Learning in Public Space:

The Design Process Behind Science World's Environmental Trail

By Luc Bagnérès

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Approval

Name:	**Luc Bagnérès**
Degree:	**Master of Urban Studies**
Title:	***Learning in Public Spaces: The Design Process Behind Science World's Environmental Trail***
Examining Committee:	**Chair:** Yushu Zhu Assistant Professor of Urban Studies and Public Policy
	Anthony Perl Senior Supervisor Professor of Urban Studies and Political Science
	Meg Holden Supervisor Professor of Urban Studies and Geography
	Jordan Magtoto External Examiner Planner 1, VIVA Vancouver, Street Activities City of Vancouver
Date Defended/Approved:	June 19, 2020

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Abstract

Urban designers and landscape architects have begun to devote more of their practice to the creation of learning opportunities in public spaces. Very little research has been conducted, however, into how these public "learning environments" have been designed. This thesis focuses on a case study of Creekside Park's TD Environmental Trail (TDET) which surrounds Vancouver's Science World. It offers interactive exhibits and interpretative posters that explore a number of sustainability-related themes. The research here reconstructs TDET's design process through interviews with key participants as well as content analysis of planning and design documentation such as the City of Vancouver's development permits.

The evidence compiled reveals how the TDET became a part of a larger urban design process that negotiated the boundaries between the site's public and private spaces. It reduced Creekside Park's public space through creation of the gated fare-paying "Ken Spencer Science Park", and in exchange, provided improvements to the remaining space, including pedestrian and bicycle pathways, landscaping, and the TDET. The compromise is shown here to have arisen through a design process undertaken between 1999 and 2013.

This thesis studies the original and evolving intentions behind the TDET, shining light on the multiple images, forces, actors and decisions that led to the creation of its interactive exhibits and interpretative posters. In so doing, it provides a first step in an assessment of Vancouver's public space learning environments.

Keywords: Public education; sustainability; urban design process; landscape architecture; interactive public space; design studies

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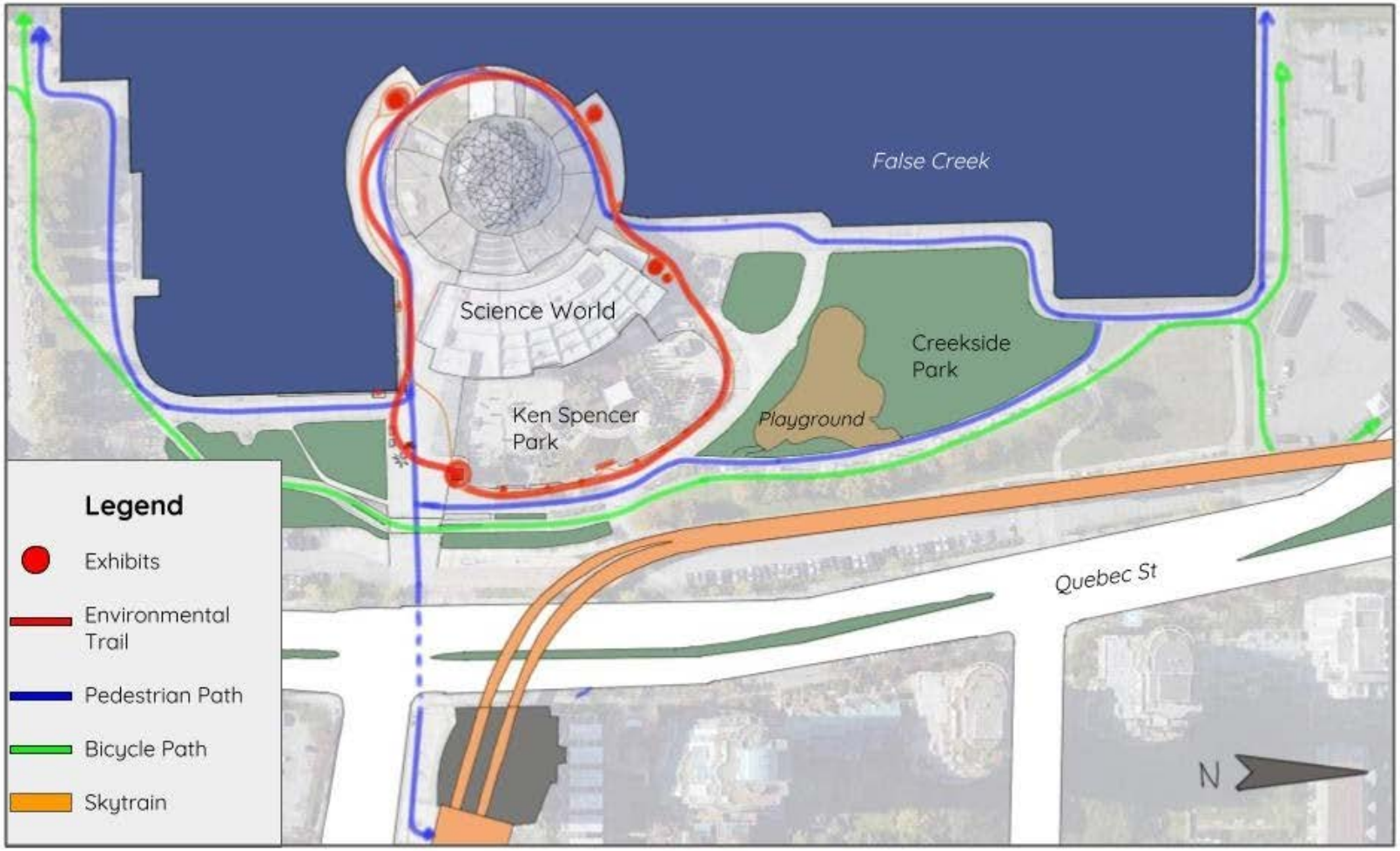
List of Acronyms

COV	City of Vancouver
IPT	Image Present Test cycles
KSSP	Ken Spencer Science Park
NEFC	North East False Creek
OSE	Outdoor Science Experience
PFS	Phillips Farevaag Smallenberg Landscape Architecture Studio
SEFC	Southeast False Creek
SOS	Statement of Significance
SW	Science World at Telus World of Science
TDET	Toronto Dominion Environmental Trail
VBPR	Vancouver Board of Parks and Recreation

Map of East False Creek

A map of the case study showing the TD Environmental Trail in the context of Creekside Park.



Chapter 1. Introduction

Design processes continually rebuild and reshape the public spaces urban citizens share. Through urban development projects, these spaces are reimagined and perhaps improved, leading to expansions and reductions of the public realm. Some processes are larger than others: buildings, boulevards, urban blocks and neighbourhoods. And some of their effects on the morphology of our cities are powerful: entire cities are now being redesigned by a single central design team.[1] These come as a result of an aligned vision, normally combining private and public interests.

This thesis studies a design process that took place between 1999 and 2013 in Vancouver, BC, as an expansion of the Science World Museum. An area within the city's parkland was converted to the gated fare-paying Ken Spencer Science Park (KSSP) in exchange for improvements to the remaining public realm. The privatization of public space is a trend in cities across the world, and Kohn (2004) identifies its risks:

> The privatization of public space gradually undermines the feeling that people of different classes and cultures live in the same world. It separates citizens from each other and decreases the opportunities for recognizing commonalities and accepting differences. Public space is made up of more than parks, plazas, and sidewalks; it is a shared world where individuals can identify with one another and see themselves through the eyes of others. Seeing oneself through the other's eyes may be a first step towards recognizing one's own privilege and, perhaps, criticizing structures of systematic privilege and deprivation. (p. 7)

Yet the outcome of privatization of public space is subject to interpretation. In this instance public and private interests were reconciled, the reduction of public space leading to an improvement in its quality. Termed the Outdoor Science Experience (OSE), the project created, not just the KSSP, but also the TD Environmental Trail (TDET) - see preface image. The TDET provides the opportunity for people to learn about sustainability through interactive learning environments in public space (Dewey, 1938/1998; Gislason, 2007). Its particular design elements

[1] A number of these projects have been documented in China, where the planning and building of 285 Eco-cities by a central organization is underway (Shepard, 2017).

ignite people's curiosity as they walk along False Creek's seawall. In turn, they reshape the possibilities open to citizens and visitors of Vancouver: how they walk, explore and exchange in the public realm adjacent to the Science World museum. A public space design like the TDET is seldom found in Vancouver: one created through the private funding of a fare-paying component. How was the dream of "exploring science in everyday life" (Science World, 1999) within this public space realized? What were the concepts and decisions that made this vision a reality?

Figure 1: The water wheel in the Waterways exhibit along the TD Environmental Trail with interpretive panels

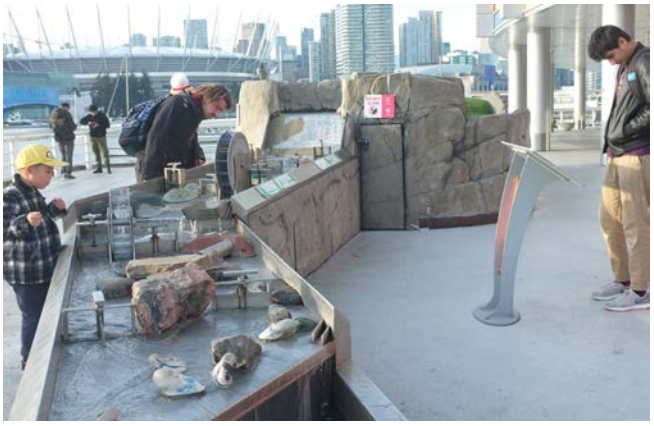


Figure 2: A child, a teenager and an adult each interacting with the Waterways exhibit

When educational infrastructure is provided, it enables people to learn about their surrounding environments interactively (St. John & Perry, 1993): Through posters and features such as the Waterways water wheel (Figure 1), the TDET provides a place for people to creatively engage with sustainability themes. The Waterways exhibit consists of a hydraulic recirculating water system controlled by slide gates, culverts and water wheels. The young adult in Figure 2 is trying to tinker with these kinetic features to make the water wheel turn and realizes that he needs to open and close certain slide gates to harness the water's flow.[2] The child

[2] Making the wheel turn with a flow of water is a simple way to understand the workings of hydroelectricity production. This is British Columbia's dominant source of energy, contributing to 90% of its power according to the TDET poster.

next to him may also understand this dynamic, although with a different goal: tinkering with the slide gates to build up water behind a dam.

The Waterways exhibit is the result of a design process that involved staff at the Science World museum, Vancouver's Phillips Farevaag Smallenberg landscape architects (now known as PFS Studio), and the City of Vancouver (COV), and brings opportunities to learn to the public edge of False Creek. Interestingly, participants of the Waterways exhibit (and the other exhibits along the TDET) are normally citizens and tourists moving through the area rather than those who have come to see Science World.[3] This might be due to the fact that the TDET is in a prime location on the outskirts of the downtown waterfront where a great view of Vancouver's Skyline can be caught.

Figure 3: Science World's Geodesic dome, a landmark amongst many others
Source: Luc Bagnérès, 2020

The TDET encircles the iconic geodesic dome, a landmark originating in Vancouver's World Exposition of 1986. Within it, the Science World museum offers thousands of children and parents an engaging way of understanding science, animating the visual, auditory, and kinaesthetic senses through a number of interactive exhibits. Around its perimeter the TDET also

[3] Preliminary research (Appendix A.2) revealed that 80% of respondents using the TDET were not on site to attend Science World exhibits (n=25).

features other interactive exhibits, offered at no cost to the public, which have been integrated into False Creek's seawall, considered Vancouver's "real public space":

> The real public space of Vancouver happens at the edges. A lot of those edge spaces are very thin. Imagine if you could take a big green common or park and stretch it out so that it is ten kilometers long and three meters wide, and that's most of Vancouver's public space: the Stanley Park seawall. The other thing is that because we're on the edge of the water, we borrow that space visually. But the water was here before we got here. That's another one of Vancouver's favourite myths: that we've created this incredible experience. (Berelowitz, 2017, p. 14)

Berelowitz makes two key points here. He first presents the fact that we "borrow" this space visually from water, reflecting the urban and mountain skyline. He then explains that Vancouver's dominant public spaces are stretched around its periphery or edge rather than concentrated in its center. He argues that the most significant public space in Vancouver is not a public square but a linear feature hugging the edge of the water known as the seawall. On the seawall, one can effectively go around Stanley Park, through English Bay and the downtown neighbourhoods, right to Science World and the TDET.

1.1. Research Question

My interest in the TDET is centered on its design process. The guiding question for the research presented here is therefore: how was the TD Environmental Trail conceived, designed and executed? Answering this question shows us how the TDET emerged from a larger urban design process involving a compromise over the creation of the gated fare-paying Ken Spencer Science Park.

Conception can be defined in multiple ways although "the capacity or process of forming ideas" (Merriam-Webster, n.d.) is the meaning used here. In this case, the initial idea, formed by Science World staff, was an exterior interactive science environment. Within the Outdoor Science Experience (OSE), the TDET emerged as a built form in the process of finding a fit between the private and public realms. Evidence of the OSE as a project originated in 1999, with the objective of creating an interactive physics-based science environment on the themes of "Water, Air, Light, and Gravity". These preceded the theme of sustainability that finally unified the exhibits.

