Reconciling Human + Regional Scale Through the Infrastructural Landscape

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Abstract

Positioned in a floodplain beneath colossal peaks, the District of Squamish is in conflict with powerful regional forces. These forces operate at a scale that is far beyond human control, and often, human perception. As a result, battle lines have been drawn and the community is heavily reliant upon an extensive dike system supported by pump machinery. These mechanical guardians, however, are tucked away as shameful eyesores in rundown shacks and behind barbed-wire fences. Revealing this infrastructure and restoring its inherent didactic quality will reaffirm to the populace the monumental scale of the regional system in which they live.

Navigation

Images and illustrations in this document are by Jordan McAuley unless otherwise noted.

Machine:

“archaic : a constructed thing whether material or immaterial”
(Merriam—Webster, 2012)

Infrastructure:

“the system of public works of a country, state, or region”
(Merriam—Webster, 2012)

Landscape:

“A portion of the Earth’s surface that can be comprehended at a glance”
(J.B Jackson on an old dictionary definition, 1984: 8)

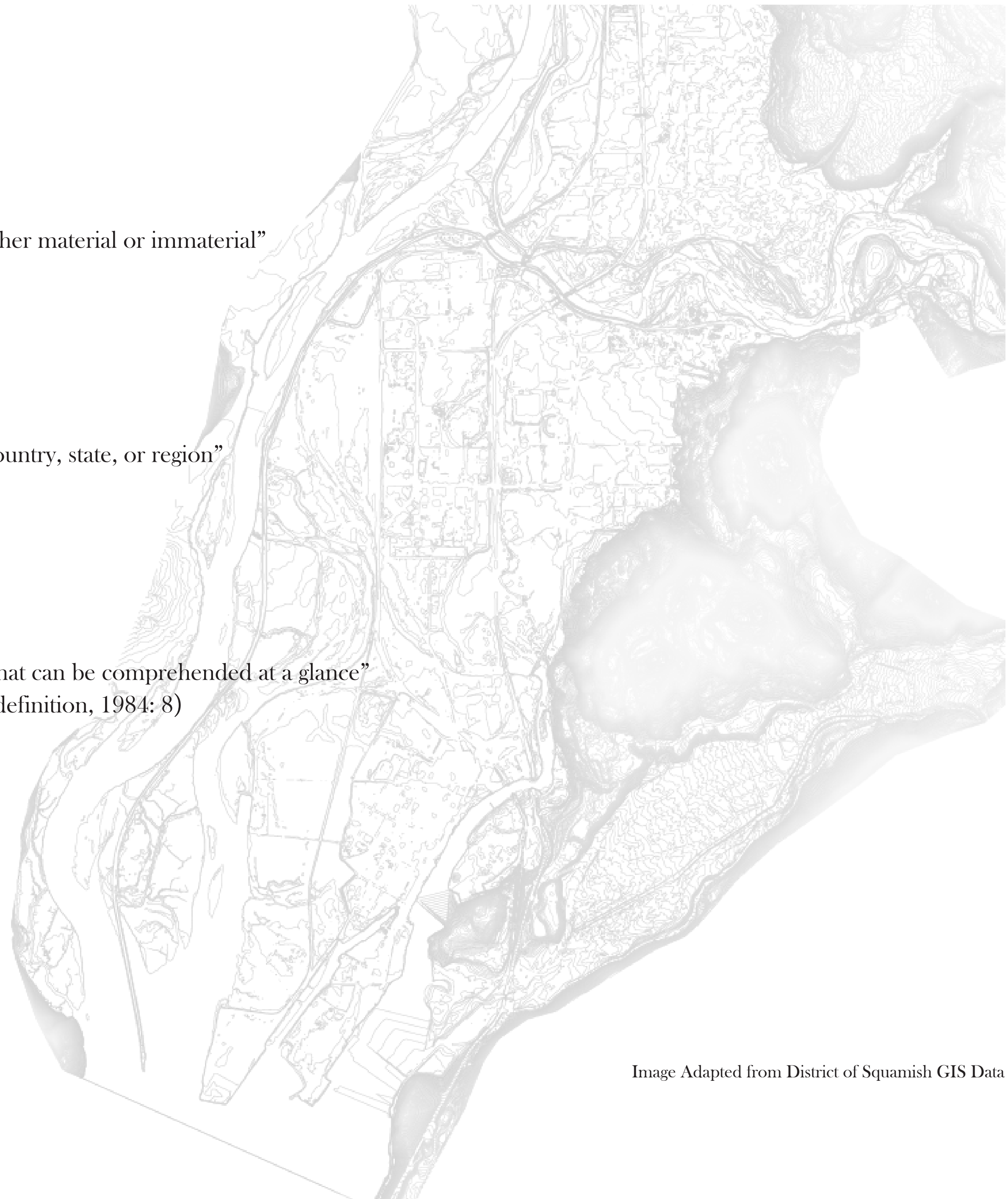


Image Adapted from District of Squamish GIS Data

I. The Issue

Reconciling Scale In Squamish

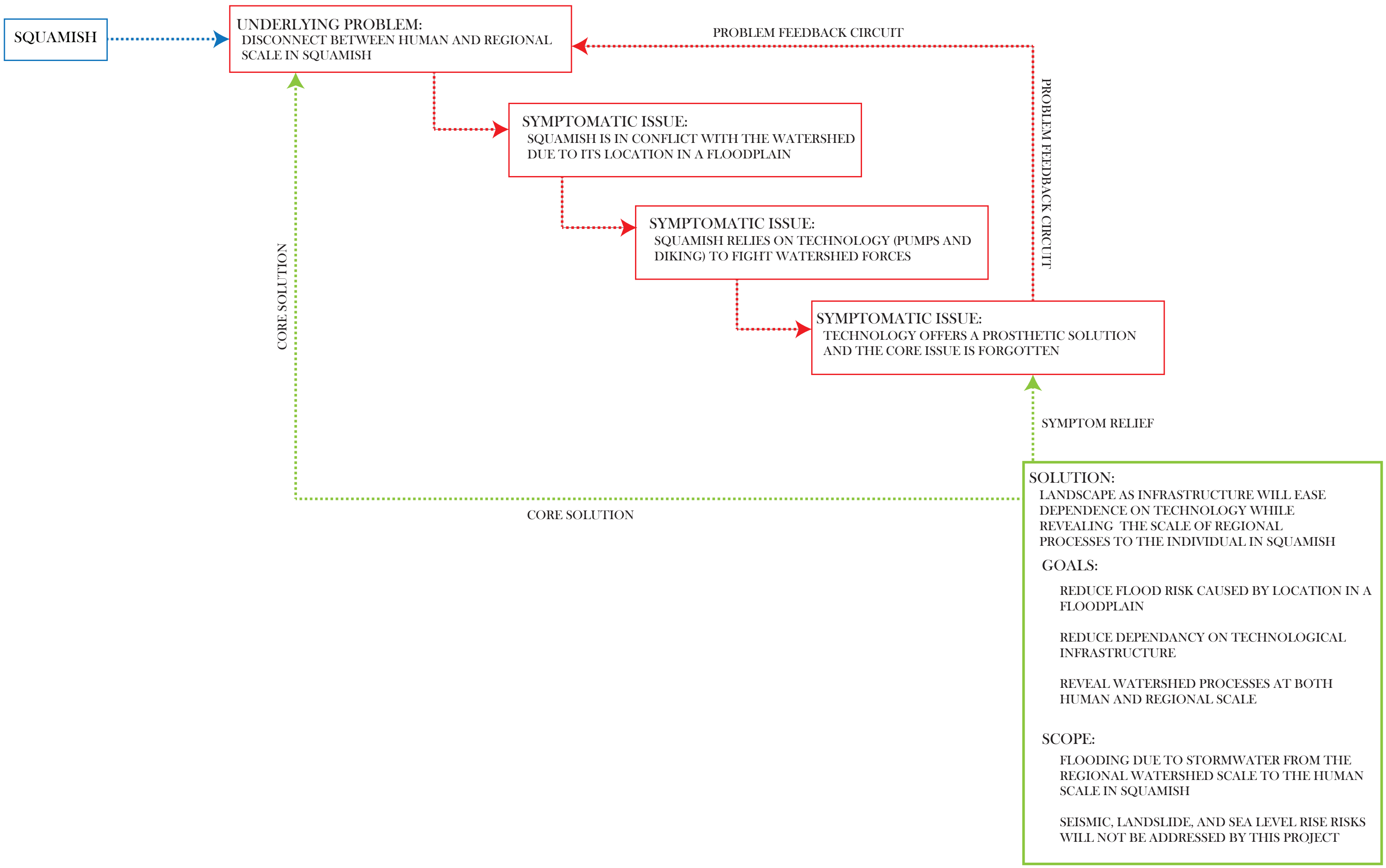
Lack of understanding of regional scale has placed Squamish, British Columbia in conflict with the exceptionally dynamic environmental forces of its region, and as a consequence, the community has become dependant upon technological infrastructure. Nestled in a floodplain, flanked by Howe Sound, and surrounded by five major river systems, a battle against floodwaters has been waged throughout the history of the District (Journeay, 2005). This struggle will only intensify as storms become more frequent, have longer duration, and are more powerful.

Squamish relies on extensive engineered infrastructure to hold its position amongst raging regional forces, and the District continues to layer further engineering on a system that is foundationally inadequate by installing additional pumps and maintaining a failing dike (Kerr Wood Leidal, 2005 and 2012b). This technical problem can be solved by using landscape as infrastructure to take the burden off of this mechanical system, however, this will not remedy the disconnect of which these engineered systems are a product. These systems are a defensive line drawn between humanity and the watershed. Establishing a harmonious relationship where there is now in conflict will require a solution that exceeds the mere transfer of workload from the machine to the landscape.

The problem lies in the misunderstanding of the place of Squamish in the midst of forces operating along an epic geographical timeline in the region. Battle-lines were drawn but were avoidable through the understanding of the regional context. This misunderstanding must be clarified. Humanity has used the landscape as a medium to contemplate the scale of the Earth and universe relative to the individual since its infancy, and this approach is what will provide a solution that goes beyond technical remediation. It will connect Squamish to regional systems both physically and experientially.

Landscape as infrastructure will ease dependence on technology while revealing the scale of regional processes to the individual in Squamish.

Illustrating the Issue



II. Reconciling Human + Regional Scale through the Infrastructural Landscape

"Humans are not the sole authors of the landscape. Volcanoes spew lava, remaking land; rain falls, carving valleys. Mountains, gardens, and cities are shaped by volcanoes and rain, plants and animals, human hands and minds" (Spirn, 1998: 17).

Observations in Squamish, B.C.

While exploring the streets of Squamish late this fall, I was struck by the exquisite white peaks surrounding the town. With the sublime but intimidating stone face of the Stawamus Chief staring down on me, I began to wonder: if this mountain were to simply fall over, what it would it look like from my point of view on the street? I could not begin to envision such a catastrophic occurrence, because the scale of it was far beyond anything in my own experience. From a contour map, the mountains spring up directly from the waters at the town's edges and cast long shadows over the settlement below. Yet from my point of view on the street, they seemed so far away – not literally, but in the sense that they were a matte painting separate from the human world from which I was observing them. My mind further wandered to contemplate whether the first people to inhabit this region struggled, as I was struggling, to grasp the true scale of their regional context. From my human perspective, I could not fully comprehend that these mountains and the town from which I was looking up at them actually occupy the same physical space.

While I am unsure that the first people to live in the area could comprehend the scale of this regional system, I am certain that those who established the town of Squamish in the early 1900's fared no better than I that afternoon in late 2012. You could not choose a less site adaptive location for a community. Due to the extreme geography of the landscape around Squamish, with its monumental peaks and the interaction of five major rivers, the potential energy in the region is astounding, and the regional processes that Squamish has always been in conflict with continue to bombard the community (Journeay, 2005).

This misplacement of Squamish was the result of the same lack of comprehension I was having when viewing the mountains that December afternoon, and it has resulted in technological solutions that only further disconnect the person from the greater regional systems.

(Figure 2.1) The dike sprawls across the District like a First World War trench system.

As I walked a portion of my study area – one of three major mechanical pump stations the community is dependent upon – I was confronted with the most significant physical divide between Squamish and its regional context. To reach Dryden Creek Pump House, I had to cross one linear barrier – Government Road – only to find an even more imposing one separating me from the Squamish River's edge – the dike. The austere geometry of the dike lining the Squamish River is nothing more than a parapet like that of a First World War trench (Figure 2.1). The metaphor of the trench is fitting, because to go "over the top" is to enter the thick of the battle between Squamish and its watershed.

The dike and pump system is what fights to keep at bay the incessant floodwaters that have been overrunning Squamish for the past century. And much like the trench hastily scraped out by the soldier under enemy fire, the dike is of poor construction and has required significant maintenance and reassessment (Thurber, 2008). This hastily drawn battle line is the work of a populace that found they were living against the flow of forces operating at a vastly larger scale and on an exponentially wider timeline than their own (Cannings et al., 2011). While we lack the technology to rectify this fundamental misplacement, infrastructure can be re-imagined to mediate, rather than fight, regional forces. The infrastructural landscape will not only relieve the dependency Squamish has on technology, but also establish the connection between human and regional scale that Squamish lacks.

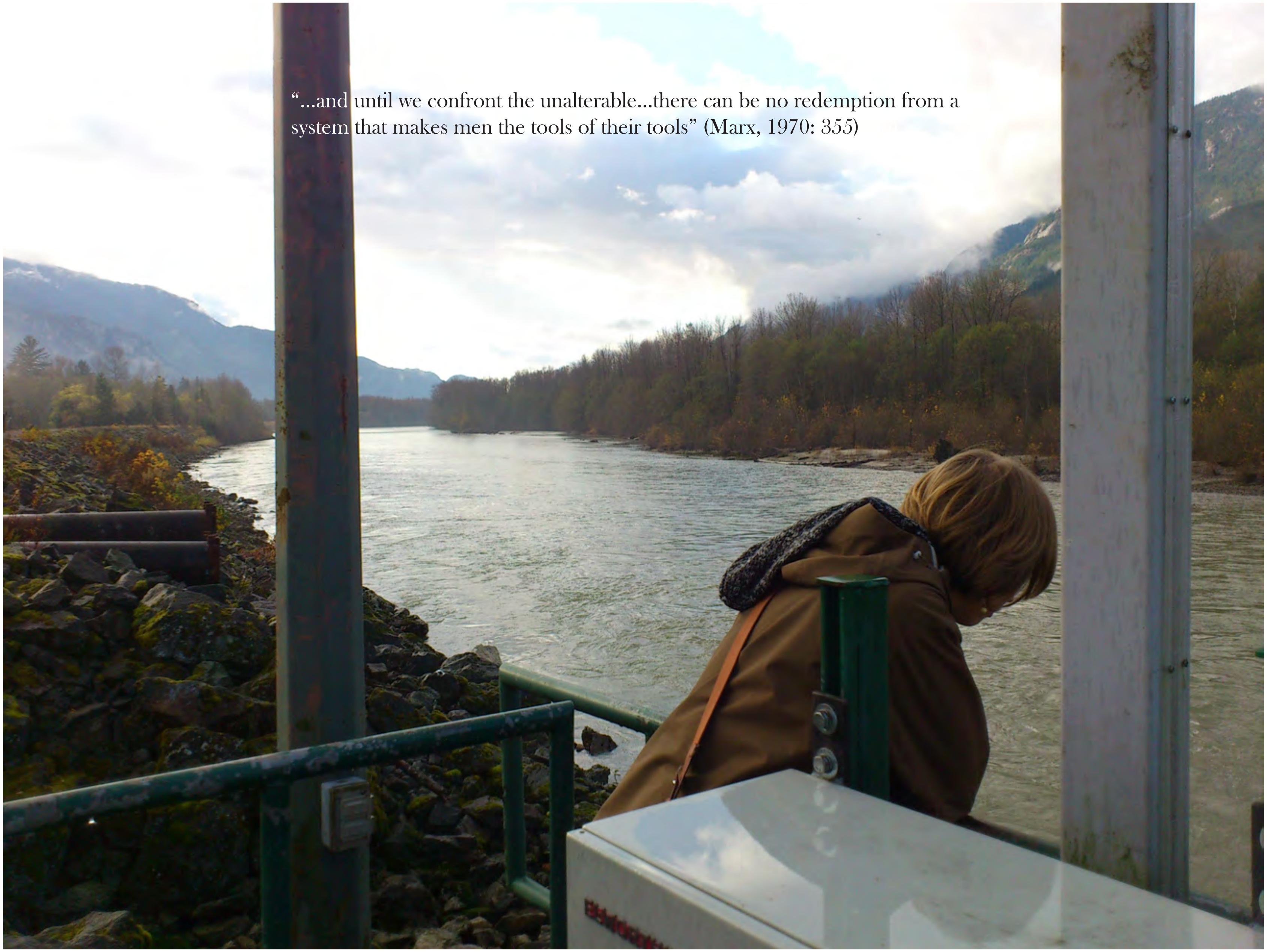
Enter the Machine

As machines grow in sophistication and power, the problems they can overpower grow in kind. Employing landscape to reduce dependency on centralized, engineered infrastructure has been the subject of significant discourse and design exploration. Humanity has struggled with infrastructure as the invited intruder since the first machines emerged as noisy, ironclad figures in the pastoral landscape (Marx, 1970). Conventional infrastructure strives for "high levels of productivity and operational efficiency to the virtual exclusion of other concerns" (Lyle, 1994: 37), and as a result, designing for aesthetics and experience around a system that has ignored anything but centralized function is exceedingly difficult. The discussion on the topic centres on the reconciliation of engineered infrastructure with the soft landscape, and generally promotes a balancing of the two "sides" in order to achieve a functional and aesthetic symbiosis of technical and natural elements. Decentralizing the workload placed on machines and engineering by augmenting these systems with landscape eases dependence on these artificial processes, however, this solution must push further to address the core issue.

It is well established that humanity has consistently built with no understanding of regional systems and forces (McHarg, 1992), and staggering advances in technology have exponentially enabled this tendency. As dependency on technology grows so does its impact on the fabric of communities, and as a consequence, "machines have insinuated themselves into our lives in ways that the futurists of the 1950's could not have anticipated" (Hayes, 2005: 502). As a result, people must inevitably live around the engineering required for their very existence amongst hostile regional forces. Confronting this inevitability is the burden of this proposed design undertaking: To confront this blindness to regional processes, landscape as infrastructure must not end at relieving dependence on machines, but be sculpted as medium through which to establish a connection between the very finite time and scale of the human being to the colossal geological time and scale of the regions we inhabit.

Human settlement in the Squamish area has existed for an unfathomably brief period in the regional geological timeline. The community struggles due a physical and perceptual disconnect that they have always had from the scale of the region they inhabit and the timeline along which it continuously changes. Mountains forged from magma over one hundred million years ago (Cannings et al., 2011) feed runoff from increasingly intense and frequent storms into the watershed in which Squamish is positioned. Lodged in the "confluence of five major river systems that have carved through towering glaciated peaks of an active volcanic belt, Squamish is no stranger to the concepts of natural hazards, vulnerability and risk" (Journeay, 2005: 1). Residents have faced regular and severe flood events throughout the history of the community as the rivers rise to challenge the place of Squamish as an obstruction in their floodplain.

To combat this incursion from surrounding water-bodies, the District of Squamish has employed an extensive dike system to armour its riverside edges, and the community relies on three major stormwater pump stations with numerous supporting floodboxes and floodgates to siphon water back into the rivers. This dike system represents very literal battle lines drawn between human and regional systems. Not only is this dyke system inadequate (Thurber, 2008), it literally separates the person in Squamish from the rivers they live amongst thereby obstructing physical access and perceptual connection to the regional watershed at large (Barron et. al., 2012). The form of the



"...and until we confront the unalterable...there can be no redemption from a system that makes men the tools of their tools" (Marx, 1970: 355)

Squamish waterfront is essentially dictated by defensive engineering.

Due this lack of understanding of the regional scale and forces that have been shaping the area for the last epoch and beyond, environmental forces, namely stormwater, have become the enemy. The town continues to fortify itself with technology and this situation shows no signs of improving as the municipality continues to layer additional technology on top of a fundamentally inadequate system. This is clearly demonstrated by its plans to acquire an additional pump unit at Dryden Creek Pump House (Kerr Wood Leidal, 2012b) and the series of upgrades to the entire flood defense system over the past two decades (Kerr Wood Leidal, 1992).

Now that these battle lines have been drawn and technology and engineering has made it possible for Squamish to maintain its existence in the face of powerful environmental forces, a simple question remains: How long can this go on? There is no "Deus ex machina" solution to transplant the sprawling District of Squamish from the floodplain to a more appropriate location within the watershed. Using the landscape as infrastructure can strike a balance, however, it will not address the fundamental disconnect between Squamish and its region.

Perceiving the Machine

"Most of the landscapes we experience in our daily lives are the piecemeal results of functional necessity rather than intentional design for human affect" (Thayer, 1992: 66).

As an end in itself, landscape as infrastructure will reduce dependency on machines and remedy the impact of conventional infrastructure in Squamish. But why is this necessary? Why do we constantly struggle to balance our lives around our own technological creations? Perception is key (Thayer, 1994). To understand our "response to the machine we must appreciate the intensity of [our] feeling for its opposite, the landscape" (Marx, 1970: 32). We see the landscape a place of escape and technology as its antithesis. Our Infrastructure is desperately held at arms length as it intrudes on our ideal pastoral landscape as a disruptive, ugly, necessary evil (Marx, 1970).

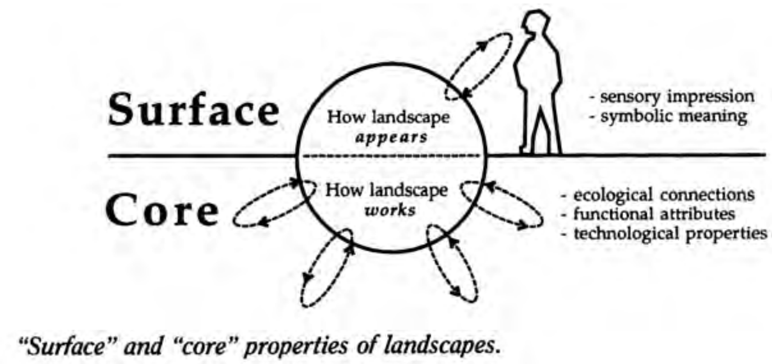
Robert Thayer has written extensively on how the human being perceives, and accepts or rejects, technology in landscape. In Gray World Green Heart (1994), Thayer has developed a triangular model to depict human attitudes toward technology in the landscape that is comprised of "Technophilia"(131), "Technophobia"(131), and "Topophilia"(131). In varied proportions, these attitudes "are embodied in simultaneous, tensile relationship to one another in nearly every landscape" (Thayer, 1994: 131): We simultaneously love our landscapes while loving our technology yet fearing its impact. Thayer's model evaluates landscapes by the degree to which they are influenced by visible technology and the degree to which the viewer considers this technology as destructive or constructive to a perceived landscape ideal. Whether or not the viewer's assessment is true or false is not the point (Thayer, 1994), what is key to our acceptance of an infrastructural landscape is how we perceive the technology present. Conflict arises, however, when an infrastructural landscape is the product of deceptive design practices: "the effect of our alienation and unfamiliarity is to make the industrial infrastructure seem all the more sinister" (Hayes, 2005: 504).

The benefits of technological systems receive far more attention than negative (Lyle, 1994), and this can hinder the individual in viewing the issue from a balanced perspective. Thayer has established that if technological processes are not observable, a landscape could be viewed positively while functioning in a manner that is destructive. Hiding mechanical elements is counter productive as it perpetuates lack of awareness and understanding of the systems that support our lives: "A healthy society with the ability to make informed decisions concerning its technological base will require the ability to live in harmony with that base. For such ability to develop, it is important that technology become an integral aspect of the common culture" (Lyle, 1994:45).

Principle 1: Infrastructure & technology must be integrated with the local community.

Thayer elaborates that deception in the infrastructural landscape is a "widening dislocation between *surface* and *core* values of the landscape in which we live" (Thayer, 1994: 140) (Figure 2.2). What he is asserting is that if a core infrastructural process that is occurring in a landscape is not apparent on the surface, the viewer is misled into believing that the technology present is not harmful – or worse – not there at all (Thayer, 1994). Designers must strive to balance the surface and core values of a landscape if its functions are to be accurately perceived (Thayer, 1994). It is therefore vital to reveal function deliberately and honestly in the infrastructural landscape.

