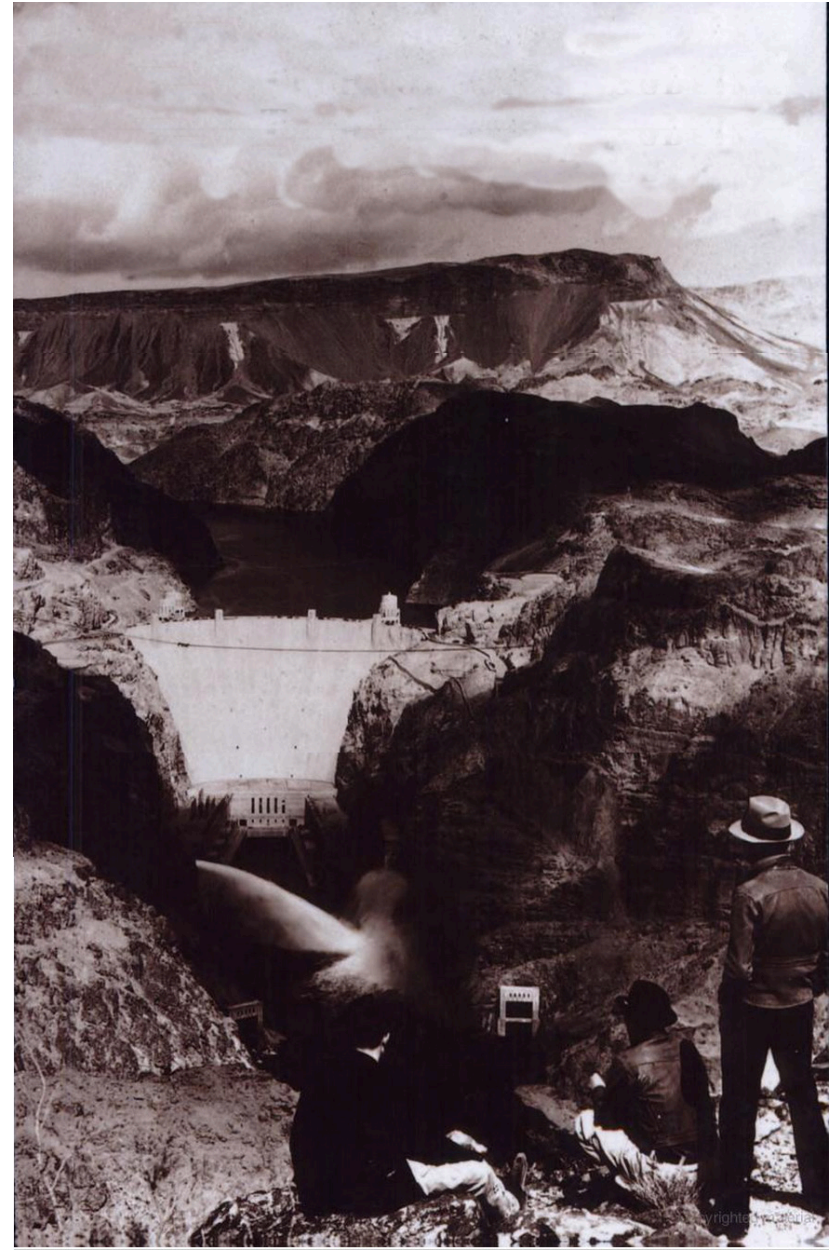


Figure 2.2 Man-Made Sublime Landscape: The Hoover Dam from David Nye's "American Technological Sublime"

## E-waste as Technological Sublime

The transference of the aesthetic qualities of the sublime from nature to technology has strengthened this sense of its ability to evoke a kind of fear, as well as veneration. David Nye, a 20<sup>th</sup> century American scholar, looked beyond natural landscapes, and applied the notion of the sublime to technology in America. The Technological Sublime is the idea that technological mastery, from bridges to railroads to man-made objects from factories, can be experienced as Sublime. In his book *American Technological Sublime*, Nye asserts that America was bound together through a shared reverence for technology, taking the place of a common religion or political stance.

The collective belief in the technological sublime propelled it forward, increasing the rate of creation and production, without much thought to its byproducts. Sabine LeBel, author of *Wasting the Future*, writes, "Because of the mutable nature of the technological sublime as it gets applied to emerging technologies, it helps to conceal or distort the complex effects of new technologies and in particular those externalities, or side effects, such as pollution or waste."<sup>11</sup> Due to the rapid advancement of technology, it is impossible to

reflect upon its impact with any real perspective. David Nye also points out that America's faith in technology blinds us to the shortcomings of its products. Americans "saw the construction of a railroad or a bridge as a triumph of *art* and they assumed that such advances could not fail to increase human happiness."<sup>12</sup> This faith allowed them to ignore the future consequences of industrialization and new technologies.

Nye concludes his book by proposing that the Consumer Sublime is the twisted consequence of the accelerating pace of a sublime technology as it becomes obsolete and is replaced with a new form. "Each form of the Technological Sublime becomes a natural (ordinary) part of the world and ceases to amaze, though the capacity and the desire for amazement persists."<sup>13</sup> The Consumer Sublime is the insatiable craving for new devices, which new technology brings us and then makes ordinary, worthless and obsolete.

James Fitch writes about the concept of technological obsolescence, framing it as a truly modern problem. "Current concepts of technological obsolescence, of objects becoming useless *economically* without reference to any residual *physical* utility, are modern invention... Rapid and uncontrolled

---

11 LeBel, 7

---

12 Nye, 46  
13 Nye, 284

technological evolution has become so institutionalized that change is now seen as synonymous with progress."<sup>14</sup> Fitch illuminates the key contradiction embedded in technological obsolescence, in that the technology is not in fact obsolete, still functioning physically as it was meant to. Rather it is the aesthetic or economic value that creates the illusion of progress that casts it as obsolete.

Electronic waste is the physical manifestation of technological obsolescence, the ideal product of the Consumer Sublime. Sabine LeBel writes, "The complex discursive actions of the technological sublime... work to further distract us from our growing waste problems. What is actually next for most technologies is the trash."<sup>15</sup> The relentless perception of technology as Sublime creates and perpetuates the rapid growth of the electronic waste stream.

---

14 Fitch, 30  
15 LeBel 9

## The Sublime Landscapes of E-waste

Waste is an undeniable global problem that has impacted the essential composition of the earth, having amassed, layered, and piled up to form man-made landscapes. Landfills have taken on the properties of natural formations that have peaks and canyons and can be excavated and mined. In their grandeur and scale, the landscapes of waste capture the horrifying power of the Sublime, evoking revulsion as evidence of disease and epidemic and of a polluted and resource-depleted planet. In her essay *Waste and the Sublime Landscape*, Amanda Boetzkes discusses the contradiction of waste landscapes representing "simultaneous progress and regress, technological advancement and degeneration."<sup>16</sup> In particular she writes about e-waste landscapes as full of products that "emblemize the information age, but whose use-value turns so quickly that they are thrown away at a frighteningly accelerated pace. It is as though products are made in anticipation of their own status as artifact."<sup>17</sup> She discusses the representation of the sublime in contemporary art that capitalizes on the power of these landscapes of waste, harnessing their beauty and terror.

The distinct character of these often hidden landscapes of e-waste has been documented by contemporary

---

16 Boetzkes, 28  
17 Boetzkes, 27

photographers, like Edward Burtynsky and Chris Jordan. The work of Edward Burtynsky captures the intersection between man-made and natural landscapes, exploring the transformation of nature through industrial processes. His photographs of quarries, refineries, mines, and recycling yards depict “places that are outside of our normal experience, yet we partake of their output on a daily basis.”<sup>18</sup> These waste landscapes are unintentional man-made creations, products of the modern world that every consumer partakes in. Burtynsky writes that his photographs “search for a dialogue between attraction and repulsion, seduction and fear.” In making visible these manufactured sites in a way that conveys a sense of splendor and destruction, he evokes the Sublime contradiction of being both awed and horrified. In addition to documenting the waste landscapes of industry, he examines that of electronic waste. In “Circuit Boards #9,” from the series “China Recycling,” electronic debris blankets the bare earth, encroaching on a tree line. By merging the natural and man-made terrain, he captures the Sublime allure of these toxic yet stunning landscapes that become imitations of nature.

A self-described environmental artist, Chris Jordan is known for his large-scale works depicting waste as the product of mass consumption. In his photographic series ‘Intolerable Beauty,’ of 2003-2005, Jordan examines consumption by turning

his camera on American waste landscapes, in shipping ports and industrial yards across the country. His photographs frame mass consumption as powerful and awe-inspiring landscapes “where the accumulated detritus of our consumption is exposed to view like eroded layers in the Grand Canyon.”<sup>19</sup>

Figure 2.3 “Circuit Boards” in Edward Burtynsky's Photo Project *China Recycling*, 2004



In the photograph "Sawdust #2, Seattle 2005," the landscape appears to be a mountain range with crests and peaks, but it is in fact the amassed byproduct of mining a forest. Without a human scale and cropping out the surrounding context, these landscapes take on a vast and isolating quality. Jordan writes, "I am appalled by these scenes, and yet also drawn into them with awe and fascination. The immense scale of our consumption can appear desolate, macabre, oddly comical and ironic, and even darkly beautiful; for me its consistent feature is a staggering complexity."<sup>20</sup> The photographer, thus, frames these landscapes as sublime, utilizing their aesthetic power to both attract and repulse the viewer.

---

20 Jordan Website, Intolerable Beauty

In much of the "Intolerable Beauty" series, Jordan turns his camera on the electronic waste epidemic in images that depict a mass accumulation of electronic devices. In the photograph "Cell Phones #2, Atlanta 2005," he captures a swirling black ocean of cell phones that can be read almost as a homogenous surface - lacking scale or context. Jordan has noted of these images, "As you walk up close, you can see that the collective is only made up of lots and lots of individuals. There is no bad consumer over there somewhere who needs to be educated. There is no public out there who needs to change. It's each one of us."<sup>21</sup> Not only do these photographs frame e-waste landscapes as Sublime, but they also unpack the root of the waste problem as mass consumption.

---

21 Jordan Website, Intolerable Beauty



Figure 2.4 Chris Jordan's "Sawdust #2, Seattle 2005"



Figure 2.5 Chris Jordan's "Cellphones #2"

The reading of e-waste as sublime elucidates its current situation at an infrastructural and material scale. Creating a psychological distance between the human and the problem, the landscapes are framed as vast incomprehensible seas, which are man-made but ironically lack a human scale. On a material level, reading electronic devices as sublime perpetuates and accelerates technological obsolescence, which condemns a functioning electronic to premature disposal. By challenging the notion of technological obsolescence, e-waste can be repositioned at a local level to allow consumers to confront its Sublime connotations.

### 3 Local E-Waste Infrastructure

The global e-waste network is undeniably defective, lacking transparency and proper oversight. As the flaws in the system have been exposed, national and local governments have begun to introduce regulations that seek to create local infrastructures. With the development of local programs to combat the global trade of e-waste, a new infrastructure that confronts its sublime perception can be integrated into the consumer's daily life.

As a relatively new civic network, e-waste infrastructure has just begun to solidify its presence at a local level. For example, *E-cycle Washington*, the program that regulates Washington State's e-waste infrastructure, has only been in existence since 2009. Most systems throughout the country are relatively new and fragmented, making it difficult to formulate a comparison between them. The authors of the essay, *Evaluating the Performance of Recycling Systems* note that,

there has been a proliferation of systems for managing the recycling of e-waste across the world in the past decade. Although these systems have generic similarities, none of them are identical. Furthermore, nearly all of the systems are relatively new, which makes them essentially experiments in effective e-waste management.<sup>22</sup>

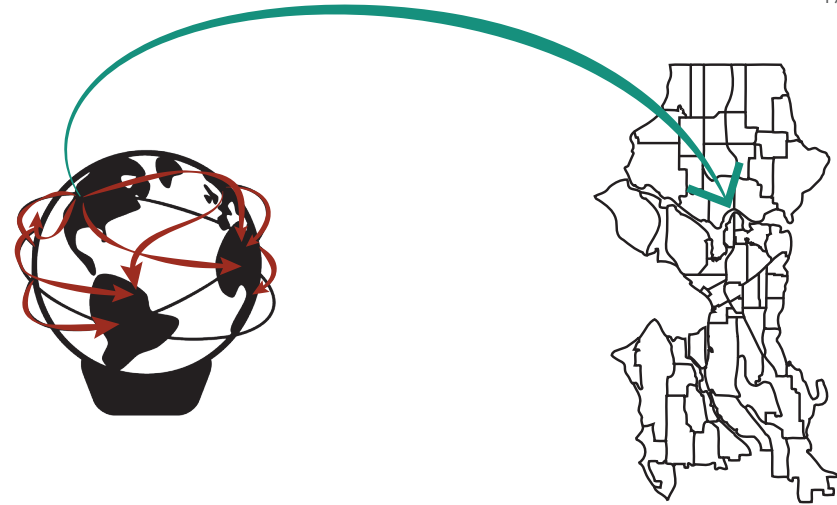


Figure 3.1 from global trade to local infrastructure

This essay proceeds to analyze the existing networks in nine European and North American cities by comparing the performance metrics and systems architecture.