The design process intertwines with project conception and "begins when an individual or team first thinks about the project – for example, a building, an open-space plan, or an object" (Zeisel, 1984, p. 3). Design, Zeisel continues, is "difficult to describe because it includes so many intangible elements such as intuition, imagination and creativity" (p. 3). Nonetheless, design is a process comprised of multiple actions, illustrated in figure 4 below.

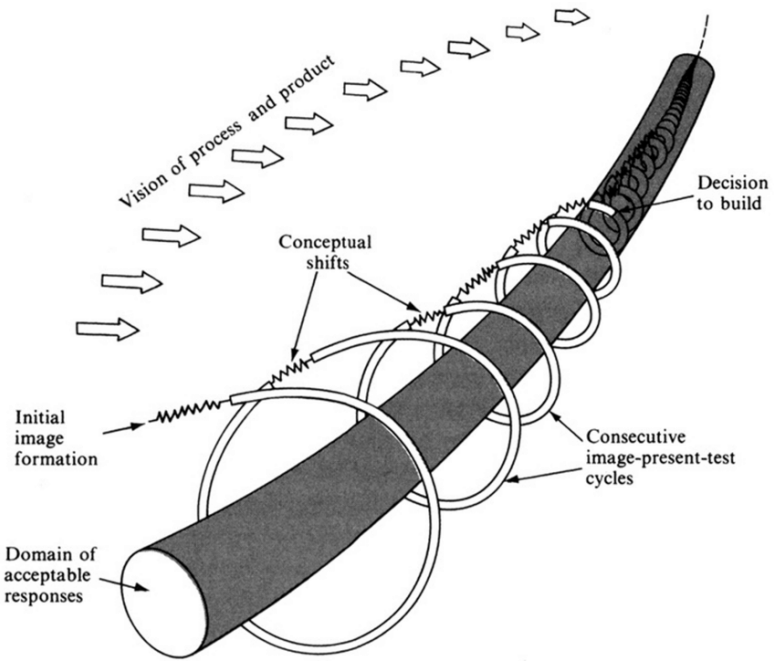


Figure 4: Design development spiral framework by John Zeisel (1984)
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This conceptual framework attempts to capture design projects over time, portraying them as comprised of three primary iterative actions, *imaging*, *presenting* and *testing*. Zeisel describes how the first image of a particular form that develops in a designer's mind, is then presented visually as a set of plans or drawings in 2D format, or in 3D models. Once an image is thus captured, it can be tested through "appraisals, refutations, criticisms, judgements comparisons, reflections, reviews, and confrontations" (Zeisel, 1984 p. 8). As was the case for the TDET, tests of the initial TDET designs took place internally within design teams like Science World and PFS Studio, with stakeholders like Ken Spencer and TD, and amongst the various departments of the City of Vancouver. Tests bring feedback to the designer or design team and raise questions such as: Is it working? If not, what elements need to be changed? This process is an opportunity to improve the design leading to a conceptual shift in the designer's

mind. And this sets off the design image-present-test cycle once more re-imaging the central vision of the project.[4] By re-imagining the exhibits in 2007-2010 through the theme of sustainability, Science World, and PFS Studio, designers entered the domain of acceptable response.[5] The City tested presentations of the TDET until they had found an appropriate fit with Creekside Park. This led to a development permit which enabled the 2011 decision to build. Design is the process of bringing a concept to its execution; in this case, bringing the concept of a science park into a series of three- dimensional representations, which finally led to its as-built form.

Execution is the final step in the design process whereby a decision to build is initiated. As Zeisel states, design "includes a stage when detailed working drawings of a project are given to contractors instructing them how the designers expect the project to be built" (1984, p. 3). The execution of the process leading to the TDET required a development permit from the City of Vancouver. This was pursued through multiple design reviews with the City through departments such as Planning, Engineering, Cultural services, Parks and Recreation.

Answering the research question as to how the TDET was conceived, designed and executed, thus rested upon multiple types of evidence, in both document and interview form. As mentioned, interviews were conducted with key informants: curators, designers, architects, and executives who took part in the TDET design process. Their input revealed the ideas and events that took place along the way to the its implementation. Where possible, these sources were corroborated by documentation including presentations as a part of the image-present-test cycle.

Other categories of documents also helped define the goals and objectives of the TDET: Chapter 3 details the methods used to collect interviews and documentation.

At the centre of this thesis, then, is Zeisel's design spiral framework, which shows precisely how the development of the TDET followed continuous image-present-test cycles that

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[4] Sometimes these tests will be so challenging that they may in fact terminate work on the vision, the vision of process and product not being seen as an acceptable response, and so terminating the design process. This could have happened for the TDET in 2003, but did not, as the project was reconsidered by COV in 2006.

[5] In this case, the acceptability of the form stemmed from a reassessment of its context amongst the departments and officials of the City of Vancouver. Success was thus achieved through "the relation of mutual acceptability between [context and form]" (Zeisel, 1984, p. 13).

kept all of the primary organizations involved: Science World, the City of Vancouver, and PFS Studio. It allows us to understand design within its sociopolitical context as a process. For details on the framework and methodology for this research see Section 2.5 and Chapter 3.

1.2. Significance of Research Question

The research question posed here is significant to those who want to understand urban design through a temporal lens: as an iterative process of evolving form. The process behind the design of this exhibit-rich public space may sound like a simple thing to understand but it turns out to be surprisingly complex.[6] Grounded empirically through interviews and documentation, this thesis presents evidence of the unfolding of a significant urban design project through the City of Vancouver's development process. Zeisel (1984) emphasizes the importance of evaluation research in improving the decision making process:

> Investigators can better use evaluation research results to improve the process of making design decisions in the future if they can identify and make visible the design decisions that led to the setting being evaluated. (p. 46)

Revealing the design decisions behind the TDET enables an evaluation, not only of the success of the space, but also of its consequence for the field of urban design. As discussed, and demonstrated below, the TDET originated within a larger design project known as the Outdoor Science Experience (OSE). The OSE itself was founded within an even longer-term municipal vision for shoreline renewal:

> The elements proposed as part of the current development permit application [of the OSE] are designed as much as possible to be permanent features that are fully consistent with the longer-term concept [of the False Creek shoreline renewal]. (City of Vancouver, 2010b, p. 7)

The TDET needed to be placed strategically within the scheme for shoreline renewal. The sustainability-themed exhibits also required careful placement in order to integrate them into these longer-term plans for removal of the Expo deck.

[6] See Appendix A.2 for detail on the evolution of the research question.

This research may, therefore, offer insight to the actors currently working on the renewal of the False Creek shoreline (City of Vancouver, 2020). In this, it follows a core intention of Zeisel's *Inquiry by Design* (1984), to aid coordination and cooperation between designers and researchers in order to improve the quality of the built environment.[7] Zeisel expands, "describing the design process may help designers and teachers of design understand their own behavior and thereby improve their design ability" (p. 5). As mentioned, the creation of the TDET required the privatization of some public space, but offered a unique quality to the public space realized. Reconstructing the design decisions of the OSE project is significant for the fields of urban, museum and educational studies. For example, the TDET in its final form builds infrastructural capacity for a public application of Orr's (1990) concept of ecological literacy:

> All education is environmental education. By what is included or excluded, emphasized or ignored, students learn that they are part of or apart from the natural world. Conventional education, by and large, has been a celebration of all that is human to the exclusion of our dependence on nature. As a result, students frequently seem to be devoid of any sense of place or stewardship, or inkling of why these are important. (p. 49)

This quote, one of six propositions put forward by Orr, explains the development of the 'ecologically literate citizen'. There is research on how these learning environments operate within school and museum settings, but these learning environments are rarely explored in urban public space. Through interpretative posters and interactive exhibits involving visual, auditory and kinaesthetic stimuli, the TDET offers an alternative form of ecological literacy (Orr, 1990). With the freedom to enter and engage with these exhibits, citizens moving along the seawall have the opportunity to form their own impromptu learning experiences. As stated at the beginning of the TDET, citizens are invited to "embark on a journey of sustainability" (Figure 5 below).

Chapter 2 presents the literature serving as a foundation or rationale for public learning environments. Chapter 3 details the methods used for collection of evidence in conducting this research. Chapter 4 articulates the TDET's design process and Chapter 5 provides an evaluation

[7] As explained "Cooperation is fostered when designers or researchers decide they want to use the other discipline as a tool to improve their control over side effects, that is, to solve more broadly defined problems then they can solve alone" (Zeisel, 1984, p.32).

of the project and suggests further steps for its development. In summary, this thesis seeks to articulate the original and evolving intentions behind the TDET, making visible the multiple forces, actors and decisions that led to the creation of its interactive exhibits and posters. In so doing, it provides a starting point for assessment of the effects of such learning environments on Vancouver citizens' understanding of sustainability.

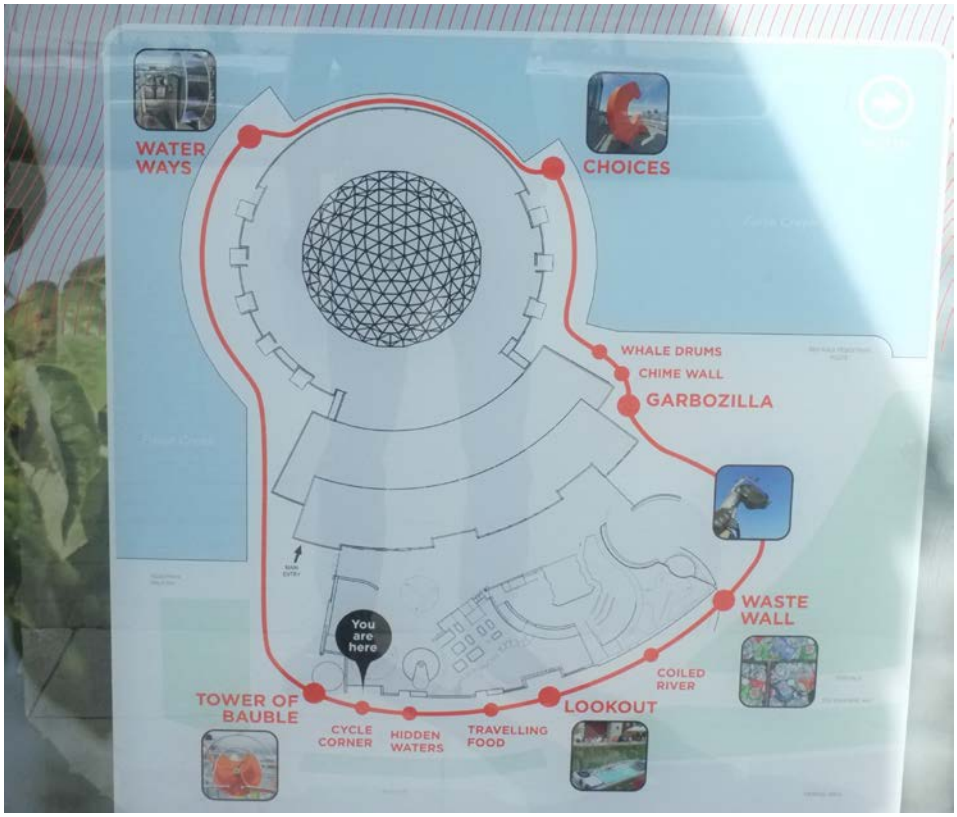

Figure 5: Introductory map displayed on the TD Environmental Trail showcasing the exhibits
Source: Photograph by Luc Bagnérès

Chapter 2. Literature Review

This review serves to ground and situate the thesis within relevant concepts drawn from urban, education, and museum studies. The theoretical framework formed by the intersection of these fields is the basis for interpretation and discussion of the findings on the TDET design process.

2.1. Navigating the City

In his 1960 classic, *The Image of the City*, Kevin Lynch documented "the visual quality of the American city by studying the mental image of that city which is held by its citizens" (p. 2). His focus was on the way in which citizens navigated their own city and the visual imagery they used to orient themselves within its complex environment. He concluded that "each individual creates and bears his own image, but there seems to be substantial agreement among members of the same group" (1960, p. 4). Lynch's key insight was that citizens, to guide their orientation, create mental maps of the city structured by five key elements: *paths, edges, nodes, districts,* and *landmarks.* A map of the application of the most relevant of these elements to the design of the TDET is presented in Figure 6 below.

1. Paths

Lynch (1960) defines paths as "the channels along which the observer customarily, occasionally or potentially moves. … [They allow] people [to] observe the city while moving through it, and along these paths the other environmental elements are arranged and related" (p. 47). If we look at the contextual map of east False Creek (Figure 6), we can see one of the most concentrated displays of public pathways in Vancouver. [8] As we move toward Science World, we can see the location of the most popular cycling route in Vancouver.[9] Its daily ridership

[8] Three Main Street arterials, Quebec Street, and Terminal Avenue, each serving vehicles with a raised SkyTrain pathway connecting to Pacific Central Station, a terminating railroad path.