We must confront our machines if we no longer wish to live around them. Designers must dispense with deceptive solutions if humanity is to come to terms with its machines. As Thayer states, infrastructural technology will always have some impact on the surrounding landscape, so the first step of overcoming humanity's addiction to technology is to leave denial behind and move towards acceptance of the problem (Thayer, 1994).



(Figure 2.2) "Suface" and "Core" properties (Thayer, 1994: 140)

Understanding the Medium: Balancing Machine + Landscape

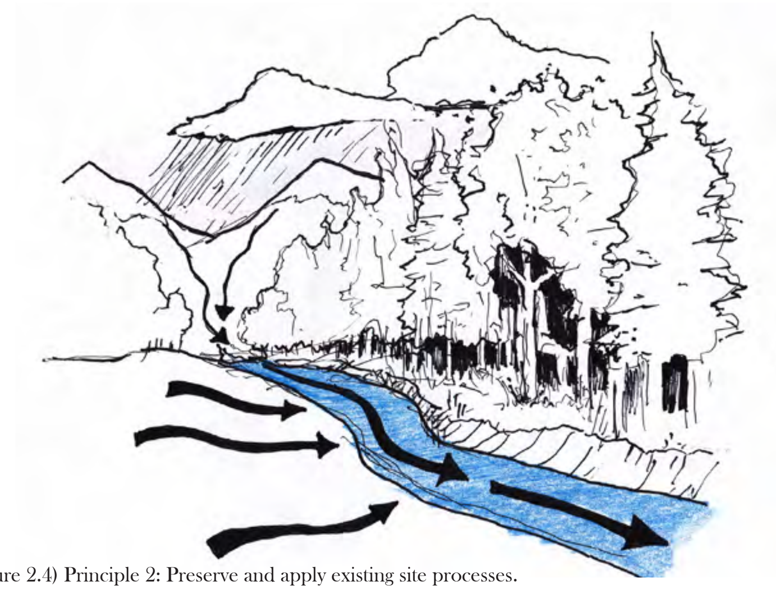
"Creativity enters the process in the key role of assembling diverse parts, often in unexpected ways" (Lyle, 1994: 37)

While accepting technology means applying it transparently, care must be taken by the designer not to swing to far to the opposite end of the spectrum and create an idol out of technological elements. As Rosenberg states: "technology's visibility should not be the goal, but rather a consequence of the design approach" (Rosenberg, 1996: 102), and if informed by the specific landscape it occupies, it becomes far more significant to the people of a community (Rosenberg 1996). Therefore, when designing the infrastructural landscape, the designer should let visibility of machinery be proportionate to the workload it shoulders and to the processes of the landscape system of which it is a component. If technology is decentralized and its excess removed, that which remains will function as supporting elements in a holistic infrastructural landscape.

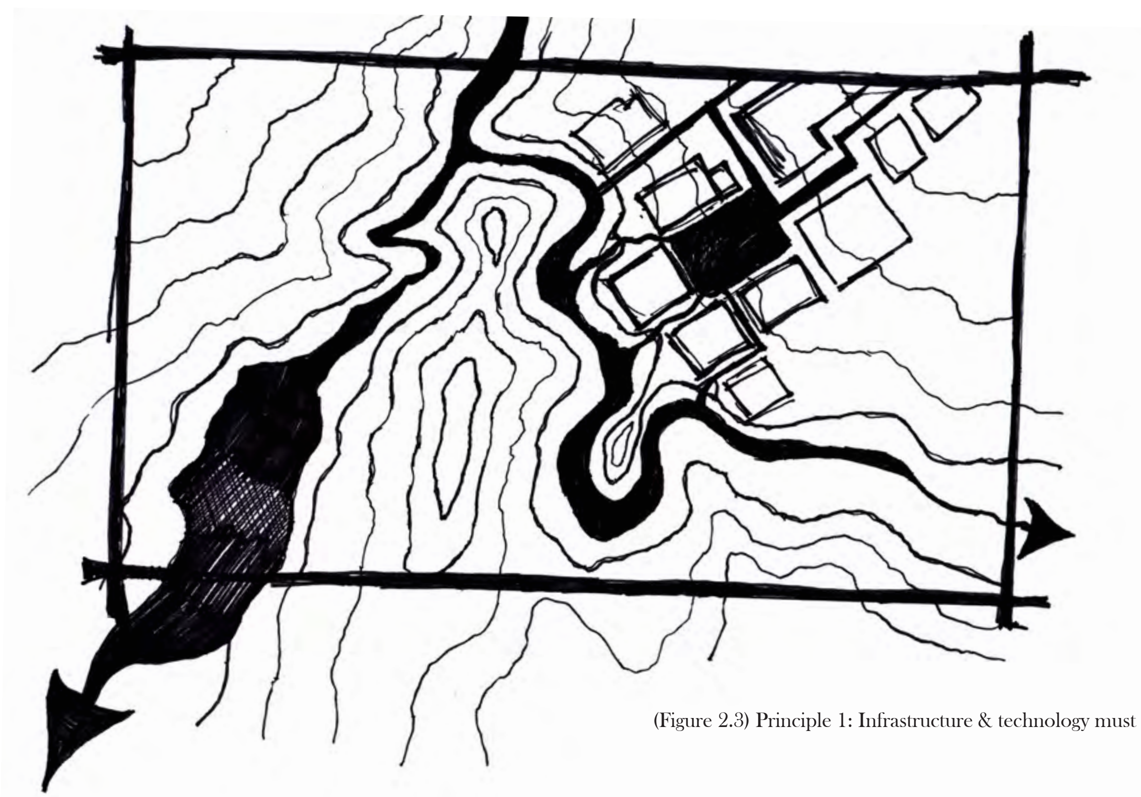
This holistic system requires not only the careful moderation of technology, but respect and understanding of existing landscape functions. The designer must "maintain local structure and function, and [must] not reduce the diversity or stability of the surrounding ecosystems" (Thayer, 1994: 243). The addition of technology into a landscape system can exact a grave toll on existing environmental processes and structures. Local systems must be what dictate what technology is necessary and the extent of its presence. Local environmental processes have shaped themselves to accomplish almost all of our vital tasks (Lyle, 1994), and destruction of these processes merely creates more communities that are dependant on technology to scrape out an existence in their regions. We can read in its observable processes how the landscape has been, and still is, functioning across

Principle 2: Preserve and apply existing site processes the geological timeline (Marsh, 2010). Once existing site processes are understood, we may use and emulate them to provide an infrastructural service. "By shaping the medium (the environment), we can guide the flow" (Lyle, 1994: 43), and the landscape can be sculpted to perform tasks in order to reduce or eliminate the need for technological interventions. This will bring tasks such as stormwater management out of the pipes and to the surface where it is observable and tangible to us, the inhabitants of the region.

And let us not forget ourselves. We, the inhabitants of the region, deserve our due consideration in the design of the infrastructural landscape. Designers must take care not to damage the community an infrastructural landscape is intended to serve (Thayer, 1994) lest we continue to be bullied by our own basic services. Designing the landscape as infrastructure gives us the opportunity to integrate

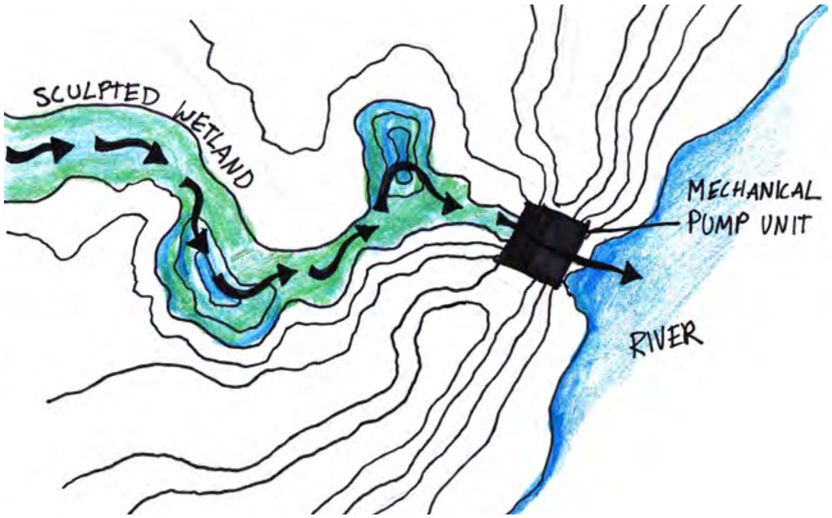


(Figure 2.4) Principle 2: Preserve and apply existing site processes.



(Figure 2.3) Principle 1: Infrastructure & technology must be integrated with the local community.

(Figure 2.5) Principle 3: Sculpt the landscape to direct infrastructural processes.



infrastructure into the urban fabric of a community. Stormwater infrastructure is again a pertinent example, as urban stormwater features such as bioswales and detention ponds are often employed for aesthetic value amongst the streets of our cities (Echols and Pennypacker: 2008). This exposure of infrastructural systems has an effect far beyond aesthetics, however, in that it brings the processes of the regional watershed to street level making them accessible to us in our daily lives.

In order to connect to region through infrastructure, the days of living around technology must come to an end. Infrastructure must integrate with landscape processes to serve communities rather than dictate their civic form and flows. Using the methods discussed in this section will enable the design of infrastructural landscapes where the use of technology is in balance with our communities and with landscape processes. But these balanced systems can provide us with a much greater service - they can be the medium through which to re-establish the physical and perceptual connection to regional systems that our lack of perception and understanding of scale has cost us.

Sculpting the Medium: Reconciling Scale in Squamish

"...a people's relationship to landscape is one of the most significant expressions of a culture, in many respects equal in importance to the relationship to the sacred" (Beardsley, 1984: 8).

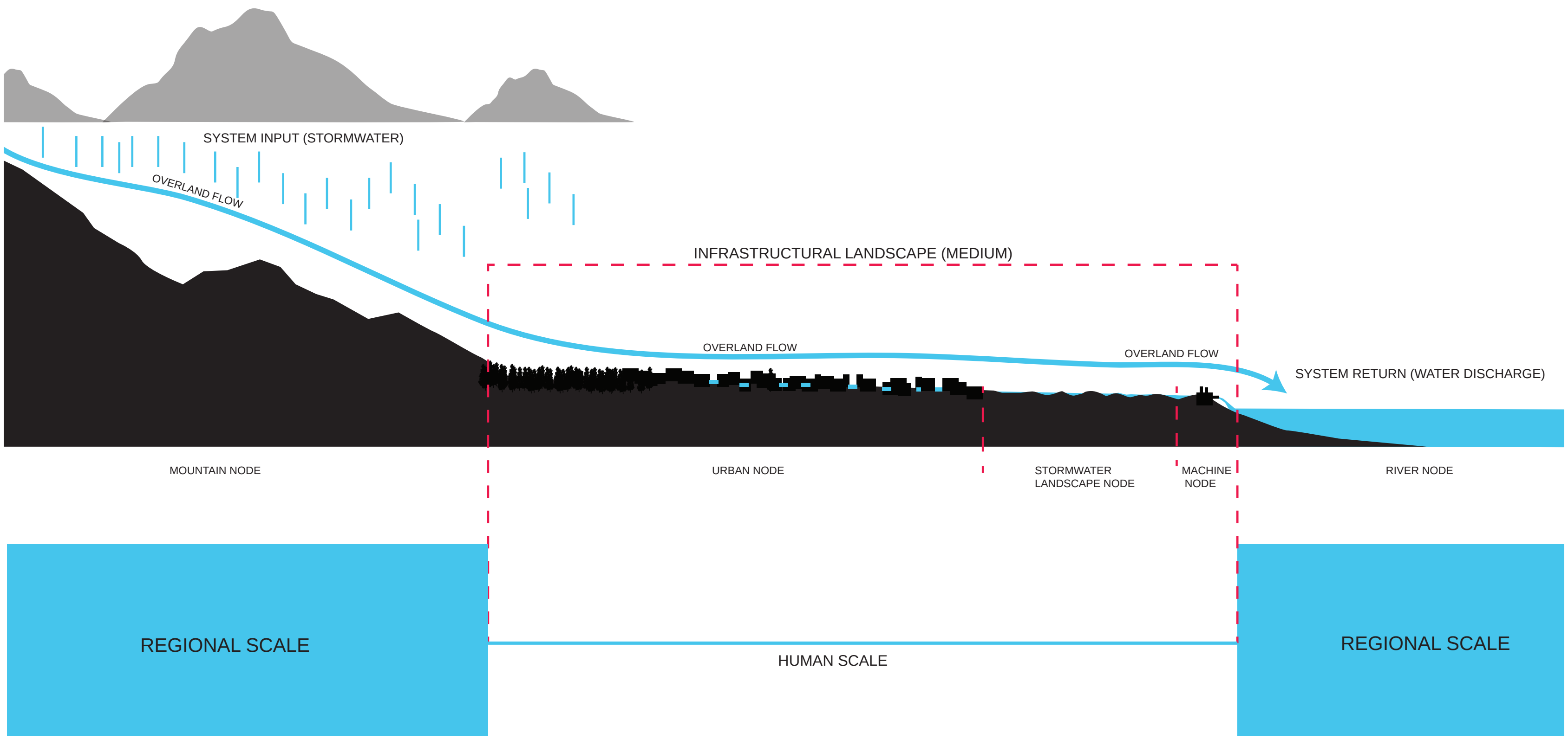
We have contemplated the workings of the environment and attempted to understand its processes since the first days of our species. From before the cave paintings in Lascaux, to the Stonehenge alignment, to modern earthworks and contemporary environmental art, we have been recording and representing the universe and its processes in the landscape. We use the land in this expressive, artistic manner in the hope of reconciling ourselves with the universe around us (Beardsley, 1984: 9). We have always seen the landscape as a connection to a scale greater than our own.

In Squamish, "earth and mountain have lost their power to evoke civic action to join with the geomorphic land forms to construct a collaborative terrain" (Morrish, 2005: i). The form of the town does nothing to establish a connection to the region, as it has become informed by technology put in place to fight regional processes. In *Civilizing Terrains: Mountains, Mounds, and Mesas* (2005), William Morrish writes of the "sacred mountain" as an essential connection between any human settlement and the cosmos. He explains how certain connecting earth structures, especially mountains, have been constructed on sites to establish a connection between "universal and local" (Morrish, 2005: v). Squamish is fortunate in that it has no need for artificial connections to the heavens, as the community is surrounded by one of the most spectacular mountain ranges in the world. But the connection these landforms are waiting to provide remains unharnessed. The blindness to regional forces and the connections they represent has placed Squamish in a position where the features and processes of the regional watershed are not windows to the cosmos, but an enemy fighting to wash the town from the floodplain it has been misplaced perilously upon.

Flooding caused by stormwater runoff from an extremely steep and vertical watershed is the most destructive environmental force acting on Squamish (Journeay, 2005). Using the infrastructural landscape can minimize this threat by reducing the velocity of flow and increasing storage and pervious surface. In doing so can be found an opportunity to repair the existing perceptual disconnect. The flow of water through each node of the watershed system can be exposed and presented to the viewer through the infrastructural landscape by emphasizing its inputs, outputs, and transitional nodes along the entire narrative of the regional watershed (Figure 2.6).

Principle 4: Use the mountains to conceptually connect the individual to regional scale.

Stormwater begins its narrative in the highest points of the Squamish River watershed. The mountains cradling Squamish, forged over millions of years, represent the extreme vertical node of the system and the potential energy stored within. They also represent the greatest connection Squamish has to regional time and scale: "The sloping terraces and contours of a mountain slope or the steep incline of canyon walls can be viewed as stairways down into the earth and upward to the heavens" (Morrish, 2005: Drawing 40). These grand peaks should be emphasized in the design of the infrastructural landscape by establishing a viewshed with key lookout points that

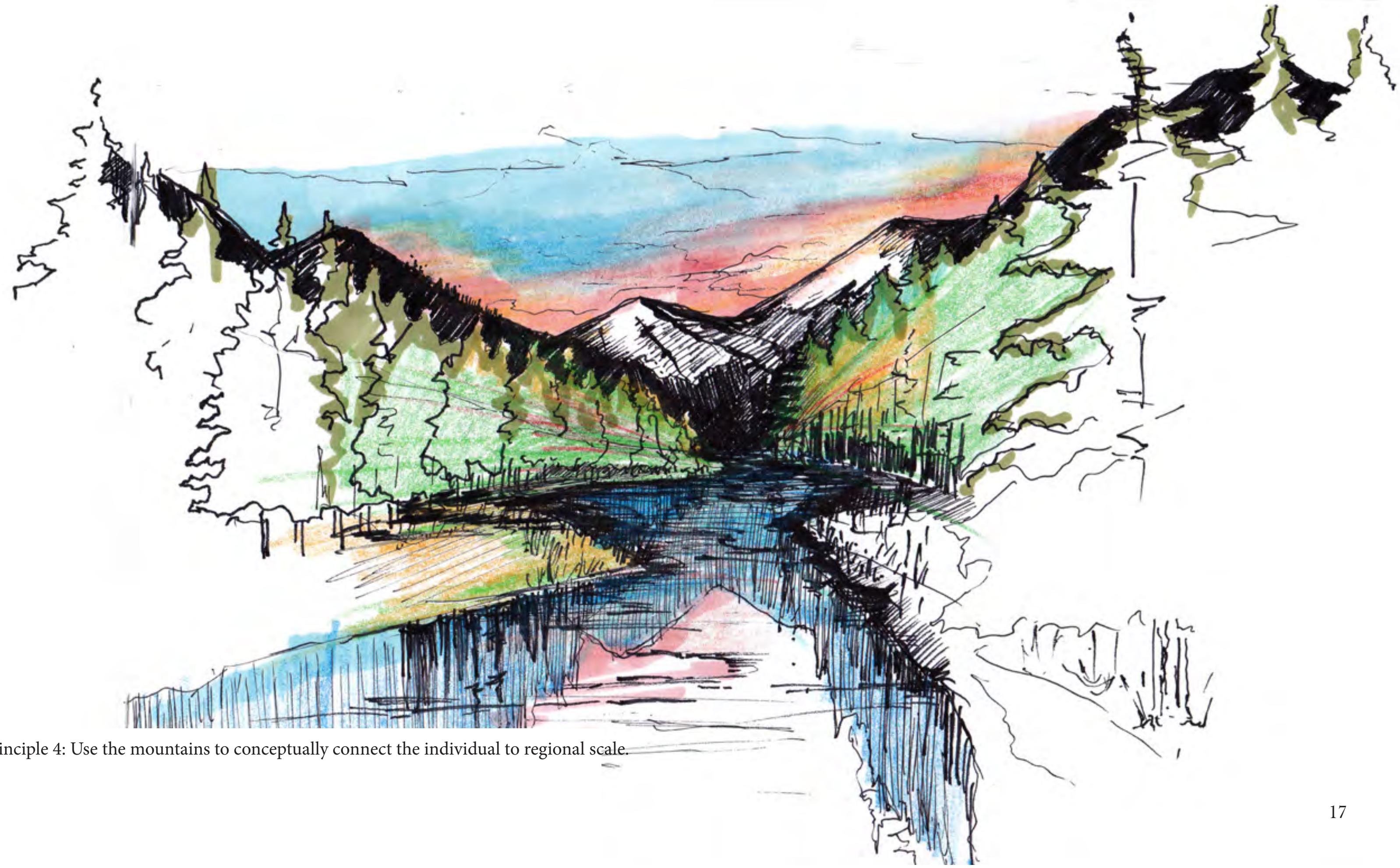


(Figure 2.6) Human and Regional Scale Transitions in the Watershed

Principle 5: Expose watershed processes occurring within the urban fabric.

encourage the viewer to reflect on these colossal landforms as they rise up to meet rainclouds forming at their peaks. This will forge an understanding of how water enters the system and of the shear scale at which the watershed operates.

As water flows down these mountains with great velocity, it enters a node in the system that consists of the built-up area of Squamish. Beginning at the foot of the mountains and extending across the floodplain, the urban fabric of Squamish is very much part of the regional watershed (Hough, 1984). The town of Squamish should emphasize its node in the system by employing "designs that call attention to stormwater management in ways that educate and delight those who visit" (Echols and Pennypacker, 2008: 268). Much of the community's drainage processes already occur on the surface in ditches and swales, which presents far greater opportunities for the redesign of the form and flow of this infrastructural system than if it were entirely buried in underground pipes. These surface drainage systems should be designed in a manner that encourages individual interaction with this system at the street level using as many of one's senses as possible. This can be accomplished through the use of artfully designed bioswales, sculpture, and materials that emphasize the natural system that is functioning right in the streets (Echols and Pennypacker, 2008: 280). We must be able to see, hear, touch, smell, and perhaps even somehow taste the water that is flowing like life-blood through the



(Figure 2.7) Principle 4: Use the mountains to conceptually connect the individual to regional scale.

urban fabric of Squamish. Then we will understand that the urban stormwater infrastructure is just a node in a regional system.

Following the watershed to the outskirts of Squamish we enter a new node in the system — the open landscape between the town and the river's edge. It is here that the designer has the greatest freedom to represent the regional watershed. Without most of the constraints inherent in the urban area of Squamish, the designer is able to create a space rich with landforms, plants, waterways and structures that

Principle 6: Celebrate watershed processes in park spaces.

are devoted to the expression of stormwater: "The revelation slowly dawns on anyone walking about the pond, following the course of the stream until it disappears into the side of the hill, and then walking up the spiraling path that leads through grasses and cedar trees to the top. This is how stormwater works" (Raver, 2011: 93). The design of a stormwater landscape in this node will provide a destination where artful expressions of topography have enhanced the structure of the dike and have created captivating water bodies, reflective of regional character, that detain runoff to ease dependency on the pump machinery beyond.

(Figure 2.8) Principle 5: Expose regional processes occurring within the urban fabric.

Principle 7: Accept and respect essential technology.

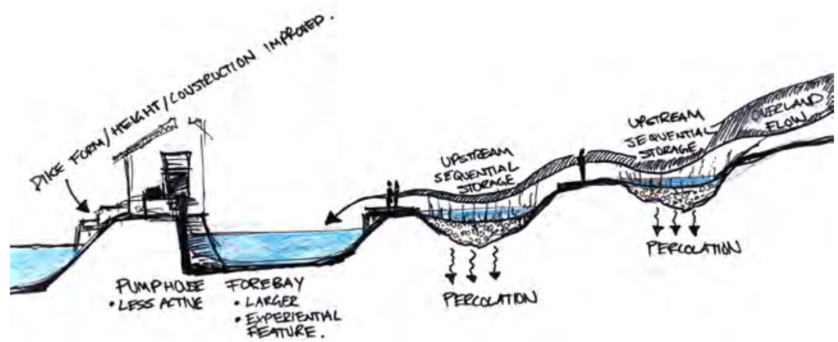
The final node of the Squamish stormwater narrative is the pump machinery embedded in the dike. These are critical pieces of stormwater technology in Squamish – they literally bail out floodwater and purge it back into the river. Thayer is correct in his assertion "we cannot kill the technological tyrant only tame it" (Thayer, 1994: 324). Squamish is dependent upon these pump units and cannot simply dispense with them. As such, these pieces of technology should be accepted and their vital functions respected. There is an opportunity for Thayer's "tyrants" to become guardians of the community. If enough stormwater load is taken off of these machines by the landscape, they will only animate on very rare occasions, and if components are no longer hidden from view in run-down shacks, the individual will then understand the importance of the service they perform. Perhaps they will then become like technological "golems", clad in wires, pipes, and steel, which awaken to defend Squamish in times of severe danger. The activation of these machines will become a metaphorically rich performance – a climax in the stormwater narrative where water leaves the human scale of the infrastructural landscape and returns to regional scale in the rivers.