Generally the e-waste networks are made up of collectors and processors, but vary greatly in their product scope, collection methods, and the mode of processing. The greatest variability in the system was in their method of collection. Switzerland for example requires electronic retailers to provide free collection for the consumer, while Sweden utilizes non-retail municipal facilities, like transfer stations. One of the noteworthy findings was that the number of collectors correlates to the

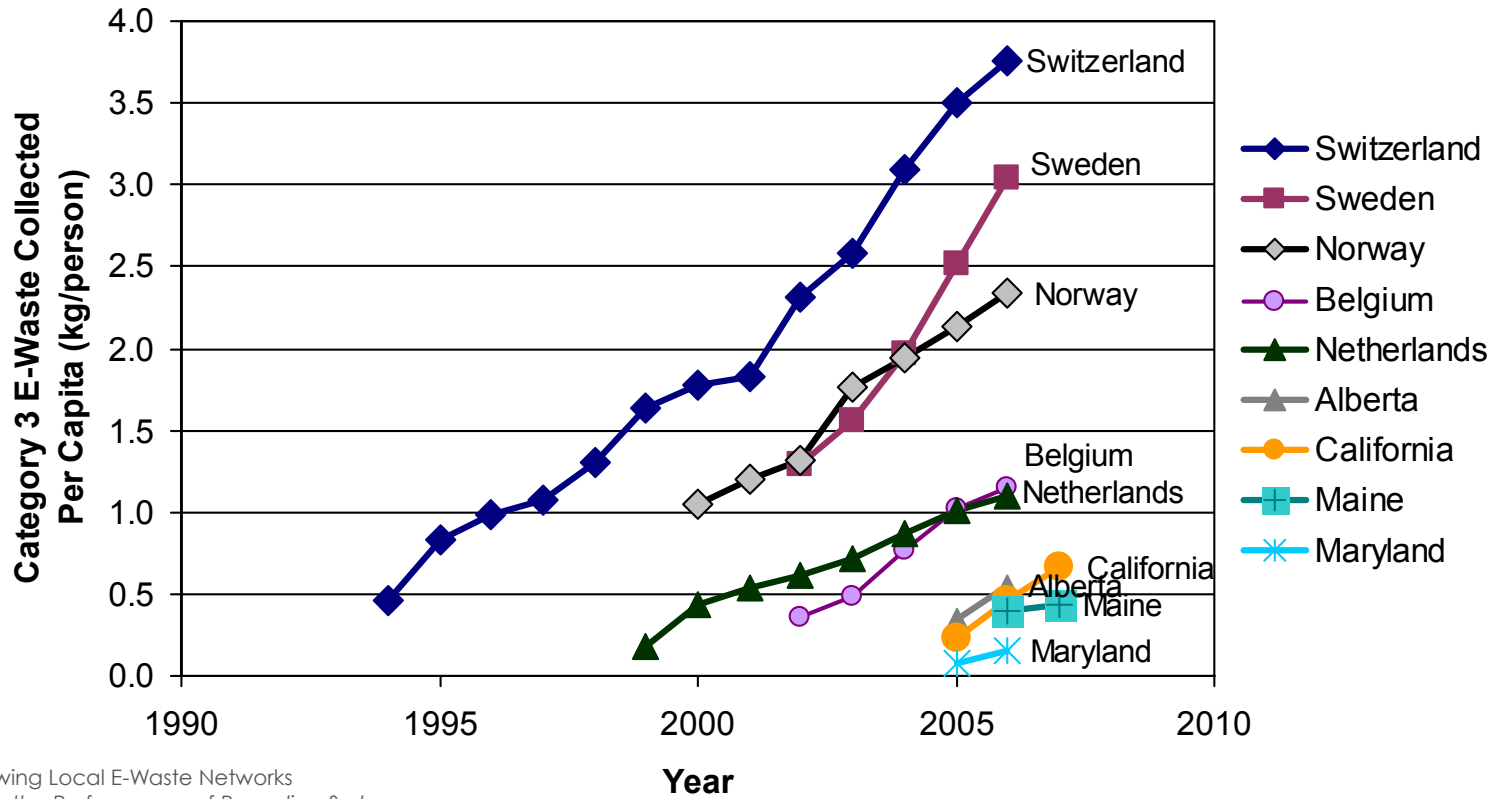


Figure 3.2 Growing Local E-Waste Networks  
 from *Evaluating the Performance of Recycling Systems*

amount of e-waste collected. “The number of collection points is an important architectural choice, as it determines the level of convenience provided to individuals eligible for using the e-waste system. Research has shown that the more convenient recycling is, the more likely people are to recycle.”<sup>23</sup> The primary reason the European systems perform better than those

in North American is the greater number of collections points per capita, making the connection between the collectors and the consumer a paramount factor. The following section will analyze the configuration of the existing e-waste infrastructure in Seattle, investigating the overall structure and facilities of this network.

23 Gregory, 125

## The Nodes in the Seattle Network

In 2007 Washington State Legislature approved the statewide Electronic Products Recycling Program (WAC 173-900), which ordered the formation of an infrastructure to handle the responsible collection, transportation, and recycling of

electronic products. “The legislature determined that such a system must encourage the design of electronic products that are less toxic and more recyclable and that the responsibility for this system must be shared among all stakeholders, with

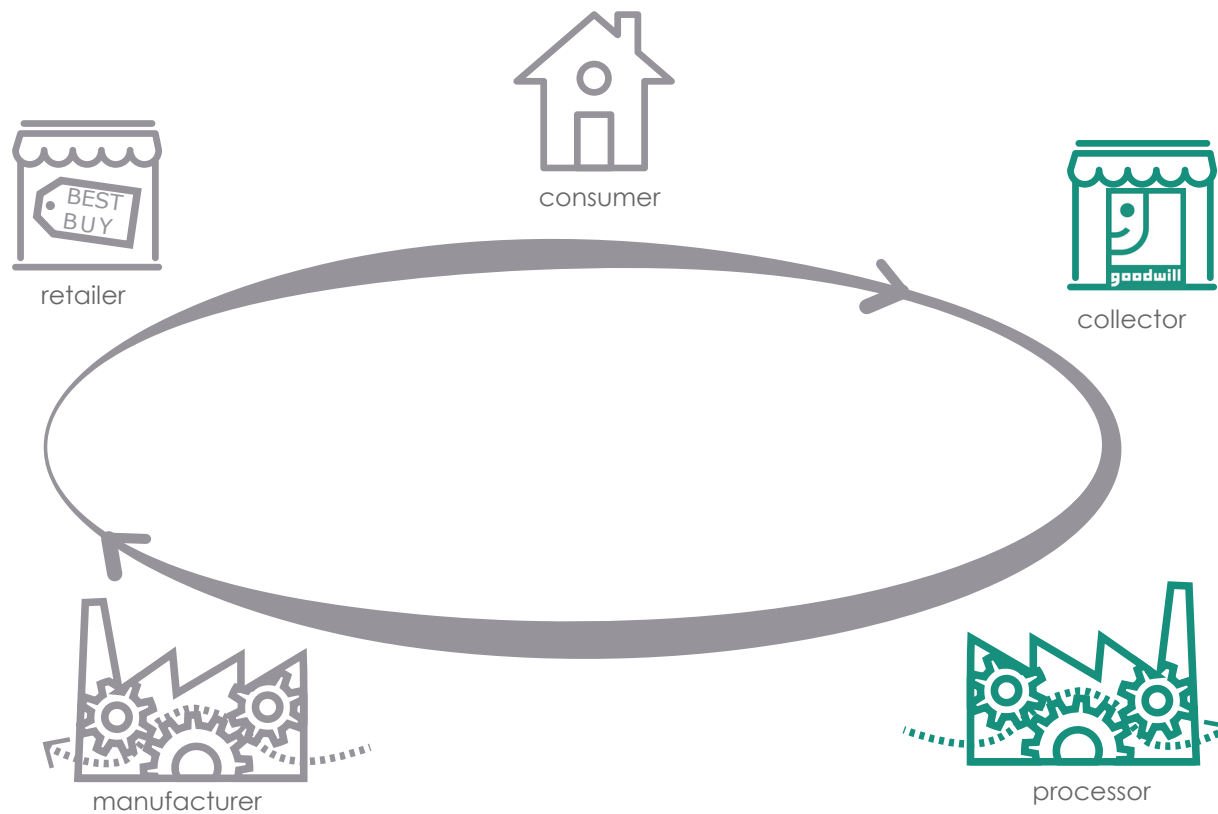


Figure 3.3 the players in local e-waste networks

manufacturers financing the collection, transportation, and recycling system."<sup>24</sup> Rejecting funding proposals that would have required the consumer to pay a processing fee or a new sales tax, manufacturers were ordered to internalize the cost of the end-of-life management, held accountable for the electronics they produce.

In 2009, in compliance with WAC 173-900, Washington State's Department of Ecology introduced E-Cycle Washington, a program that provides free recycling of computers, laptops, tablets, monitors, TVs, and e-readers for households, small businesses, school districts, small governments and charities. The program is essentially a collaboration between public and private sector: electronics manufacturers, the Washington State Department of Ecology, local governments, retailers of electronics, and non-profit organizations. However the primary oversight entity is the Washington Materials Management and Financing Authority (WMMFA) that handles the business and registration of all of the parties involved. Most importantly, this oversight guarantees that the processors, transporters and collectors, who are registered in the program, will not export toxic materials to developing countries. E-Cycle Washington provides lists of registered participants to make the system accessible and transparent.

Since the start of the program in 2009, manufacturers have put over 47 million dollars into the system so there has been no cost to local governments or consumers. Over 200 million pounds of electronics have been collected, with 29% being refurbished and reused.<sup>25</sup> However the law does not require recyclers to participate and loopholes exist for manufacturers to opt out of the program. For the purpose of clarity, the businesses registered in the E-Cycle Washington Program will be the facilities under analysis in the following section.

With funding from the manufacturers and managerial oversight from the WMMFA, the E-Cycle Washington infrastructure is simply composed of the Processors and the Collectors. Siegfried Kreibe, author of *Current and New Electronic Waste Recycling Technology*, notes that after funding has been established, "it is necessary to decide how the work will be divided between collection points, dismantlers, mechanical recyclers, smelting plants and other companies."<sup>26</sup> The E-cycle Washington program divides the work by clearly defining and separating each individual function. To receive the manufacturer's funding, each entity must become a registered participant in the program by meeting a set of standards regarding the specific service provided.

---

24 WAC 173-900, p.2

---

25 E-Cycle Washington Website  
26 Kreibe, 26

## The Collector and the Processor

A prerequisite for any type of recycling is the collection of the obsolete electronics. E-Cycle Washington defines the Collector as the gatherer of covered electronics from households, small business, school districts, small governments and charities. The Collector is the connection point to the public, where visibility and accessibility are desirable. They are also the primary point of recovering working electronics for resale. According to the WMMFA's 2013 Annual Report, 94% of the electronics recovered for reuse and resale were handled at the collection sites, never reaching a processor.

Collection can be arranged in a variety of ways. In the temporary model, take-back events or pre-arranged pick-ups are provided by charities or manufacturers. More common is the permanent model, in which the collector is affiliated with a facility or storefront that acts as a drop-off and receiving location. It is rare for these facilities to be exclusively e-waste collection centers. More often than not, they piggyback on other existing businesses and infrastructural nodes, and become a secondary function of the business. The diversity of collection sites depends on how the overall system is being financed. For example, in the SWICO network in Switzerland, a very high performing infrastructure, consumers are responsible for

paying a "take-back" fee to the electronics retailer, who in-turn becomes the primary Collector of the e-waste. In contrast the funding structure in Washington places the responsibility on the manufacturer, ultimately creating a more distributed collection system.

In Washington, any business that has the space and work force to perform the tasks of receiving, sorting and packaging electronics can become a registered e-waste Collector. However non-profit thrift stores and waste transfer stations make up the vast majority of collection sites in the state. These facilities assumed the role because they were already receiving e-waste, creating an easy and inexpensive way to integrate e-waste collection into an existing system.

While thrift shops were an obvious fit for the role of the Collector, they may not be the most effective solution. These stores handle diverse, high volume inventories, primarily clothes, household items, and furniture. Donations are constantly flowing in, requiring fast paced sorting, cleaning and processing, which does not leave time for proper testing and packaging of the electronics. The sheer volume and variety of merchandise that thrift stores handle ultimately conceals its connection to the e-waste network. Often times, the public is not even aware that thrift stores resell electronics now, let alone accept e-waste.

The utilization of the waste transfer station as a Collector



Figure 3.4 Thrift Store Electronic Selection



Figure 3.5 Transfer Station as E-Waste Collector

is problematic for similar reasons. Like the thrift store, the transfer station was a natural fit for collecting e-waste, as gathering municipal solid waste is its primary purpose. This new waste stream could be integrated into the existing infrastructure relatively inexpensively because the public already recognized the transfer station as a place to take obsolete items. However, unlike the thrift store, this system usually does not provide upfront testing that enables immediate resale of items in secondary markets, which is crucial in the fast paced world of electronics. Therefore using the transfer station as a Collector for e-waste eliminates the ability to combat premature obsolescence through immediate reuse.

Both of these methods of collection, which rely on a preexisting infrastructure, scale down the collection process to conform. The e-waste infrastructure is thus concealed from the public, preventing a more direct confrontation with the consumer. Also it lessens the chances for immediate recovery of reusable items. In order to create an efficient and accessible e-waste infrastructure, where the public can engage with technological obsolescence, these sites of collection must be removed from obscurity.

The Processor, or recycler, is the entity that de-manufactures the discarded device in order to recover material

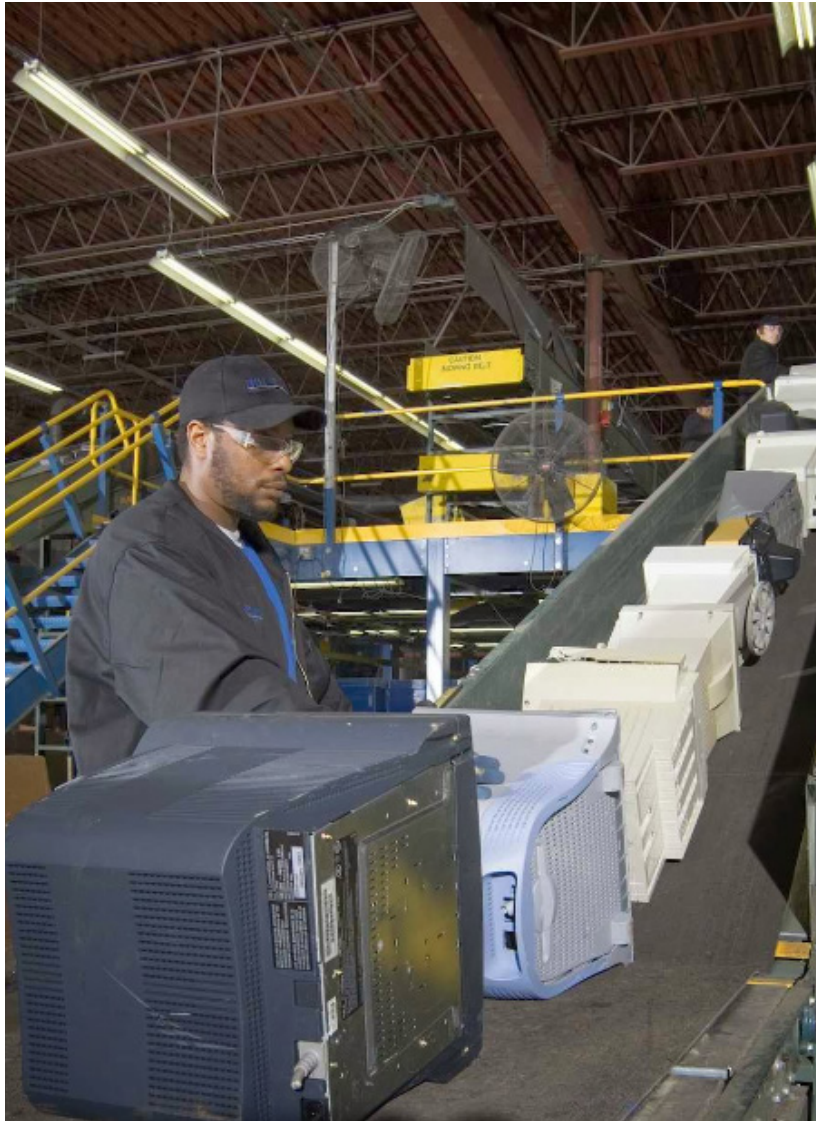


Figure 3.6 Inside an E-waste Processor

contained in the products. They also prepare those materials for reclaiming or reuse in new products, and often sell recycled materials back to a manufacturer. An electronics recycling plant can take on many different forms, depending on the mechanical systems employed, the cost of labor, the legal framework and the desired end product. Generally, there are three steps to the process of recycling an electronic device, and each step produces varying degrees of reusable products.