[9] Bike lane statistics released by the City of Vancouver Engineering Services show that (the most recent available data), the second most used path in ridership is the Burrard Bridge at 216,000 trips in July 2018, and Point Grey Road in third at 111,000. Science World's bike path has the highest ridership throughout the year.

numbers are displayed publicly on a screen on the TDET. Finally, the pedestrian routes along the seawall and inside Science World are connected to the TDET.[10]

2. Edges

Edges, defined by Lynch, are "boundaries between two phases, linear breaks in continuity: shores, railroad cuts, edges of development, walls" (1960, p. 47). Edges are important features for many people as they play a particular role in "holding together generalized areas, as in the outline of a city by water or wall" (1960, p. 47). As land comes to its termination and falls under the surface of the ocean, it provides vantage points to many other parts of the city. The seawall barrier marks a boundary for those on land, forcing those who walk or bike to move alongside it. In so doing, the seawall path serves as an orienting device, providing a vantage point to the city. The edge may also be understood as a barrier, separating water from land. Through creation of this seawall in 1980 (City of Vancouver, n.d.), land was defined, transformed into urban form, restricting the forces of water and preventing them from degrading the use of these desirable public spaces.

3. Nodes

Lynch defines nodes as "the strategic spots in a city into which an observer can enter…they may be primarily junctions, places of a break in transportation, a crossing or convergence of paths" (p.47).[11] As seen in Figure 6, the most prominent node on site is the Main Street/Science World SkyTrain station.

[10] The TDET, as will be shown, was part of an intervention into a network of paths serving a number of transportation modes. As shown in the Preface image (p. xviii), its placement enhanced the cycling and pedestrian pathways while removing access to cars and buses.

[11] The Main Street terminal serves as an essential access point to the area for people of Metro Vancouver. It allows for transition between the SkyTrain and the bus lines which then move users onto the paths Quebec Street and Main Street. Another more regional node is Pacific Central Station to the east, which connects to regional railway paths like VIA Rail and Amtrak.

Figure 6: Map of surrounding context of Science World noting Lynch's five design elements. Plaza of Nations, BC Place, and Science World are all landmarks in Lynch's sense

Source: Luc Bagnérès illustration

4. Districts

The edge conditions of the TDET and Science World place them outside the city's surrounding neighbourhoods.[12] The most prominent example of a district nearby is the Olympic Village neighbourhood located a few hundred meters west.

5. Landmarks

As will be discussed, the geodesic dome of Science World is one of Vancouver's most prominent landmarks. Such a landmark may serve as a reference point for citizens, involving "the singling out of one element from a host of possibilities. Some … are distant ones typically seen from many angles and distances" (Lynch, 1960, p. 48). Here, distant elements are the profiles of Harbour Center, the downtown skyline and the north shore mountains. Some urban landmarks are more iconic than others. In September 2019, Science World was voted the most iconic building in Vancouver, beating out the Vancouver Public Library and the Marine Building.[13]

In summary, Lynch's five defining elements (paths, edges, nodes, districts and landmarks) are essential building blocks in the creation of legible and highly imageable public environments.[14] But an understanding of form as the configuration of these elements is also useful to citizens themselves. Lynch describes the retraining of the citizen as follows:

> The final objective of such a [legible] plan is not the physical shape itself but the quality of an image in the mind. Thus, it will be equally useful to improve this image by training the observer, by teaching him to look at his city, to observe its manifold forms and how they mesh with one another. Citizens could be taken into the street, classes could be held, the city could be made an animated museum of our society & hopes...An art of city design will wait upon an informed and critical audience. (Lynch, 1960, p. 117)

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[12] As Lynch (1960) states, "Districts are the medium-to-large sections of the city, conceived of as having two-dimensional extent, which the observer mentally enters "inside of", and which are recognizable as having some common identifying character" (p. 47).

[13] In a Twitter poll hosted by CBC reporter Justin McElroy in 2019, the Science World building obtained the most votes (25,000), further justifying a general sense of the iconic nature of the geodesic dome, a legacy of the World Exposition of 1986.

[14] As argued by Lynch (1960), "To heighten the imageability of the urban environment is to facilitate its visual identification and structuring. The elements isolated above: the paths, edges, landmarks, are the building blocks in the process of making firm, differentiated structures at the urban scale" (p. 95).

Lynch justifies an education in seeing as an important counterbalance to the reshaping of the built environment, both leading to "a critical and attentive audience". He argues that such "a highly developed art of urban design" *depends* upon interested and engaged citizens. If we connect this argument to the focus of this thesis, questions arise: Do the exhibits of the TDET foster, in citizens, a more critical attention to their surroundings? Does this then forge an audience more informed about the reshaping of city elements through urban design?

2.2. Enclosures, Incidents, and Hazards

A year after publication of *The Image of the City*, Gordon Cullen released his *Concise Townscape*, stating:

> There is an art of relationship just as there is an art of architecture. Its purpose is to take all the elements that go to create the environment: building, trees, nature, water, traffic, advertisement and so on, and to weave them together in such a way that drama is released. For a city is a dramatic event in the environment. (1961, pp. 7-8)

Cullen (1961) argued "that the slightest variation on a plan has disproportionally powerful effects in the third dimension" (p. 16). How can urban environments inspire and uplift citizens in their everyday lives? Cullen demonstrated how the "unfolding drama of solid geometry" (p. 20) should be studied and understood by urban planners following World War II. He proposed a "box of concepts and a range of gambits" (p. 196) derived from his experience as a designer which together would heighten the experience of urban environments. While many of his concepts would fit the context of the TDET, those of *enclosure, incident,* and *hazard* played a pivotal role in its design. As Cullen (1961) defines:

> [*Enclosure*] is the basic unit of the precinctual pattern; outside, the noise and speed of impersonal communication which comes and goes but is not of any place. Inside quietness and human scale of the square, quad or courtyard. This is the end product of traffic, this is the place to which traffic brings you. Without enclosure, traffic becomes non-sense. (p. 25)

> The value of *incident* in a street – tower, belfry, silhouette feature, vivid colour and so on – is to entrap the eye so that it does not slide out into the beyond with resulting boredom. The skillful disposition of incident gives point to the basic shapes of the street or place; it is a nudge. (p. 44)

> The process of linking and joining together raises the problem that although it may be visually rewarding to link here and there, it may not suit immediate purposes of those who are charged with the control of the place...Hence the use of *hazard*...The railing, water, planting, and change of levels. All these hazards permit visual access whilst denying physical access. (p. 56)

As part of the TDET design process, Creekside Park was divided into a series of smaller enclosures to create a better sense of place. And as part of this equation, the exhibits of the TDET became incidents along its public pathways. The use of hazards was employed to create variation in the Ken Spencer Science Park's implied fence line using water, planting and railings. As Cullen explains: "Unless you define your notes and establish a musical grammar, you will never be able to play a tune" (1961, p. 193). To extend this metaphor, we may understand enclosure, incident, and hazard as elements of such a grammar alongside Lynch's paths, edges, nodes, districts and landmarks. Going forward, those most pertinent to an analysis of the design of the TDET itself are Cullen's enclosure, incident and hazard and Lynch's paths, edges and landmarks.

2.3. Self-Reinforcing Process

Engagement with the TDET exhibits will hold seawall users in place for a longer period of time. Duration was of particular importance to Jan Gehl, in his 1971 *Life Between Spaces*. He argued that "it is not the number of people or events, but rather the number of minutes spent outdoors that is important" (p. 79). To illustrate, stopping at an exhibit for 30 seconds with a group of five people may animate the public space somewhat. However, Gehl argues, longer durations of two to ten minutes spent by a single person is much more significant to the anchoring of other activities in the space and becomes self-reinforcing:

> When someone begins to do something, there is a clear tendency for others to join in, either to participate themselves or just to experience what the others are doing. In this manner, individuals and events can influence and stimulate one another. Once this [self-reinforcing] process has begun, the total activity is nearly always greater and more complex than the sum of the originally involved component activities. (Gehl 1971, p. 75)

This has been illustrated with multiple exhibits along the TDET such as Waterways and the Tower of Bauble (see section 5.1). Visual or auditory elements often attract initial onlookers,

providing an anchor whereby others may be attracted, curious to see what is happening.[15] This demonstrates that when designers are able to enrich a public space with learning opportunities, the enrichment will have self-reinforcing effects that inject more consistent life into that space. To better understand the concept of learning within a public space, we will turn to John Dewey's concept of learning environments.

2.4. Learning Environments

John Dewey wrote *Education & Experience* in 1938, stating that "the immediate and direct concern of an educator is with the situations in which interactions take place" (p. 43). He described how learning occurs within particular environments (1938/1998):

> Where schools are equipped with laboratories, shops, and gardens, where dramatizations, plays, and games are freely used, opportunities exist for reproducing situations of life, and for acquiring and applying information and ideas… Ideas are not segregated, they do not form an isolated island. Information is vitalized by its function; by the place it occupies in direction of action. (p. 96)

Dewey illustrated the ways in which an environment can either support or isolate the learning process. From this, it can be understood how a given space, such as that of the Environmental Trail's exhibits, functions as a pedagogical instrument. Yet environments can also impede learning.[16] The role of a school space according to Dewey (1938/1998), and expanded on by Gislason (2007), must be reconciled with its encompassing social context. A learning environment is understood to extend well beyond school walls. The primary responsibility of the educator is knowing how to utilize and select the best environments for their students:

> The immediate and direct concern of an educator is then with the situations in which interaction takes place. The individual, who enters as a factor into it, is what he is at a given time. It is the other factor, that of objective conditions, which lies to some extent within the possibility of regulation by the educator. (Dewey, 1938/1998, p. 43)

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[15] Supporting Gehl is William Whyte in the *Social Life of Small Urban Spaces.* He remarked that "what attracts people most is most often, quite simply, other people" (Whyte, 1980, p. 14).

[16] Dewey demonstrates how traditional school environments risk the creation of "divided worlds" within their learners, where schools are detached from their social surroundings, confining ideas to the spaces within school walls. As Gislason (2007) argues in *Architecture as Pedagogy*, "such a school is disorienting, furthermore, in that its materials and general environment spiral students' perceptions away from the enveloping space outside" (p. 9).

Dewey's conception of learning environments can be understood as a feedback loop connecting the objective environment to the internal conditions of the learner, forming a *situation* (p. 39). As he states: "it is a transaction taking place between an individual and what, at the time, constitutes his environment, whether the latter consists of persons with whom he is talking about some topic or event, the subject talked about being also a part of the situation; or the toys with which he is playing; the book he is reading; or the materials of an experiment he is performing" (p. 41). The environment seen through this perspective is "whatever conditions interact with a person's desires, purposes, and capacities to create the experience which is had" (p. 41).

Gislason (2007) expands Dewey's concept in his article "Placing Education: The School as Architectural Space", distinguishing the components of learning environments into three broad categories: *immaterial phenomena* (e.g., the imaginary worlds of books), *social activities* (dialogue and play), and *physical objects* (tables, chairs and experimental materials), all co-existing to engage the learner's capacities. These three elements are particularly striking in the TDET's Waterways exhibit (Figure 7) where the "material surrounding and experience mutually support, and indeed penetrate one another" (Dewey, 1938/1998, p. 46).

Figure 7*:* The Waterways exhibit along the TDET with elements of Dewey and Gislason's learning environments highlighted
Source: Luc Bagnérès

In Figure 7, posters in blue (immaterial) describe the trajectory of water in Vancouver's context. In red (physical), a recirculating water system with pulleys and gates allows participants

to shape the passage of water alongside others (social). These three elements provide the granularity of learning environments clarified by Gislason (2007). As he expands on Dewey's concept he argues for a better integration of architecture and the school curriculum. "[I]t is important to consider how a given school space functions as a pedagogical instrument. Places can serve as effective teachers, but they can also impede the educative process if they are inadequate" (p. 6).

The learning environments that were conceived, designed and executed as part of TDET were not a part of a school or a school curriculum, but of a municipal program for public space (City of Vancouver, 2010b). This is precisely Gislason's (2007) definition of a learning environment: "built environments that convey potent messages about how to think and act within a particular milieu" (p. 5). Through careful and inventive design, the TDET conveys a potent message about how to think about and act in support of sustainability.