Concluding Thoughts

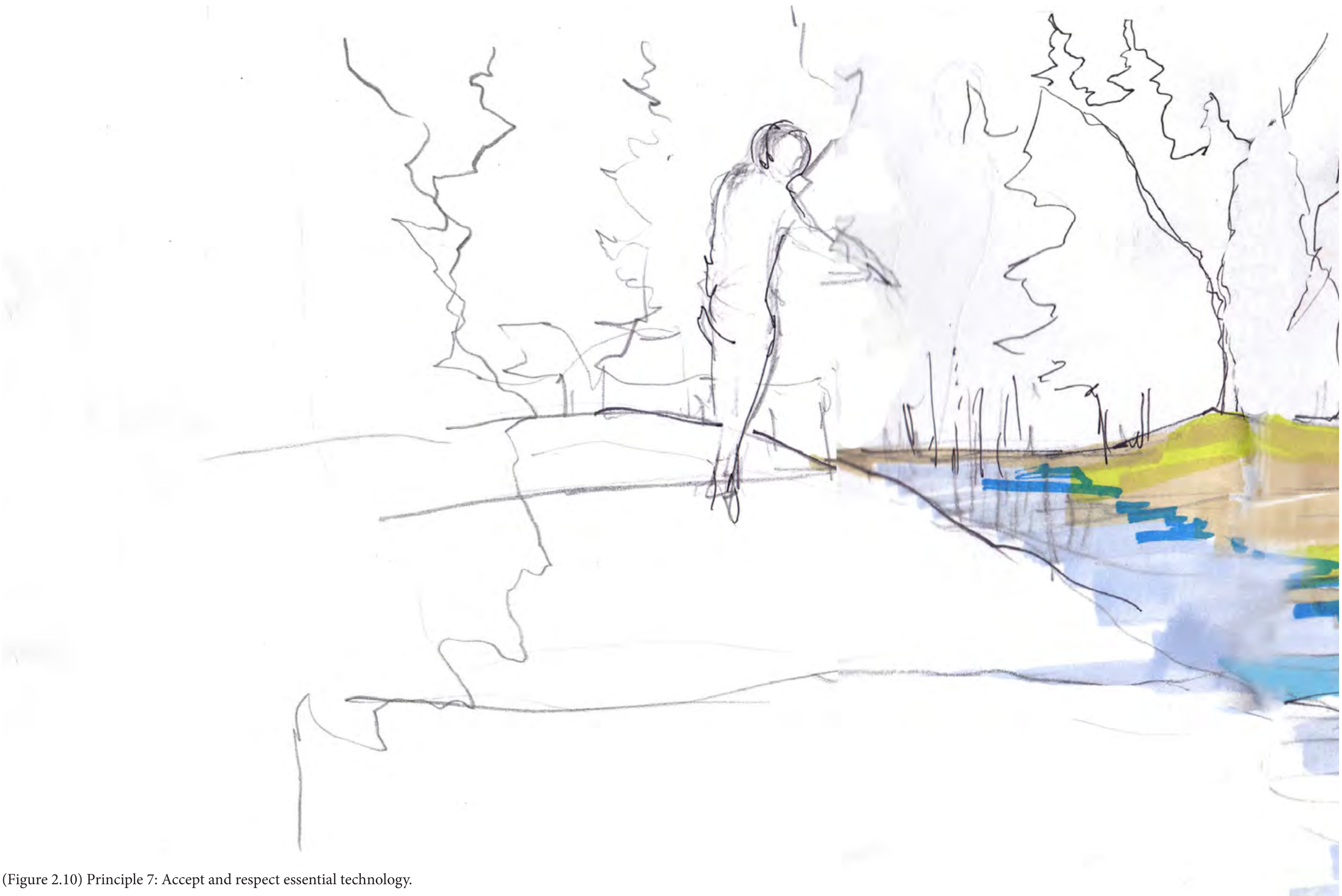
The tale of misplacement will continue in Squamish and countless other cities if we continue to ignore what regional systems are telling us. We must understand that the regions we build our communities within are operating on a scale that dwarfs our own and along a timeline in which we are a brief instant. We have ignored regional processes at our own peril, because our technology has grown at a rate that has enabled us to do so.

This technology has come at a steep price. We are now forced to live around the systems that support our lives. The perceived ugliness of our machines is hidden behind facades of deceptive design in our attempts to deny what has become necessary to maintain our misplacement in our regions. We must not hide our technology. We must understand that we are repulsed by our own creations because they threaten the image of a perceived ideal landscape that is not attainable in our machine-dependant reality.

Designing the landscape to serve as infrastructure can strike a compromise with our technology. If we learn to stop hiding our machines and living around our infrastructure, we can begin to remove the excess and replace it with processes that are already occurring in the landscape. This will enable us to design amenity into our infrastructure, as function will become decentralized across a holistic system. But we can ask more of the infrastructural landscape than amenity. We can repair the disconnect that exists between human and regional scale. By using the infrastructural landscape as a medium to perceive environmental processes, we will perceive our place in the systems of which our communities are part. It is then we will understand our own scale and time relative to the regional narrative, and then we will understand why we have lived in conflict for so long.



(Figure 2.9) Principle 6: Celebrate watershed processes in park spaces.



(Figure 2.10) Principle 7: Accept and respect essential technology.

Like metaphorical golems, pump machinery will now animate to protect the town only under the most dire of flood events.

III. Precedents

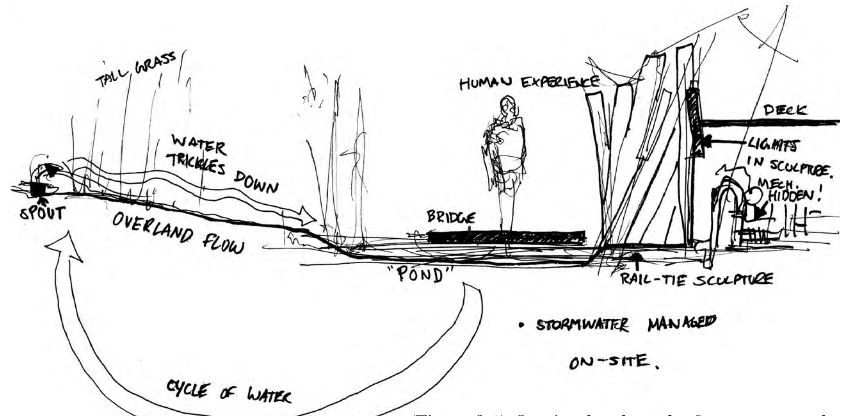
Tanner Springs Park
Atelier Dreiseitl, Portland, Oregon, USA

This work by Dreiseitl, while not serving a significant infrastructural purpose for the City of Portland, represents an approach to the handling and celebration of stormwater that is greatly relevant to my project. “Stormwater management is a central feature”(Hazelrigg, 2006) through which the park visitor is given insight into Portland’s history in the region. While the park is too small to serve as stormwater infrastructure beyond its surrounding sidewalks, the park is a self-contained system that largely captures and cycles its own stormwater in a manner that references the past processes of the site (Hazelrigg, 2006).

Tanner Springs Park is located in the Pearl District of Portland, an area that was once a wetland lake fed by streams from hills southwest of the city (Portland Parks and Recreation, 2012). This system was eventually buried and piped due to industrial and rail expansion in the city (Portland Parks and Recreation, 2012). This project resonates in my own for Squamish in that Tanner Springs is likewise addressing lack of human understanding of regional systems (Hazelrigg 2006).

Water bubbles up from a small spout in the highest area of the park, and trickles down through vegetation as it winds its way through the park (Figure 3.2). As I walked through subtle paths in the tall grass, I periodically encountered this stream at my feet. It eventually makes its way into the wetland pond, where the visitor can walk across it on the walkway. Dreiseitl has skillfully established a narrative where the viewer can interact with water in the system in key areas where it changes speedand form – from a trickle to a pond. I was disappointed that the final trip of the journey, where the water enters machinery to complete the cycle back to a trickle, is concealed

I am critical that the site does not transparently portray the mechanical elements it relies on to complete the cycle of water through the site.



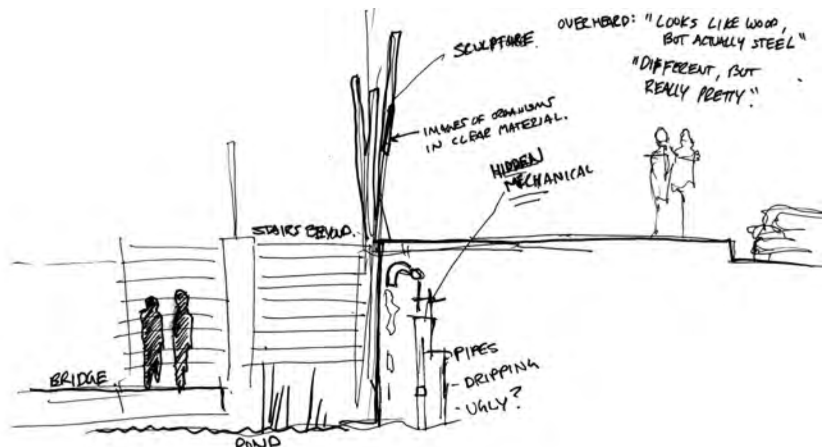
(Figure 3.1) On-site sketch study: Stormwater cycle


(Figure 3.2) Pipes are hidden from the viewer under the boardwalk and behind the sculpture

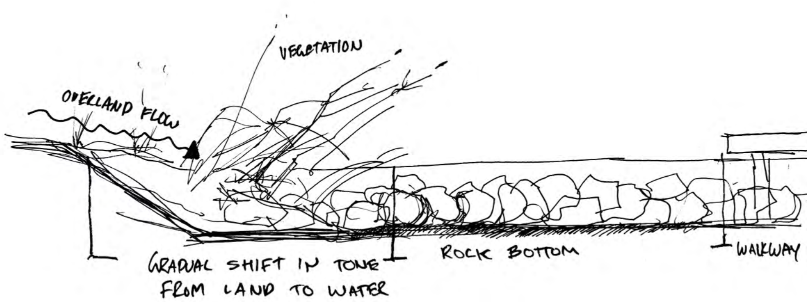
(Figure 3.3) Tanner Springs reveals forgotten watershed processes in Portland

Although it is obvious that machinery must be involved somehow, its concealment implies it is unsightly, and instead an illusion of a "natural" system that is independent of machinery has been created (Figures 3.1, 3.2, & 3.4).

The concept of reconnecting to a wetland system lost to industry (Hazelrigg, 2006) would be stronger if the machines that are required to restore this process were exposed as the "prosthetics" they are. Had this been the case, this park would stand as a place of atonement – where humanity, at a loss to truly recreate a wetland in the middle of Portland, has used its machines to revive a lost piece of a regional process.



(Figure 3.4) On-site sketch study: Hidden machinery



(Figure 3.5) On-site sketch study: The wetland ecotone

In addition to the conceptual examples outlined above, the use of materials at the detail design level in Tanner Springs is rather skillful and an example worth following in my own work:

- Historic elements such as the use of old rail ties memorializes the industrial past of the site.
- The use of native wetland plants is vital to the function and aesthetic of the project.
- Imagery of organisms that once inhabited the site hand-drawn by Dreiseitl on class pieces installed in the rail-tie sculpture.
- The narrative approach to stormwater flow. The viewer should perceive the story the system is telling by following the water.
- Emphasis on materials and quality detail design


(Figure 3.6) An encounter with water flowing through the tall grass

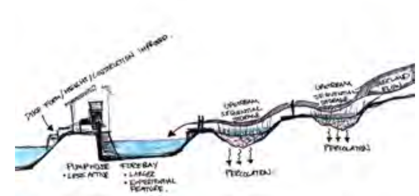
(Figure 3.8): Benches create a performance-space around the artfully-designed spout

(Figure 3.7): Organisms hand-drawn by Dreiseitl connect to an ecological past

Ningbo Eco — Corridor
SWA, Ningbo, China (Not Yet Constructed)

While this work is currently in the design process, it serves as a very current and highly relevant precedent for the experiential potential of the infrastructural landscape. The objective of this project is to “serve as a living filter, actively improving the condition of the city’s water resources on a daily basis” (Hung et al., 2011: 78). While its purpose is not reducing flood risk from stormwater, the programming and form of this project are highly similar to the appoach I am interested in taking in Squamish: “The proposed plan revitalizes and regenerates the environments to create a green lung for the city, providing recreation, education, and cultural facilities (Hung et al., 2011: 78).

The Ningbo Eco-Corridor will utilize topography and waterbodies to guide the flow of water and expose it for human experience (figure 3.11). I am interested in such an approach for a stormwater earthworks space between the urban node Squamish and the river. The topography fluxuates in cross-section (figure 3.11) between hills and lowlands, creating a dynamic network of wetlands (figure 3.10). The result will be a landscape that explores water through playful yet



Above: (Figure 3.9) The fluctuating wetland approach SWA proposes is quite similar to the direction I am taking in Squamish.

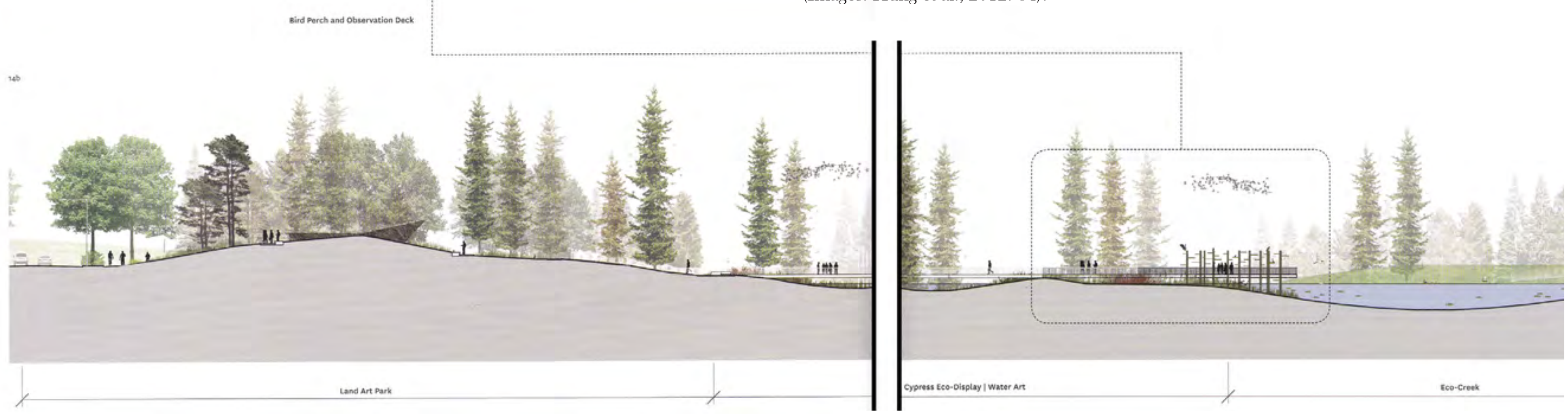
Left: (Figure 3.10) Spread across a 100 hectare site (Hung et al., 2011), the Ningbo Eco-Corridor will express an interesting interplay between land and water in its network of wetlands (Image: Hung et al., 2012: 80).

functional forms.

As this project has not yet been built, I am hesitant to rely on it for more than ideas for general moves, as it could turn out to be unsuccessful upon its completion. In addition, the scale of this project is far larger I intend to focus in Squamish. It will however be useful to reference when I establish the overall scenario that will inform the design of my specific site. Lastly, this project does not provide significant guidance toward the goal of reconnecting to regional systems. Despite this, SWA does offer an intriguing approach for integrating the infrastructural landscape into the community.

Strategies from this project I am interested in extracting for my own intervention in Squamish include:

- The use of rolling topography that fluctuates between high and low ground to create areas of stormwater detention in Squamish.
- The use of wetlands to provide water filtration and connection to local ecology.
- The use of lookout points such as decks and towers to provide prospect over the system and of the region beyond.
- The use of a variety of edge conditions along the waterfront. The dike in Squamish cannot remain a monotonous mound along its entire length. Varying its form will forge a unique narrative of experiences.



Left and Below: (Figure 3.11) The artful use of topography proposed by SWA will provide both emenity and infrastructural function (Images: Hung et al., 2012: 84).

Water Pollution Control Laboratory
Murase Associates, Portland, Oregon, USA

Murase's design of this treatment facility is highly consistent with the approach I intend to take in Squamish. Like my area of exploration in Squamish, Murase's site is located beside a major river and is surrounded by views of spectacular topography. This project is essentially a stormwater detention basin that has been designed artfully to consider function as well as human experience, aesthetics and education ("Murase Associates: Water Pollution Control Laboratory", 2002). Like Murase, I intend to use the landscape to detain and direct the flow of stormwater to the pump stations in Squamish while revealing the process to the viewer.

The ingenuity of detail design in this project is very impressive, and the interaction of hard and softscape elements is carefully choreographed. Stormwater flows of the roof top through protruding scuppers that allow it to freefall into bioswales below ("Murase Associates: Water Pollution Control Laboratory", 2002). The detention basin is sculpted from two conjoined circles, and contains a curved flume that is suggestive of a glacial moraine ("Murase Associates: Water Pollution Control Laboratory", 2002). Such use of regional forms at the site scale is an excellent method to connect the stormwater processes at the site scale to those at the largest scale of the watershed.

Murase uses native wetland planting to great effect. "These plants naturally facilitate sedimentation and biofiltration to ultimately return clean water to the Willamette" (Murase Associates, 2012: np). The power of vegetation to perform both technical and aesthetic services should not be ignored as I proceed with my design for Squamish.

Noteworthy strategies to extract from Murase's work include:

- The detention basin in general can be a highly aesthetic and meaningful element while providing a valuable stormwater service

- Architectural elements should be integrated into the stormwater system so that the flow of water is seamless from the built site to the soft site.

- Detail design is an opportunity to embellish stormwater processes. The scuppers and flume Murase has employed are devices to keep in mind for my own treatment of the dike and pump technology in Squamish. Such devices could make the movement of water to and from the machines highly interesting.

- Native wetland plants can be powerful tools for the cleansing of stormwater, and can significantly enhance the aesthetic value of the infrastructural landscape.

(Figure 3.12) Vegetation can treat stormwater while enhancing site aesthetics (Image: "Murase Associates: Water Pollution Control Laboratory", 2002: 57).

(Figure 3.13): Murase's design is not only a functional detention basin but a place the celebrates regional watershed processes at the scale of human experience (Image: "Murase Associates: Water Pollution Control Laboratory", 2002: 56).

The Lightning Field
Walter De Maria, New Mexico, USA

Facing Page: (Figure 3.15) The Lightning Field activates as a medium between human and regional scale (Image: Beardsley, 1984: 61)

While certainly not an infrastructural landscape, The Lightning Field is a valuable precedent for connecting scales through the landscape. This grid of 400 stainless steel poles was created by De Maria for the purpose of celebrating the power of lightning in a remote landscape near Quemado (Beardsley, 1984: 62). A classic work of land art, this peice is an iconic use of landscape as a medium to connect to the workings of the universe.

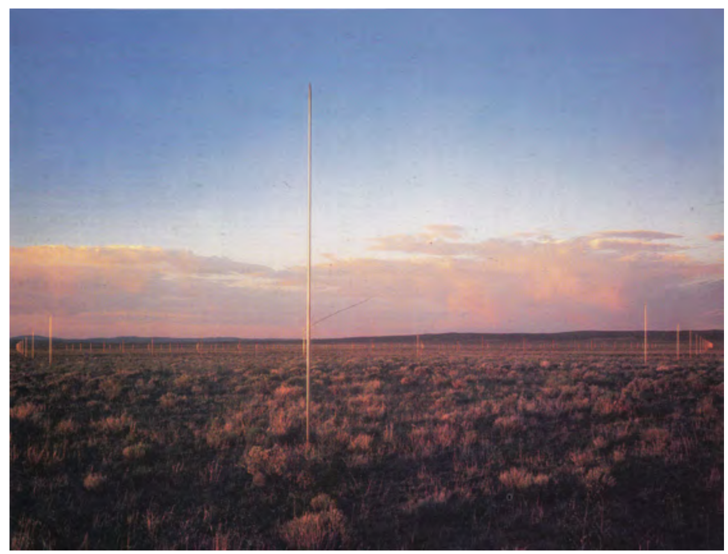
I am most interested in this site for its use of the mechanical device, even as one as simple as a steel pole, to channel an environmental vector such as lightning. The power of the atmosphere strikes the pole and is tranferred through it to the landscape and to the human scale of the viewer. These machines are not inert without lightning, however, as they vanish in the day and reappear to reflect the light of dusk and dawn (Beardsley, 1984: 62).

In Squamish, the pump units are serving the same role as De Maria's lightning rod. They serve as a channel for regional forces. When water enters the pump, regional forces have been compressed to a scale of a human machine before exploding back to regional scale when they are deposited back into the river. The human machine is able to breifly compress and contain regional scale. The concept behind the lightning rod is no different, as electricity is compressed as it travels through a medium of human creation between the "heavens" and the "earth".

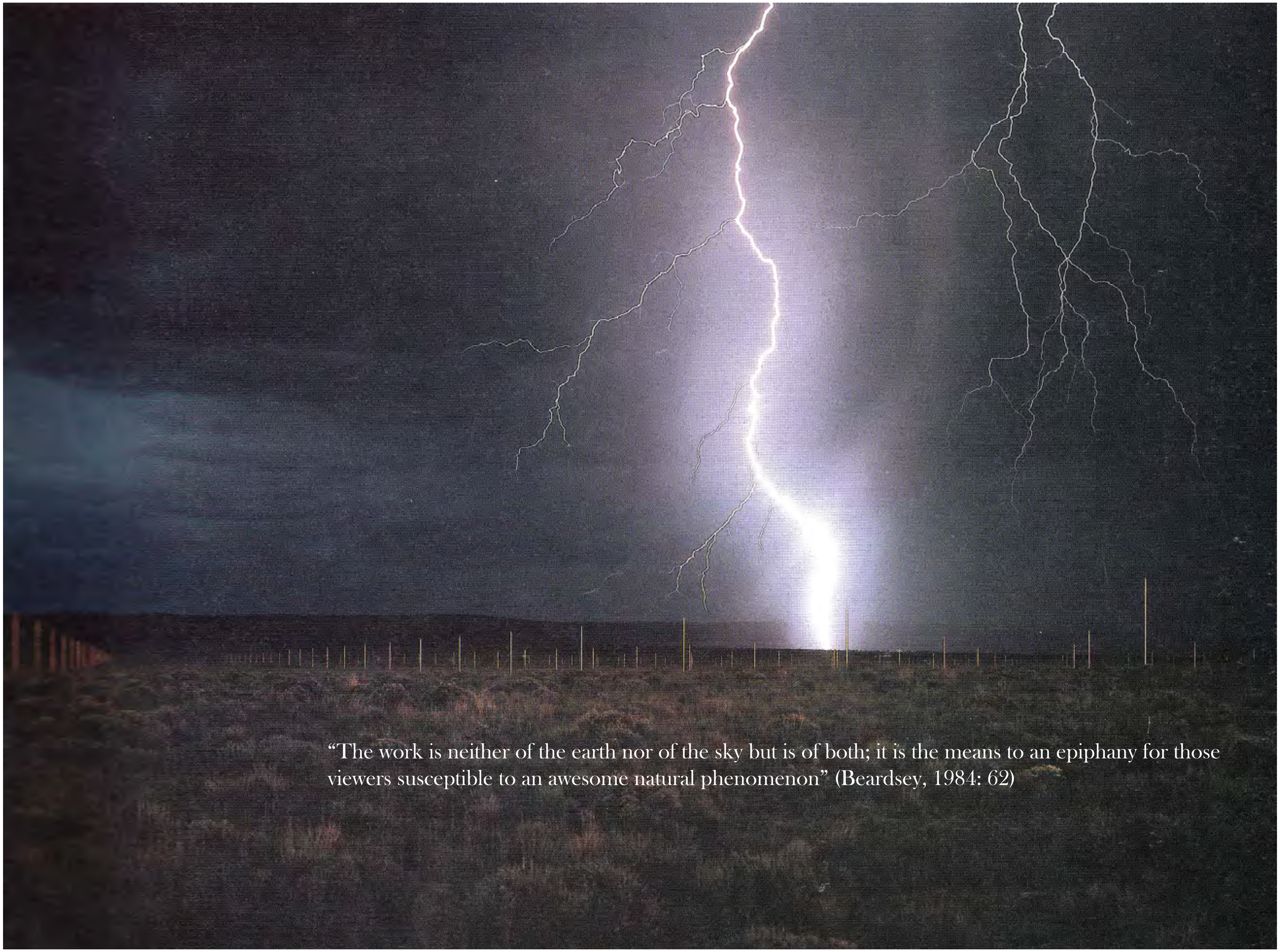
This precedent is highly valuable conceptually, but does not offer much of a technical solution to my issue. I intend to use De Maria's piece as an example of how machinery - namely the pump units in Squamish - may be used to connect the viewer to a scale that far exceeds their own. If the pump activation becomes as rare as lightning striking these poles, then perhaps it will become an equally worthy spectacle of natural systems flowing through a mechanical node.