Figure 3.7 Hazardous Work: Manual Disassembly of CRTs

Figure 3.8 Manual Disassembly of Desktop Computers



The first step is largely manual. The electronics are weighed, sorted, and tested. Then they go to the manual disassembly line. Trained technicians, who use a range of hand tools and machines, perform the process of dismantling. Metals, plastics, and glass are separated from the hazardous materials, like CRTs. The separated materials are compacted for transportation. This can yield fully functioning electronics or whole components that can be resold in secondary markets.

The second step handles the residual components that have material value that can be recovered or toxic parts that need to be safely disposed. This process can be performed by a range of shredding and separating machines. Separation can be done magnetically or with vibrating tables. The more cutting edge plants employ electrostatic or optoelectronic separation techniques, utilizing digital sensors. This step requires fewer workers, involving minimal manual labor.

The third step produces marketable raw materials from the separated and shredded parts. Using smelting and refining machines, aluminum, copper, steel and a variety of plastics can be recovered in large quantities for raw resale. There are seven registered processors in Washington, and they each provide varying degrees of recycling services. There is one official processor in the city limits of Seattle, located in SODO, an industrial neighborhood, who provides manual disassembling and machined shredding and sorting.

These processors are located in industrial zones, neither highly visible nor accessible to the general public. These processors do act as collection points as well, but that program element is obscured by the rest of the industrial operation. At present the e-waste infrastructure in Seattle is inaccessible and invisible to the public. To increase collection and recycling rate, and to bring awareness to the mounting problem, these facilities must be sited in locations accessible to the public, and must include a program that allows the public to interact with the process.



Figure 3.9 Machine Shredding of Electronic Components



Figure 3.10 Warehouse Storage & Staging for Processing

## 4 Making the Process Visible

With the goal of making Seattle's e-waste infrastructure more accessible and visible to the public, particularly to the individual consumer, this proposal strives to unify the collection and processing programs. Positioning these functions adjacent to one another will allow for a new interplay between consumer and infrastructure.

The act of collecting electronics at a processor will allow the consumer to observe the mass accumulation of electronics and experience the dismantling of these products. In addition, recovering functioning electronics early in the process will allow for immediate reintroduction into the market, creating another programmatic element, resale. This would produce another

opportunity for the consumer to connect and engage with the infrastructure. Adapting the second hand retail model to better suit electronics, this programmatic element could include refurbishment and exchange.

The proposed facility will preform the first two steps of the recycling process, the stages exclusively tied to e-waste; the manual disassembly of these complex electronic products and the shredding of the separated material. This process produces whole components and raw materials, which can be resold to manufacturers. The following is a programmatic break down of the functions at the proposed facilities.



Figure 4.1 Parti Diagram

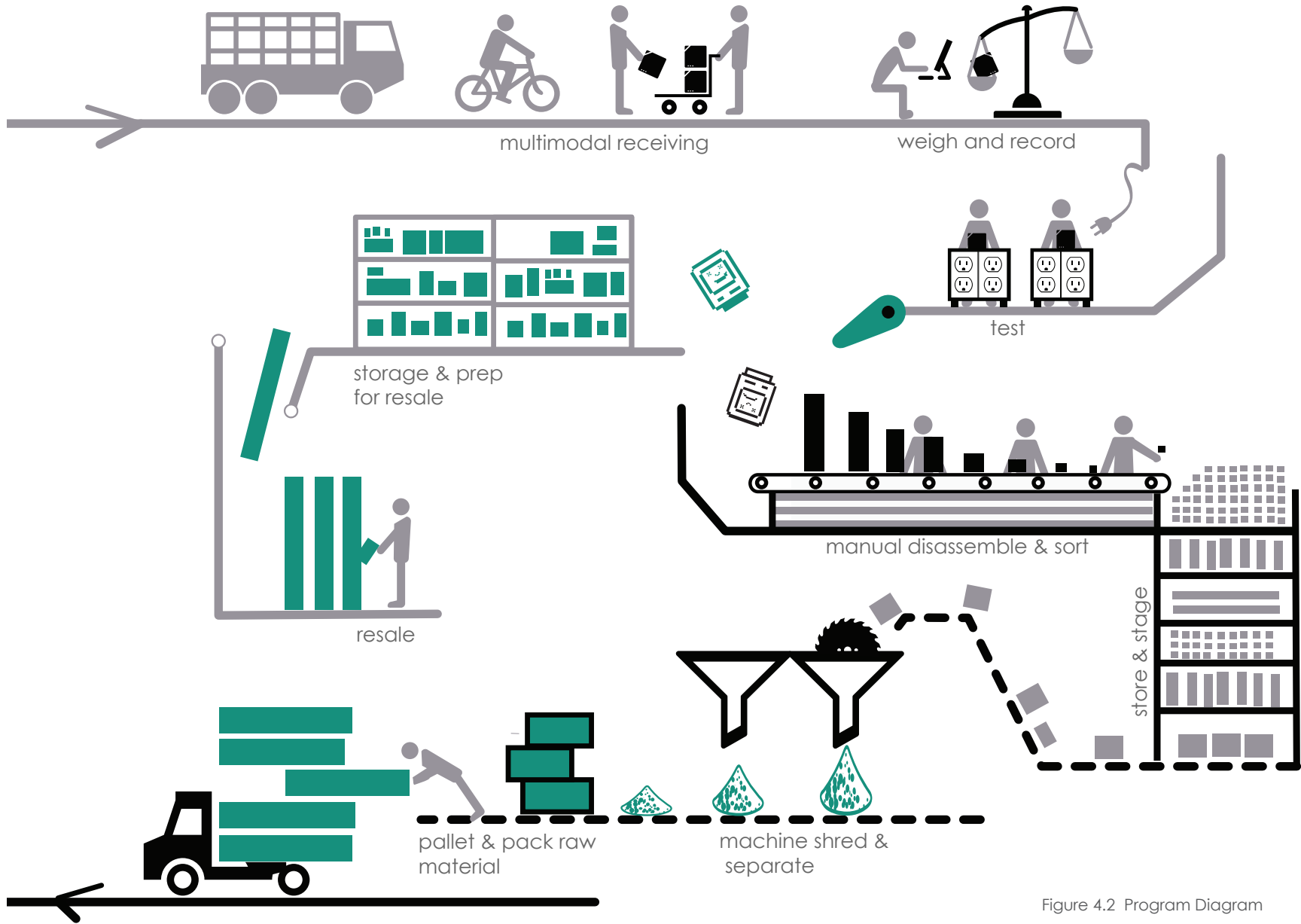


Figure 4.2 Program Diagram

## FACILITY PROGRAM:

**Multimodal Receiving Area** – Individual consumers and businesses drop-off material to the receiving area where it is unloaded. Loads are weighed and catalogued

**Testing Stations** – Electronics are tested to see if they function and can be available for resale.

**Inbound Storage Area** - Electronics are sorted into functioning and non-functioning products. The non-functioning are further sorted and stored in preparation for the disassembly line.

**Demanufacturing Area** - The primary function of demanufacturing is the disassembling of electronics and sorting into different recyclable commodities. Using a combination of hand and power tools at divided workstations, employees sort the marketable components into large boxes.

**Staging for Shredding and Compacting** - This space is for interim storage of materials awaiting further processing.

**Processing Area** –Contains the industrial scale processing equipment: a shredding/pulverizing machine for metals and plastics. The shredded material lands on a vibratory table, which distributes the material onto a transfer conveyor.

**Outbound Storage** – Plastic is baled, other material is shipped in large boxes. Marketable material can include circuit boards, wire, hard drives, power supplies, fluorescent tubes, batteries, inkjet and laser cartridges, scrap metal, crushed glass, plastics.

**Shipping Area** – The loading dock area must be able to stage and store boxes and pallets ready to be shipped.

**Resale Store** - Resale and Refurbishment of second hand items are available in a commercial space. Includes back of house storage for working items not on retail floor yet.

**Staff Support Space** - Office space for administrative and managerial staff. A break room and restrooms for technicians and staff.

This complex program relies on a precisely choreographed flow of materials. Therefore the circulation through the facility becomes a programmatic element in and of itself and is of central importance to the design.

In addition, a research and education component will be added to the program in order to engage the public at a different moment in the cycle. The facility will host an interdisciplinary studio for electrical engineer and industrial design students, striving to create a new generation of electronics that are durable & updatable. In order to change the planned obsolescence business model to one of planned upgrade, the studio will focus on the design of electronics that have modular parts and interchangeable components, leaving room for new technology.

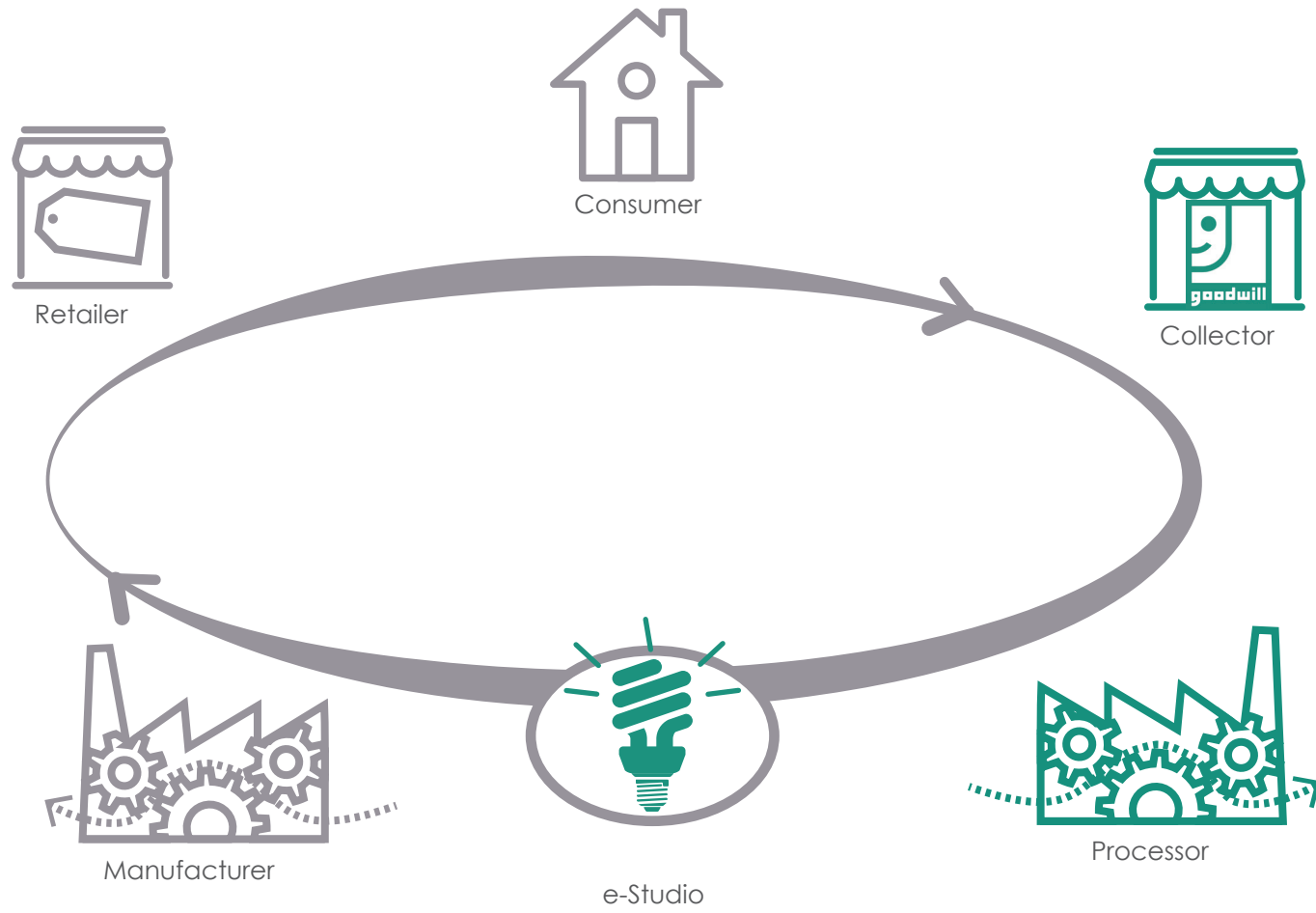


Figure 4.3 Education Program as New Player in Infrastructural cycle



Figure 4.4 Concept Diagram by Dow Jones

## Case Study: Integrated Industry

Siting an industrial project adjacent to commercial or residential zones is not common practice, however it is a plausible scenario, as the following case study demonstrates. This project addresses the negative connotations of industrial infrastructure, by attempting to reposition and rebrand municipal solid waste facilities in an effort to form a stronger connection to the public. Through an investigation of its architectural strategies, this case study will inform the methods of design for this thesis. “Rubbish In – Resources Out: Design Ideas for Waste Facilities in London”

was a strategic report and theoretical design project provided by Dow Jones Architects in 2009. The Greater London Authority commissioned the project to explore novel waste treatment technologies, like anaerobic digestion and plasma gasification, in order to meet the ambition recycling targets of the 2020 London Plan. The project proposes a family of facilities, which address different scales and types of operation. The architects proposed multiple locations throughout the city, from riverside transfer hubs to urban infill plants. While the report goes into great



Figure 4.5 Conceptual Renderings by Dow Jones



detail about the new treatment technologies, the architectural focus is on a visible and coherent spatial expression.

The intention of the project was to demonstrate that waste facilities can be architecturally integrated into the city. Dow Jones stating that “through their central urban location and their prominent designs, the buildings have the ability to raise awareness of the waste treatment process and to become a means of focusing communal responsibility.”<sup>30</sup> Using new quiet and odor free technologies, the design makes the process visible to the public through clever siting and street level transparency, as a way of to raise awareness of the process.

The architects also use a common architectural language to unify the diverse facilities, linking the network through its shared appearance. The bold punctured metal cladding and modular construction of the dispersed facilities allows them to respond to their individual site yet remain visually connected. Positioned strategically throughout the city, these landmarks are not only destinations for waste collection, but also become a powerful and positive addition to the neighborhood. This case study illustrates the role architecture can play in making a dispersed infrastructure cohesive and visible to the public; in an effort to change the way that infrastructure is perceived.

## Site: Finding a Middle Ground

To achieve the proposed program, the facility must be sited in an industrial zone but also be visible to the public. Finding this juxtaposition in a site proves challenging because industrial zones tend to be located at the margins of neighborhoods and cities. Often there is a buffer area, separating the industry from residential or commercial spaces near by. However, finding a heavily utilized public adjacency is essential to the goal of the design project.

In Seattle, 12% of the total land area is industrial zoned.<sup>27</sup> The Department of Planning and Development created four industrial zone classifications, but the type that reflects the proposed program is Industrial Commercial (IC). The DPD zoning regulation states, "the intent of the Industrial Commercial zone is to promote development of businesses which incorporate a mix of industrial and commercial activities, including light manufacturing and research and development, while accommodating a wide range of other employment activities."<sup>28</sup> In addition to promoting the interplay of commercial and industry, some of the permitted land uses include salvage and recycling.