2.5. Free Choice Learning

An educator's aim, according to Dewey (1938/1998), is to select the appropriate environment to guide each learner. In everyday life, however, "educators" are not often present and learners are guided more freely by their interests. They often choose the environments and media they wish to learn through. Falk (2005) argues that learners take part in a vast set of "milieus" during the process of their education. Falk places schools and universities into the context of a much larger web of learning environments to which each citizen potentially has access.[17] Falk (2005) claims that:

> Given the proliferation of environmental information and its potential impact on virtually every facet of our lives, environmentalists concerned with creating and supporting a public environmental ethic need not only to accept, but also directly support, the expansion and improvement of these free-choice venues where such environmental information and understanding might be acquired. (p. 267)

Free-choice venues, such as those in Science World, allow learners to explore and understand environmental information at their own pace. This expands Dewey's concept of learning

[17] This represents "'the other 80%' of time when children are awake and not in school" (Hassinger-Das et al. 2018, p.16).

environment to include science museums. And in this case, Dewey's "educator" (creator of the conditions for the learning experience) seems to be subsumed into the responsibility of the exhibit designer. The designer as educator takes the notion of free-choice environment a step further, to allow for the possibility of environmental education without the presence of an educator. Interestingly, free-choice learning is also shown to support important neurological development in children and adults (Miller & Almon 2009; Slunjski & Ljubetic, 2013; Vasta et al., 1998).[18]

Thomas Humphrey, director of San Francisco's Exploratorium Science Museum, extends the notion of learning environments into free-choice venues in his 2005 *Active Prolonged Engagement*. Here, a team of exhibit designers distinguished two fundamentally different kinds of free-choice learning exhibits: "Planned Discovery" (PD) and "Active Prolonged Engagement" (APE). Planned Discovery exhibits are those which "focus discovery on specific ideas or concepts, the path to which has been orchestrated by the museum exhibits based off instruction" (p. 1). Active Prolonged Engagement exhibits support free-choice exploration with gentle guidance to promote "self-driven discovery by minimizing instruction and explanation and by encouraging visitor-initiated observation, speculation, play and construction" (p. 3). The shift from PD to APE, as they explain, leads to "a shift in the visitor's role from that of a recipient of information to that of participant in the generation of activities, questions, and explanation related to phenomena" (Humphrey et al., 2005, p. 3). APE's emphasis on prolonged exhibit engagement supports Gehl's argument for the self-reinforcing quality of activities of longer duration.[19]

[18] Free-choice learning has also been described as "informal education" where learning is accomplished through exploration and discovery, rather than explanation (CUREE, 2012). In their 2013 article "The Pedagogical Potential of Playing", Slunjski and Ljubetic analyze the role of play in its transition into a higher stage of cognitive and social development (p. 128). Other studies by Hassinger-Das et al. (2018) describe play as a "laboratory of the possible", stating further that "the flexible context of play allows children to encounter situations and enact behaviors that contribute to their scientific reasoning abilities" (p. 168).

[19] The design of TDET exhibits such as Musical Chimes integrate the concept of exploration, play and free-choice learning in turn fostering a self-reinforcing process in public space.

The TDET is a type of outdoor public learning environment, rather than the fare-paying museum that typically house the APE exhibits: these have recently been recognized by Philadelphia research and design group Urban Thinkscapes:

> Incorporating playful elements into architecture and public space also promotes curiosity and a desire to learn. This is critical, because learning and development are significantly impacted by individuals' and families' environments. The physical environment can influence internally-driven curiosity, through the creation of a *mise en place*—a disposition and readiness to engage in and explore a learning activity — while also encouraging caregiver-child discourse and engagement in activities involving language, mathematics, and spatial topics. (Hassinger-Das et al., 2018, p. 3)

This description closely follows the concept of "learning environment" in its interrelation of physical and immaterial elements as a 'mise-en-place' (Hassinger-Das et al., 2018). The work of Hirsh-Pasek and her colleagues Hassinger-Das et al. (2018) is guided by the notion that "children only spend 20% of their waking hours in school. How can developmental scientists and educators address this other 80% for the benefit of children's development?" (p. 1). In the context of North America, examples of outdoor urban public learning environments such as those created by Urban Thinkscapes are given in Table 1.[20]

Table 1: Some examples of North Amercian public learning environments

Outdoor Public Learning Environments	Completion Date	Designers	Location
Cienca Publica Parklet	2015	Exploratorium / BGSF	San Francisco, CA
Golden Gate Bridge Exhibits	2016	CUREE / Exploratorium	San Francisco, CA
Urban Thinkscapes	2017	Urban Thinkscapes	Philadelphia, PN
Confluence Project	*ongoing*	Maya Lin Studio	Colombia River, Celilo Park, WA
Trottier Observatory	2015	PWL Partnerships/SFU	Burnaby, BC
The Shipyards	2019	Pechetstudios/Dialogue	North Vancouver, BC
Sound Commons: UN Plaza	2018	Exploratorium / San Francisco's Office of Planning	San Francisco, CA
Pause: Market Street	2016	Exploratorium / San Francisco's Office of Planning	San Francisco, CA
Entry sequence to Museum ?	?	Liberty Science Center.	Jersey City, NJ
TD Environmental Trail	1999-2013	Science World/ PFS Studio	Vancouver, BC.

The selection of examples in Table 1 is based on criteria set by Dewey (1938/1998) and expanded by Gislason (2007). First, the environments must include physical (3D objects/interactive exhibits) and immaterial phenomena (information conveyed via interpretive

[20] Urban Thinkscapes's creation of public learning environments include "Puzzle Benches", and "Jumping Feet" targeting low and middle class neighbourhoods in Philadelphia, New York and other regions of eastern United States.

panels and posters). Second, each of these projects must be set within outdoor public spaces. Amongst other projects in North America, the TDET meets these criteria.[21] Such learning environments in the public realm are now often incorporated into urban design projects as will be expanded in Appendix C.4.

In summary, the literature in Section 2.1 to 2.5 can be categorized into three research fields: education studies, museum studies, and urban studies.

Table 2: List of the literature presented above and its research field

Types of Literature	Title	Author	Research Field
Books	Image of the City - Kevin Lynch	Kevin Lynch	Urban Studies / Urban Design
	Life Between Buildings - Jan Gehl	Jan Gehl	Urban Studies / Urban Design
	Experience and Education - John Dewey	John Dewey	Education Studies
	Architecture as Pedagogy - Neil Gislason	Gislason	Education Studies
	Active Prolonged Engagement - Exploratorium	Exploratorium	Museum Studies
	Synthesis of Form - Christopher Alexander	Christopher Alexande	Urban Studies / Urban Design
Journal Articles / Papers	Life Long Learning - Falk	Falk	Museum Studies
	Pedagogy of Play - Slunjski	Slunjski et al.	Education Studies
	Principles of Interpretation - Tilden	Tilden	Museum Studies
	Environmental Education & Ecological Literacy -	David Orr	Education Studies
	Educating for Ecological Literacy	Goodwin	Education Studies

Education studies brings us the notion of a learning environment and the ways in which it can be applied by educators in schools. Museum studies takes learning environments and removes the need for an educator in free-choice learning experiences curated for interactive museum exhibits. Urban studies, finally, enfolds free-choice learning environments into the design of urban public spaces.

[21] In Vancouver, the Trottier observatory on the SFU campus incorporates elements such as star maps and sundials. The Shipyards Urban development project, using artifacts of its prior use of shipbuilding, brings an interpretative walkthrough to users of its public realm. Some in San Francisco take on an exhibit approach such as the Golden Gate Bridge Exhibits and Cienca Publica.

2.6. Conceptual Framework

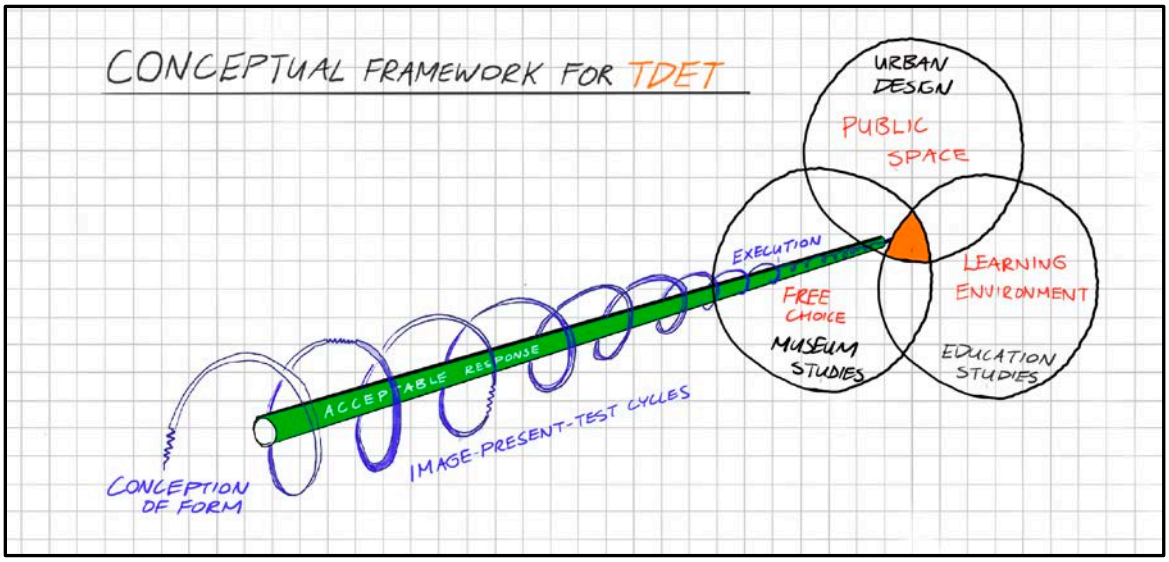

Figure 8*:* Conceptual Framework for the TDET adapted from Zeisel
Source: Luc Bagnérès

Figure 8 adapts Zeisel's design spiral to creation of the TDET as a free-choice learning environment (at the intersection of urban design, museum studies, and education studies) in urban public space. Next required is a group of actors to conceive, design and execute its form. The "initial image formation" instigating the process in the original is seen here as the "conception of form". At the end of this spiral lies execution, defined as the point where the "decision to build" is made (Zeisel, 1984). Image-present-test cycles (in blue) and the acceptable response (in green) are expanded upon below.

2.6.1. Image-Present-Test Cycles

Zeisel's design development spiral focuses on its three elementary activities: image-making, presentation, and testing. It was based upon research into the dynamics of the design process conducted by a series of environmental behaviourists in the 1970s, who sought to better work with, and align the efforts of, architects (Hillier et al., 1972; Korobkin, 1976; Simon, 1969). Zeisel concluded that design is comprised of three core activities organized into a spiral.

> One way to envision re-cycling and repetition is to think of design as a conversation among three activities: imaging, presenting, and testing. The discussants remain the same, but the intensity and topics of the conversation

> change as time passes. The many adaptations, revisions, and conceptual shifts that take place during design are guided by the designer's vision of the design process leading to action. Something is built. (Zeisel, 1984, p. 16)

Imaging is "the ability to go beyond the information given, seeing something where nothing seems to have been seen before" (Zeisel, 1984, p .6). Imaging first involves the formation of a mental image, and then the spatial representation, and working out of that image until it is ready to present. *Presenting* images then involves the use of sketches, plans, the building of models and photography in order to communicate to an audience.[22] Once the presentation of an image is complete, designers may take a step back with a critical eye and test it.[23] By making these attributes of design more explicit, "testing helps designers reimage and re-present their designs with greater precision" (Zeisel, 1984, p. 11). Tests bring about the possibility of *conceptual shifts* illustrated by the zig-zag line instigating another image-test-present cycle:

> Creative leaping [a conceptual shift] is triggered by testing the presentation of a tentative design response against quality criteria within the situation and its context to find out where the response is strong and where it is weak. (1984, p. 11)

Conceptual shifts are creative leaps that bring a designed form closer to an acceptable response. These three design activities will be highlighted throughout Chapter 4, which explains development of the TDET in terms of its elements, in order to provide a clearer understanding of the process.

2.6.2. Acceptable Response

How is an acceptable response assessed? Zeisel understands this through Alexander's concept of *form* and *context*. In his 1964 *Synthesis of Form,* Alexander discusses "the pursuit of urbanism, the ensemble which confronts us is the city and its habits. Here the human background which defines the need for new buildings, and the physical environment provided by the

[22] As Zeisel (1984) states: "designers present ideas to make them visible so that they themselves and others can use and develop them"(p. 8).

[23] *Testing* involves the comparison of image presentations "against an array of information like the designer's and the implicit images, explicit information about constraints or objectives, degrees of internal design consistency, and performance criteria" (Zeisel 1984, p. 9).

available sites, make a context for the form of the city's growth" (p. 16). He argues that every design process involves a design problem:

> Every design problem begins with an effort to achieve fitness between two entities: the form in question and its context. The form is the solution to the problem; the context defines the problem. (Alexander, 1964, p. 21)

The form of the TDET responded to multiple scales of context (Figure 9), with the site of Creekside Park, including Science World, as its most important scale. False Creek and Vancouver may also be seen as larger scales of context, from which the building materials and audience are taken. Once a problem in a scale of context is identified, Alexander argues, the effort to achieve fitness is enabled. The term *fitness* is the relation of mutual acceptability between form and context. Fitness may be understood through "several layers of form-context boundaries in concert" (1964, p. 18) with an ultimate interest in the ensemble.[24] As will be discussed, the TDET design process would need to solve multiple problems of fit between form and context in order to reach a final state of fitness. Finding this state in the context of False Creek required a high level of understanding on the part of its designers. Yet, as Alexander points out, it is difficult to understand the context of any form:

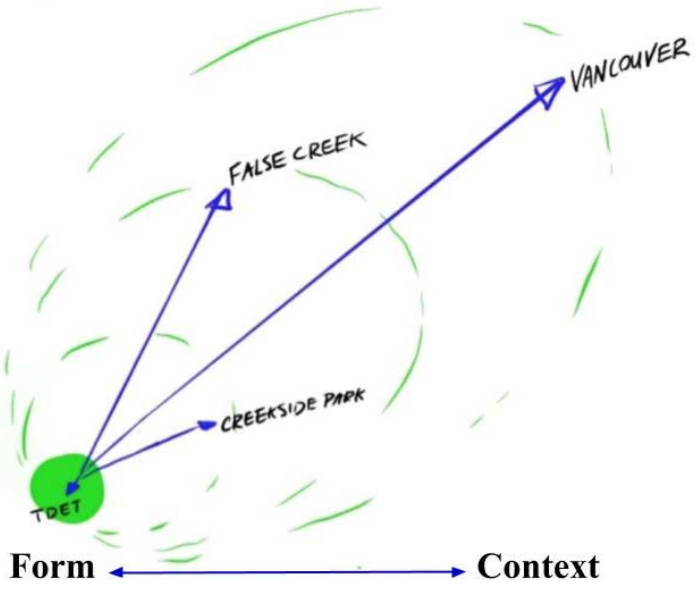

Figure 9: The form of the TDET must be considered holistically within its various layers of context (Alexander, 1964)
Source: Luc Bagnérès

> Understanding the field of the context and inventing a form to fit it are really two aspects of the same process. It is because the context is obscure that we cannot give a direct, fully coherent criterion for the fit we are trying to achieve, and it is also its

[24] This follows Cullen's (1961) concept: "… the environment is one whole and … all these devices are part of the art of linking and joining that whole into a significant pattern rather than allowing it to remain a disjointed and petty chaos" (p. 39).