Examples to harvest from The Lightning Field:

- The channeling of regional forces through mechanical systems to create a spectacle is a very promising treatment of the pump units in Squamish.
- Mechanical components should still be highly interesting even when not activated. How might the pump unit evoke facination when it is not activated, as this will be the state it is in for most of its operational life span.?
- Very minimal machinery can have a very powerful effect through the use of pattern and repitition.
- Mechanical components should enable the spectacle, and not be a "technophilic" (Thayer, 1994) spectacle in themselves.



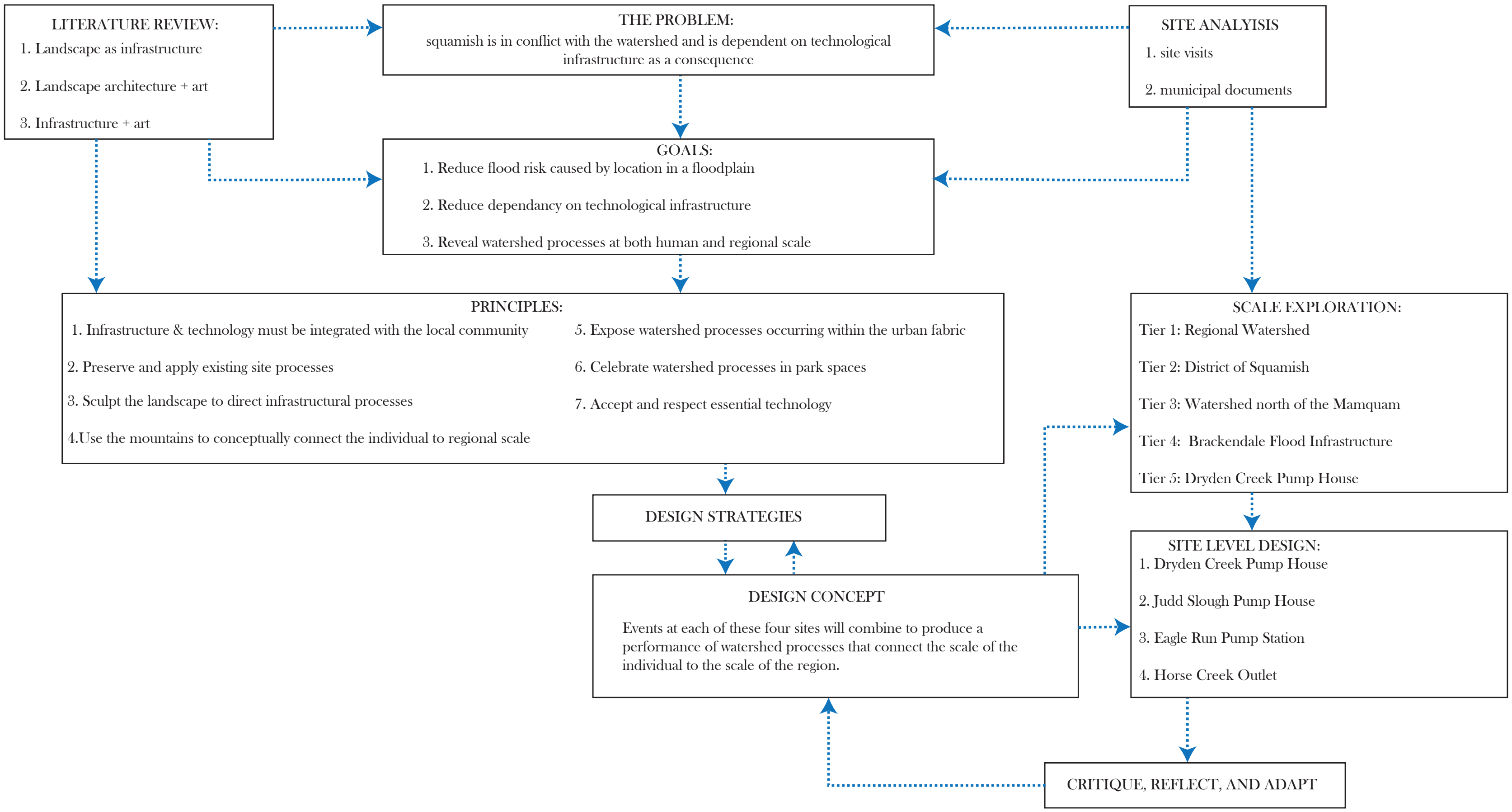
Below: (Figure 3.15) The Lightning Field, while inactive.
(Image: Beardsley, 1984: 60)



“The work is neither of the earth nor of the sky but is of both; it is the means to an epiphany for those viewers susceptible to an awesome natural phenomenon” (Beardsey, 1984: 62)

IV. Methodology

My Process



Potential Design Strategies

POTENTIAL STRATEGIES

PRINCIPLE 1: Infrastructure & technology must be integrated with the local community
- Remove excessive chainlink and barbed wire fencing
- Educational programming to build understanding of flood infrastructure
- Re-shape the dike to allow access to the river

PRINCIPLE 2: Preserve and apply existing site processes
- Use existing streams to convey stormwater runoff
- Use existing wetlands to percolate and treat stormwater runoff

PRINCIPLE 3: Sculpt the landscape to direct infrastructural processes
- Shape topography to guide runoff to the pump machinery
- Design artful depressions to detain/retain stormwater
- Design wetlands and bioswales to clean and percolate stormwater

PRINCIPLE 4: Use the mountains to connect the individual to regional scale
- Build lookout towers to establish a viewshed of the mountains
- Provide connections to trail systems that lead to the mountains
- Use the forms of the surrounding mountains to inform site topography

PRINCIPLE 5: Expose watershed processes occuring withing the urban fabric
- Design plazas that celebrate stormwater
- Design a bioswale system that weaves through the entire District
- Design sculptural elements that interact with or utilize stormwater

PRINCIPLE 6: Celebrate watershed processes in park spaces
- Express the flow of stormwater over dynamic, sculptural topography
- Create a narrative in the flow of stormwater for the viewer to follow
- Use vegetation that signifies natural stormwater processes

PRINCIPLE 7: Accept and respect essential technology
- Reveal the pump machinery using transparent architecture
- Allow the viewer to come as close as safely possible to the pump stations
- Make the activation of the pump units an intriguing performance

The Design Framework

In order to reconcile scale on as wide a range as the individual person to the regional watershed, I have developed an approach structured around five scale tiers. At each tier I will explore the technical stormwater issue as well as the lack of human connection to regional scale. This process is not linear, however, and I intend to cycle through each tier repeatedly as the project continues to develop and new issues arise at each scale of design. This framework will be explored in further detail in part 6: "Setting the Stage".

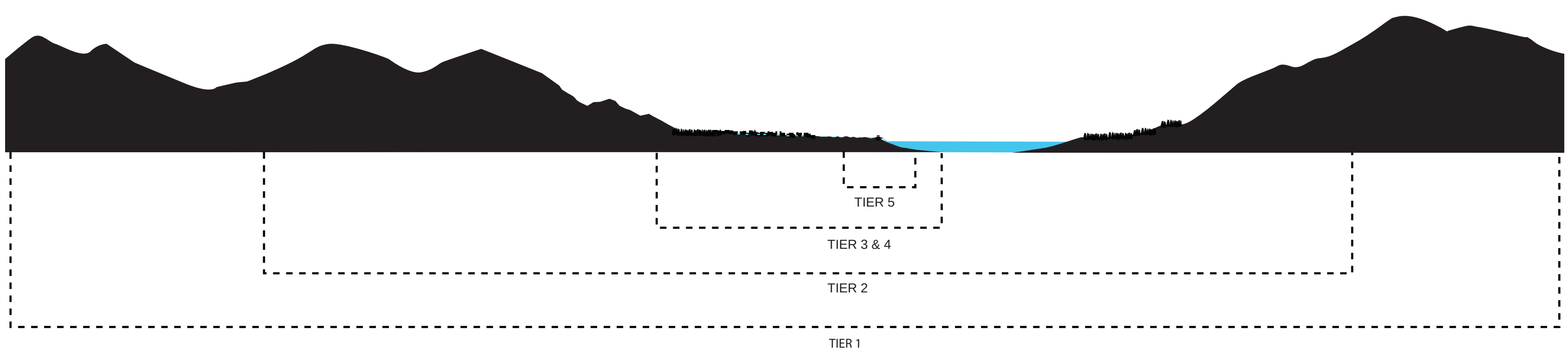
Tier 1: The regional scale

Tier 2: The District of Squamish scale

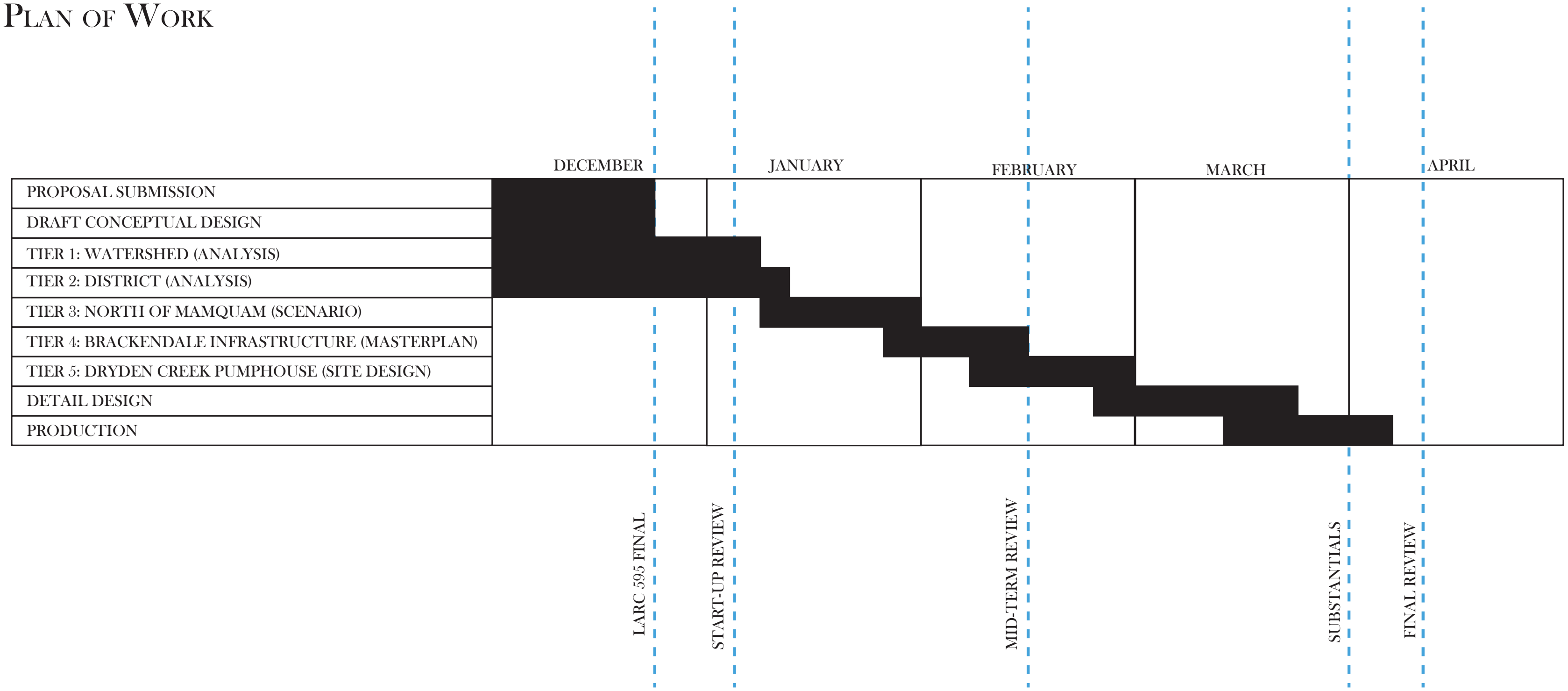
Tier 3: The urban watershed north of the Mamquam.

Tier 4: Flood Infrastructure in the Brackendale Neighbourhood

Tier 5: Dryden Creek Pump House
Note: This is the most critical pump station in the system, so it will receive the most detailed design attention, however, the other stations will all be addressed in Tiers 3 and 4.

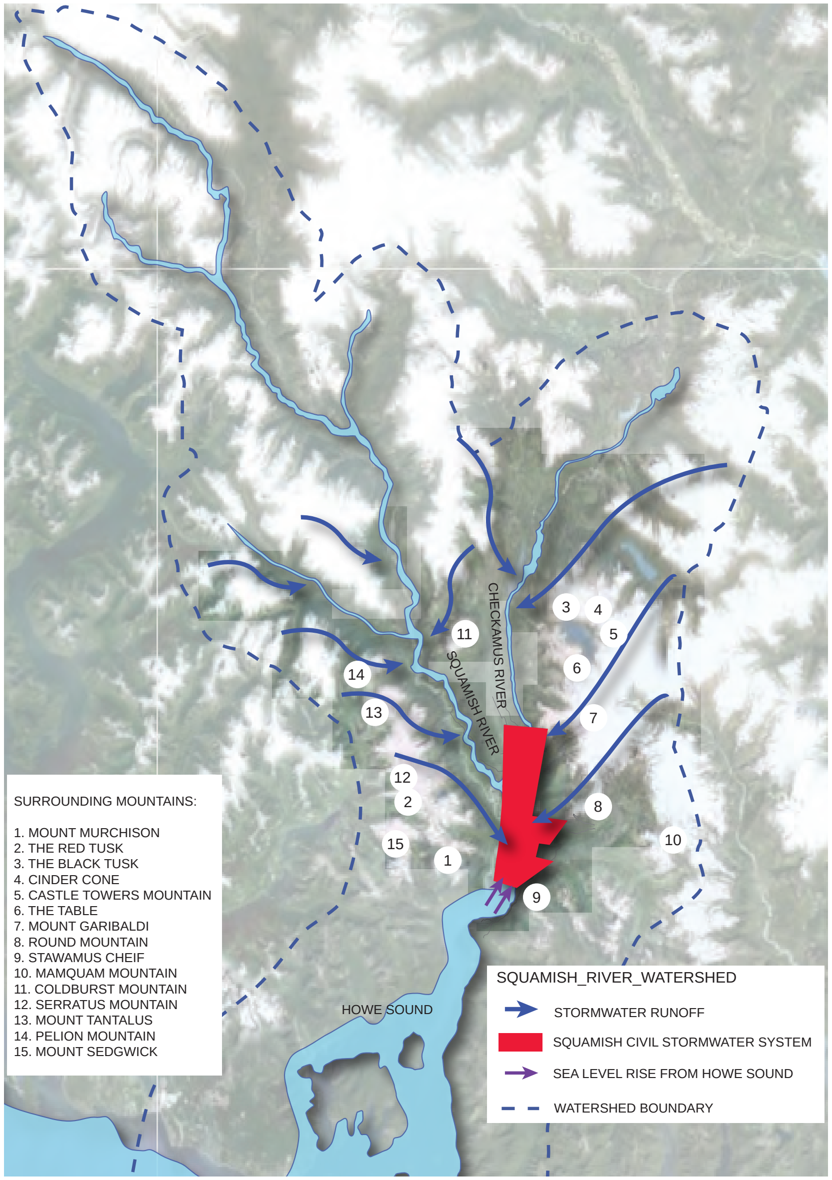


Plan of Work


DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
PROPOSAL SUBMISSION
DRAFT CONCEPTUAL DESIGN
TIER 1: WATERSHED (ANALYSIS)
TIER 2: DISTRICT (ANALYSIS)
TIER 3: NORTH OF MAMQUAM (SCENARIO)
TIER 4: BRACKENDALE INFRASTRUCTURE (MASTERPLAN)
TIER 5: DRYDEN CREEK PUMPHOUSE (SITE DESIGN)
DETAIL DESIGN
PRODUCTION
LARC 595 FINAL
START-UP REVIEW
MID-TERM REVIEW
SUBSTANTIALS
FINAL REVIEW

V. Setting the Stage

Tier 1: Regional Watershed



Left: (Figure 5.1) Squamish is located at the convergence of major overland flow vectors, and faces potential sea level rise from Howe Sound. Flooding due to overland flow will be the focus of this project. (Adapted from Google Maps image & Distric of Squamish GIS Data)

Living in Conflict

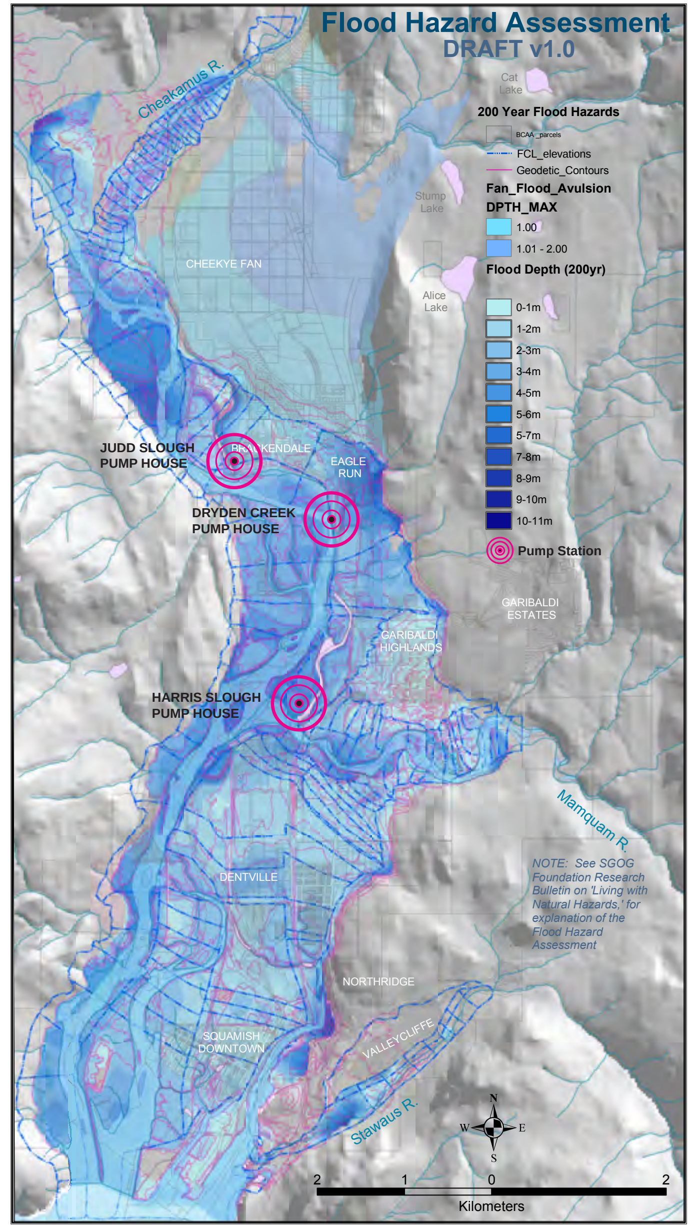
Squamish, BC, Canada is located in a beautiful yet hazardous position. Situated in the watershed of five river systems and surrounded by 100 million year old mountains, Squamish has spectacular scenery as well as spectacular risks (Journeay, 2005). Due to its extreme context, the District of Squamish has faced significant natural hazards for the entirety of its existence (Journeay, 2005).

Squamish currently faces three major environmental risk factors:

- Flooding from stormwater, melting snowpack and receding ice fields (Journeay, 2005).
- Landslides and debris flow on slopes to the south of the Cheekeye River (Journeay, 2005).
- Earthquakes from seismic activity in the subduction zone between the North America and Juan de Fuca plates (Journeay, 2005).

Flooding has been the most frequent and destructive hazard in Squamish, with major events occurring regularly in the past century (Journeay, 2005). Major flood events have occurred in "(1921, 1940, 1955, 1968, 1975, 1980-1984, 1989-1991, and 2003) resulting in millions of dollars in damages and indirect losses" (Journeay, 2005: 3). Therefore, this project will address the flood risk in Squamish.

Right: (Figure 5.2) The location of Squamish at the convergence of the watershed leaves the community open to severe flooding. Note the depths vary by area, some being relatively safe, while others face over 5m of flood depth (Adapted from Journeay, 2005:np)



Considerations at the Regional Scale

Scale is critical to this project, as the lack of understanding of the scale and timeline of regional processes has led to the conflict Squamish has with its region. While it is not possible to solve the fundamental problem with the location of Squamish, it is possible to address the lack of understanding. I do not intent to make any planning recommendations at the watershed scale, however, I will make interventions in subsequent scales that establish conceptual connections to the watershed and the region as a whole. Programming considerations at the regional scale include:

- The District of Squamish is part of the regional watershed system, and the continuity of regional processes must be maintained at every node, including the urban fabric of Squamish.
- Flood risk must be understood at the regional scale if it is to be remedied at the site level. Squamish is at the receiving end of a very dynamic watershed, and flooding has the potential to exceed 5m in depth in some areas (Figure 5.2) during a 200 year storm event (Journeay, 2005). The Brackendale and Eagle Run areas are especially vulnerable (Figure 5.2).
- The viewshed of surrounding mountains and the rivers are a vital opportunity to provide a connection between human and regional scale. Key viewpoints at subsequent scales should be based on the location of these regional features (Figure 5.1).