An additional criteria for the site search was to find a

location that worked within the existing infrastructure, a site that filled a gap of the e-Cycle Washington system. The only processor in the Seattle city limits is located in the SoDo, which is on the south end of downtown. This focused the search on the north industrial center, which runs along the north edge of Lake Union and Lake Washington Shipping Cannel. This industrial corridor also runs parallel to the Burke Gilman Trail, a popular pedestrian and bike trail that extends 27 miles. Established in 1885, the route was originally a railroad, thus the industrial corridor that runs along it. Northern Pacific railroad acquired the line in 1913 and it was heavily used until 1963. When it was abandoned in 1971, plans for preserving the route as a public right-of-way were set in motion. The high volume of pedestrians and cyclists that frequent this trail make it an ideal adjacency.

A site was selected which fit all of the criteria: zoned Industrial Commercial, filling a gap in the existing infrastructure, and adjacent to a multimodal right-of-way. The site is located immediately to the south of the Burke Gilman trail. In the *University of Washington Burke-Gilman Trail Corridor Report*, a 2011 study, which measured user volumes on points along the trail, this particular site counted an amazing 408 cyclists and 174 pedestrians during the peak hour.<sup>29</sup>

<sup>27</sup> DPD, Industrial Lands Report, 15  
<sup>28</sup> DPD, Industrial Lands Report, 11

<sup>29</sup> "University of Washington Burke-Gilman Trail Corridor," 24

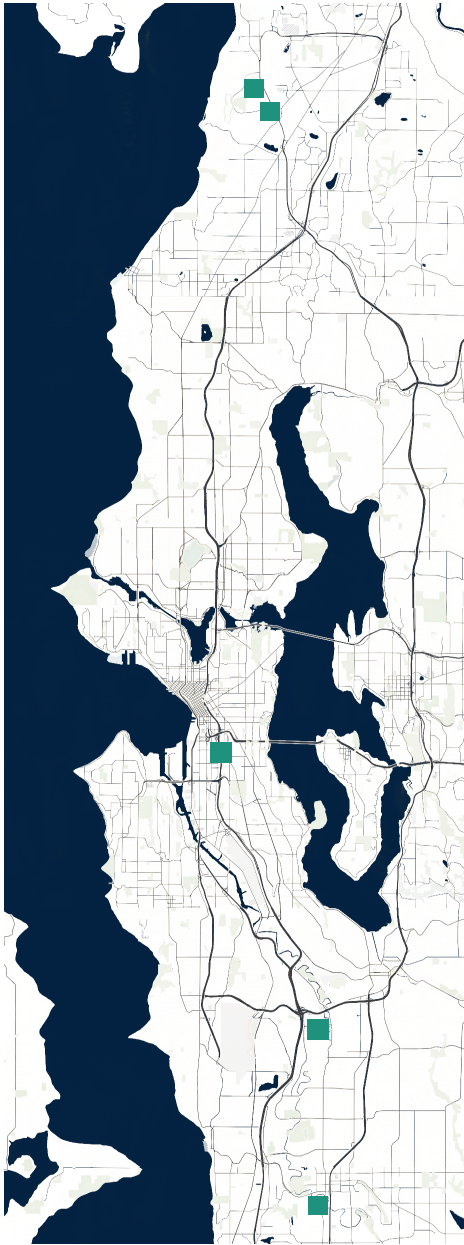


Figure 4.6 Seattle-Area Processors

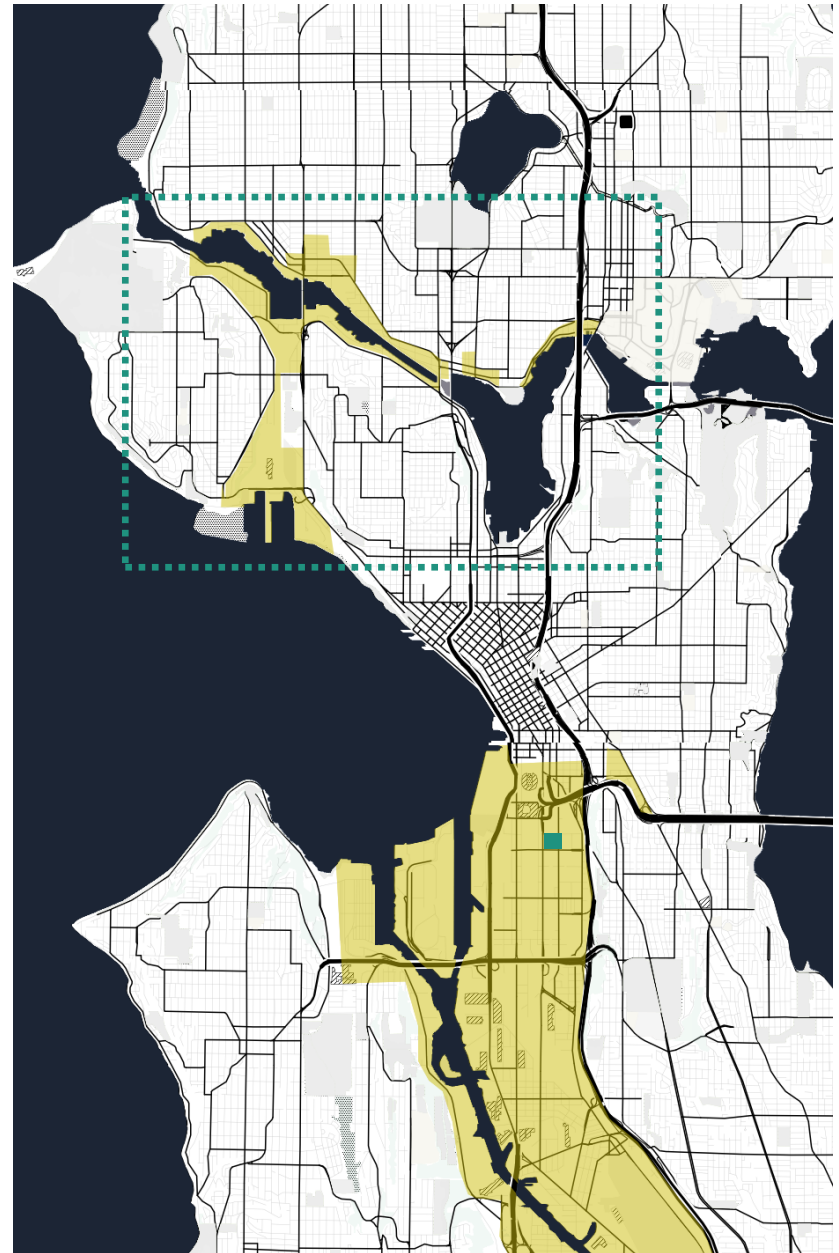


Figure 4.7

Seattle Industrial Zones   
E-Cycle Washington Processors 

Directly to the site's east is the University Bridge, a multi-modal bascule bridge that carries cars, bikes and pedestrians, creating another high-traffic neighbor. It is also located just to the west of the University of Washington campus, which hosts 40,000 students, a population flush with electronics. Additionally, having the University as a neighbor allows the e-Studio program to be affiliated with the institution.

As for industrial access, it has a direct connection to NE Northlake Way, an industrial arterial street, with close access to I-5, which is located just to the west. Each abutting route connects to the site at a different elevation, which creates interesting sectional conditions. This site manages to be both industrial zoned and visible to the public, circumscribed by diverse site connections.

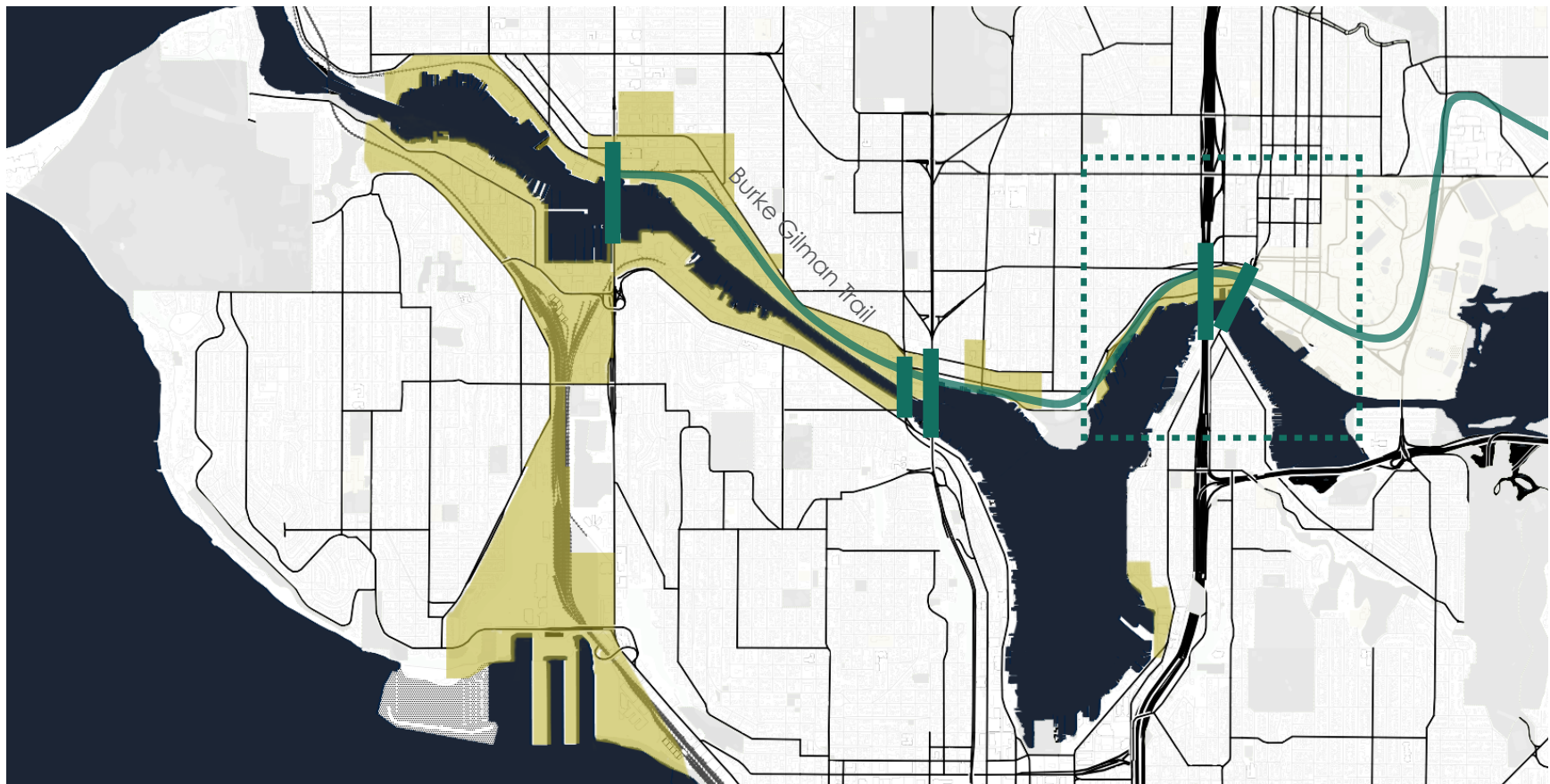


Figure 4.8 Transit Infrastructure

Seattle Industrial Zones   
Bridges & Trail

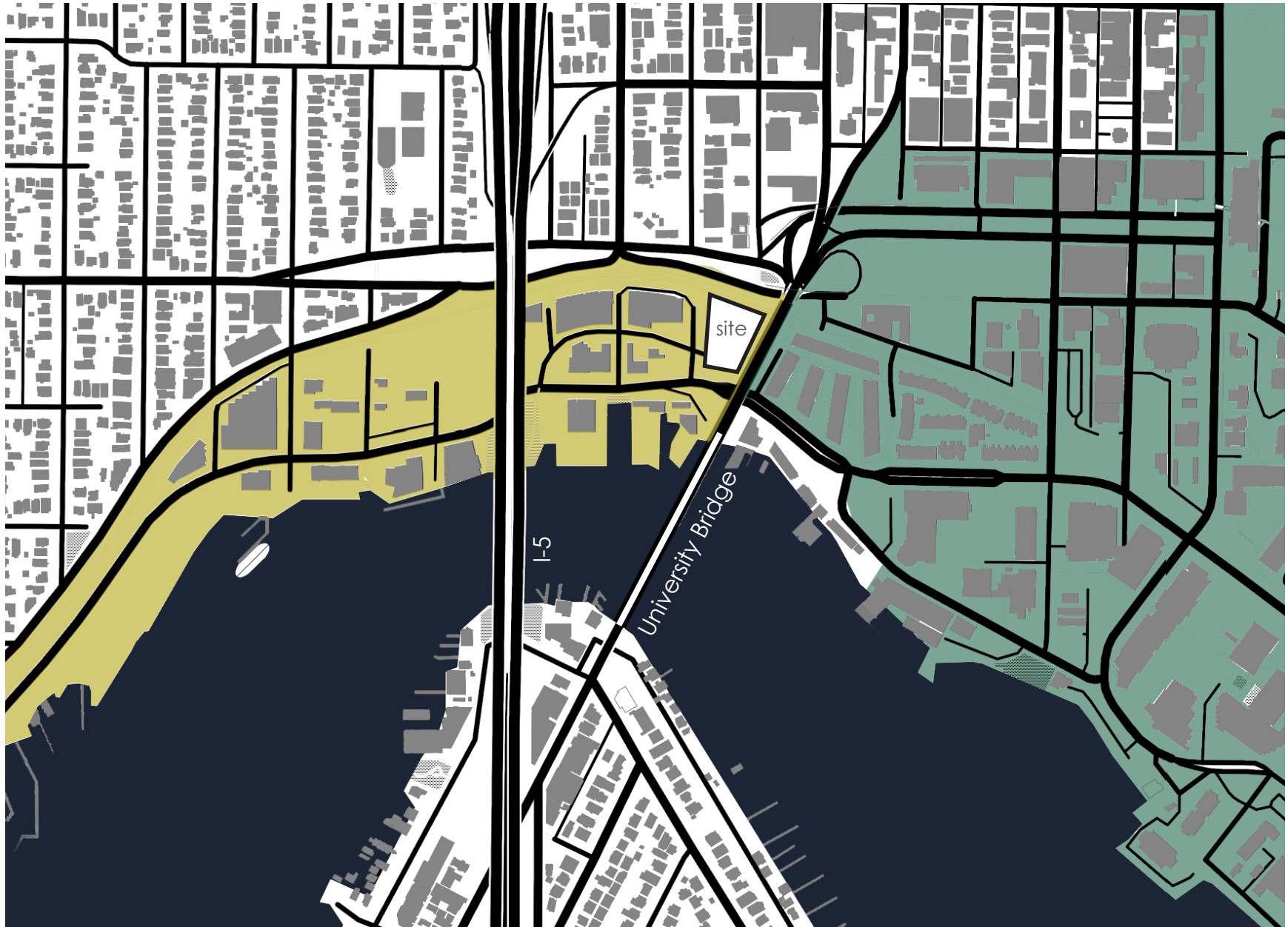


Figure 4.9 University Adjacent

Seattle Industrial Zones   
University of Washington Campus



Figure 4.10 Public & Industrial Access Points

Car/Truck Access █  
Pedestrian/Bike Access █

Connection to Three Levels of Transit Infrastructure



Figure 4.11



Figure 4.12



Figure 4.13

University Bridge - el. 90'



Burke Gilman Trail - el. 70'



Northlake Way - el. 36'



## The Existing Condition

Not only does the site fit the proposed parameters, it also houses a very intriguing existing building, which is ripe for reuse. The building is a four-story warehouse, which is currently being used as UW storage and facilities. Its pie-shaped plan is wedged into the site so that it responds both to the Burke Gilman Trail and the University Bridge at their varying elevations. Not only does the building address those two different levels, historically it physically connected to both transit routes.