> obscurity which makes the task of shaping a well- fitting form at all problematic. (1964, p. 21-22)

As Alexander explains, the obscurity of Creekside Park made it difficult to define the qualities of a "well-fitting" form and thus to reach an acceptable response (Zeisel, 1984). All actors could not achieve a fully coherent understanding of the context: it was, rather, comprehended to different degrees by different actors. Here, as in general, finding the fitness of a form was possible only through its design. The process of design, understood here through cycles of imaging, presenting and testing, was what made the qualities of fitness apparent.[25]

2.6.3. Public and private interface

One of the primary design problems of the TDET was the privatization of public space in Creekside Park. As discussed, the TDET arose within a larger project (the Outdoor Science Experience, or OSE) and was therefore embedded within a larger process of design. Science World was seeking to create, in space that had previously been public, a gated science park accessible only to fare-paying visitors. Kohn (2004) describes the role of design in distinguishing public from private space:

> The design and regulation of the built environment can either reinforce or challenge existing patterns of inclusion or exclusion. By structuring people's perceptions, interactions, and dispositions, spatial practices and architectural markers can mitigate or intensify ingrained social dynamics. One of the purposes of public space is to create a shared set of symbols and experiences that create solidarity between people who are separated by private interests. (p. 6)

Exhibits in the KSSP are exclusive to those who can pay a fee[26] whereas exhibits of the TDET are open to any member of the public. For this thesis, the distinction between these spaces will be understood through Ford's (2012) continuum of publicity/privacy. As seen in Figure 10, private and public space can be seen as lying along a continuum rather than as dichotomous. The terms *semi-private*, *semi-public* and *public* will be used here to define the interface gradient

[25] Understood in this way, it would have been almost impossible for the designers of the TDET to have found a seamless fit in their first exhibit sketches. Yet, without the conceptual design presentation, good fit could not be grasped by the designers or the stakeholders. It is through design presentation that tests can then unfold and allow for better images to be developed.

[26] To access the boundaries of Ken Spencer Science Park the basic fare ranges from $18.57 for a child to $27.62 for an adult (Science World n.d.).

understood by the designers as they negotiated their compromise. KSSP, restricted and controlled by Science World, was, because fare-paying, semi-private**;** TDET's wetland exhibit, open to the public during the day as a viewpoint into the park but closed at night by Science World, was understood as semi-public; and Creekside Park, the site of all other TDET exhibits, was free to all to use and so, public.

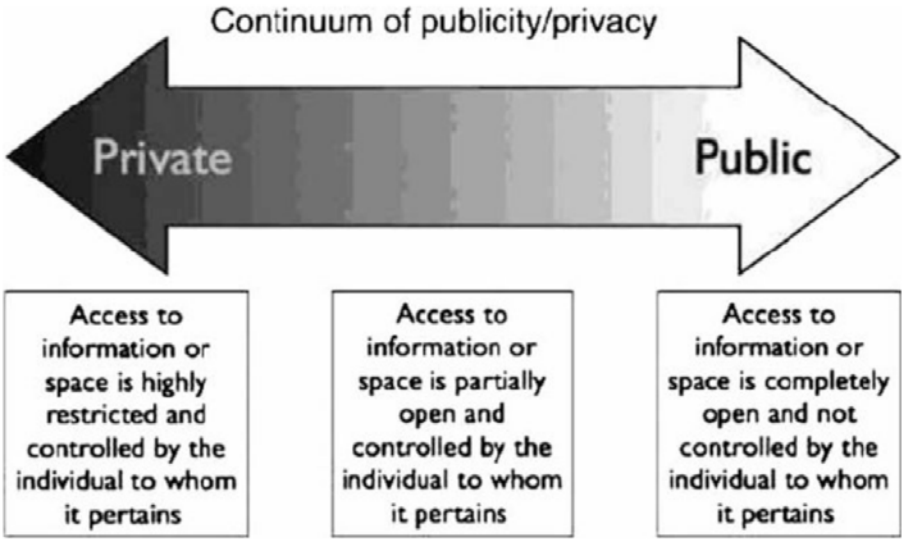

Figure 10: Diagram by Ford (2012) on the continuum of publicity and privacy
Reprinted with permission by Taylor & Francis Group

To conclude, authors from three quite separate research fields (urban design, museum studies, and education studies) bring valuable ideas to bear on this case study research. The TDET is thus termed here a learning environment within the outdoor public space of Vancouver (Gislason, 2007; Falk, 2005; Ford, 2012) and will be referred to more simply as a "public learning environment".

Chapter 3. Methodology

As a child, between the years of 1998 and 2005, I would often visit Science World with family or my school, engaging with gallery exhibits such as Our World (see Appendix B.2). It is important to recognize this experience as an influence on my perspective and possible source of bias in my research interpretation. Appendix A.2, provides an auto-biographical summary of my preliminary research intentions and their evolution as I shifted focus mid-way through data collection. It explains the change to my primary research question and its ultimate form: *How was the TDET conceived, designed and executed* ? This chapter will detail the sources of empirical evidence, and their collection, analysis, and interpretation, in the construction of a design chronology.

3.1. Research Design

This research uses a case study methodology to "describe and diagnose single, internally complex objects." (Zeisel, 1984, p. 65). As the aim is to understand the complex process of conception, design and execution behind the TDET's learning environments, the case study approach will provide "information specific to the particular study object and context, rather than information easily generalizable to a large population" (p. 65). Case studies, where "the boundaries between phenomenon and context are not clearly evident" (Yin, 2009, p. 18) are most appropriate in answering "how" questions. The bounded time-scale of the TDET design process (1999-2013) and its specific location make the case study format suitable for advancement of "phronetic" research. As Schram (2012) in his *Real Social Science* states:

> Phronetic social science understands that social science is best equipped to offer contextualized knowledge appropriate to particular settings and focused on specific problems. The case study becomes not just an acceptable alternative, but central to conducting phronetic research. Further, phronetic social science stays true to its principles and allows for a diversity of data-collection methods to help produce relevant contextualized knowledge. (p. 24)

Using multiple research methods, a range of qualitative and quantitative data are normally collected in order to explore and understand the complexity of human behaviour in processes such as the design of public learning environments (Cresswell, 2014). Data in this case

is collected and interpreted to capture the "individual meaning and the importance of rendering the complexity of a situation" (Creswell, 2014, p. 14.) The purpose here is to develop a better understanding of how the TDET came into existence and to produce "research that has relevance to decisions about what can and should be done [in a particular context] and also how to do it" (Schram, 2012, p. 20).

These are aims supported by Zeisel in his design spiral rationale.[27] Making a design process visible within a particular context allows for reflection and improved design decisions in the future (Schram, 2012; Zeisel, 1984). This chapter's analysis will therefore rest upon the logic of Zeisel's design development spiral which situates the various sources of data chronologically (Yin, 2006, Section 3.3). The evaluation of my findings will rest on principles established in Chapter 2. Chapter 4 will show the process of design as an evolving iteration of form to reach a state of fitness with its context (Alexander, 1964).

3.2. Data Sources

3.2.1. Interviews

Key informant interviews were the primary source of evidence used to reveal the TDET's design process. Babbie and Roberts' (2017) method of in-depth interviewing was followed closely, "asking open-ended questions, listening to and recording the answers, and then following up with additional relevant questions" (p. 293). I interviewed a total of nine people, seven of whom were part of the team of TDET designers, managers, content creators and facilitators. Some interviewees are identified by their initials (e.g., JB) while others are identified only as e.g. Interviewee #7, as they requested that their anonymity be retained. See Appendix A.1 for details.

The recruitment process for interviews used the snowball sampling technique. After each interview, I asked for a name or two, which would provide the source for the next interview. Recruitment carried on until a reasonably full picture emerged, keeping in mind the timeline

[27] As Zeisel (1984) states "What were the designers' original intentions and how did they try to implement them? Answers to such questions can be used to re-organize design teams, improve designers' control over the effects of future design decisions, and test theories on which design decisions are based" (p. 46).

needed to complete a thesis. Interviews ranged from one to two hours. I sent each interviewee a set of the potential questions approximately a week beforehand.

During the interviews I used probes which, as Zeisel (1984) defines, "are primarily questions that interviewers interpose to get a respondent to clarify a point, to explain further what she meant, to continue talking or to shift the topic" (p. 140). Indeed, probes are an essential device in interviews "when one person is interested in precisely what another has to say" (Zeisel, 1984, p. 140). In this case, a range of probes were employed: (1) Transitional probes were used to ensure that the respondent discussed a broad range of salient issues; (2) Situational probes aimed to stimulate the respondent to specify the parts of a situation that prompted a response; and (3) Reflecting probes were used to determine, in a nondirected way, which of "the topics presented in the interview were significant to the respondent and which new ones to add because they were overlooked" (Zeisel, 1984, p. 140). Once each interview was completed and recorded, it was transcribed. Some interviewees required re-interview in order to reach a level of detail and accuracy on an issue that could not be clarified by another interviewee.

As such, this research attempted to re-create the events that influenced, and led to, the creation of a public learning environment through the memory of those who participated in its process. The technique, however, has its limits.[28] As Zeisel explains "often so much time elapses during a design and so many people work on a design project that asking decision makers what they intended creates a problem of recall" (Zeisel, 1984, p. 46). To resolve it, recollections of events by interviewees were triangulated with documentation of the design project explained in the next section.

3.2.2. Documentation

The documentation shown in Table 3 below served as a secondary source to support interviews, triangulated to confirm the inter-relation of particular events.

[28] The search for data through interviews clearly has its limits. As Zeisel (1984) states "we can think of assessing the reliability of a method in the same way we think of assessing the reliability of a child's memory about an event. We cannot re-create the event, but we can test his memory of it in order to share in his experience" (p. 78).

Table 3: List and types of documentation used in Chapter 4

Type of Documentation	Documents	Source
Meeting Minutes	OSE Development Board November 2010	City of Vancouver Website
	Science World Facility Renewal Development Board	City of Vancouver Website
	Urban Design Panel Workshop October 2010	City of Vancouver correspondence
	Urban Design Panel Workshop November 2010	City of Vancouver correspondence
Planning & Policy Documents	Greenest City 2020 (2010)	City of Vancouver Website
	SEFC Interpretative Strategy 2006	City of Vancouver Website
	SEFC Art Masterplan 2007	City of Vancouver Website
	False Creek Flats Statement of Significance (2013	City of Vancouver Website
	Science World Statement of Significance (2010)	Science World
	OSE Creative Brief (June, 2009)	Science World
	ReGeneration: A strategy for Change (November, 1999)	Science World
Site Design, Architectural & Engir	Expo 86 Deck Architectural Plans	City of Vancouver Sustainability Department
	Expo 86 Expo Center (Science World) Architectural Plans	Science World
	Expo 86 Full False Creek Plan	City of Vancouver Archives
	OSE Visualizations	City of Vancouver employee
	SWITCH - Design Conceptualizations 2009	Science World
	PFS Visualizations	talentpun.ca
	Pre-Engagement SWITCH Map	vancouverisawesome
	Facility Renewal Proposal (May, 2010)	City of Vancouver correspondence
	OSE: SWITCH - Design Booklet July, 2010	City of Vancouver correspondence
	Development Permit For OSE (November, 2010)	City of Vancouver correspondence
	Development Permit for Science World Facility Renewal	City of Vancouver correspondence
Archive Photographs & Maps	Historical Archive Photos	False Creek Flats
	Vancouver Old Streams Map	City of Vancouver Archives
	Historical Land Survey	Harris Cole, 1993)
	1908 Shoreline Map	City of Vancouver Archives
	Our World Exhibit Photos	Interviewee #2, #3
	Systems of Sustenance Photos	Interviewee #6

Meeting Minutes

Meeting minutes were a strong source of evidence for the design process, as they provided documented transcriptions of negotiations for approval of the development permit for the TDET's execution. The meeting minutes were found through the City of Vancouver database, and given by City of Vancouver through correspondence. They were referred to by Interviewees #4, #5, and #7 (all present at the meetings) as essential to their recall and description of the negotiation of interests among the organizations involved.

Planning/Policy Documents

This category includes city planning documents such as interpretive plans, policy statements, statements of significance and Development Board reports. As explained: "Research organized on the basis of systematic plan analysis is likely to include essential design questions,

especially small-scale ones, that might otherwise be overlooked" (Zeisel, 1984, p. 48). These documents were important to the strengthening of claims made in interviews. Some of them, such as the Creative Brief (Science World, 2009), were essential in recreating the design process of the TDET, setting the outline and pedagogical goals for each exhibit. These were generously shared by Science World's Research Evaluation Team.