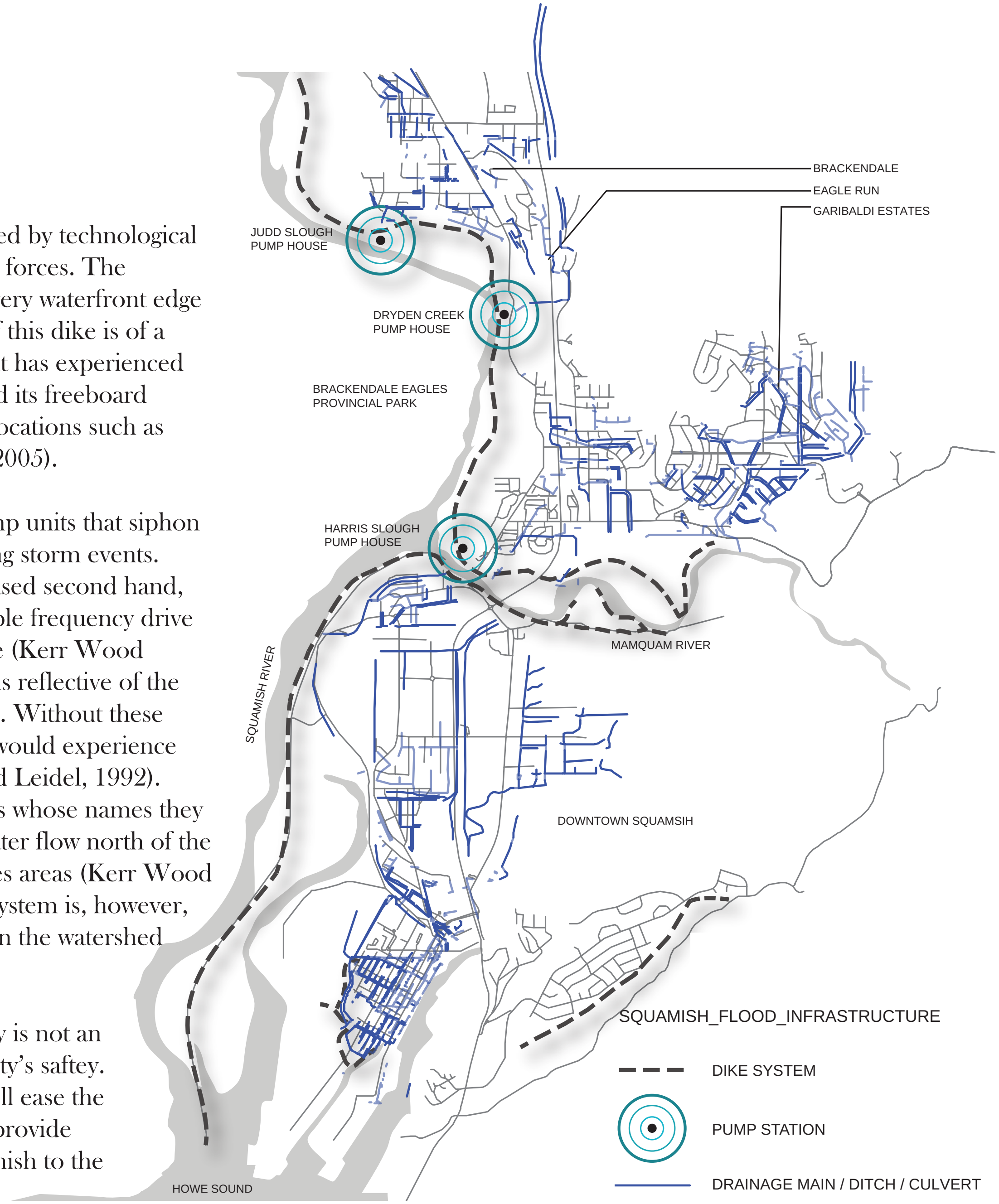
Tier 2: District of Squamish

Prosthetic Infrastructure

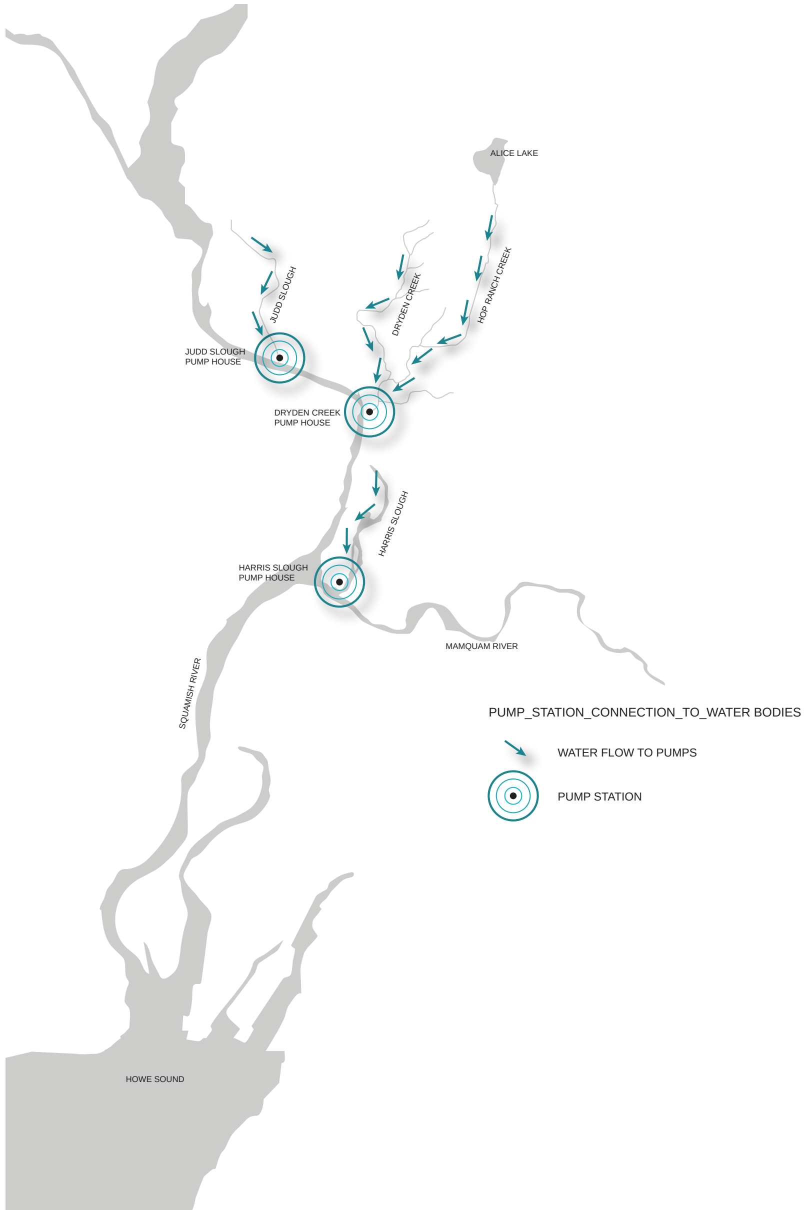
The form of Squamish has been significanlty marked by technological solutions due to its misplacement amongst regional forces. The extensive dike system dictates the form of nearly every waterfront edge in the community (Figure 5.3). The construction of this dike is of a questionable standard (Kerr Wood Leidel, 2005), it has experienced issues with erosion and piping (Thurber, 2008), and its freeboard during high tide events is as low as half a metre in locations such as Dryden Creek Pump House (Kerr Wood Leidel, 2005).

The Dike system is augmented by three major pump units that siphon water from behind the dike and into the river during storm events. Some of these pump units were old models purchased second hand, and the District has supplemented them with variable frequency drive (VFD) units such as at Dryden Creek Pump House (Kerr Wood Leidel, 2012b). This layered-technology approach is reflective of the dependency on machines Squamish has developed. Without these failing dike and these pump units, the community would experience far worse flooding during storm events (Kerr Wood Leidel, 1992). The three pump stations are fed by the waterbodies whose names they bear (Figure 5.4), and receive much of the stormwater flow north of the Mamquam in the Brackendale and Garibaldi estates areas (Kerr Wood Leidel, 1992 & Journeay, 2005) (Figure 5.4). The system is, however, not efficient due to chokepoints in culverts higher in the watershed (Kerr Wood Leidel, 1992).

Doing away with the dike and pump system entirely is not an option due to how entwined it is with the community's saftey. A landcape as infrastructure approach, however, will ease the dependency on this system and such a system will provide significant design opportunities to reconnect Squamish to the region against which it has always fought.



(Figure 5.3) Adapted from District of Squamish GIS Data



(Figure 5.4) Adapted from District of Squamish GIS Data

Much of the current urban drainage system is inhereted from the same "do it yourself" spirit that is behind the dike, and this industrious spirit is one of the community's greatest assets. Many of the old pipes - some made from wood - are still functional. Much of the stormwater system, however, has not been clearly documented as a result. Although dificult to map, it is fortunate that a significant portion of the District's drainage occurs in surface swales, especially in the Brackendale area. Since there is not total dependance on pipes, as is not the case in many other municipalities in B.C., there will be far less constraints and complications in creating an experiential surface stormwater system as the existing system already lends itself well to such an approach.

Considerations at the District of Squamish Scale

Considerations at the District scale focus mostly on the urban stormwater infrastructure such as pipes, swales, ditches, the pump units, and the dike. I do not intend to design for the whole of Squamish, however, solutions developed at the scenario and site scales for the northern Brackendale area should be replicable at the District scale. Programming at the district scale will be subject to the following general considerations:

- The replacement or alteration of the dike/ pumps at the site scale must consider the risks at the District and regional scales.
- Runoff from the site scale should not increase the load on other scales of the drainage system. Site drainage should be managed at the site level.
- Increased use of surface drainage systems and enhancement of the existing system.
- Removal of large caliper trees from the dike to prevent piping (Kerr Wood Leidel, 2005 and Turber, 2008)
- Improved access to the waterfront that the dike currently obstructs

Tier 3: Urban Watershed North of the Mamquam

Before a design may be proposed at the site scale, a larger scenario must be established. For this purpose I have decided to focus on the area of Squamish north of the Mamquam River (Figure 5.5). The site will begin at the edges of the Squamish and Mamquam Rivers, and extend to include the urban drainage systems as well as the entire length of the waterbodies that directly feed the pump units. The reasoning behind this decision is twofold:

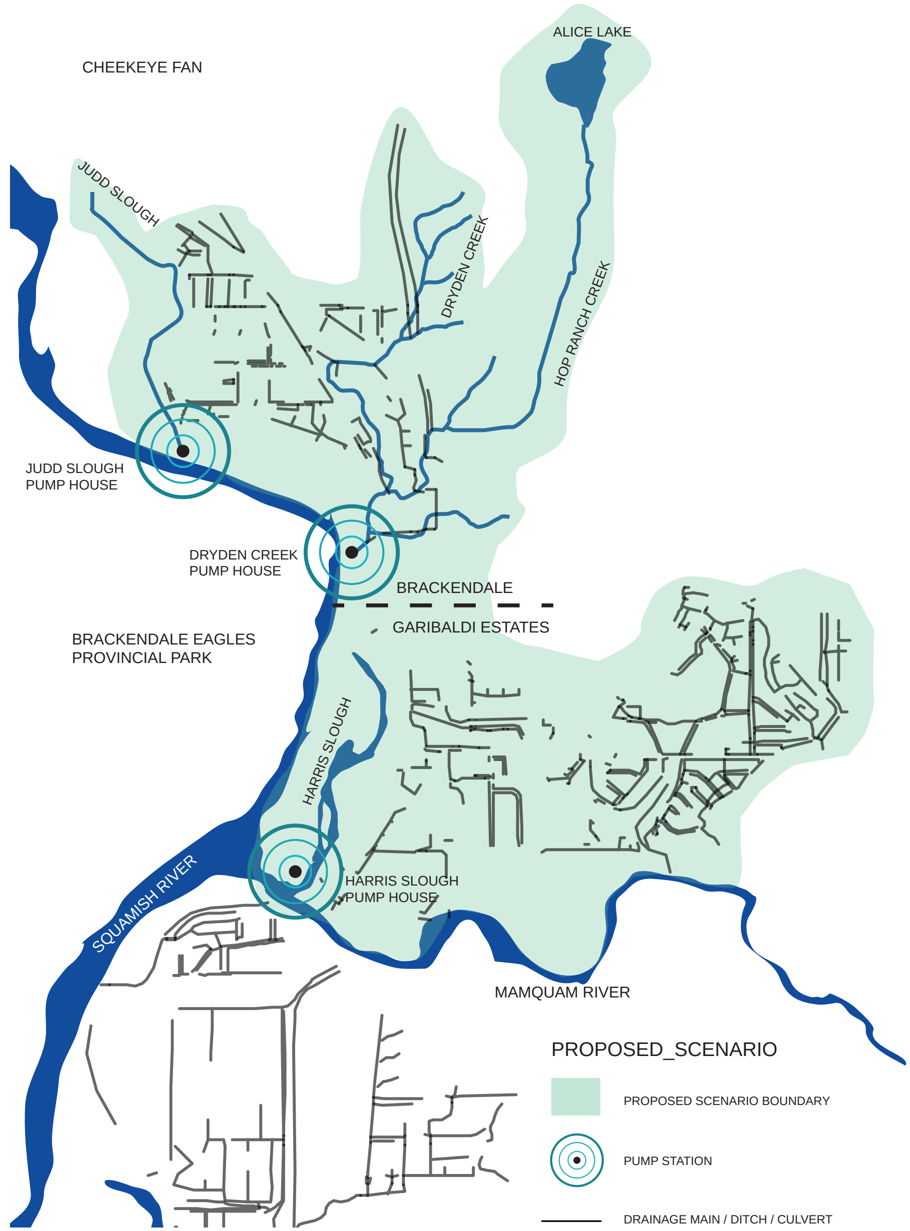
1. This is the area that will experience the most significant flooding druing a 200 year event (Journeay, 2005) (Figure 5.2).

This portion of Squamish north of the Mamquam river contains 3 out of 5 “areas of principle flood hazard” (Journeay, 2005: 3). These include:

- Flood risk in Brackendale from the Squamish River (Journeay, 2005)
- Flood risk in Garibaldi Estates from the Mamquam River (Journeay, 2005)
- The Cheakamus river may cause “debris flows and avulsion flooding on the Cheekeye Fan” (Journeay, 2005: 3).

2. This area includes all three major pump stations (Figure 5.5).

- Judd Slough Pump House
- Dryden Creek Pump House
- Harris Slough Pump House



(Figure 5.5) Adapted from District of Squamish GIS Data

These pump units are, aside from the dike, the most significant and overt peices of flood defense technology in Squamish, and therefore understanding how they operate together is of crucial importance before I may go further down in scale.

Programming at the Scenario Level

At this stage of the project it will be critical to establish conditions and assumptions neccessary before I may proceed into the site design stage of the project.

Key Scenario Conditions:

- Stormwater runoff is managed at the neighbourhood scale in a way that is visible and accessible to the public using open drainage systems such as bioswales, rain gardens and wetlands (Figure 6.6).

- The infrastructural landscape in the area north of the Mamquam, including the dike and pumps, must be able to handle at least a 100 year flood event (Kerr Wood Leidel, 2012b & 1992).

- Viewpoints of key natural features will be created throughout the scenario area to provide a connection to the regional scale of the watershed

- Each of the mechanical pump units and their functions will be revealed as experiential nodes in the system.

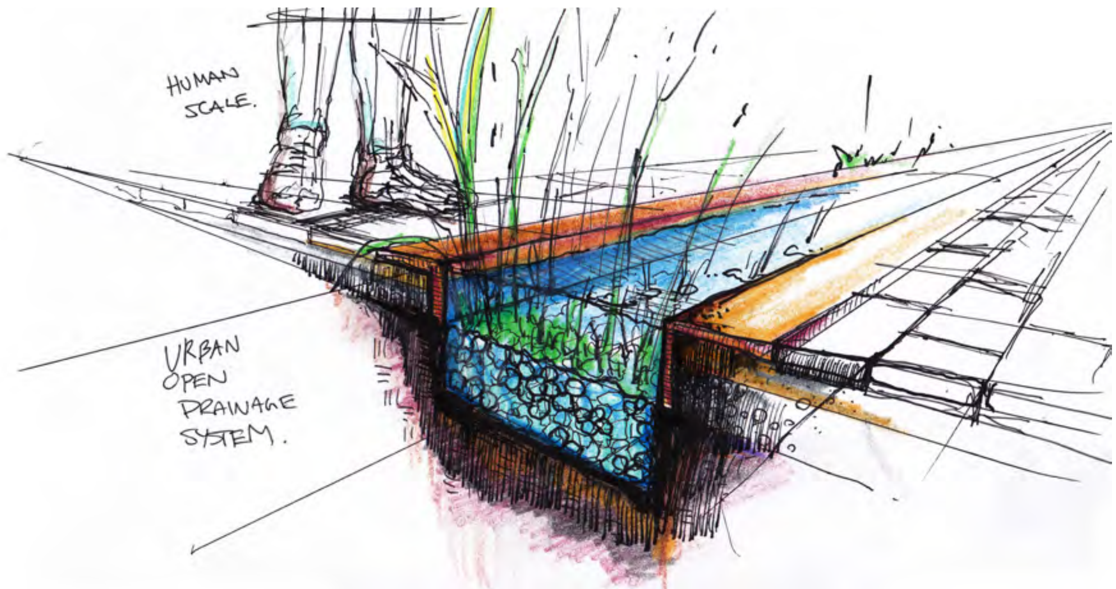
Key Scenario Assumptions:

- The people in Squamish will be in favour of an exposed surface drainage system.

- Funding will be available to carry out interventions.

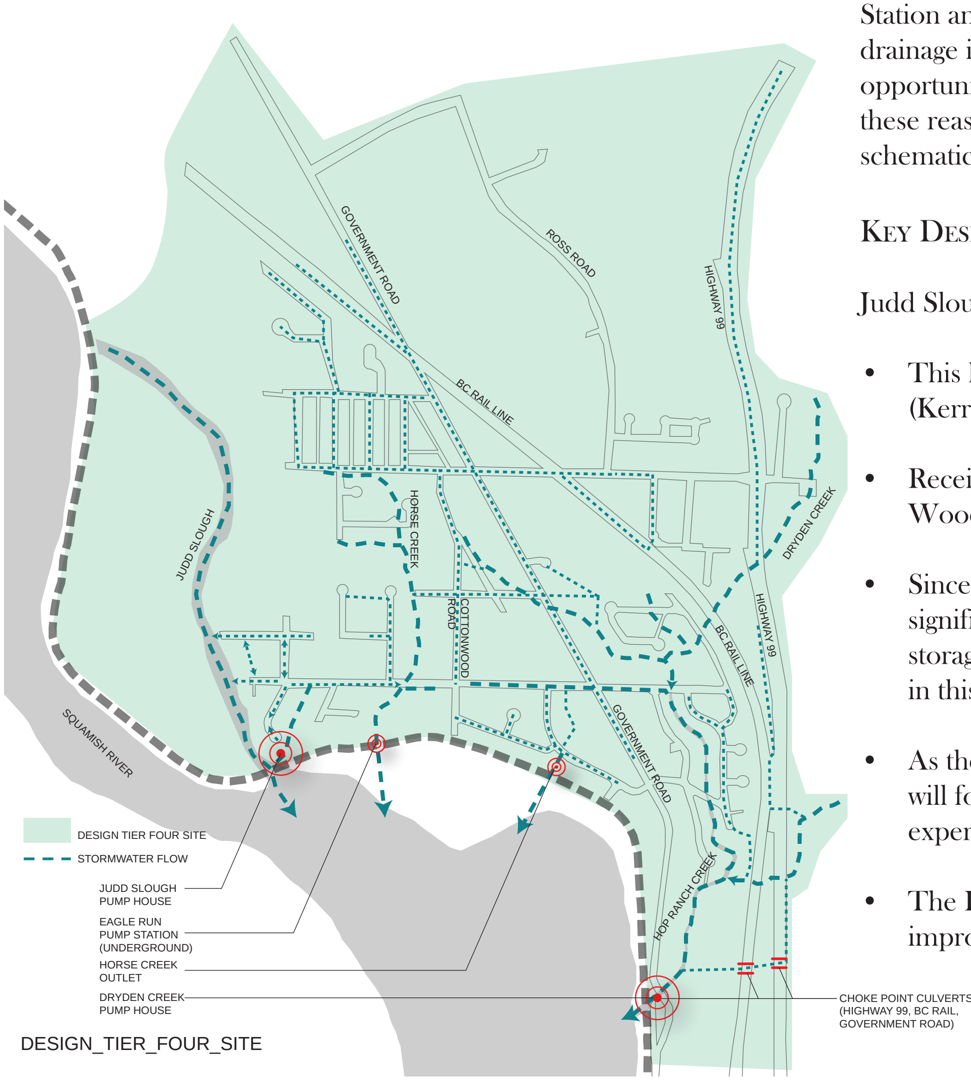
- Stormwater infrastructure outside of the scenario can handle a 100 year event without failure (Kerr Wood Leidel, 2012b & 1992).

- The possible interventions developed for the scenario will be generally replicable outside of the scenario boundary.



(Figure 5.6): Concept sketch for a surface – based stormwater drainage system that brings the regional watershed down to the urban, human scale.

Tier 4: Brackendale Flood Infrastructure



(Figure 5.7) Adapted from Kerr Wood Leidel, 1992 and District of Squamish GIS Data

Significant schematic design for this project will begin at in the Brackendale neighbourhood scale (Figure 5.7), as this portion of Squamish is at a much higher risk than Garibaldi Estates, which sits on highground (Figure 5.2). This area includes two of the three major pump stations, as well as the underground Eagle Run Pump Station and the Horse Creek Outlet (Figure 5.7). The majority of the drainage in Brackendale occurs in surface ditches, which provdes an opportunity for the design of an experiential urban watershed. For these reasons, Brackendale will be the area for which I develop the schematic masterplan for the project.

Key Design Considerations for Brackendale

Judd Slough Pump House (Figure 5.8)

- This location includes two pump units and a gravity flood box (Kerr Wood Leidel, 1992).
- Receives mostly residential runoff from ditches and culverts (Kerr Wood Leidel, 1992).
- Since the installation of this pump house, there have not been significant problems with drainage as the slough has a very high storage capacity and already takes the burden off of the machinery in this area (Kerr Wood Leidel, 1992).
- As there is no technical issue with this station, efforts in this area will focus on exposing the machinery itself as an aesthetic and experiential feature. This will include replacing the architecture.
- The Dike in the area will be redesigned schematically to allow for improved access to the water.

Eagle Run Pump Station (Figure 5.9)

- Includes a single 0.13cms pump (Kerr Wood Leidel, 1992).

- Is located underground with a surface right of way (Figure 6.3). This right of way presents an opportunity to design a corridor, such as a path or garden, which acknowledges the pump system below to inform the viewer of its presence below.

Horse Creek Outlet (Figure 5.10)

- Creek is low velocity, fed by groundwater and residential runoff (Kerr Wood Leidel, 1992).

- Likely used to be connected to Judd Slough long ago, but has been cut off by the dike and development (Kerr Wood Leidel, 1992). A conceptual reconnection may be possible here through the design of residential surface drainage that recalls the old stream route.

- There is a floodbox at this outlet that closes when water levels in the Squamish River are high, and this directs water to Judd Slough (Kerr Wood Leidel, 1992). This is an event that could be revealed to the viewer as an intriguing event in the stormwater narrative.

- The outlet itself should be redesigned to address its lack of aesthetic appeal and to capture the viewer's interest.

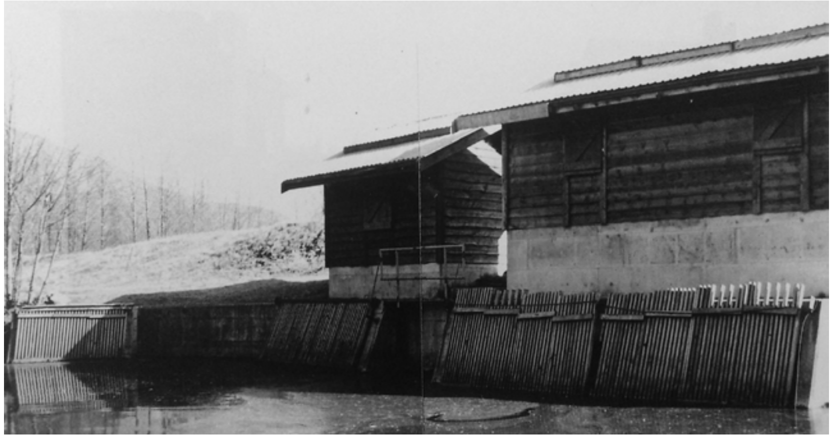
Brackendale Urban Drainage System

- The existing system has experienced significant flooding and is not reliable do to poor storage and surface drainage (Kerr Wood Leidel, 1992). Additionally, this system, while largely surface based, does not provide and connection between the viewer and the regional watershed. Therefore, a redesigned neighbourhood open drainage system is proposed (Figure 5.6).

Dryden Creek Pump House

- The most critical stormwater machinery is located at this pumphouse

- Due to its importance to the system this will be the site of the final tier of design and explored in depth in design Tier Five.



(Figure 5.8): Judd Slough Pump House (Image: Kerr Wood Leidel, 1992: Appendix A)

(Figure 5.9): Underground Eagle Run Pump Station Right of Way
(Image: Kerr Wood Leidel, 1992: Appendix A)

Figure 5.10: Horse Creek Outlet (Image: Kerr Wood Leidel, 1992: Appendix A)

Tier 5: Dryden Creek Pumphouse

(Figure 5.11): Dryden Creek Pump House with forebay and culvert

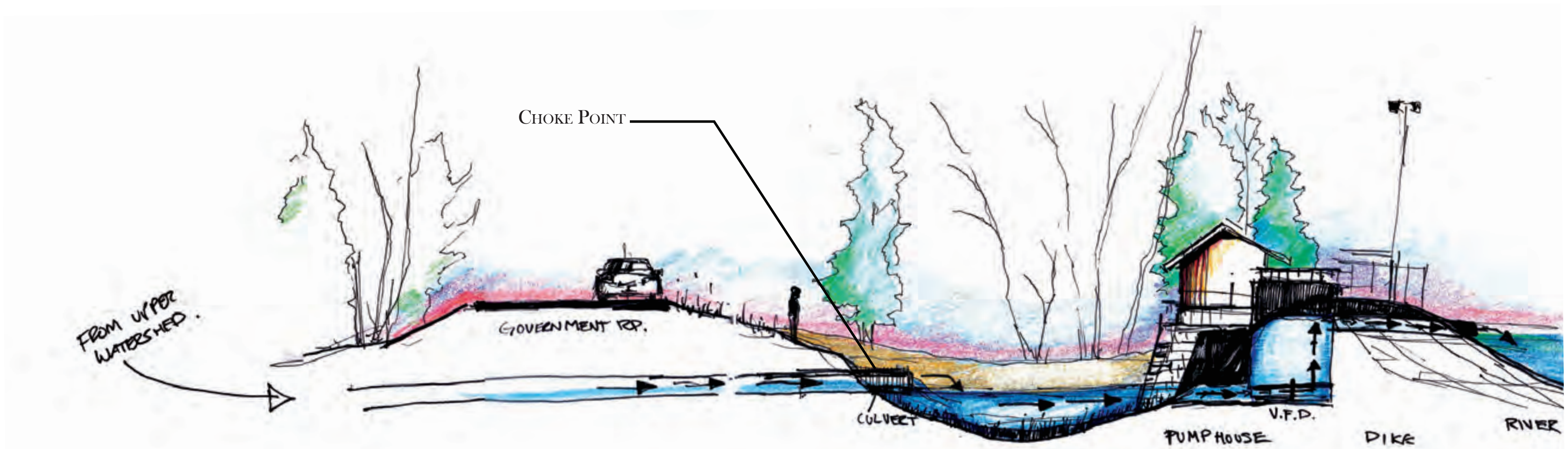
Dryden Creek Pump House contains the most critical pieces of pump machinery in Squamish, and it is the location of most concern to the municipality — both for its vulnerability and for its potential. The pump station is situated in the existing dike, which also serves as a waterfront trail system, and is directly across from the Brackendale eagle — viewing area making it very high profile. The District is understandably interested in a work of "public art" that capitalizes on this high profile location. The term "public art" is a label I intend to avoid. My intent is to create a performance that emphasizes the flow of water accross regional and human scaled landscapes, and the whether this result fits the term "art" or not is secondary to that end.