The warehouse was built in 1928, made out of site-cast concrete. There is minimal embellishment of the simply framed

building, except for the cornice detail on the east façade. The single pane steel sash windows were cast directly into the concrete. Architect and engineer John L. McCauley, stamped the original drawings and can be credited with the design. He is noted for designing a number of buildings in the Columbia City business district in the 1920s, including the Columbia Theater. He also was involved in the design of the Bush Hotel and the Rainier Heat & Power Co. in the International District.

In its current condition, the east façade, the side facing the University Bridge, is entirely opaque and boarded over. However the 4th floor was originally intended to be storefronts abutting the bridge, transparent and accessible to the public.



Figure 4.14 East Facade from Bridge with I-5 bridge visible beyond



Figure 4.15 West facade with original windows

The layout of the building was inverted because of the odd site conditions. The 4th floor was to hold retail space and the bottom three floors were to be warehouse storage. From the original plans and east elevation, it is clear that an exterior sidewalk and an exit off of the top floor were intended to connect directly to the bridge.

However due to the economic crash in 1929 and following Depression, the building sat vacant for the first six

years of its life, and the bridge level retail never came to fruition. The exterior sidewalk can be seen in the images of the 1932 rebuild of the University Bridge, a depression-era public works project. Over the years the windows in the east façade were removed and infilled with CMU.

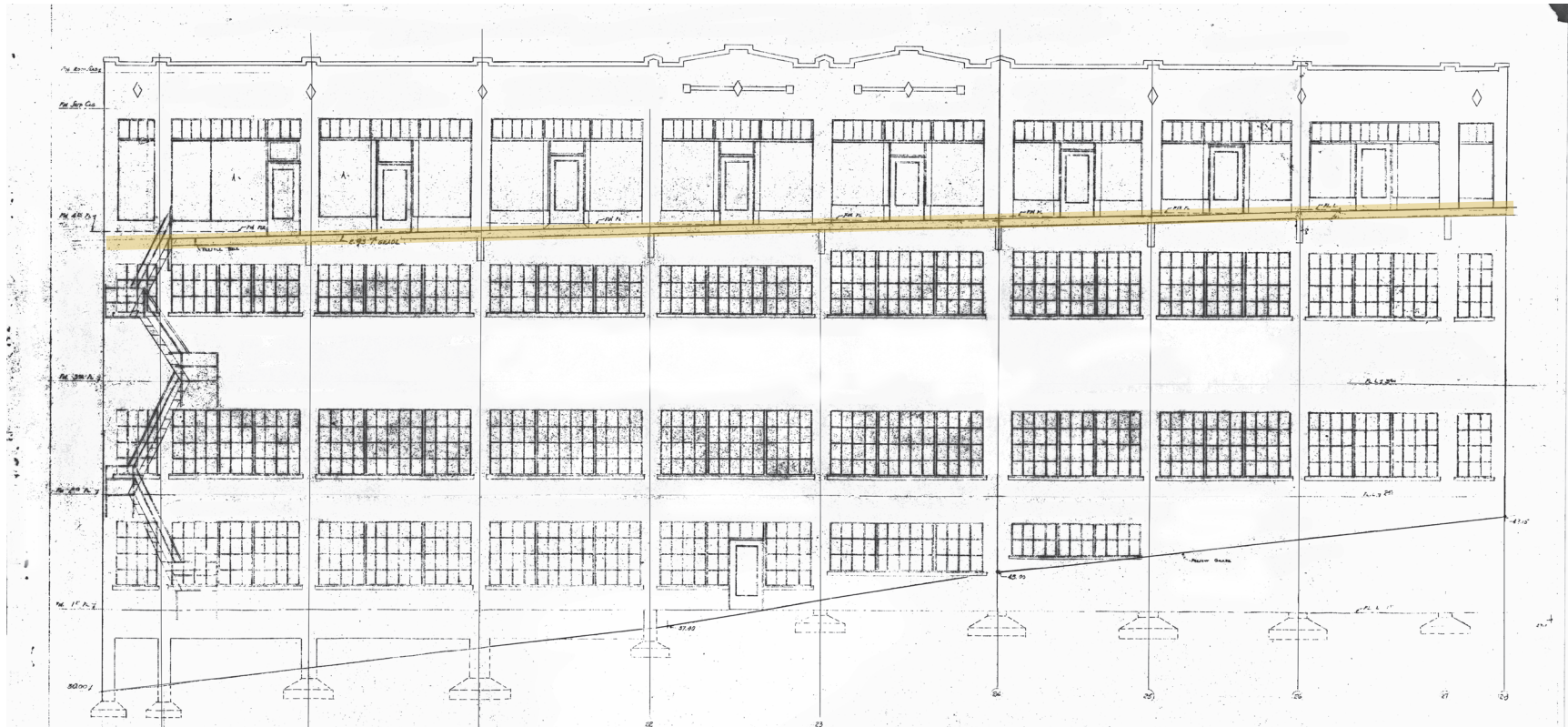
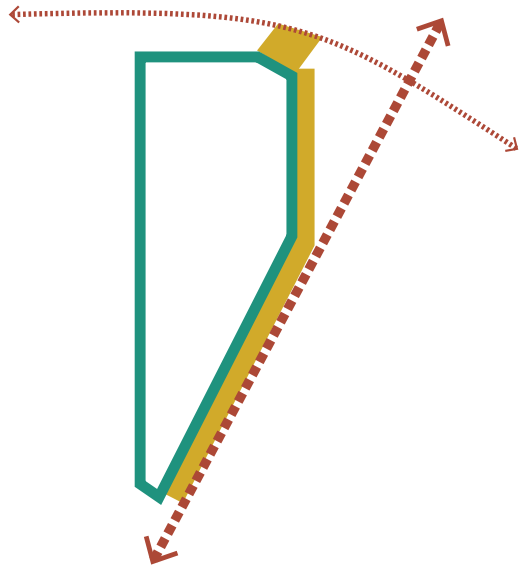


Figure 4.16 - 1928 East Elevation: Exterior Sidewalk

Historic Bridging & Connection



Building Responds to Transit Infrastructure

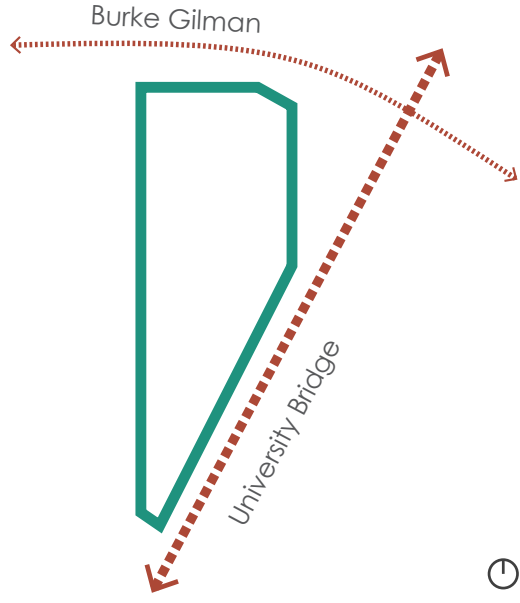


Figure 4.17 - Existing Conditions Diagram

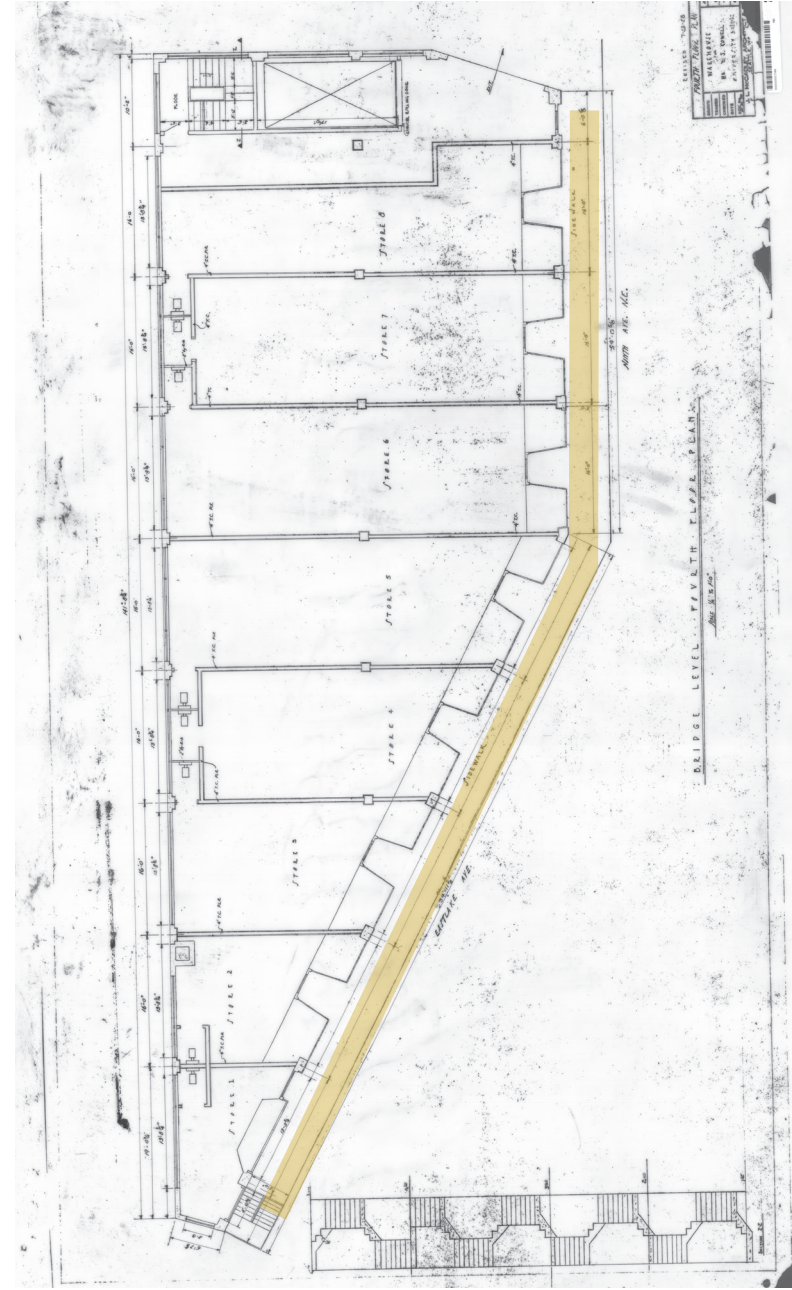


Figure 4.18 - Original 4th Floor Plan



Figure 4.19 - 1932: Bridge Rebuild with Exterior Sidewalk Visible

In the mid-1930s, Lyon Storage Co. occupied the building. They utilized the connection to the railroad, now the Burke Gilman trail, to access the third floor of the building for loading. The position of the building allowed these uncanny connections to occur.

The prominent position and visibility of the building also allowed it to function as a billboard over the years. For Lyon storage, painting signage all over the building was effective advertisement for the business inside. During its vacancy, a billboard for S&W coffee sat on the roof for years.



Figure 4.20 - 1937: Building as Billboard

Historically, the existing building was visible and accessible to the public, the two primary goals of this thesis's architectural design. As such, an adaptive reuse of the building will be incorporated into the overall design, reclaiming the building's transparency and accessibility to the trail and bridge. The 20,000 square feet of floor space will only accommodate one third of the proposed program so a new building also becomes a necessary piece of the design project.



Figure 4.21 - 1959: I-5 Bridge Under Construction



Figure 5.1 - Proposed Intervention: Reconnecting to Bridge with Transparent Facade



Burke-Gilman Trail

NE Northlake Way

University Bridge

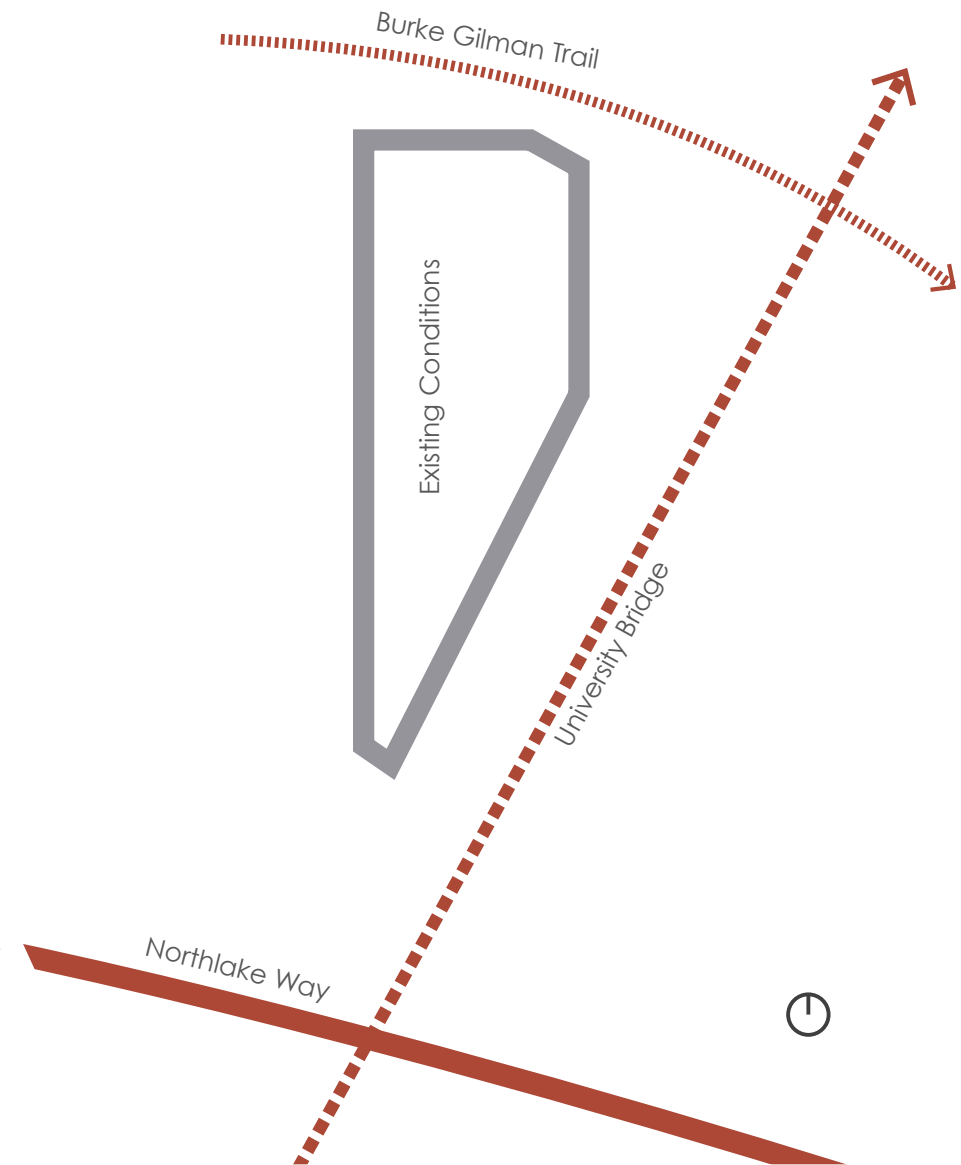
Site Plan  
Figure 5.2



## 5 The Architectural Design

The architectural intervention focuses on bridging the gap between industrial processing and public life, in order to make e-waste infrastructure transparent and accessible. The site conditions and existing building are poised for creating a connection between Northlake Way (industrial) and the Bridge & the Trail (public). By exploiting the unique site conditions, the architecture strives to create new urban connections to generate greater visibility of the buildings.