Design/ Architecture / Engineering Plans

This category includes conceptual design sketches, executable design plans and other spatial representations of the TDET designs. Providing clear evidence of the 'presenting' phase, they were also essential to an understanding of what was being designed and its visual appearance: "Other useful sources for understanding designers' behavioural implications are presentation drawings...that present places in perspective drawings as designers see them, often including people. Visual documents like these are particularly fruitful because they represent a designer's overall image of life in the future setting" (Zeisel, 1984, p. 48). Some of the most significant plans were found in the Development permits. For future researchers, persistence is absolutely essential to receiving such critical documentation. The payoff -- a significantly deeper understanding -- can be worthwhile. [29]

Historical Archives / Google Satellite Street view / Photography

This category of data includes photos found in the Vancouver Archives, on historical websites, and documents which gave a tangible reality to the conditions preceding development of the TDET. Photographs of the TDET in use were taken personally in 2019. In order to gain evidence of the construction process of 2010-2012, I relied on Google Street View archives.

3.3. Spatiotemporal Analysis

To trace the development process of the TD Environmental Trail, a chronological time series analysis was conducted, delivering what Yin (2009) describes as a "valuable descriptive

[29] Although these are legally public documents accessible to anyone, it took six attempts to obtain the City of Vancouver documents used in this research. I discovered that after seven years, all permit application reports are removed from online databases and stored in physical storage cabinets. The two permit reports of 82 and 78 pages respectively needed to be scanned one by one by a generous COV development staff member.

rendition of events" (p. 149). The time series can be the basis for causal inferences, to identify "how" the TDET came into existence and "why" the City allowed an exchange to take place of a public learning environment for privatization of a public park. For this analysis, the context will be understood as both geographical and historical. It supports Miles and Huberman's (1994) statement that "a researcher must identify the dimensions of the case studied in terms of its conceptual nature, its social size, its physical location, and its temporal context" (p. 27).

Chapter 4 will therefore take a chronological look at the design process, fitting together its timeline of events, documents, and images, to build as accurate a reconstruction of the design process as possible. Describing past events using solely an interview method would run into the limits of human memory. Triangulating these with documents to solidify events in the process was critical to creating a reliable picture. Supporting evidence of surveys and observations is presented in Appendix B following the diversity of data collection as outlined by Schram (2012).[30]

[30] For Schram (2012) twenty-five surveys and more than 100 hours of quantitative and qualitative observations served as contextual evidence of placed-based empirical knowledge in an emerging new typology for public space.

Chapter 4. Design Process

This chapter describes just how the TD Environmental Trail was conceived in 1999, reached the design sent for approval to the City of Vancouver in 2011, and was executed (i.e., constructed) from 2011 to 2013. As will be shown, a few names were used prior to adoption of the "TDET" in 2011 (i.e., Breadcrumbs in 2002 and SWITCH in 2009). Here, the Trail will be referred to consistently by the acronym TDET. As mentioned, its design should be understood as part of the larger process commissioned for the Outdoor Science Experience **(**OSE**).** The fate of the TDET depended on the fate of the OSE. In the quest to build the resulting Ken Spencer Science Park (KSSP), the notion of a sustainability themed "environmental trail" played an instrumental role in the assessment of its fitness for the OSE). Figures 11 and 12 show the changes made to Creekside Park by construction of the OSE.

Figure 11: Aerial view of Creekside Park in 2007 prior to TDET project
Source Google Earth®

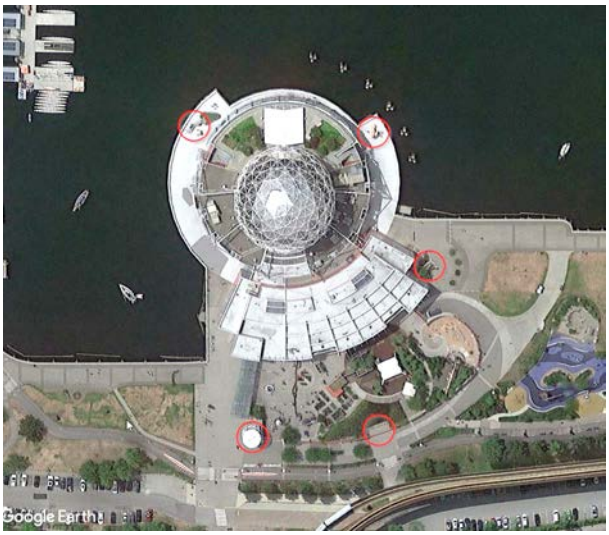

Figure 12: Aerial view of Creekside Park in 2019 after TDET project (exhibits circled in red)
Source Google Earth®

4.1. Setting the stage

As we begin our discussion, it is important to recognize that the land comprising Creekside Park, where the TDET now stands, is unceded traditional Coast Salish territory. The park was historically an estuarine marshland ecosystem that had nourished the Squamish, Tsleil-Waututh and Musqueam First Nations since time immemorial. Appendix C.3 describes the relationship of Coast Salish Nations to this area prior to European settlement through the project "Systems of Sustenance". Appendix C.1 gives a brief history of the human intervention that changed the morphology of False Creek and allowed for the conception of the TDET.

The chronology below (Figure 13) illustrates the spatiotemporal context of False Creek prior to the TDET design process.

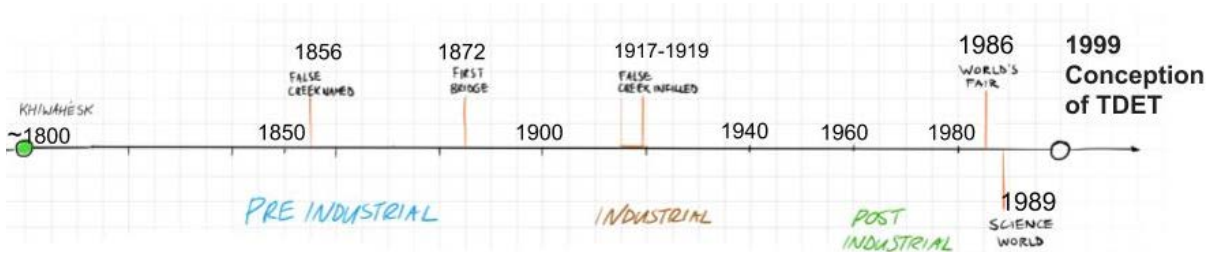

Figure 13: Chronological timeline showing the evolution of False Creek leading to the conception of the TD Environmental Trail
Source: Luc Bagnérès

4.1.1. The Expo Deck

In 1981, the seawall was constructed, redefining the purpose of the False Creek shoreline from shipbuilding to sight-seeing (City of Vancouver, n.d.). Science World and the adjacent Creekside Park, suspended on the Expo deck, were completed in 1985, supported by soil from the False Creek infill of 1919. The deck expanded the length of the seawall, establishing the foundation of Creekside Park. It also subsequently formed the platform for the TDET, constructed thirty years later.

The deck was fabricated from concrete, and wooden piles penetrating the depths of False Creek (Figure 14). The circular slanted piles extended out from the deck (Figure 15), providing support for the temporary gondolas installed for the 1986 World's Fair (Expo 86) (Figure 16).

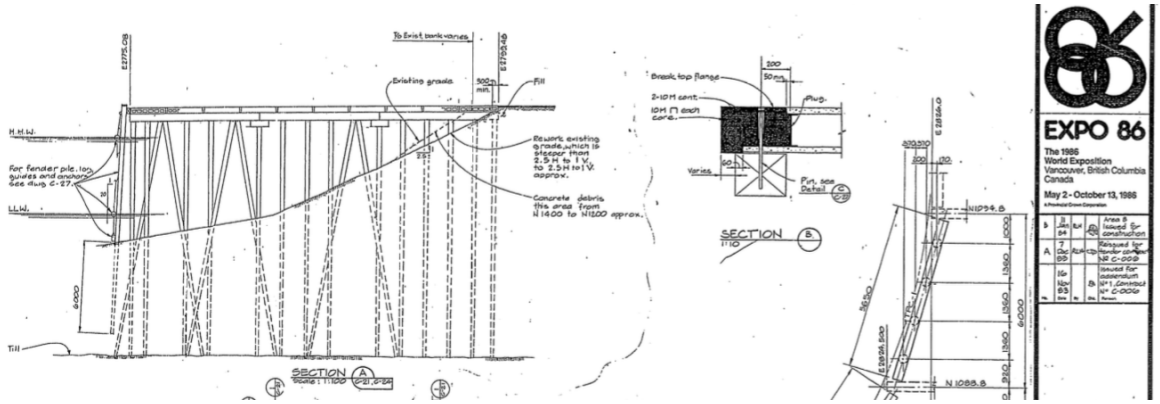

Figure 14: Section of Expo 86 deck
Reprinted with permission by City of Vancouver

Figure 15: Expo Deck in its current state in 2019
Source: Luc Bagnérès

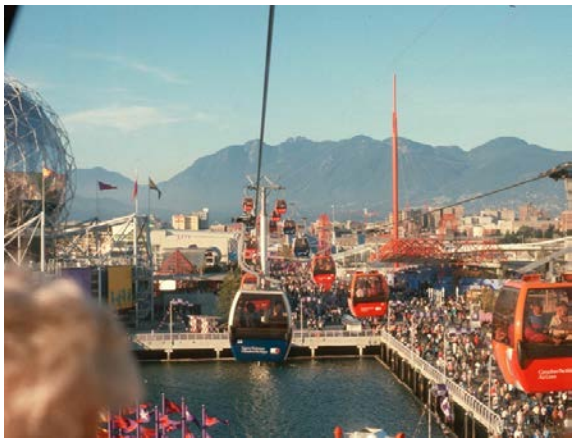

Figure 16: Gondola in use during Expo 86
Source: City of Vancouver archives

As a platform, its initial purpose was shoreline support for the temporary pavilions and exhibitions of the World's Fair. Now, with the redefined False Creek shoreline, it provided a structure onto which the Expo Center (Science World) could be built:

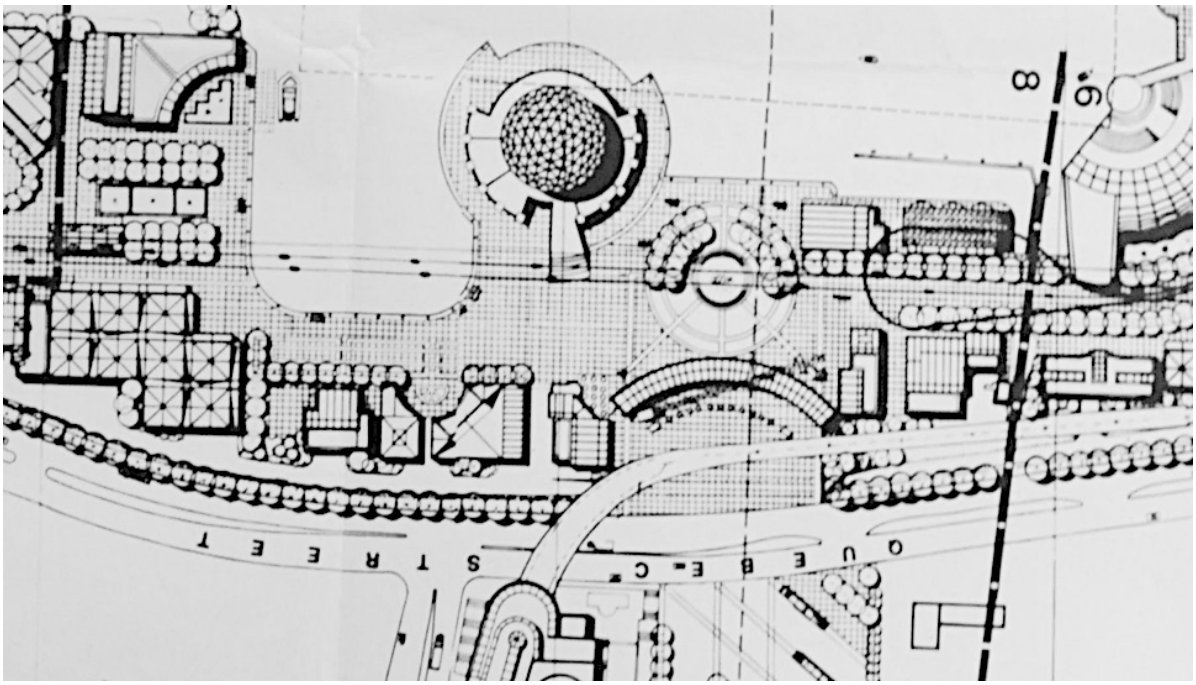

Figure 17: Top Plan of Science World's geodesic dome, designed by Bruno Freschi
Reprinted with permission by City of Vancouver

The geodesic dome[31] named the "Expo Centre" for the World's Fair can be seen distinctly in Figure 17, along with the Fair's other temporary structures, many of which rested on the Expo deck. The Centre served as a presentation space for the various technologies and exhibits on the Fair's themes: transportation and communication. The chief architect of the Expo 86 site, Bruno Freschi, designed the dome as a prefabricated tubular steel structure to be "easily dismantled" once Expo was finished (Luxton & Associates, 2010, p.14).