Currently this station has two out — dated pumps and one modern variable frequency drive (VFD) pump which can regulate its speed relative to water levels in the forebay making it far more efficient. The municipality intends to install a second VFD pump for a total of four pumps at this station (Kerr Wood Leidel, 2012b). Additional fall - back pumps are available to be transported in from off site in case these four units are overwhelmed. A landscape as infrastructure solution would reduce thevolume and intensity of storm water reaching the pumps and, therefore, drastically decrease the frequency of pump activation and the need for the continuous layering of machinery. This is especially true at this location as the forebay is currently undersized (Kerr Wood Leidel, 2012b). The pumps are very powerful and can purge the forebay very quickly, so an increase in the size of the forebay will increase the system's carrying capacity.

Technical Overview

Stations no. 1& 2 (Figure 5.13 & 14)

- 2 x 30" Paramount mixed flow pumps (Kerr Wood Leidel, 2012b) (Figure 5.13)
- 2.6m^3/ s capacity each (Kerr Wood Leidel, 2012b).
- Bought second hand 1993 (Kerr Wood Leidel, 2012b).
- The so called "holy shit" pumps (anonymous, 2012) that come on if the VFD units become overwhelmed



(Figure 5.12): During flood events, runoff enters the forebay through the restrictive culvert. When the forebay is full the pumps quickly siphon it into the Squamish River. Increasing the forebay capacity would decrease pump activation frequency making it a significant experiential event for the viewer.

(Figure 5.13): One of two second-hand pump units in station 1 & 2 (in the shack).

Stations no. 3 & 4 (Figure 5.15 & 16):

- 1 x Flygt Submersible Pump VFD (Figure 5.14).
- Expecting a second unit (Kerr Wood Leidel 2012b).
- 1.6m^3/ s capacity each (Kerr Wood Leidel 2012b).
- Nicknamed “Big Bertha”.
- Equipped with Supervisory Control and Data Acquisition (SCADA) computer automation.

(Figure 5.14): Station 1 & 2 outlet pipes to Squamish River

(Figure 5.15): Man standing on top of Flygt VFD Submersible pump housing. There is one unit in this housing with a cavity for the expected second (Kerr Wood Leidel, 2012).

Total Performance of Dryden Creek Pump House:

- 100 year event peak flow of Dryden Creek Watershed= 16.2m^3/s (Kerr Wood Leidel, 2012).
- 6.8m^3/s Total Station Capacity (8.4m^3/s with expected second VFD)(Kerr Wood Leidel, 2012b).
- Culverts before pump only allows 4.2m^3/s causing back-up up stream (Kerr Wood Leidel, 2012b) (Figure 5.12) which ironically prevents the pump from becoming overloaded.
- The station forebay is therefore too small and to manage a 100 year event (Kerr Wood Leidel, 2012b).
- The dike height is too short, current freeboard is only 0.5m above high—water levels (Kerr Wood Leidel, 2005).

(Figure 5.16): The rusted gate in the foreground is the outled for the "Big Bertha" VFD's.

This concludes the proposal phase of the project. What follows is the design solution, some of which may differ from what you have just read as my ideas have evolved significantly through the design process.

VI. Final Design

(Figure 6.1): The dike accumulates sediment in a microcosm of the process that formed the floodplain on which the District of Squamish sits.

Final Design Concept: The Didactic Machine

The District of Squamish has been "misplaced" amongst very powerful regional processes that have been in operation for an unfathomable period of time (Cannings et al. 2011). As a result, the community has become reliant upon significant engineered infrastructure to hold its ground against a raging watershed. The scale of technological intervention required, while intrusive, has given Squamish a highly unique character.

The community rests on a floodplain of sediment compressed against spectacular mountain ranges. Massive amounts of kinetic energy flow through this system, and it has been in a constant state of flux for millions of years (Cannings et al. 2011). The district has employed an extensive dike system, which runs along the entire length of the community's Squamish River flank. This dike represents a human effort to freeze in place these ancient - yet still operational - regional processes. Ironically, the dike accumulates sediment in a microcosm of the process that formed the floodplain on which the District sits (figure 6.1).

(Figure 6.2): Judd Slough Pump Station. A mechanical artifact in the wilderness.

As a result of this technological reliance, the now highly infrastructural landscape of Squamish is peppered with mechanical artifacts such as the striking Judd Slough Pump Station (figure 6.2). These mechanical artifacts vary greatly in scale from monumental, shear, concrete walls (figure 6.3) to outfalls protruding from the ground one has to stumble over as they journey down a floodplain trail (figure 6.4 - 6).

Despite the fundamental misplacement of the settlement that resulted in this biomechanical landscape, these technological artifacts are a vital part of the character of Squamish. They are Squamish. During my own stumbles through the floodplain wilderness, I became enamoured by this landscape of discovery, where these rusted, battered, magnificent machines perforated the winter snow and rough floodplain vegetation. As I cannot solve the problem of Squamish's location on a floodplain, my goal became to reveal the machines that make life in this spectacular region possible. These machines have inherent didactic qualities that can connect the individual in Squamish to regional scale.

The aging machinery scattered throughout Squamish strikes a personal chord with me as it brings to mind my service as a soldier in Afghanistan. Near the gate to the main base in Kandahar Province was a derelict Soviet tank sitting forgotten in the desert. We would often drive past this relic as we departed on certain missions (figure 6.7). Looking at this tired machine decades after it fell, I, as a young Canadian soldier, was able connect to the young Soviet soldiers who were my position a generation earlier. Perhaps they died in that tank, or abandoned it in haste - I'll never know. But every time I went by it I was given a reminder of the risk I was facing - the scale of myself as an individual in a region that has seen generations of warfare. Squamish is such a battlefield. The machines they trust to hold their ground against the region have the same didactic power and dark beauty as that burnt-out tank. It is this didactic power I intend to reveal in Squamish.

(Figure 6.3): The rugged, concrete wall at Judd Slough Pump Station speaks to the scale of engineering required to live in this powerful region.

(Figure 6.4): Horse Creek Outlet protrudes from the dike at the Brackendale waterfront edge.

(Figure 6.5): Horse Creek Outlet releasing water to the river

(Figure 6.6): A weathered-steel artifact in the floodplain wilderness.

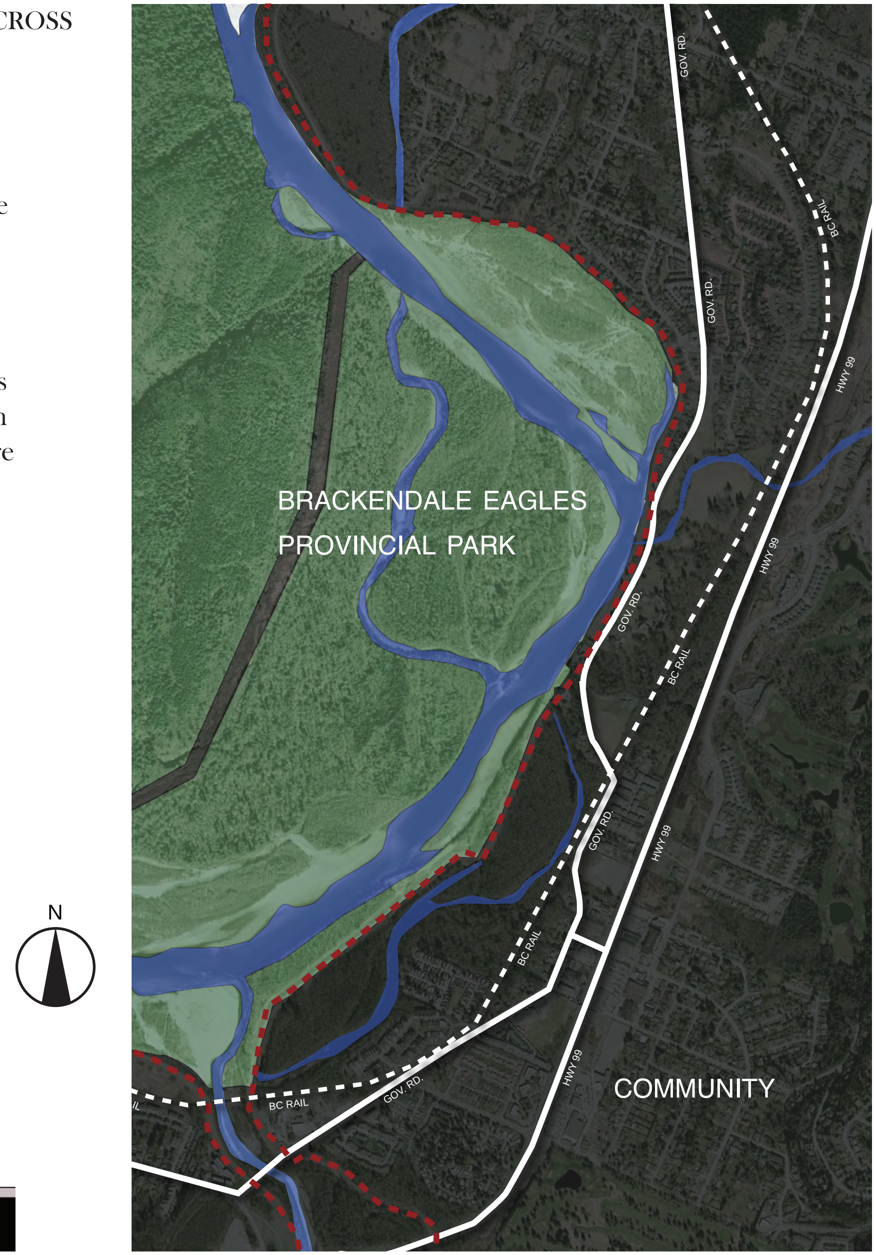
(Figure 6.7): Another battlefield: like this destroyed Soviet tank in Kandahar, the battered machines of the infrastructural landscape of Squamish have a didactic quality that allows the viewer to transcend the scale of the individual person. (Photo: Sgt. Ian MacDonald, 2006).

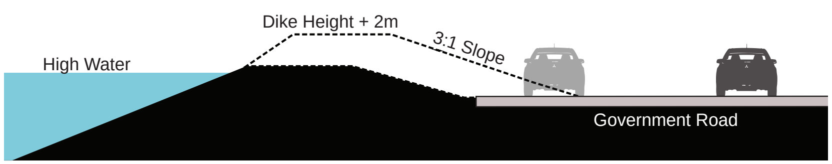
Enhancing the System: Bringing the Wilderness Across

To maximize the effectiveness of any design intervention at the scale of a site as small as Dryden Creek Pump House, the larger system must be enhanced. The dike and Government Road currently act as a barrier between the built-up community of Squamish and Brackendale Eagles Provincial Park (figure 6.8). This creates a dichotomous condition between "wilderness" and humanity.

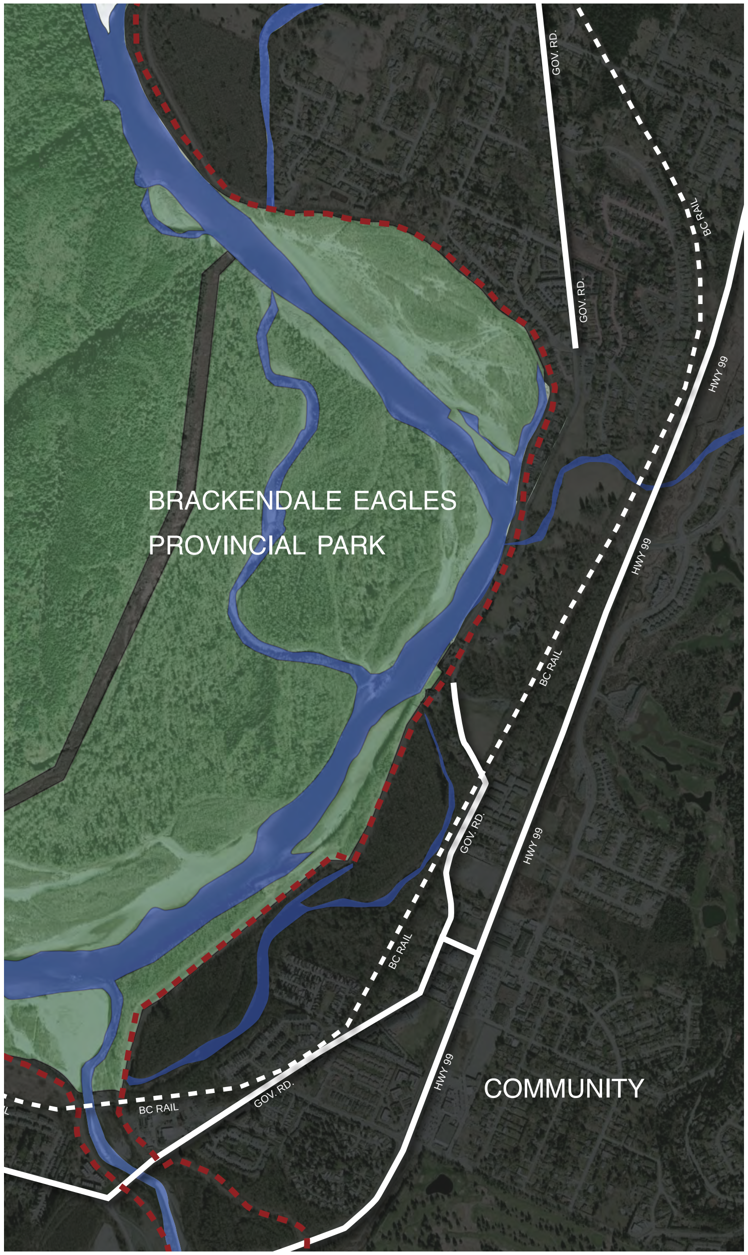
The height of the Squamish River dike is inadequate (Kerr Wood Leidel, 2005) and I recommend raising it by an additional 2m along its entire length. With a 3:1 slope on the landward side, this will encroach on Government Road just south of Dryden Creek Pump House (figure 6.9). Instead of re-engineering Government Road, I will remove the portion taken out by the dike-raise (figure 6.10), and reroute its traffic load through a new connection to Tantalus Road and to HWY 99 (figure 6.11).

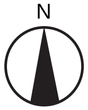
Right (Figure 6.9): The dike and Government Road separate the community from Brackendale Eagles Provincial Park (Adapted from District of Squamish GIS data and Google Earth imagery).





(Figure 6.8): Raising the dike by 2m will take out a portion of Government Road.


GOV. RD.
BC RAIL
HWY 99
BRACKENDALE EAGLES
PROVINCIAL PARK
COMMUNITY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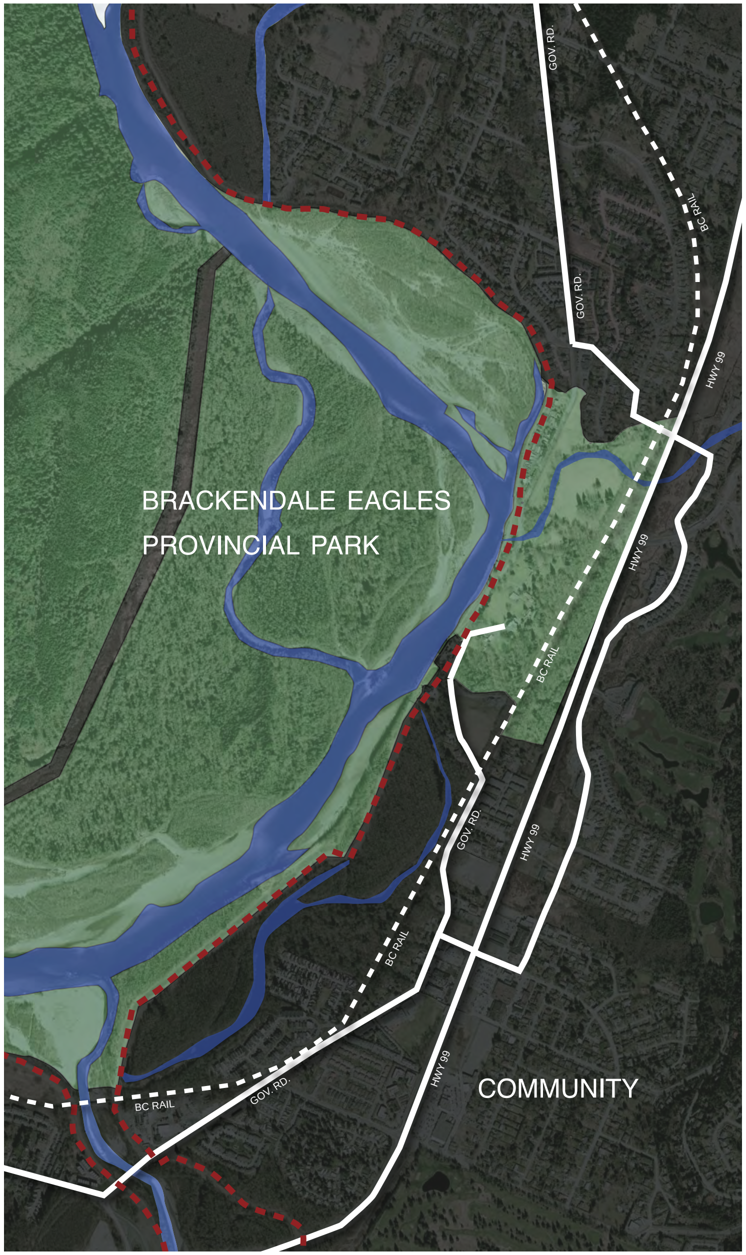
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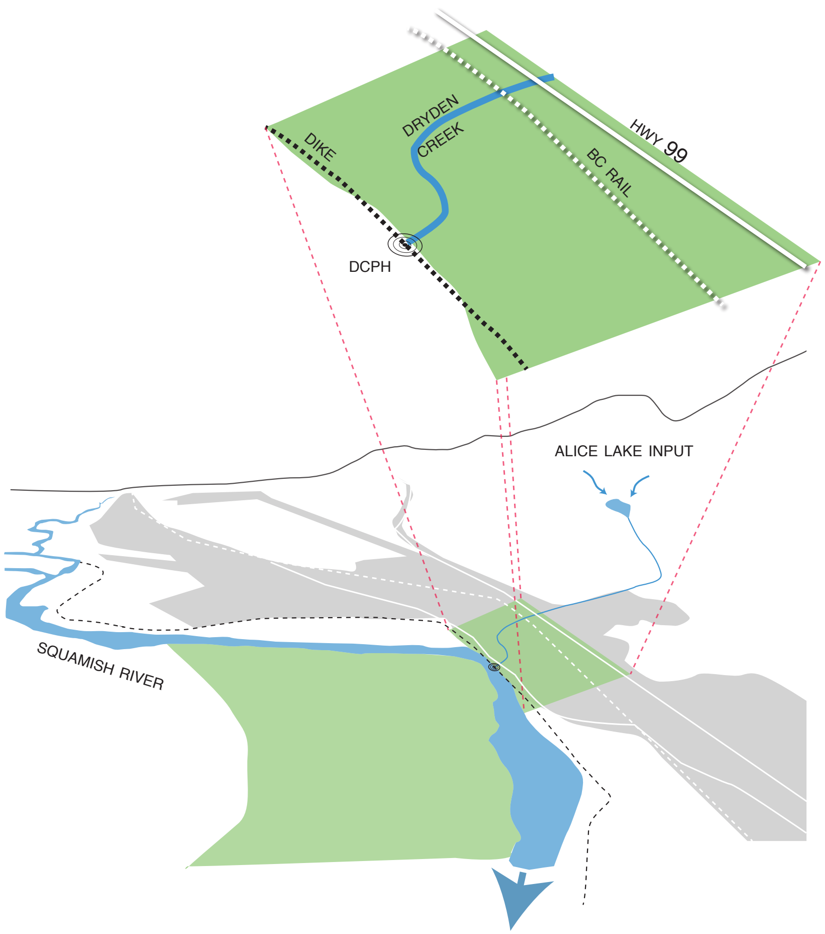
HWY 99
BRACKENDALE EAGLES
PROVINCIAL PARK
COMMUNITY



With the barrier of Government Road is removed, the "wilderness" of Brackendale Eagles Provincial Park expands conceptually across the Squamish River (figure 6.11). In the process, remaining human artifacts such as Dryden Creek Pump House are embedded in this new wilderness patch. What was once a dichotomous condition becomes an integrated hydrological, ecological, mechanical, and human system.

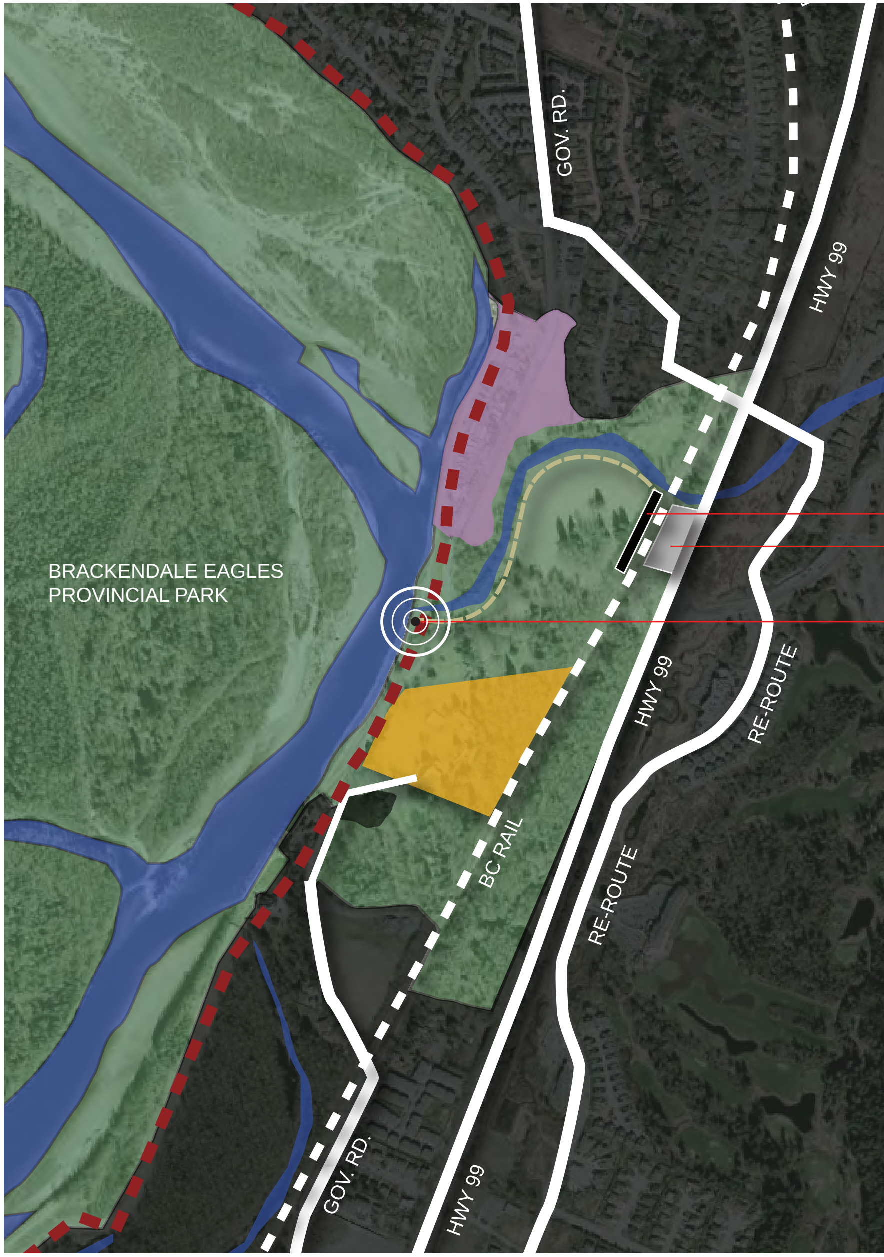
As the infrastructural landscape of Squamish is highly scalable, this new "wilderness component" created on the eastern side of the dike may be "extracted" and its own subcomponents explored, modified, and enhanced (figure 6.12).