The first gesture was to locate the collector's program in the existing building. This allows the existing building to take on the programmatic elements that the public can directly interact with, like the multimodal receiving area and resale store. Additionally the e-studio program will be sited there, creating new moments of human interface within the infrastructural cycle. By positioning the existing building as the human face, the new building is free to be a flexible industrial space where e-waste processing can occur, from manual disassembly through machine shredding. In addition, allowing the collector and processor to remain architecturally distinct highlights the different stages in the cycle.



As the public face, the existing building can connect to the Burke-Gilman Trail and the University Bridge, both routes that carry pedestrians and bikers. As the industrial face, the new building will be sited so it can connect to the truck route, NE Northlake Way.

The final conceptual gesture creates a continuous link between the different pieces of infrastructure. The Link will connect the old building to the new, joining the e-waste infrastructure visually and physically. But it will also act as a physical connector between the Bridge, the Trail and the industrial arterial, creating a new urban route for bikes and pedestrians. The Link will carry passerbys through the buildings,

taking them directly past the demanufacturing of electronics, making the process fully visible to public.

The architecture of the new building was inspired by the industrial shed typology. The space needed to be open and flexible, as the equipment and process for demanufacturing electronics will most likely change as technology progresses. The rigid portal frame of a steel industrial shed was not only a functional manifestation of flexible space but also an iconic representation of industrial work. By exposing the frame on the exterior, the architecture expresses the industrial process to the public, calling attention to the recycling that is occurring within.

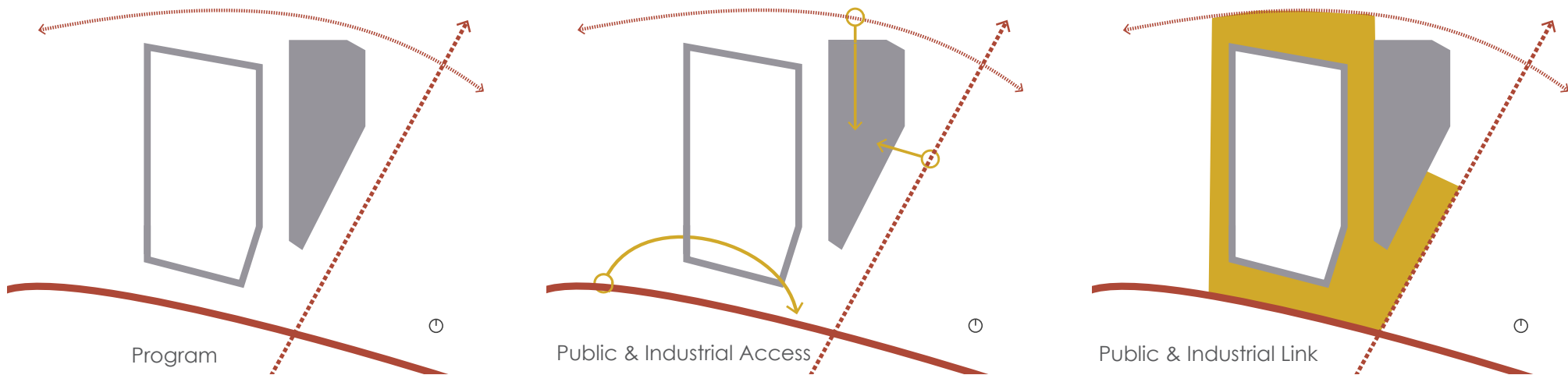


Figure 5.3 - Concept Diagram

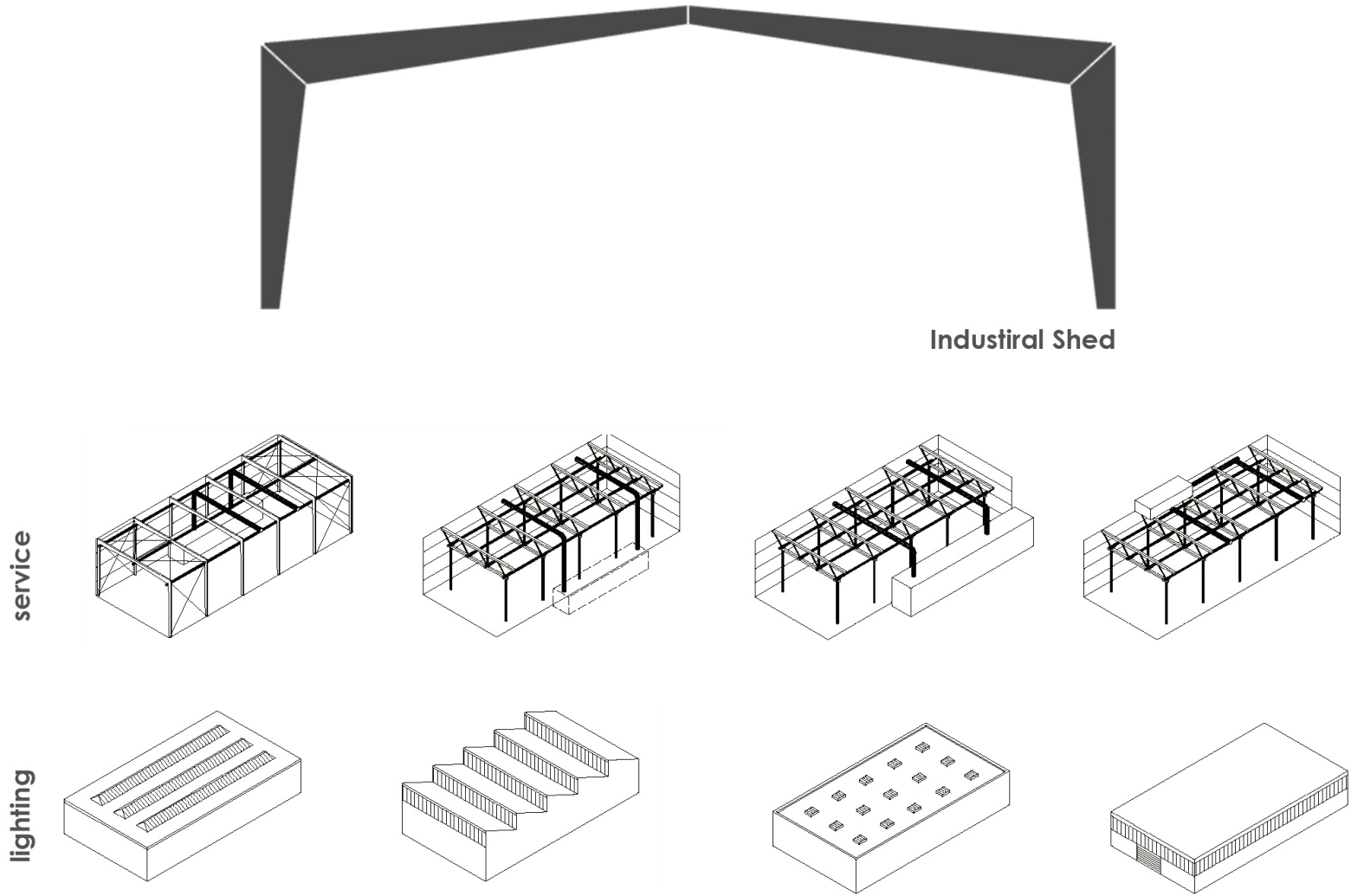


Figure 5.4 - Industrial Shed Typology Study

With a 35' grade change across the small site, the architectural intervention takes advantage of the vertically variable points of access. The program necessitates the circulation of pedestrians, bikes, cars and trucks through the site simultaneously. Utilizing the stacked elevation, the various paths are permitted to loop and flow without hindering one another. The ground floor, on the same elevation as Northlake, handles the trucks and cars' of employees. The 2nd floor, just 10' below the Trail, conveys the cars' of visitors, dropping-off electronics, looping them up and around the entire site. The Link, which circles the site and ducks between the buildings, ramps down from the Bridge to Northlake, conveying pedestrians and

bikers. Choreographing these flows proved to be the most rigid constraint on the design.

The circulation of the electronic material, from drop-off to staging to processing to shipping, also required a great deal of consideration. The flow needed to be visible but also practical, providing places for storage and staging along the way. The multimodal receiving area occurs on the 2nd floor, where the electronics are tested and recorded. Then they go down a level, where they are stored and staged in preparation for moving to the processing floor. All of the processing occurs on the first floor and then is again moved a level down via a large vertical reciprocating conveyor to the shipping dock.

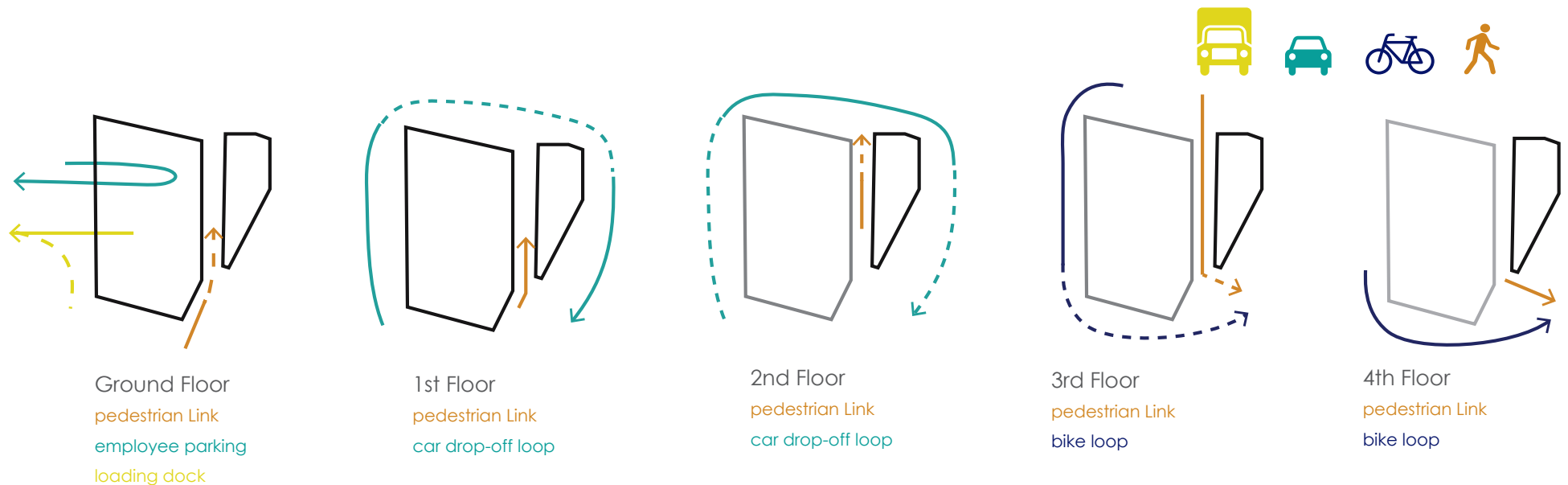


Figure 5.5 - Circulation Diagram

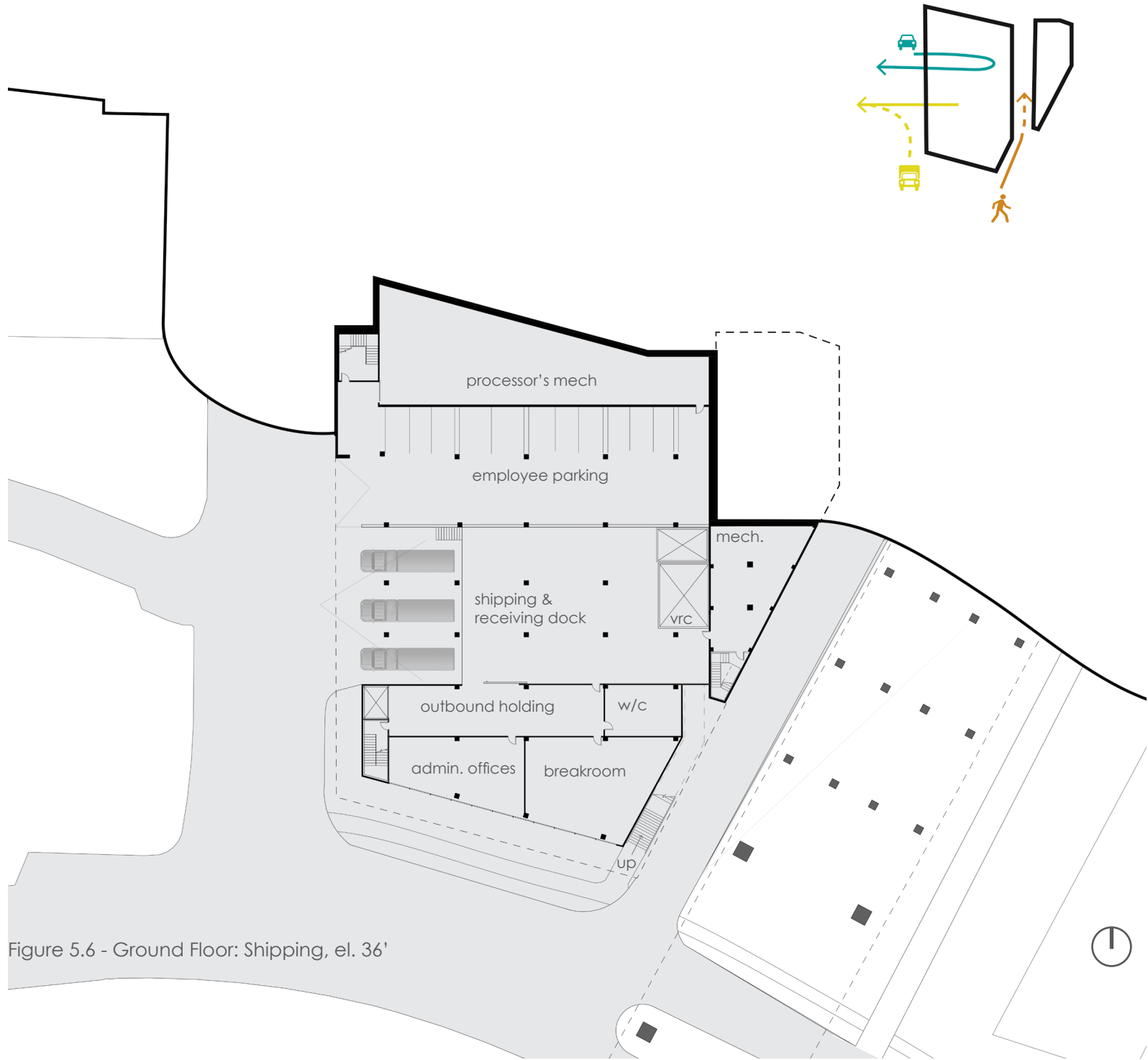


Figure 5.6 - Ground Floor: Shipping, el. 36'