4.1.2. World's Fair

Expo '86, the World's Fair that put Vancouver on the global map, led to the creation of many landmark structures[32] around North and East False Creek. Interestingly, the Fair coincided with Vancouver's 100th anniversary (celebrated between May 2nd and October 13th 1986). And it

[31] The geodesic dome was popularized by visionary Buckminster Fuller in the 1950s becoming an oft-replicated typology in the 20th century as a result of its lightweight modular construction (Rothman, 1989).

[32] It gave birth to the Expo Centre soon to become "Science World", Canada Place, BC Place, the Plaza of Nations and the SkyTrain, with one of its stations just east of Science World.

was, overall, an overwhelming success, surpassing its anticipated numbers to reach an attendance of 22 million (Luxton & Associates, 2010).

Bruno Freschi borrowed the iconic dome structure from visionary architect Buckminster Fuller and perhaps the World's Fair of 1967. [33] As Lang (2005) explains, pavilion infrastructure such as the Expo deck, or the one used in his case study of Seville's 1992 Exposition (p. 342-46), must be adaptable: assorted pavilions must be able to "plug into" it. As he states, "plug-in urban design focuses on the strategic building of infrastructural components of a city" (p. 318). The deck can be seen as a form of plug-in urban design serving both the pavilions, and the gondolas. [34] Not only did the Expo Centre dome make an impression on Vancouverites, it anchored False Creek as an area for global socio-economic exchange. The next section will describe how significantly the dome marked the city: could we be witnessing the emergence of a more permanent landmark on Vancouver's urban shoreline or was the Expo Centre one of the fleeting experiences of Expo 86?

4.1.3. Overcoming temporality

Once Expo was finished, ownership of the buildings was to revert to the City. The Expo Centre, like many other buildings and exhibits of the World's Fair, was set to be dismantled. During this time, volunteers at the Arts, Science and Technology Centre (later renamed A.S.T.C Science World), located in downtown Vancouver, asked whether they could use any of the Expo facilities that remained. A year after the Fair ended, the provincial and municipal governments announced that the Expo Centre would become one of its few enduring legacy buildings, along with BC Place and several others.[35] In 1987 on a visit to Vancouver, Queen Elizabeth II, at the request of the City, proclaimed that the Expo Centre building would be "for the people of British Columbia" and the new home of science education in Vancouver (Chan, 2019). The building was

[33] The Expo Centre was about one-third the size of Montreal's dome: 27 m in diameter compared to the 76 m diameter of that of Expo 67. Expo 67 was enormously successful, with more than double the attendance of Vancouver's event. Yet perhaps it's not about the crowds which deems the Expo a success, but the legacy it leaves the city.

[34] As Lang (2005) explains, while plug-in urban design is intended to work with longer-term plans, "the principle applies to most World's Fairs, although in their case everything is done in a great hurry. The infrastructure is built and the individual exhibitors then plug their [temporary] buildings into it" (p. 339).

renamed “Science World” in 1987. Just like the Eiffel tower, it presented an example of how World’s Fair landmarks preserve themselves:

> “The question with World’s Fairs is: ‘What do you do with the site when the Fair is over?’ Most of the World’s Fairs are demolished after their run is over and the sites completely turned over for other uses.” (Lang, 2005, p. 335)

After the World’s Fair, however, donations from the federal, provincial and municipal governments poured in. Between 1987 and 1989, the building went through a $19 million-dollar renovation[36] and expansion. The land itself was leased by the City of Vancouver to the BC Expo Corporation, a semi-autonomous Crown Corporation, for 50 years. The lease was then transferred to Science World (Interviewee 3, 2019 – see appendix A.1). Interviewee 3 who began working for Science World prior to the 1986 move describes the transition:

> Interviewee 3: When we leased [the Expo Centre]… the big thing was … maintenance: it still leaks to this day. When it gets sunny out, all the panels expand at different rates. They were using this high bond stainless steel tape and it only lasted for 2 months…not sustainable at all, but it’s a legacy building. It was not deemed a legacy building until 1984 [with design nearing finalization]. The challenge [has always been] that the building [was] built as a temporary building.

Rather than durability, the structural elements of the dome’s landmark design emphasized short-term, modular, visually expressive elements. After its designation as a legacy building, Science World could not change its physical structure, and had to raise additional revenues to maintain it. Bryan Tisdall, the CEO of Science World at the time explains this challenge:

> BT: [Science World museum] had to renovate when moving in and part of their plan was an outdoor science park back in the 1988, but they ran out of money so it didn’t happen. But they went on, they renovated the building with the money they could raise and opened [Science World] in 1989.

BT explained the origin of an “outdoor science park” as an idea initially conceived by his predecessors, prior to his joining Science World in 1997, but one not pursued due to other

[36] Science World explains how, “The Provincial and Federal Governments announce their support of $5 million each, the City of Vancouver and the Greater Vancouver Regional District join with a further $1 million apiece and a capital campaign raises $7.1 million from the private sector for a total of $19.1 million to build an addition to the Expo Centre, redesign the interior and develop and build exhibits.” (Shepert, 2017)

budgetary priorities.[37] The funds were used instead to maintain the impermanent geodesic dome and realize Science World's exhibit Master Plan, which consisted of 54 interactive and environmental exhibits. The first sustainability-related exhibit entitled "Compost Critters" aimed to educate children on composting food scraps through a video kiosk (Vancouver Sun, 1989).

Through the 1990s, the Science World museum faced many financial challenges:

> BT: Late 90s come along, and things are in rough shape as a business. It's a not-for-profit business, but it's a business... We did a bit of an organizational restructuring, to the extent that in late 1999, we were comfortable [that] there [would be] a future. The future wasn't a week from now, it was 5 maybe 10 years from now. What are we going to look like? Where are we going as an organization?

This organizational restructuring, described by the CEO at the time, led to the creation of a document entitled *ReGeneration: A proposal and strategy for change*, released in November 1999. It was this document that initiated the planning and design of the TDET (Science World, 1999).

4.2. Conceptualization (1999-2002)

The desire for an outdoor science park was expressed in 1989 at Science World's launch, but the funds necessary to realize it were not available. In 1999, this desire was materialized in a regeneration plan.

4.2.1. Regeneration Plan

Tisdall describes the 1999 document on organizational restructure:

> BT: We created something called "ReGeneration", and that was the plan that was developed. What it imagined was an entire reworking and expansion of Science World including an outdoor science park.

[37] BT clarifies that while the BC and Canadian governments provided initial funds, "To this day [Science World] has no ongoing government support, that distinguishes it from every other science center in Canada".

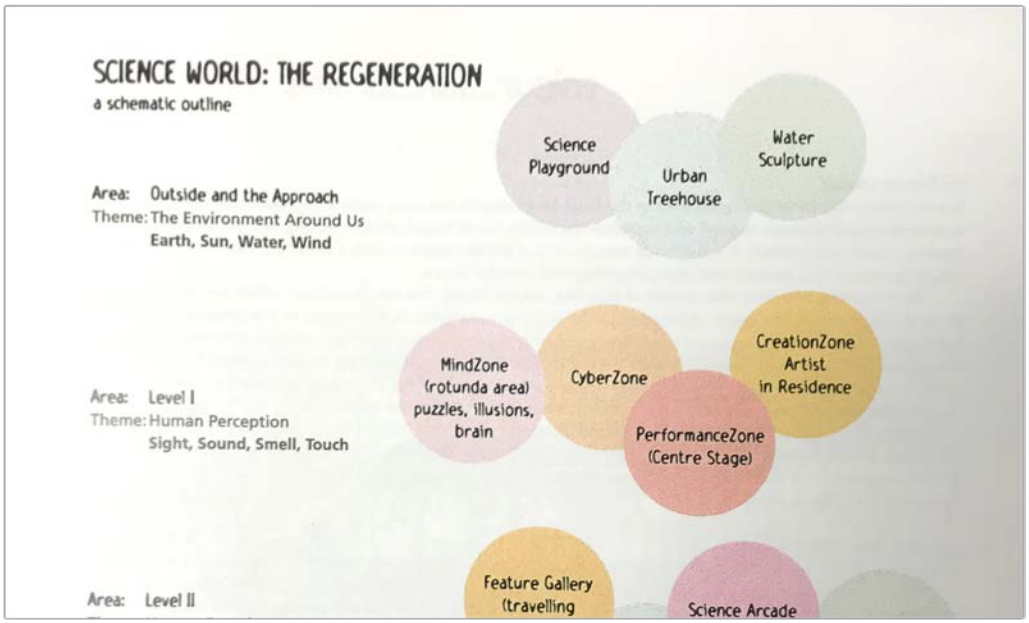

Figure 18:Themes of interior and exterior areas in the 1999 ReGeneration vision
Reprinted with permission by Science World

As seen in Figure 18, the science park, located in the "Area: Outside and Approach", was originally intended to display themes of Earth, Sun, Water, and Wind. This contrasted with the interior gallery themes of Human Perception on Level I and Human Experience on Level II. "Outside and the approach" can be understood as the first context given to the Environmental Trail (TDET).

4.2.2. Initial Image Formation (1999)

The Regeneration document conceived of a "Science Playground" at the base of an "Urban Treehouse" in the public space of Creekside Park supported by the Expo Deck.

Figure 19: Initial Image of the Environmental Trail
Source: ReGeneration document (1999). Reprinted with permission by Science World

Figure 19 shows an August 1999 presentation of these concepts by an internal designer on the Science World team. The Treehouse was illustrated as a series of "elevated canopied pods" containing interactive exhibits connected by walkways to the main building. Underneath would be a pond and stream with the Science Playground surrounding it. This illustration is evidence of the earliest presentation found in my research. From here, we can understand how the initial 1989 idea of an outdoor science park evolved between 1998 and 1999.

It was the Urban Treehouse vision that initiated the design process resulting in the 2013 creation of the TDET and the Ken Spencer Science Park. The KSSP was the counterpart to the public exhibits of the TDET: its entry fee rendering access semi-private (Ford, 2012). The interplay of public and semi-private built into the TDET and the KSSP was initiated here in descriptions of the Science Playground and the Urban Treehouse:

Science Playground

> First appearances are critical. In keeping with the concept of exploring and enjoying science in daily life, we are proposing that visitors first encounter an outdoor Science Playground when they approach Science World. Situated on parkland at

> the north side of the existing building, the playground will include interactive kinetic sculptures such as whisper dishes, large levers, giant pin wheels, and other simple machines. It will also feature a pond and a stream that courses around the legs of the giant pods of the Urban Treehouse. *The playground will be accessible to all visitors to the park.* The approach to the building will be modified to mirror the feeling of the playground and impart a sense of fun and interactivity. Colour and motion will surround visitors as they arrive. (Science World, 1999, page number not found, emphasis added)

Urban Treehouse

> The Urban Treehouse (*accessible to paying visitors from an entrance off the Living Planet on Level II*) literally sprouts up out of the Science Playground as a series of elevated, canopied pods of various diameters. Walkways link the pods to the main building. Visitors can turn giant water screws that lift water to create water arcs, waterfalls and fountains… Colourful windmills, air socks and kinetic sculptures will further animate the area. (Science World, 1999, page number not found, emphasis added)

For Science World, these two visions implied one other: they represented an animation of both a public and a semi- private realm. The public realm would include a playground with its pond remaining open to all visitors, while the treehouses would be accessible only to paying visitors who entered through an elevated walkway from within. From the description of the Science Playground, then, we find the first traces of the Environmental Trail's physical conception. The playground introduced the concept of "exploring and enjoying of science in everyday life" as one approached Science World through the public space of Creekside Park. With "colour and motion", one's arrival brought the larger themes of "earth, sun, water, and wind" literally into play with "a sense of fun and interactivity". BT describes this further:

> BT: Science World was not about content. It's not that we wanted to teach you about the content of science. Simplistically, we want to do two things. First, we want to raise people's understanding that science is important, science is everywhere, science affects your life and your quality of life. The design of the chairs we're sitting in. That's all science. Second is thinking. We want people to think like a scientist, be curious be inquisitive. The way you do that, is to talk about things in people's lives…You have got to find the hook.

BT explains how this conception targeted the public accessing Creekside Park, raising their understanding of the importance of science. While both concept and initial design ("image") were viewed by Science World's 1999 organization as "desirable form", Creekside Park was not under its ownership. The project could not simply be built at will. The site was

owned by the City of Vancouver and managed by Vancouver's Park Board (VBPR).[38] VBPR had jurisdiction over Creekside Park, and needed to be convinced that the concept would meet their criteria as "acceptable form". In the initial "tests" with the Park Board in 1999-2000, Science World hired the landscape architecture firm Phillips Farevaag Smallenberg (PFS: later renamed PFS Studio) to begin refining the initial "image": semi-private Urban Treehouse and public Science Playground.

> BT: I remember [a PFS Planner] accompanying me to a Park Board presentation in 1999- "Your Park Board should give us authority to develop an experience in the land surrounding Science World, for the benefit of the community".