Facing Page Left (Figure 6.10): The removed portion of Government Road. (Adapted from District of Squamish GIS data and Google Earth imagery).

Facing Page Right (Figure 6.11): traffic from government road may be re-routed to Hwy 99 and Tantalus road which will have much less risk of being cut during a major flood. Removal of this barrier will bring the provincial park across the Squamish River and into the community. (Adapted from District of Squamish GIS data and Google Earth imagery).

Left (Figure 6.12): This new wilderness land unit can be "extracted" from the system to reveal a further set of subcomponents in the system. (Adapted from District of Squamish GIS data and Google Earth imagery).

Dryden Creek Pump House is the mechanical "guardian" of this new wilderness component. It is directly responsible for the protection of two vulnerable adjacent sites - the Squamish Nation community and the Easter Seal's youth camp (figure 6.13). The Squamish Nation land is extremely vulnerable to flooding due to its location at the foot of the dike (figure 6.14). It is highly recommended that an agreement of some kind be reached that would allow for a dike height increase and to ensure the necessary increased space for this community to live and grow safely. The youth program at the Easter Seal's camp will be significantly enhanced by the wilderness setting. Additionally, children at the camp will be able to explore the new Dryden Creek Pump Station and understand the infrastructure that protects their community.



(Figure 6.13): Wilderness component schematic plan (Adapted from District of Squamish GIS data and Google Earth imagery).

(Figure 6.14): The Squamish Nation community at the foot of the dike is in a position of significant flood vulnerability.

The Macro Mechanism

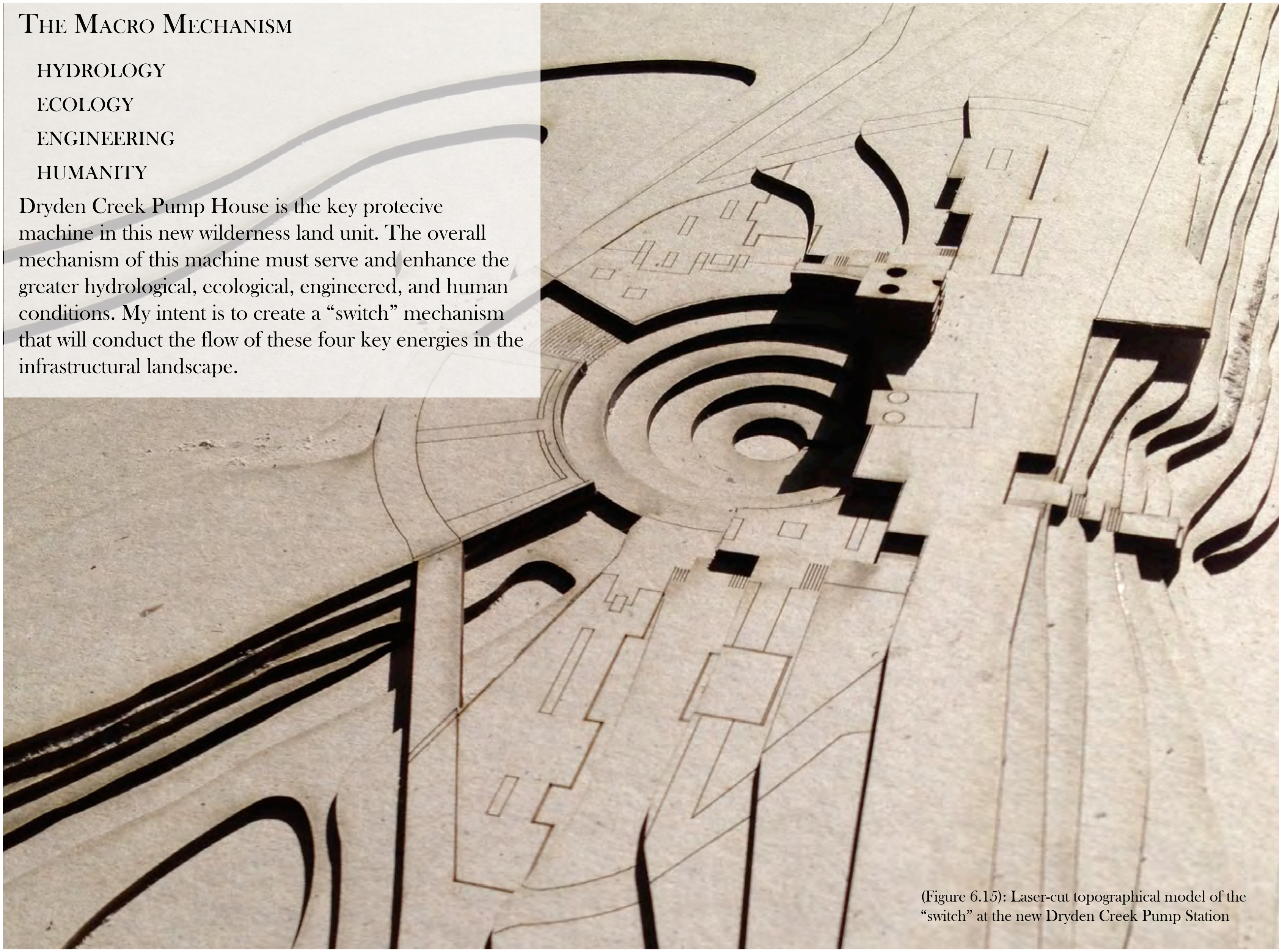
HYDROLOGY

ECOLOGY

ENGINEERING

HUMANITY

Dryden Creek Pump House is the key protecive machine in this new wilderness land unit. The overall mechanism of this machine must serve and enhance the greater hydrological, ecological, engineered, and human conditions. My intent is to create a “switch” mechanism that will conduct the flow of these four key energies in the infrastructural landscape.



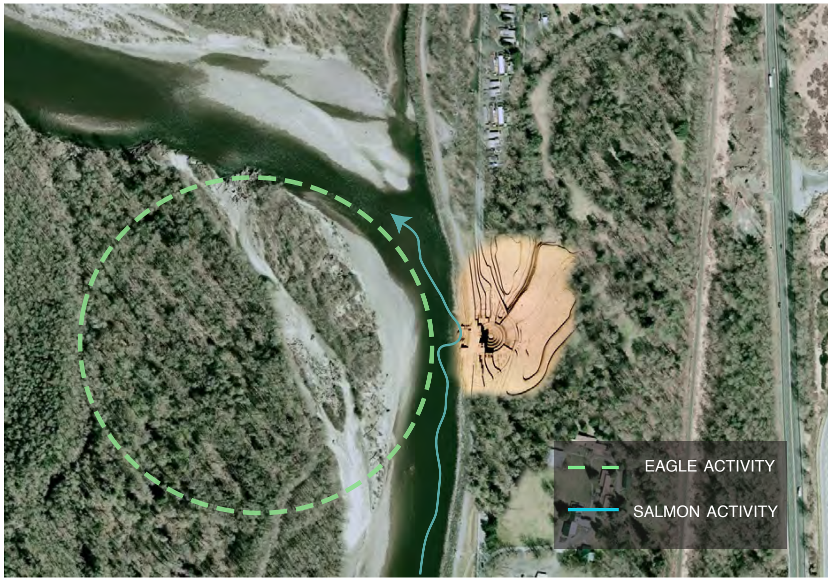
(Figure 6.15): Laser-cut topographical model of the “switch” at the new Dryden Creek Pump Station

1. Hydrology: Reducing Force of Impact

Dryden Creek Pump House is on the receiving end of a massive amount of kinetic energy from the Squamish River. As piping and erosion have been significant problems (Thurber, 2008), force of impact from the river should be reduced to increase dike resiliency and decrease the need for substantial riverside armouring. Opening the channel in the Provincial Park will divert much of this energy away from the site (figure 6.16 & 17).

(Figure 6.16): Force of impact before opening the channel. (Adapted from Google Earth imagery).

(Figure 6.17): Reduced force of impact after opening the channel. (Adapted from Google Earth imagery).



(Figure 6.18): Existing salmon and eagle activity. (Adapted from Google Earth Imagery).

2. Ecology: Making the Barrier Permeable

Dryden Creek Pump House is directly accross the river from a world-record holding area for bald eagle activity (BC Ministry of Environment, 2013) (figure 6.20). Additionally, there is significant salmon activity in the area. Salmon can be seen attempting to swim into the gravity outflow at the pump house or, unfortunately, found dead in the V.F.D. housing. By allowing salmon a safe path through the pump station new spawning habitat will be created up Dryden Creek. This may in turn encourage bald eagle activity on the eastern side of the dike. What was once something that occurred on the other side of the barrier would then become a 360-degree occurrence (figure 6.18 & 19).

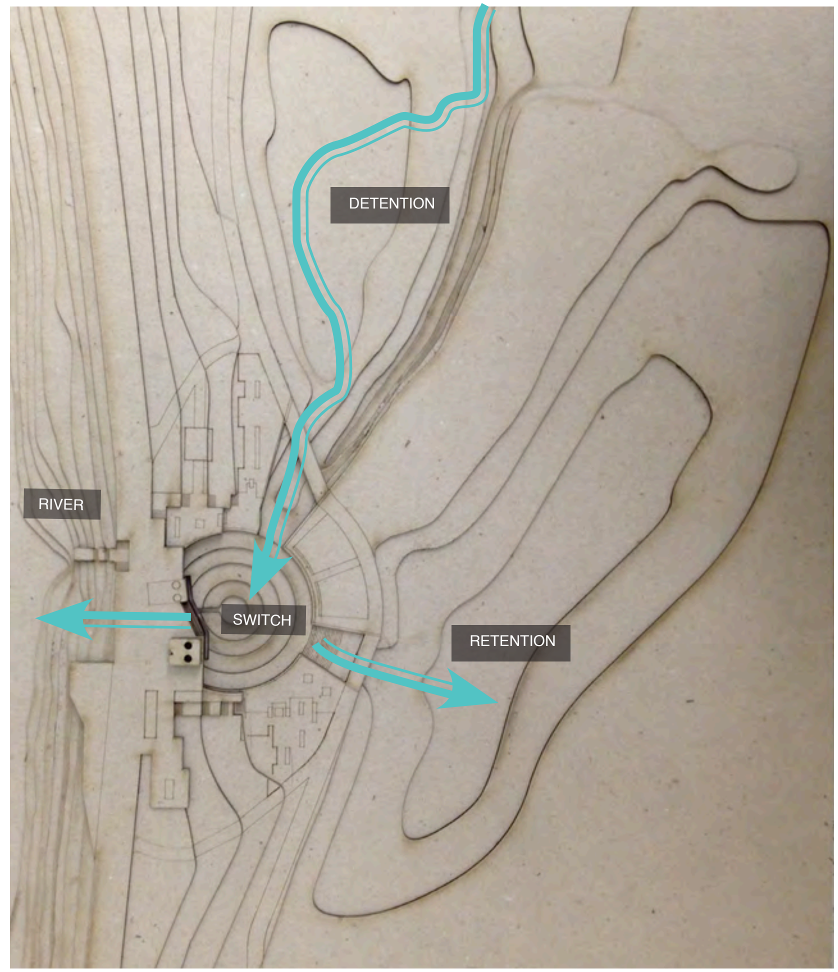
(Figure 6.19): Enhanced salmon and eagle activity. (Adapted from Google Earth imagery).


(Figure 6.20): Eagles at Brackendale Eagles Provincial Park. (Photos: Sean Yen-Hsiao Lin, 2013)

3. Engineering: A Switch in the Landscape

To increase storage capacity and decrease dependence on the pump machinery, my intent is to create a "switch" in the landscape. Water received from Dryden Creek will be slowed with a detention basin immediatly before the entrance to the facility (figure 6.21). The switch mechanism will then direct flow between a retention basin or the pumps, thereby adding versatility and options to what is currently a linear system (figure 6.20 & 21).

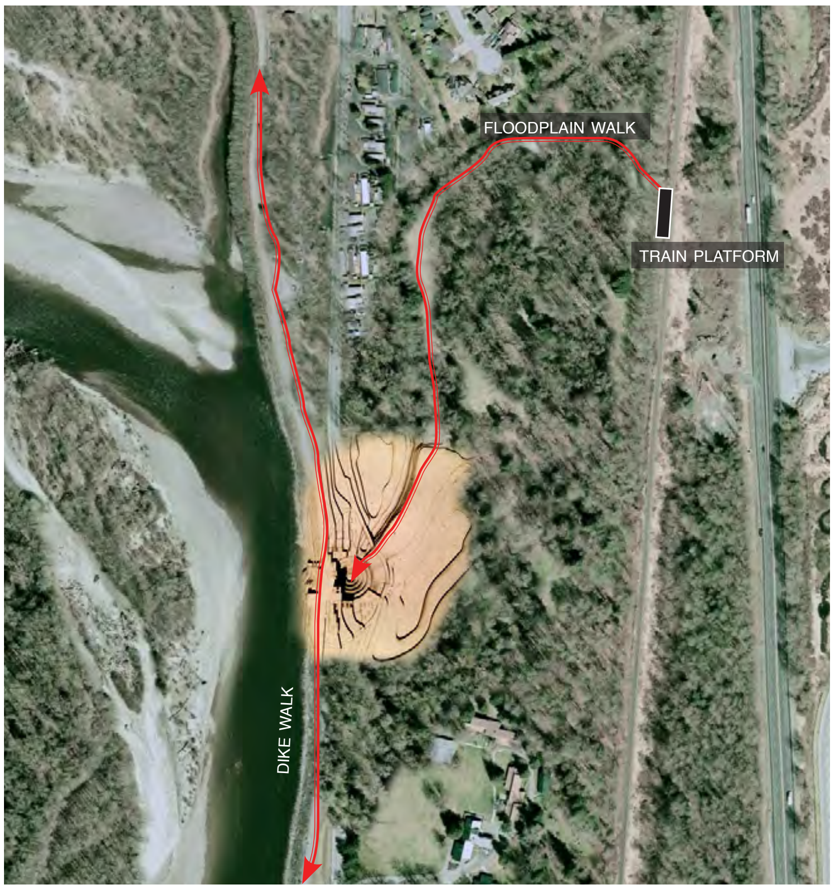
(Figure 6.21) A "switch" to direct the flow of water in the landscape. (Adapted from Google Earth imagery).



(Figure 6.22): The "switch" action will direct water between the pumps or a retention basin.

4. Humanity: An Artifact In The Wilderness

With the removal of Government Road, Dryden Creek Pump House will become a mechanical "artifact" in a wilderness setting. It is vital that people experience this technological outpost for the statement its juxtaposition in the floodplain makes about humanity's place in this sublime regional system. To reach this site one must travel along the dike beside the powerful Squamish River (figure 6.23), or dismount the train, an icon of technology, at the new platform and traverse the floodplain wilderness on a light boardwalk path (figure 6.23, 24 & 25).



(Figure 6.23) Dryden Creek Pump House: an artifact in the floodplain wilderness.
(Adapted from Google Earth imagery)

(Figure 6.24) One dismounts an icon of technology, the train, and steps onto a simple wooden deck.

(Figure 6.25): Leaving the train behind, one follows the riverside boardwalk into the wilderness where a mechanical artifact awaits.

Dryden Creek Pump Station

In its current from Dryden Creek Pump House is quite literally a run-down shack in a hole in the ground on the side of a road. Its name itself is just as uninspiring. My design will give this place the protective, didactic, and interactive quality it deserves as a vital piece of flood infrastructure. The title “Dryden Creek Pump Station” far better captures the essence of my proposed design and the unified interplay between machine and landscape I envision occurring on site.

(Figure 6.26) Dryden Creek Pump House: A run-down shack in a hole in the ground on the side of a road.

DUNGEONESS ACOUSTIC MIRRORS: "GUARDIAN" INFRASTRUCTURE

Our infrastructural machines can offer so much more than utility. The Dumgeoness Acoustic Mirrors were used to detect incoming enemy bombers during WWII (Hall, 2012). Like the pumps in Squamish, these acoustic mirrors serve as guardian infrastructure. The Dungeoness mirrors, however, go far beyond the pumps in Squamish, as they are highly effective on levels that go beyond their intended function. They are effective for three reasons (figures 6.2-29). First, they were protective against a threat. Second, they are didactic, then and now, in that they speak to the desperation of global conflict and convey this message to the individual. Thirdly, they are interactive. One can approach them to see their powerful scale, touch the rough concrete surfaces, and experience a small piece of the terrible past when these machines were required. For these three reasons the Dungeoness acoustic mirrors provided much inspiration for my own design solution.

(Figure 6.28) Image: http://www.amusingplanet.com/2011/01/wartime-sound-mirrors-at-denge.html

(Figure 6.27) Image: http://www.amusingplanet.com/2011/01/wartime-sound-mirrors-at-denge.html

(Figure 6.29) Image: http://www.amusingplanet.com/2011/01/wartime-sound-mirrors-at-denge.html

Dryden Creek Pump Station

Dryden Creek Pump Station will be a mechanical artifact embedded in the wilderness setting. Living landscape will entwine with the artificial as living tissue accepts a vital prosthesis. The junction basin brings versatility to the system that will greatly increase storage capacity and reduce dependence on the pump machinery. A salmon ladder allows the safe passage to new spawning grounds up Dryden Creek. Pump machines become key features - revealed and respected for their vital service. The amphitheatre in the basin is a place of gathering, the use of which is dictated by the processes of the regional system. All together, Dryden Creek Pump Station becomes a powerful mechanism of hydrology, engineering, ecology, and humanity.

1. Paramount mixed flow pumps
2. VFD pumps (Big Bertha)
3. Existing gravity outflow / salmon entry
4. Wing terraces
5. Salmon ladder
6. Eagle viewing platform
7. Amphitheatre + stage
8. Washroom facility

- - Freshwater force main (underground)

- - Sanitation force main (underground)

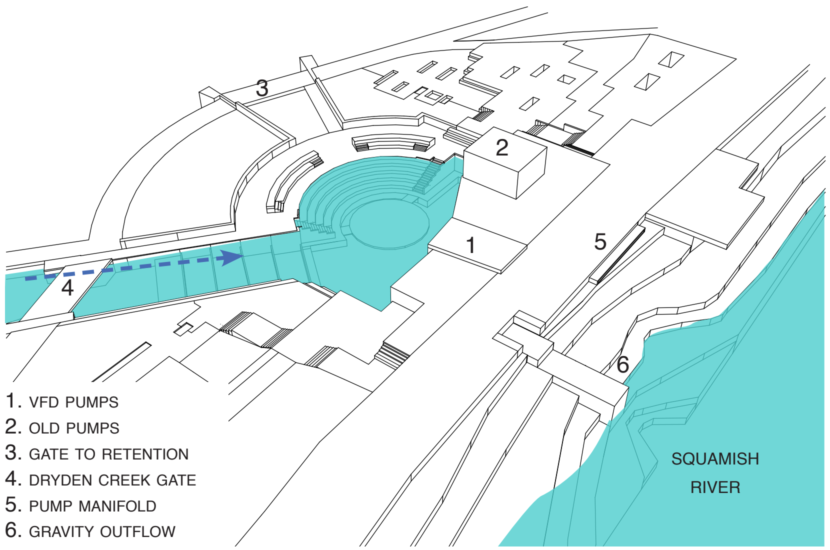
0m 50m

N

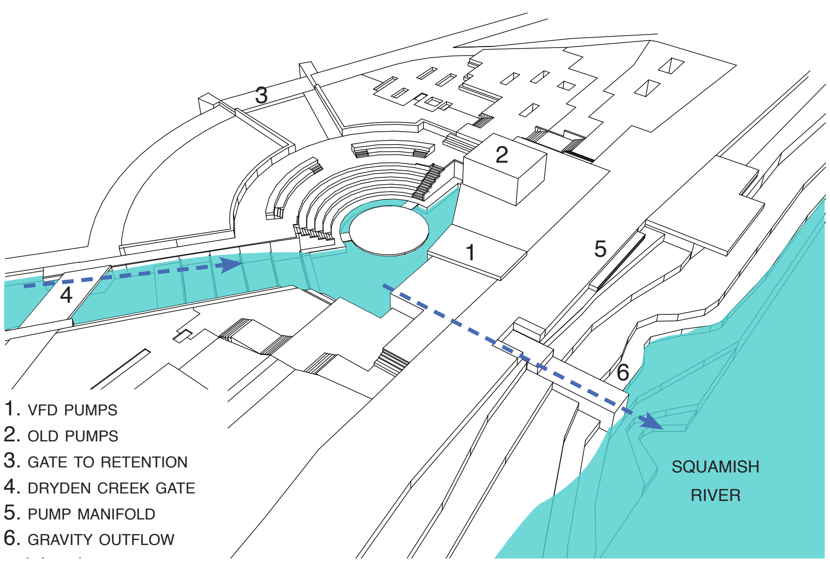
(Figure 6.30) Dryden Creek Pump Station site plan. An interplay between hydrology, ecology, engineering, and humanity.

Junction Basin

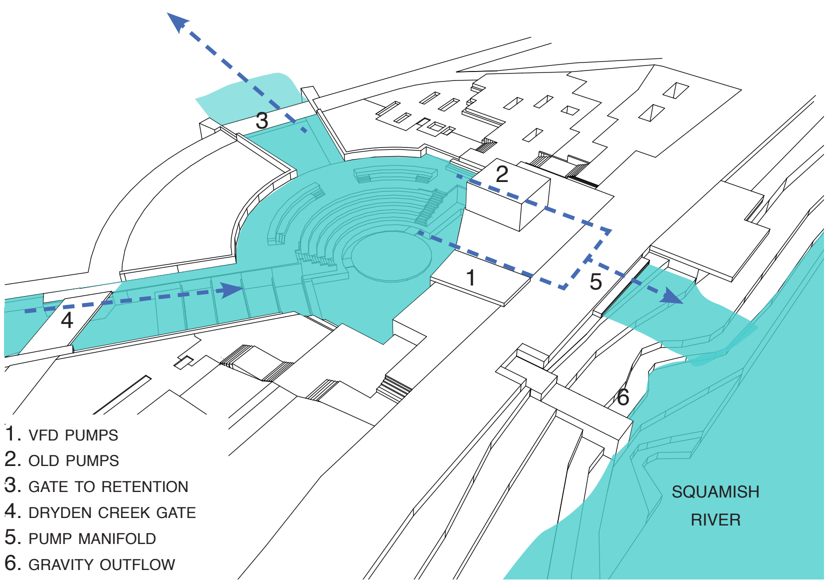
The protective function of Dryden Creek Pump Station will be centred on the concrete "junction basin" that also forms the amphitheatre. Under calm conditions, water will enter the basin via the gate at Dryden Creek, pass through the existing gravity outflow and into the Squamish River (figure 6.31). During major storm events that present a significant flood risk, the gravity outflow will be closed and the basin will begin to fill (figure 6.32). When the basin is filling the decision may be made to open the gate to the retention basin or activate the pump machinery - or both if required (figure 6.33). This mechanism will provide more options during emergencies, add storage capacity, and relieve the complete dependency on the pumps that currently exists.



(Figure 6.32) Junction basin filling after the gravity outflow is closed.