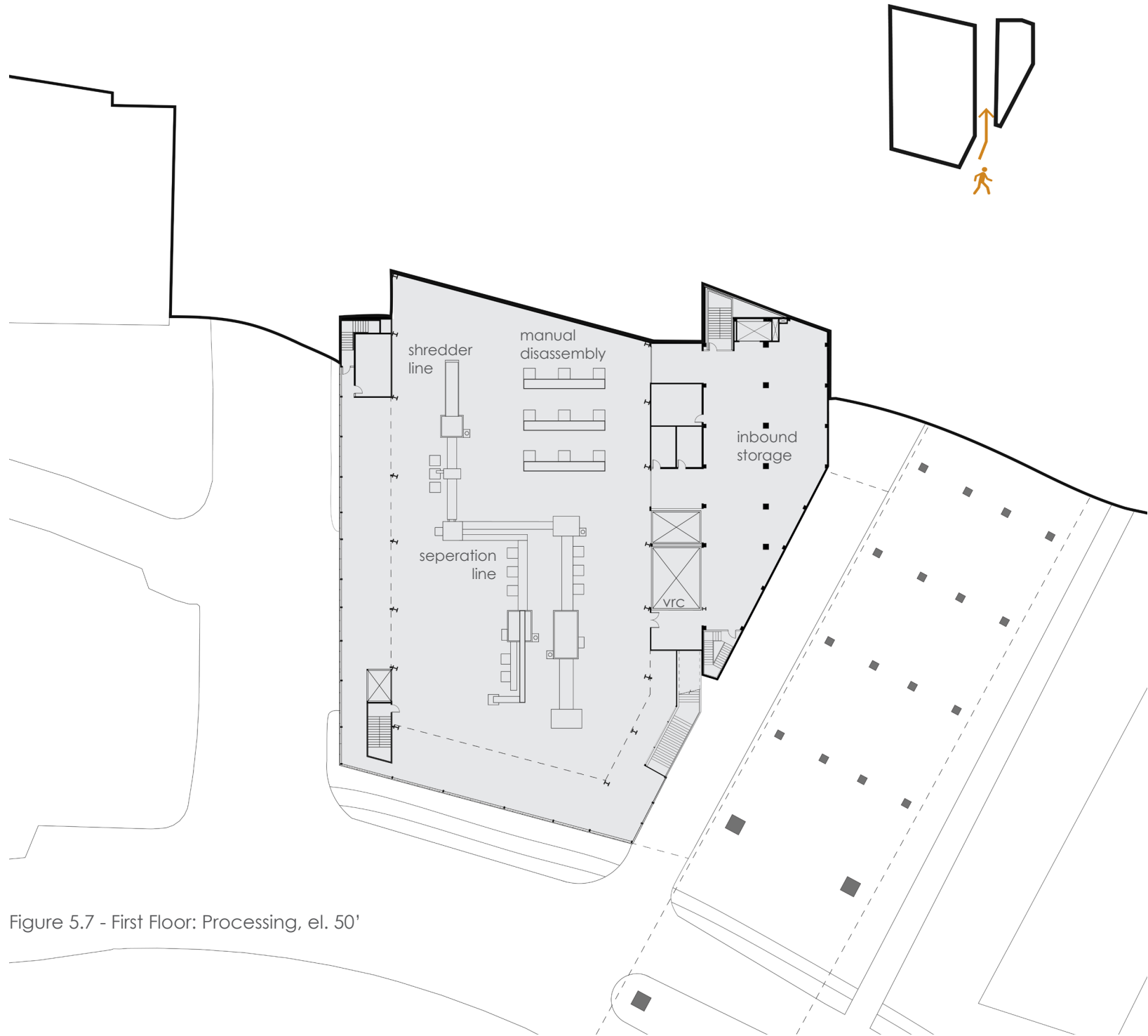


Figure 5.7 - First Floor: Processing, el. 50'

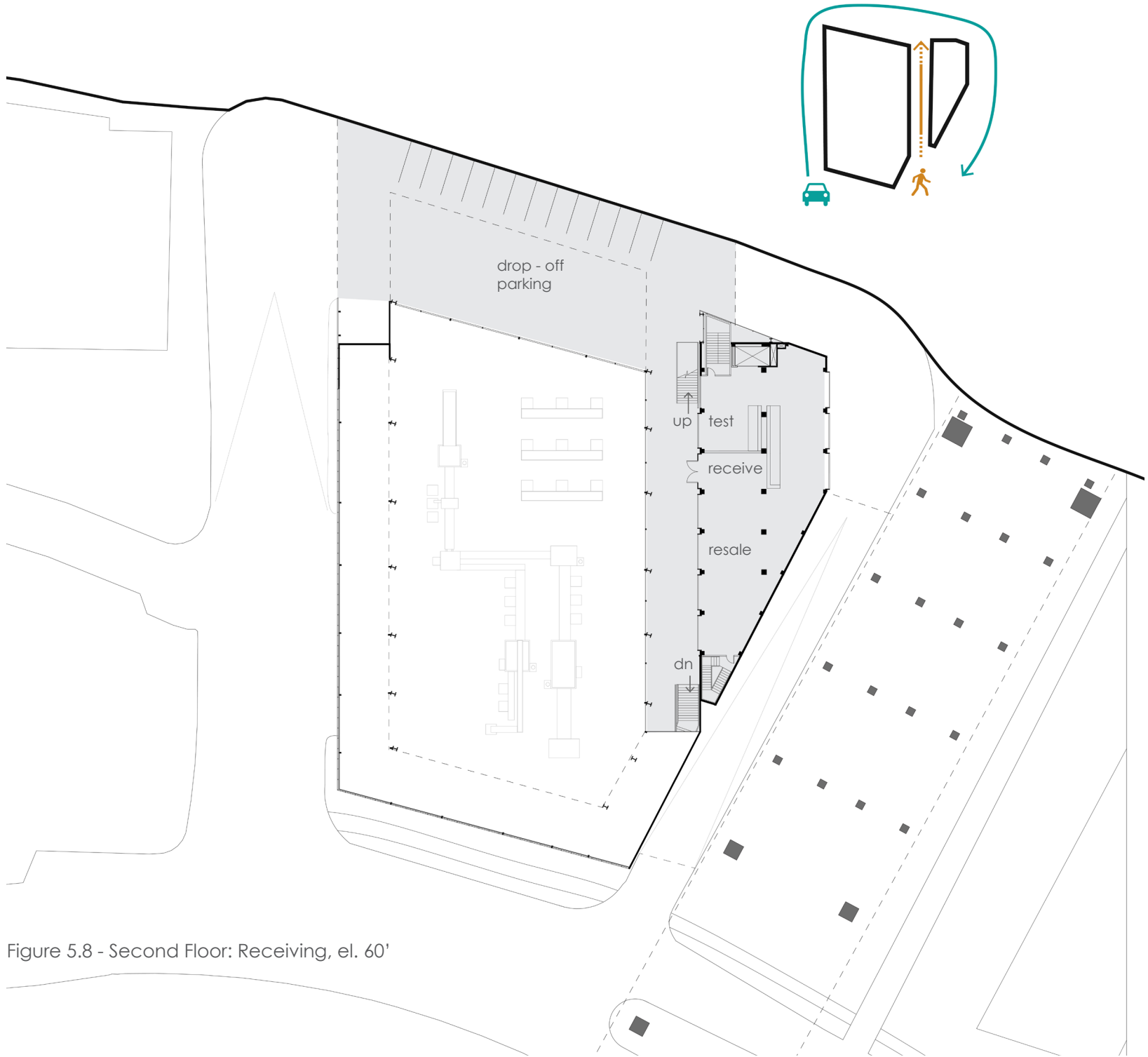


Figure 5.8 - Second Floor: Receiving, el. 60'

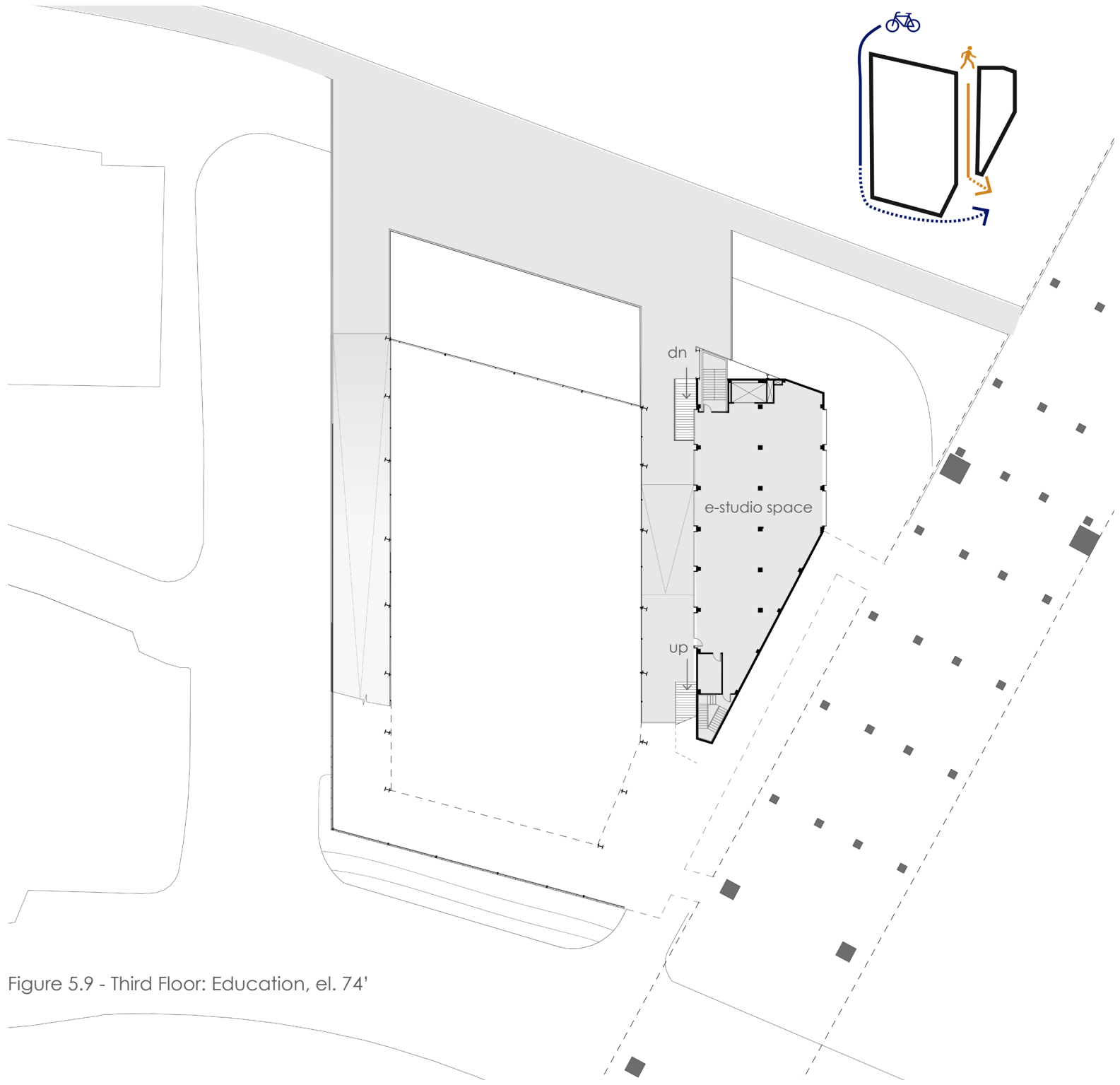


Figure 5.9 - Third Floor: Education, el. 74'

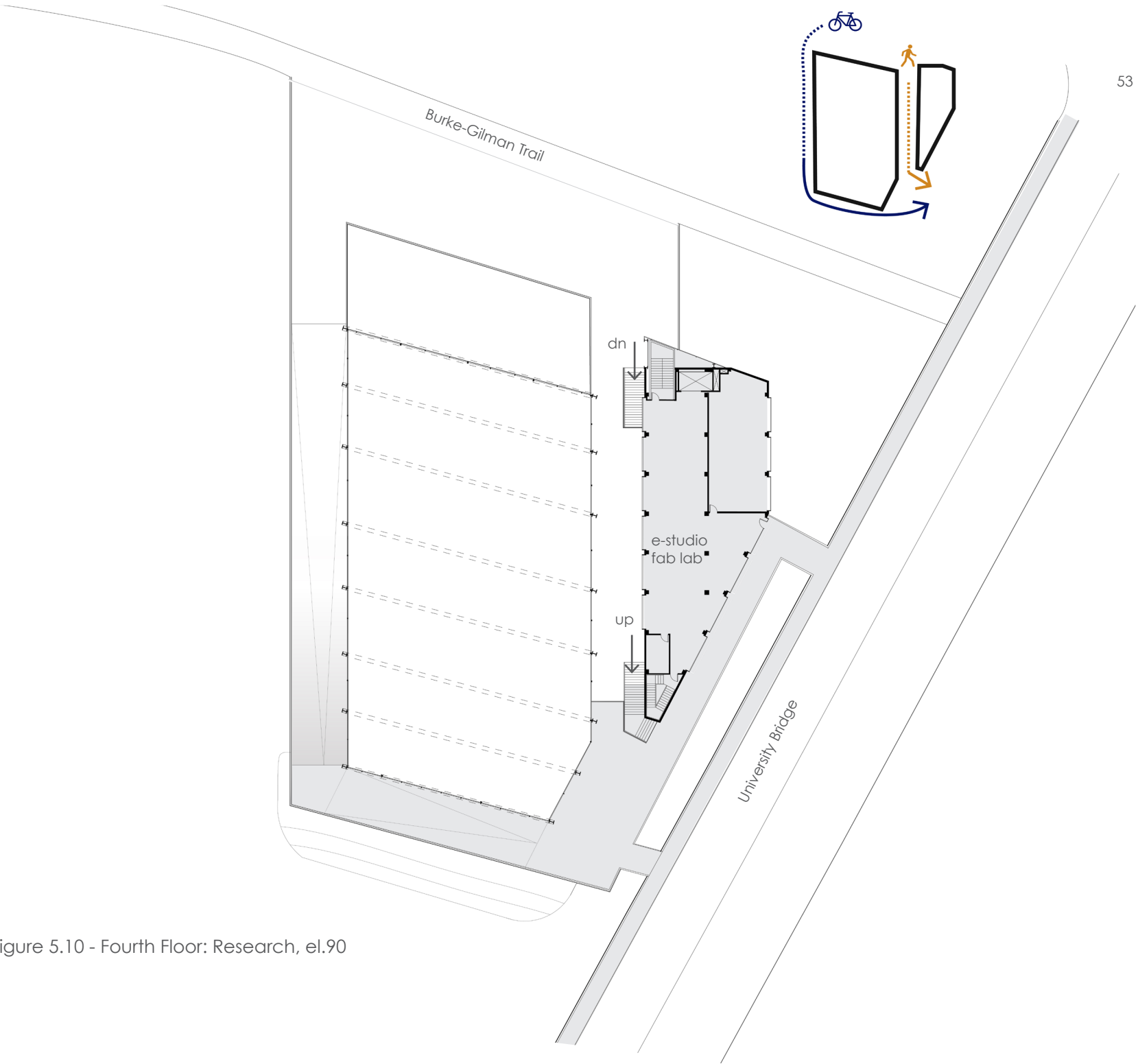


Figure 5.10 - Fourth Floor: Research, el.90



Figure 5.11

The vertical orientation of the site creates important sectional relationships, which help illustrate the flow of users and material. This section illustrates the relationship between the two buildings and how the Link ties them together and attaches to the bridge.

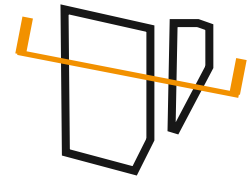




Figure 5.12

This section illustrates the change in elevation between the loading dock for trucks on Northlake and the pedestrian link up to the Bridge.

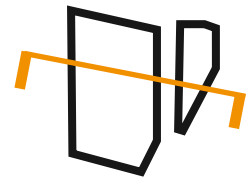




Figure 5.13

This section illustrates the spatial quality of the new industrial shed, and explains its connection to the Link, which wraps around the new structure.



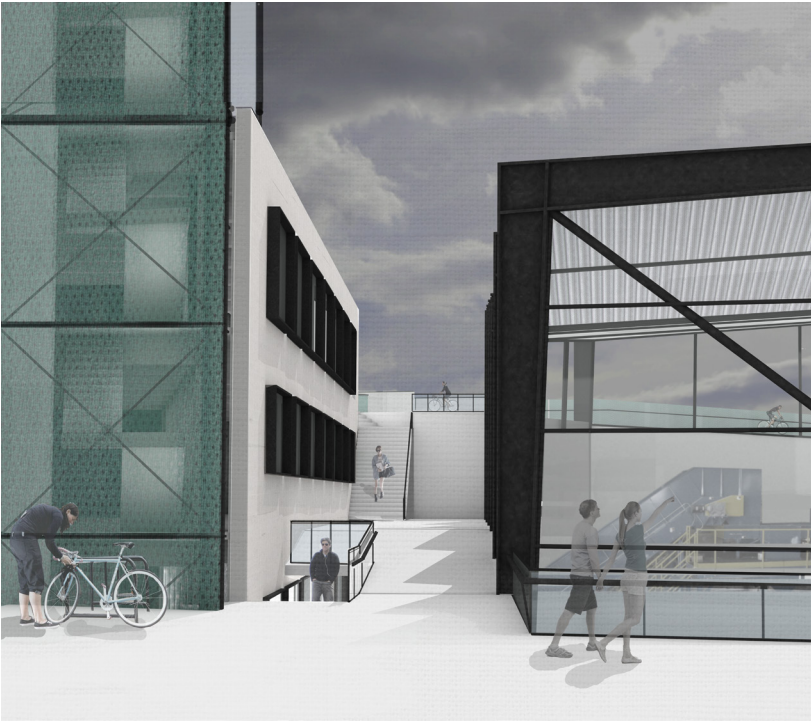


Figure 5.14 - Drop-off Entry Between Old & New

The two buildings remain materially distinct. The new shed is composed mainly of full height glazing, which is articulated by the exposed heavy steel frame and lateral supports. The old building retains its white board-formed concrete roughness. However it begins to speak the language of the new shed by creating transparency with punctured openings, mounted in black steel frames, which pop out from the facade. Lastly the ramped Link is sheathed in a pre-weathered copper mesh, an ode to the material composition of a circuit board. The mesh acts to unify both buildings, by wrapping through the entire site. The partial transparency allows a suggestion of the recycling process that is occurring inside. It also provides a prominent architectural element, which defines the new urban route.

The last three renderings capture the different levels of access on this complex site. They illustrate the overall intention of the architectural intervention; to connect the public to the industrial process of recycling e-waste. The architecture utilizes the adjacency to different transit infrastructure to bring visibility and accessibility to the e-waste network. By creating a transparent piece of architecture in a prominent location, this architectural intervention strives to spread awareness of the e-waste problem.



Figure 5.15 - From Northlake Way Looking East- el. 36'



Figure 5.16- From Burke-Gilman Trail Looking East - el. 70'



Figure 5.17 - From the University Bridge - el. 90'

## Conclusion

The Digital Age conjures images of information whizzing through ephemeral space, barely leaving a mark. In reality, the material byproduct of the era is quite physical and quickly amassing. As the hidden manifestation of rapid technological progress, e-waste must be confronted. This thesis advocates for increasing the visibility and accessibility of e-waste infrastructure in Seattle, strengthening the local network in order to mitigate the global export of the toxic byproducts. This architectural proposal removes the recycling process from the fringes, repositioning it in the urban fabric, where the consumer can directly confront the Sublime landscape of digital accumulation. Through the juxtaposition of industry and urban life, the design endeavors to educate and inspire new avenues for creating and managing electronics.

On the urban scale, the proposal draws in the public by creating a new connection between two major transit routes, the Trail and the Bridge. On the building scale, the expanded educational program and prominent site allow the architectural intervention to create moments where the public can directly engage with technological obsolescence. In a sense, the architecture aspired to capture the Sublime sensibility, both

attracting and shocking the observer. This thesis has only begun to explore the avenues in which architecture can act as such a beacon of contradiction. A further exploration would involve investigating how to truly balance a Sublime architecture with an integrated site design.

What proved successful in capturing the essence of technological obsolescence was the adaptive reuse of the underutilized existing building, a building that was born to be transparent but was hidden from view due to time and progress. By reengaging the building as a site of public interface the intention of this thesis was realize, creating an architecture that not only confronts the notion of technological obsolescence but endeavors to change its outcome.

**List of Figures:**

Images produced by author unless otherwise noted

Figure 0.1 McLellan, Todd. "Old Macintosh" & "Apart Macintosh" *Things Come Apart*, a photographic series from 2013.

Figure 1.1 Graph from *Electronic Waste Management in the United States Through 2009*. EPA Report 530-R-11-002, 2011. P.9

Figure 1.2 Burtynsky, Edward. "Waste Sorting." *China Recycling Photographic Series*, 2004  
< [http://www.edwardburtynsky.com/site\\_contents/Photographs/China.html](http://www.edwardburtynsky.com/site_contents/Photographs/China.html) >

Figure 2.1 Friedrich, Caspar David. "Wanderer Above the Sea of Fog" painting 1818

Figure 2.2 Photograph of the The Hoover Dam; Unknown Photographer  
From the Cover of David Nye's *American Technological Sublime*. Cambridge, Mass: MIT Press, 1994.

Figure 2.3 Burtynsky, Edward. "Circuit Boards" *China Recycling Photography Series*, 2004  
< [http://www.edwardburtynsky.com/site\\_contents/Photographs/China.html](http://www.edwardburtynsky.com/site_contents/Photographs/China.html) >

Figure 2.4 Jordan, Chris. "Sawdust #2, Seattle 2005" *Intolerable Beauty*, photography series  
< <http://www.chrisjordan.com/gallery/intolerable/#sawdust2> >

Figure 2.5 Jordan, Chris. "Cell Phones # 2, Atlanta 2005" *Intolerable Beauty*, photography series.  
< <http://www.chrisjordan.com/gallery/intolerable/#cellphones2> >

Figure 3.1 Diagram: From global trade to local infrastructure

Figure 3.2 Graph from "Evaluating The Performance of Recycling Systems." *E-Waste Management: From Waste to Resource*. p.126

Figure 3.3 Diagram: The players in local e-waste networks

Figure 3.4 Thrift Store Electronic Selection < <http://thrift.mcc.org/shops/kildonan-mcc-thrift-shop/shop>>

Figure 3.5 Transfer Station as E-Waste Collector from Metro South Station, Oregon City website  
< <http://www.oregonmetro.gov/tools-living/garbage-and-recycling/garbage-recycling-hazardous-waste-disposal-oregon-city> >

Figure 3.6 Inside an E-waste Processor at Total Reclaim: From Total Reclaim Google Plus Page  
< <https://plus.google.com/114870790625038710544/about?hl=en> >

Figure 3.7 Hazardous Work: Manual Disassembly of CRTs at Electronic Recyclers International, Inc., Image is a still from video  
< <http://electronicrecyclers.com/services/dismantling.aspx> >

Figure 3.8 Manual Disassembly of Desktop Computers at Total Reclaim: From Total Reclaim Google Plus Page  
< <https://plus.google.com/114870790625038710544/about?hl=en> >

Figure 3.9 Machine Shredding of Electronic Components  
< <https://www.flickr.com/photos/25329480@N08/2814055321/> >

Figure 3.10 Warehouse Storage & Staging for Processing  
<[http://www.wired.com/images\\_blogs/gadgetlab/2012/01/ewaste\\_recycle269edit.jpg](http://www.wired.com/images_blogs/gadgetlab/2012/01/ewaste_recycle269edit.jpg)>

Figure 4.1 Parti Diagram

Figure 4.2 Program Diagram

Figure 4.3 Diagram: E-studio - Education Program as New Player in infrastructural cycle

Figure 4.4 Concept Diagram by Dow Jones Architects from  
"Rubbish In-Resources Out: Design Ideas for Waste Facilities In London." p. 39

Figure 4.5 Conceptual Renderings by by Dow Jones Architects from  
"Rubbish In-Resources Out: Design Ideas for Waste Facilities In London." p. 28 & 34

Figure 4.6 Map of Processors in the Seattle Area

Figure 4.7 Map of Seattle Industrial areas

Figure 4.8 Map of North Seattle Industrial areas with Transit Infrastructure Overlay

Figure 4.9 Map of University Adjacent siting

Figure 4.10 Map of Site conditions: Public & Industrial Access Points

Figure 4.11 Photo of Site from University Bridge - 2014

Figure 4.12 Photo of Site from Burke Gilman Trail - 2014

Figure 4.13 Photo of Site from Northlake Way - 2014

Figure 4.14 Photo of existing building - east facade - 2014

Figure 4.15 Photo of exiting building - west facade - 2014

Figure 4.16 Original East Elevation, Drawn by John L. McCauley 1928; Provided by University of Washington Facilities Records Vault

Figure 4.17 Diagram: Historic Conditions

Figure 4.18 Original 4th Floor Plan Drawn by John L. McCauley 1928; Provided by University of Washington Facilities Records Vault

Figure 4.19 Photograph of "University Bridge: Laying Concrete" Oct 18, 1932.  
Courtesy of Seattle Municipal Archives: Item 139494, Fleets and Facilities Department Imagebank Collection  
(Record Series 0207-01), Seattle Municipal Archives

Figure 4.20 - "Lyon Truck Leaving Warehouse" 1937 from PEMCO Webster & Stevens Collection.  
Provided by Museum of History & Industry, Seattle image, # 1983.10.13792

Figure 4.21 - Freeway. Canal Crossing from 1959  
Courtesy of Seattle Municipal Archives: Item 62967, Engineering Department Collection  
(Record Series 2613-07), Seattle Municipal Archives

Figure 5.1 - Rendering of Reconnection to Bridge with Transparent Facade

Figure 5.2 - Site Plan

Figure 5.3 - Concept Diagram

Figure 5.4 - Industrial Shed Typology Study

Figure 5.5 - Circulation Diagram

Figure 5.6-5.10 - Plans

Figure 5.11-5.13 - Section Perspectives

Figure 5.14 - Rendering of Entry Between Old & New

Figure 5.15 - Rendering from Northlake Way

Figure 5.16- Rendering from Burke-Gilman Trail

Figure 5.17 - Rendering from University Bridge

## Bibliography:

- Boetzkes, Amanda. "Waste and the Sublime Landscape." *Canadian Art Review: Volume XXXV*, Number 1, University of Alberta: 2010.
- Burke, Edmund. *A Philosophical Enquiry into the Origin of Our Ideas of the Sublime and Beautiful*. (written 1757) Oxford's World Classics. Oxford University Press, 1914.
- Burtynsky, Edward. "Urban Mines." Edward Burtynsky Photo Project. Web. 1997. <[http://www.edwardburtynsky.com/site\\_contents/Photographs/UrbanMines.html](http://www.edwardburtynsky.com/site_contents/Photographs/UrbanMines.html)>
- Burtynsky, Edward. "China." Edward Burtynsky Photo Project. Web. 2004-2005. <[http://www.edwardburtynsky.com/site\\_contents/Photographs/China.html](http://www.edwardburtynsky.com/site_contents/Photographs/China.html)>
- Dow Jones Architects. "Rubbish In-Resources Out: Design Ideas for Waste Facilities In London." *Greater London Authority Report*, 2008.
- Fitch, James Maston. *Historic Preservation: Curatorial Management of the Built World*. Virginia: University of Virginia Press, 1990.
- Fredholm, Susan. "Evaluating Electronic Waste Recycling Systems: The Influence of Physical Architecture on System Performance." *Master of Science in Technology and Policy Thesis*. MIT: Sept 2008.
- Kreibe, Siegfried. "Current and New Electronic Waste Recycling Technology." *E-Waste Management: From Waste to Resource*. Ed. Klaus Hieronymi, Ramzy Kahhat, and Eric Williams. New York: Routledge, June 2013. 25-48. E-Book.
- Jordan, Chris. "Intolerable Beauty: Portraits of American Mass Consumption." About Project. Web. 2005. <<http://www.chrisjordan.com/gallery/intolerable/#about/>>
- Gregory, Jeremy, Susan Murphy, and Randolph Kirchain. "Evaluating The Performance of Recycling Systems." *E-Waste Management: From Waste to Resource*. Ed. Klaus Hieronymi, Ramzy Kahhat, and Eric Williams. New York: Routledge, June 2013. 115-133. E-Book.
- LeBel, Sabine. "Wasting the Future: The Technological Sublime, Communications Technologies, and E-Waste." *Futures of Communication*. Volume 1, Article 7. York University: 8-29-2012.
- Nye, David. *American Technological Sublime*. Cambridge, Mass: MIT Press, 1994.

Puckett, Jim. "A Place Called Away." *Basel Action Network*. Web, 2011.

SvR Design Co. "University of Washington Burke-Gilman Trail Corridor Study," University of Washington. July 2011.

*Department of Planning and Development*. "Seattle's Industrial Lands Background Report." City of Seattle. May 2007.

Washington State Department of Ecology. *Electronic Products Recycling Program*. Chapter 173-900 WAC.. Publication # 07-07-042, November 2007.

U.S. Environmental Protection Agency. *Electronic Waste Management in the United States Through 2009*. EPA Report 530-R-11-002. Office of Resource Conservation and Recovery. Prepared by ICF International, May 2011.

U.S. Environmental Protection Agency. *Management of Electronic Waste in the United States: Approach Two*. EPA Report 530-R-07-004b. Office of Resource Conservation and Recovery. April 2007.

Basel Action Network. "The E-waste Crisis." *E-Stewards*. Web. <<http://www.e-stewards.org/the-e-waste-crisis/>>

Washington State Department of Ecology. *E-Cycle Washington*. Web. <<http://www.ecy.wa.gov/programs/swfa/eproductrecycle/>>