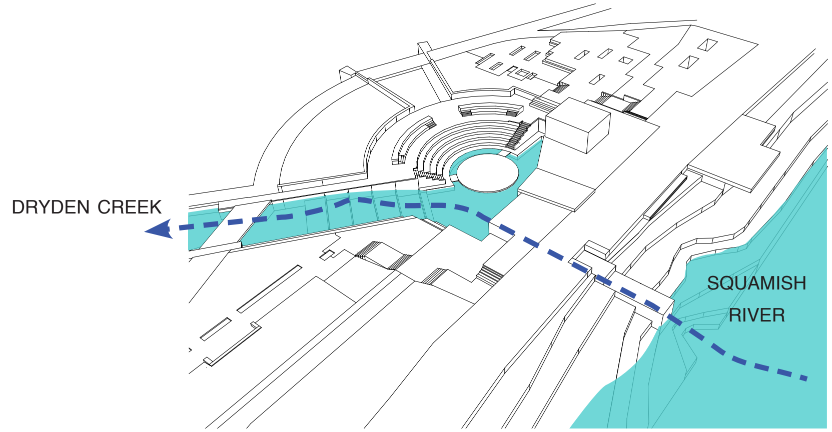
(Figure 6.31) Junction basin under calm conditions.



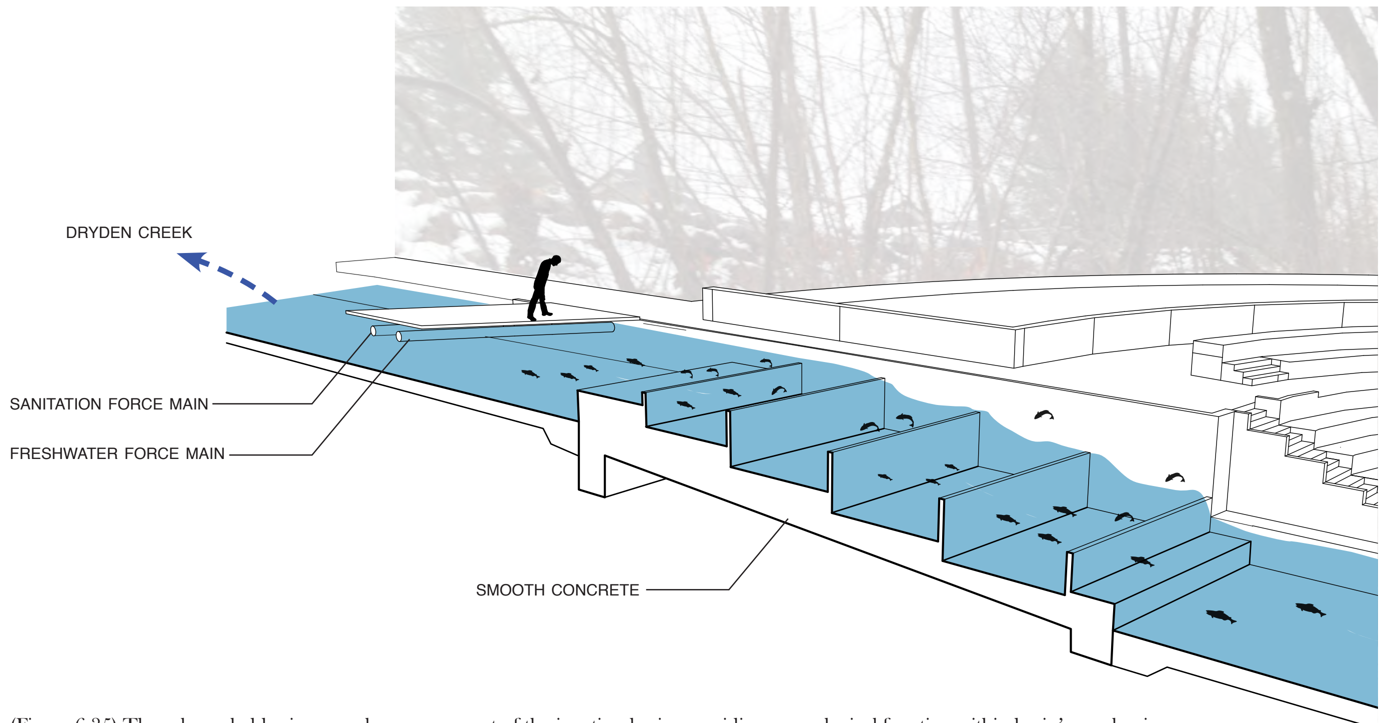
(Figure 6.33) Junction basin under high flood risk conditions.

Salmon Ladder

The Dryden Creek input to the junction basin serves as a salmon ladder to allow access to new spawning areas up the creek. Salmon enter through the existing gravity outflow (figure 6.36) before leaping up the salmon ladder and up Dryden Creek (figure 6.34). This ladder will have the same smooth, industrial concrete composition as the junction basin of which it is part (figure 6.35). The weathered, rusty patina of the existing gravity outflow is an appropriate, 'sympathetic" welcome to the tired fish, as it echoes the deterioration of their own bodies as they force their way up stream to reproduce (6.37). Seeing the salmon swim through this tired machine will remind the viewer that although the bodies of the fish will fail, it is a sacrifice they make for new life. When this protective machine fails, however, it will in time be consumed by the power of the region and cease to be (figure 6.38).



(Figure 6.34) Salmon movement through the junction basin



(Figure 6.35) The salmon ladder is a seamless component of the junction basin, providing an ecological function within basin's mechanism.

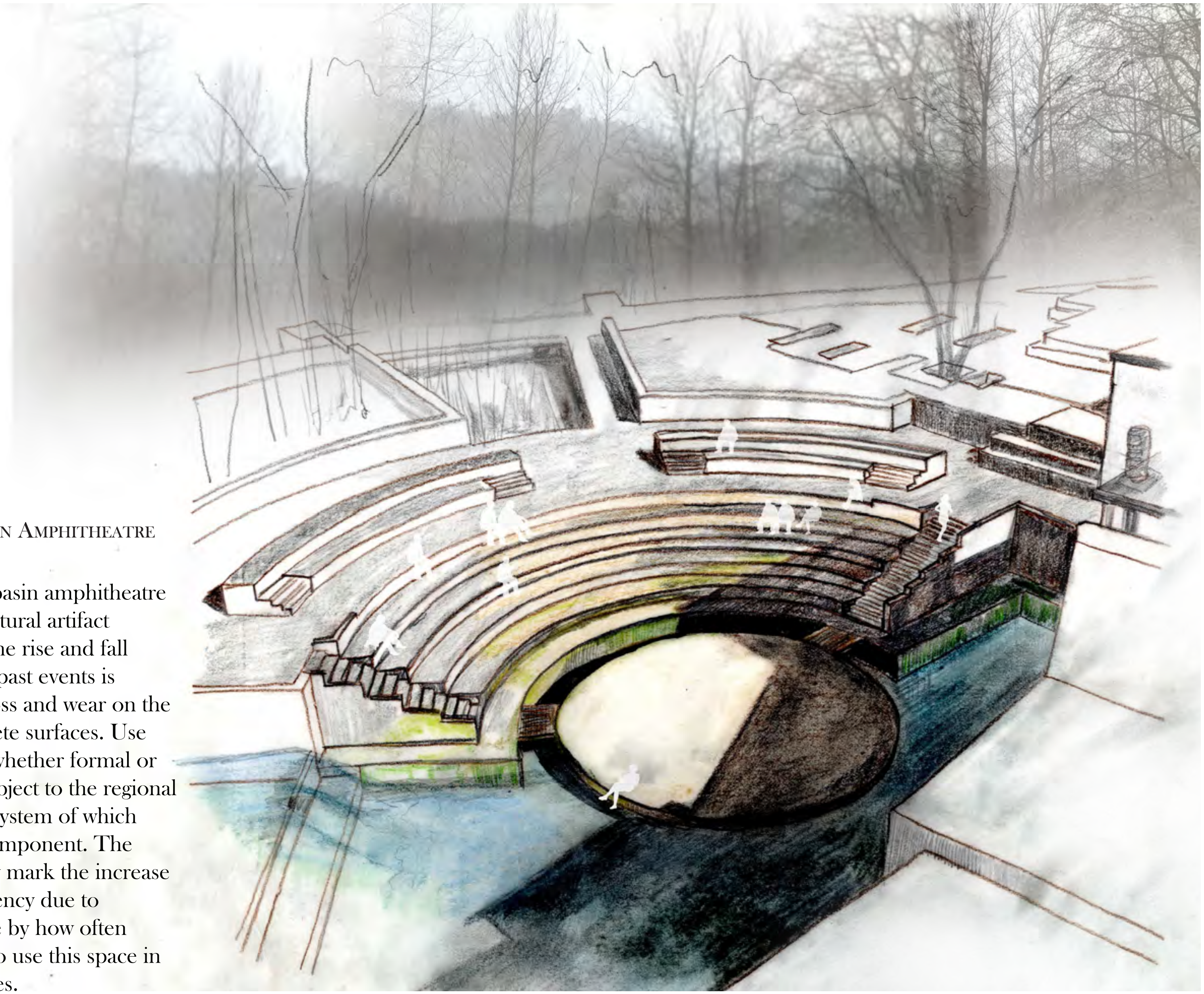
(Figure 6.36) Existing gravity outflow. A sympathetic machine welcomes the spawning salmon.

(Figure 6.37) The bodies of the salmon wear as they battle up stream to spawn.
Image: http://photography.nationalgeographic.com/photography/photo-of-the-day/pacific-salmon-migrating/

(Figure 6.38) This tired machine will eventually be consumed by the region.

Junction Basin Amphitheatre

The junction basin amphitheatre is an infrastructural artifact to discover. The rise and fall of water from past events is marked by moss and wear on the smooth concrete surfaces. Use of this space, whether formal or informal, is subject to the regional watershed - a system of which it is a direct component. The individual may mark the increase in flood frequency due to climate change by how often they are able to use this space in coming decades.



(Figure 6.39) The use of the junction basin amphitheatre is subject to regional watershed processes.

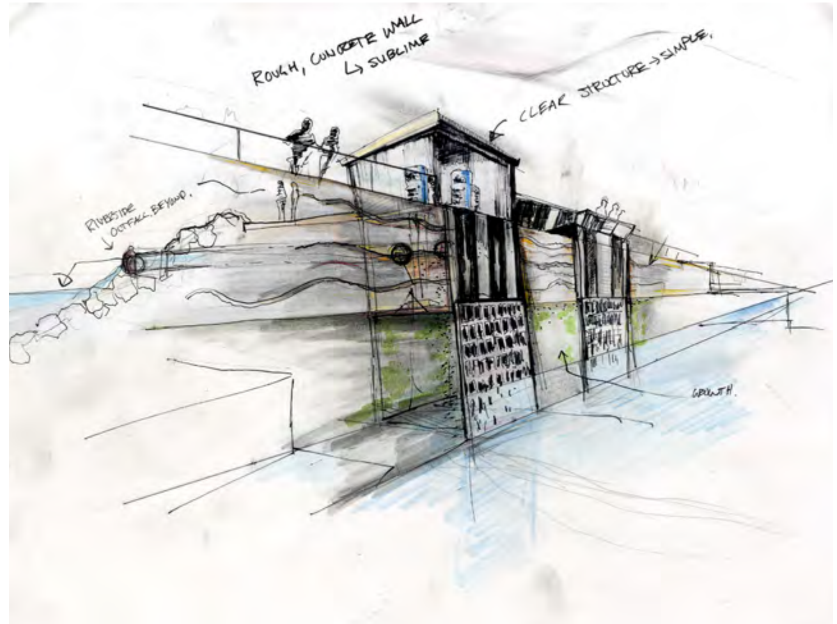
Wing Terraces

In the wing terraces granite and basalt pavers meet while vegetation erupts between these two local stones. This is a testament to the interplay between hard and soft - stone and vegetation - that is ongoing in the region. These terraces may serve as “lobbies” for formal events or simply as places to sit down for those who need to rest while wandering the floodplain wilderness.

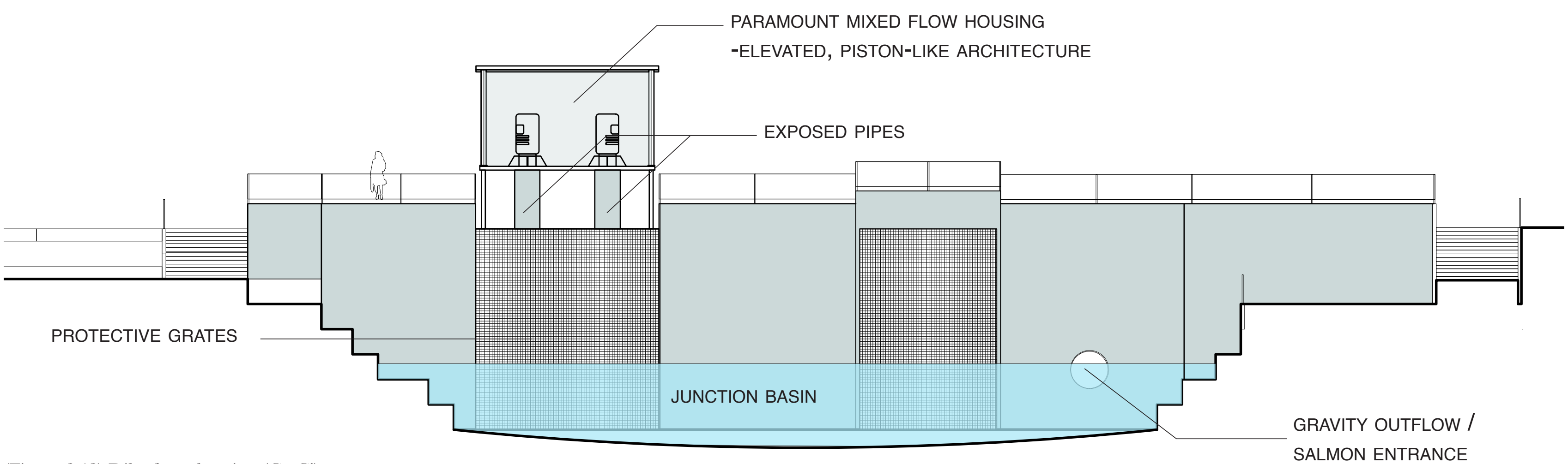
(Figure 6.40) Vegetation erupts from local stone in the wing terraces.

The Wall

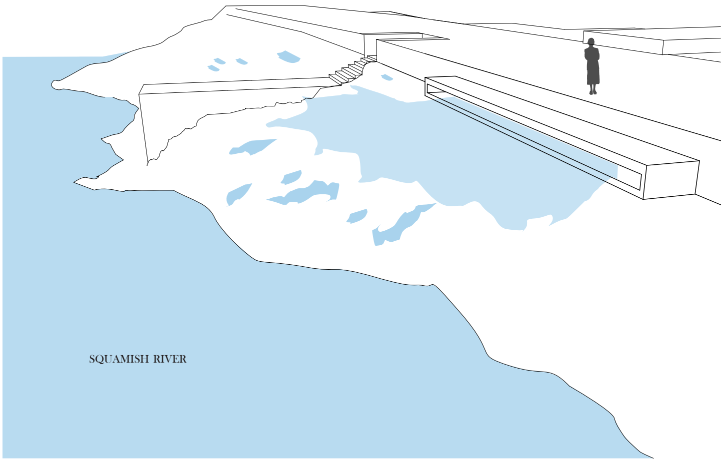
The dike that defends the District of Squamish is the most powerful technological intervention in this infrastructural landscape. The additional 2m of height will make the dike 9m tall from the bottom of the junction basin. Its height will be emphasized on the landward side with a rough, vertical, concrete face (figure 6.41 & 42). Massive steel grates will protect the pumps from debris while adding to the industrial presence of the wall (figure 6.42). The old Paramount pumps will be revealed in transparent, piston-like architecture that emphasizes the action they perform. The pipes that feed these pumps are exposed as they descend into the wall structure below (figure 6.42).



(Figure 6.41) Wall concept sketch: rough, concrete, moss covered.

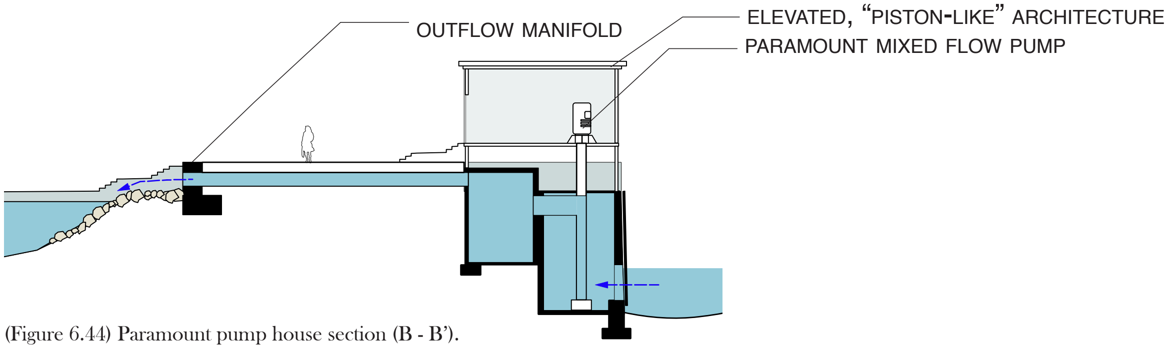


(Figure 6.42) Dike face elevation (C - C').

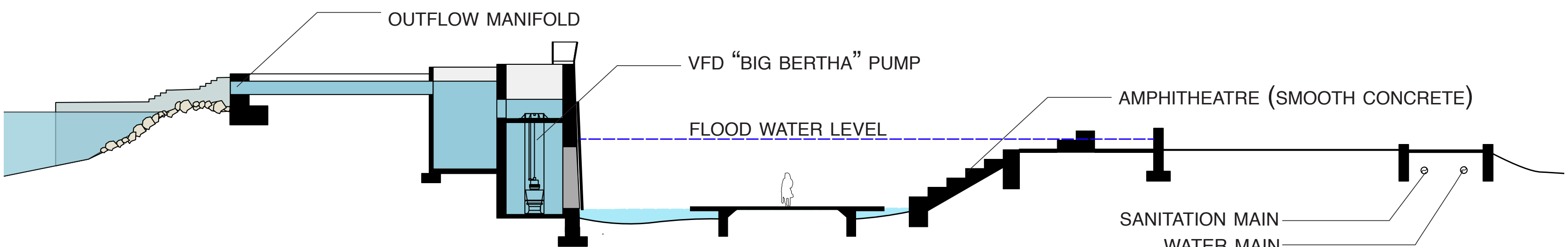


(Figure 6.43) The outflow manifold expels water into the Squamish River.

The function of the pumps remains the same aside from the additional 2m of dike height. As the basin fills, water enters the chambers in the structure where the pumps activate to lift it, send it through the dike, and release it into the Squamish River (figure 5.44 & 45). On the riverside water is expelled from the system in a fittingly spectacular manner through a collective manifold for the flow of all four pumps (figure 5.43).



(Figure 6.44) Paramount pump house section (B - B').

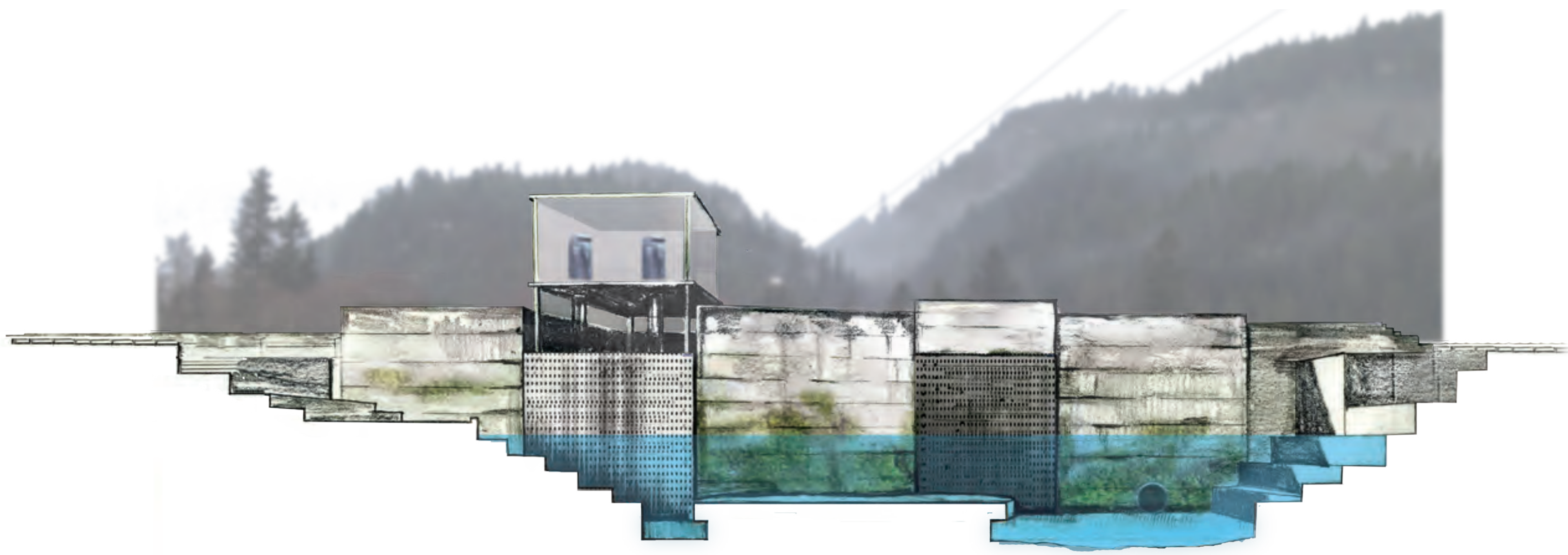


(Figure 6.45) VFD "Big Bertha" housing and junction basin section (A - A').

Moss growth on the rough concrete face marks the water levels of past flood events. The Paramount pumps tower overhead in their piston like structure as the mountains rise in the background. Perhaps this could be the industrial background for an elegant performance on the stage (figure 6.46).

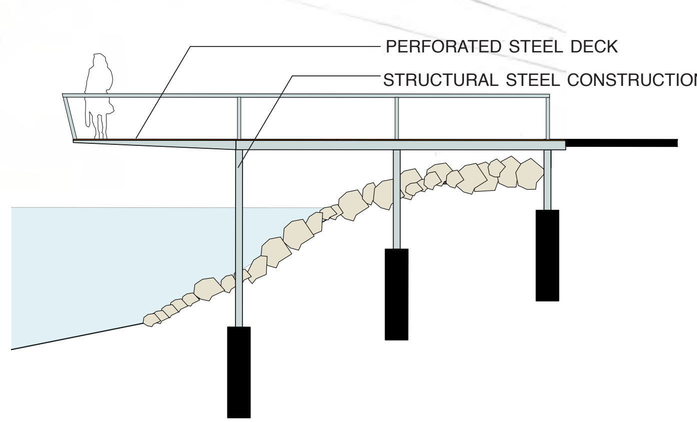
(Figure 6.46) The wall provides an industrial backdrop to activity on the amphitheatre stage.

But, of course, these human activities must give way to the fury of the regional watershed (figure 6.47). When the water level in the junction basin rises, all of these activities must cease until it subsides. Perhaps this period of time is increasingly long - perhaps some day it never subsides. Until then the people of Squamish may explore this machine embedded in the wilderness and reconcile with their region by understanding the infrastructure required to protect them.



(Figure 6.47) Human use of the basin must give way to the processes of the regional watershed.

(Figure 6.48) The cantilever eagle viewing platform provides an extension into the eagle's "world".



(Figure 6.49) The platform is elegantly industrial, and allows one to see the river below through a perforated-steel deck (D - D').

Eagle Viewing Platform

On top of the dike an elegant, yet industrial, cantilever platform serves as a lookout for eagle watchers. The perforated-steel deck allows one to see the powerful Squamish River below one's feet (figure 6.49). Previously, the eagles were viewed from the top of the dike. This platform serves as an extension for the viewer to step off of the dike and into the eagle's "world" across the river (figure 4.8).

(Figure 6.50) The dike serves as a fine, infrastructural line between Squamish and the powerful regional system.

The Infrastructural Line

As one walks atop the thin, local-basalt covered dike, one is lead from Dryden Creek Pump Station to downtown Squamish, and eventually, all the way to Howe Sound. The Squamish River rages to the right, and on the left is a 9m vertical drop into the junction basin (figure 6.50). This is a firm reminder that a fine infrastructural line is all that protects the District of Squamish from the power of the region beyond.

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