While Science World designers conceived the initial image, they did not have the level of professional experience to follow through the redesign of an outdoor park, hence their decision to hire PFS. The landscape architects' vision for the public space also imposed a canopied semi-private treehouse onto public space under jurisdiction of the City of Vancouver Park Board (VBPR). Science World needed to show how its vision could align with VBPR's mission "to provide, preserve, and advocate for parks and recreation services to benefit all people, communities and the environment" (City of Vancouver, n.d).

4.2.3. Liberty City Science Center

The 1999 Treehouse and Playground vision was not met favourably by the Park Board. In 2002, Science World's board members went to New York City looking for inspiration from other museums:

> BT: Every year our board members went on a trip somewhere in North America, we would visit other Science Centres, Natural Museums to learn from them. I remember distinctly, we took the train from Manhattan and you get off the train at Liberty station [New Jersey], and from where you got off to the Liberty Science Center, about a half mile walk… it was full of exhibits. It had exhibits sprinkled along that walkway… .

[38] As BT Explains: "Although formally it was the city who owned it, any management was by the parks. So, we had to convince the Park Board that we wanted to use that space. I remember in 1999 making a presentation to the Park Board about an outdoor park experience".

Bryan Tisdall specifically noted how his board was inspired by science exhibits in the public space between the subway station and Liberty Science Center. A Google street view of these is shown below, about eight years later:

Figure 20: Public exhibits entering Liberty Science Center in Jersey City
Source Streetview® 2011

On the approach to Jersey City's Liberty Science Center (Figure 20), whisper dishes are encountered. As just mentioned, these are also present in Vancouver's Science World 1999 Science Playground vision. Aligned with themes of "exploring and enjoying science in daily life", New Jersey's exhibits also embrace Dewey's principle of continuity.[39] Situated along a public sidewalk, they intercept citizens engaged in the more necessary activities (Gehl, 1971) of their everyday lives. After the trip, Science World's Board of Directors wondered how they could incorporate that sort of experience in the approach to its Science museum.[40] The TDET was not the product of a single conception; it emerged from a process of conceptualiz*ing:*

> BT: It began in 1989, it got reflected in 1999, it got motivated by a visit to the Liberty Science Center, it got translated into the context of our planning … It was much after this [Regeneration proposal] but it's as we're thinking about implementing these various exhibits, it comes time to do this one.

[39] As Dewey (1938/1998) states: "As an individual passes from one situation to another, his world, his environment, expands or contracts. He does not find himself living in another world but in a different part or aspect of one and the same world (p. 43) This concept of continuity from one situation to another allows the learner's personality to "be built up only as a world of related objects is constructed" (p.43).

[40] Interviewee BT. Personal Communication, November 13th 2019.

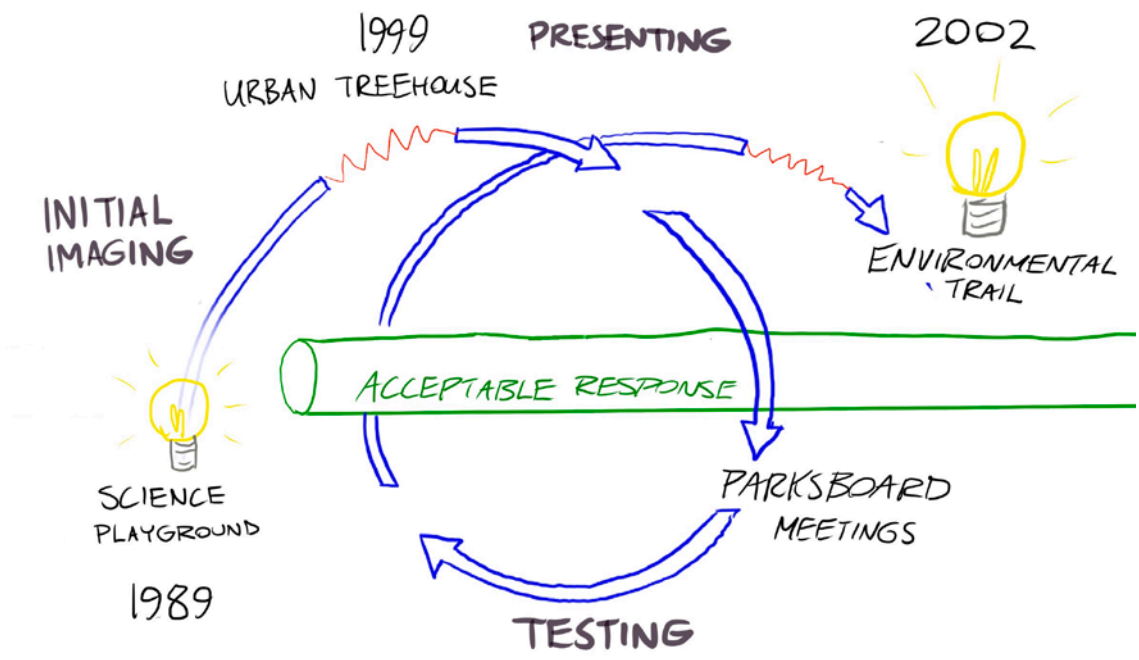

Figure 21: Evidence of Image-present-test cycle loops refining initial image formation for the Environmental Trail
Source: Luc Bagnérès

The Liberty Science Center stimulated a conceptual shift in the Science World design process (marked as red zig-zags in Figure 21), and initiated another re-imaging through which its design team produced the first real evidence of an environmental trail (i.e., a set of public learning environments along a public pathway). The TDET was thus conceived in 1989 as part of an initial image for a science playground. This was expanded in 1999 into an image of an Urban Treehouse. Both, when presented to the Park Board, tested unfavourably. A conceptual shift made by the Science World team following a visit to Jersey City's Liberty Science Center finally brought the idea of the sidewalk learning experience into the vision, in 2002.

4.2.4. Breadcrumbs

"Breadcrumbs" was the working title given to the TDET concept following the Liberty Science Center excursion (Science World borrowed the idea of exhibits sprinkled along the sidewalk). While the final form of the TDET was an enclosed loop around the Science World

building, the Breadcrumbs vision proposed the extension of science exhibits towards Cambie Bridge. PFS Studio worked with Science World to imagine a series of learning zones.

> BT: Our concept was to create the top end of False Creek, from Cambie Bridge to Science World, as the Environment Zone. We wanted the [Environmental Trail] to be to the South and the North. It wasn't just [to be] around the building.

The outer layer would consist of scattered exhibits, building anticipation to Science World. The Science World team and PFS Studio landscape architects together pursued an expanded vision of common outdoor space animated by exploration and enjoyment of science. In this vision, developers of properties in Northeast and Southeast False Creek were engaged:

> BT: On the North side is Concord Pacific properties. They were difficult but they had big environment plans and a whole bunch of responsibility from the city. So, there was tremendous opportunity because it was going to be developed by developers who had to pay back to the community.

Attempts were made, then, in 2002 to build relationships with developers Concord Pacific and Concert Properties through a common interest in the conceptual design that evolved into the TDET. Science World and PFS presented some of the Breadcrumbs designs to the developers in the hope of expanding the trail around False Creek. After multiple tests, however, the developers remained uninterested and the scope of the project was reduced.[41]

4.2.5. The Outdoor Science Experience

Because a fare-paying park on the public seawall was always a component of the Breadcrumbs concept, so was an "Intervention Zone".[42] Together, they were to be known by the working title of the Outdoor Science Experience (OSE). Nastaran Moradinejad, a designer at PFS, explains this concept further:

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[41] There is a lack of evidence documenting how Concord and Concert developers tested the presentations (Zeisel, 1984). This lack of evidence, triangulated with the drawing and interviews that sought to engage such developers, leads to the conclusion that north and southeast False Creek developers passed on the opportunity of Breadcrumb (TDET) exhibits in 2001-2002.

[42] This Intervention Zone would initially have included a pedestrian bridge connecting the end of Ontario street with the Expo deck (PFS Storybook, 2003). This was an initial inspiration to create a looped learning experience like the TDET of today.

> NM: [It] was more about connecting different parts of the site. These were all done at a high level establishing an "Intervention Zone". And then the notion of breadcrumbs, which was yet a bigger idea.

The Intervention Zone was a re-imagination of the fare-paying space first introduced in the1999 Urban Tree House. Between the years of 2001 and 2002, a vast array of presentations on the OSE were made by PFS studio to their client, Science World. These are contained in two booklets: the "Ideas Book" and the "Story Book". Variations in both the Breadcrumbs trail (TDET) and the Intervention Zone (KSSP) created multiple scenarios in these books, each attempting to better respond to the interests of the City, the adjacent residents to the east, and Science World.

The City had a strong desire to keep a continuous walkway along the seawall, and the fare-paying Intervention Zone to a minimal square footage. The adjacent residents had interests such as maintenance of views to the water, and reduction of the noise from the OSE to a minimum. Science World, in its creation of the OSE, was driven by a set of purposes explained by the CEO:

> BT: Why did we want to do this [OSE]? First, we needed more space. Attendance was growing…and we knew that for the organization to stay vibrant as a business, we needed more space.
>
> Secondly, we wanted to animate the outside spaces. As much as Science World is visible, it's static, it's this big ball sitting there. You have no idea of the animation and energy that's inside. We needed something that was visually striking and kinetic.
>
> Third, playing more tourist mode, or local pride, what distinguishes the Pacific Northwest? It's the outdoors. Our identity is closely related to fleece vests, and hiking and biking and walking, … and the environment.

Science World's objectives were thus: (a) the expansion of the fare-paying space; (b) the animation of its exterior; and (c) the introduction of the themes of the Pacific Northwest. In his *Site Planning*, Lynch (1962) explains the relationship between project purposes and the design process:

> The existing site, and the purposes for which it will be modified, are two sources from which the design springs. These two sources are curiously interrelated in a circular way. Purpose cannot be stated until the limitations that the site will impose are known, and the site itself cannot be analyzed until the purpose for which it will be used is set forth. (p. 11)

Lynch describes how a circular relationship between purpose and site leads to the emergence of the design process. Following his logic, BT's ability to state the OSE's purposes required knowledge of the limitations of the Creekside Park site. The vision of an urban treehouse, for example, which served to fulfill purpose (a), required a site analysis from which limitations of the Expo Deck became known. Together, the process of refining purposes and understanding site limitations transformed initial conceptions; the Urban Treehouse was not seen as suitable for the site but a Science Playground could be. The OSE design project comprising Breadcrumbs and the Intervention Zone originated, then, as an update of the 1999 ReGeneration vision:

> The False Creek East Bay will be filled with the buzz and excitement of children and adults engaged in the Outdoor Science Experience, the biggest, greatest, outdoor science area in the world. The OSE will be creation of a fun, wild recipe, the very excitement of Disneyland whipped together with whimsy larger-than life, "totally cool" exhibits. With this formula, *we explore the natural forces of Water, Air, Light, Gravity* and through physical play, wild laughter, and zany demonstrations. Humour will be a vital ingredient to the OSE. No exhibit environment will be too serious. All will be slathered with a sense of humour. Imagine riding a bike, not to power a lightbulb, but to power a mechanical dog that pees into a bowl. People will arrive with anticipation and will leave with smiles on their face, a sparkle in their eye, a question in their head with the anticipation of coming back 'REAL SOON'. (Phillips Farevaag Smallenberg Studio. (2003a, emphasis added)

A shift in theme has been made here from "Earth, Sun, Water and Wind" (Science World, 1999) to "Water, Air, Light, and Gravity" (Phillips Farevaag Smallenberg Studio. (2003a, 2003). The 2003 Storybook vision is light-hearted, attempting to capture the experience of pedestrians as they approach Science World. The theme of sustainability only came later:

> Interviewee 4: When they originally pitched the idea [for the OSE], it had nothing to do with sustainability. It had everything to do with expanding the footprint of Science World so [it could be] outside and visible, and you could do things outdoors that you can't indoors. Like in terms of the size and scale, we thought it would be fun…The concept [of the TDET] has been floating around for a long time.

Interviewee 4 helps to explain the transitions involved in moving from initial OSE themes to their refinement in its third purpose: reflection of the local identity of the Pacific Northwest. It was this theme that gave rise to that of sustainability between 2006 and 2009 (explained in Section 4.3).

4.2.6. Lacking Momentum

Multiple factors, which were not made explicit during this research,[43] caused the design process to slow down. In Zeisel's terms, the span between imaging, presenting, and testing came to halt, suggesting that the conception had lost life. As BT explains, Science World is a not-for-profit business with a continuing need to sustain its organization financially. This is the primary purpose for OSE's proposed fare-paying Intervention Zone. Despite the existence of the Breadcrumbs concept (TDET) within the OSE vision, the City did not find the design to have the kind of fitness with its surroundings described by Alexander (1964):

> BT: The city was treating Science World like it was a developer, and putting the same constraints on us. For example, what's your amenity contribution. We said, what do you mean? [The OSE] is an amenity, we are going to go out and raise millions and millions of dollars to enhance the experience for the benefit of the citizens and you want us to give you money to do it?
>
> NM: The city did not take [the OSE] very seriously, and they tried to set up different meetings and workshops [but were unsuccessful].

With the city uninterested in the OSE designs, the project lost its momentum. No documented evidence was found between 2003 and 2006 in relation to the OSE design process. During this time period, Science World hired a new director[44] who played a strong role in the OSE project, reimagining with PFS, ways to bring this vision to life.

It is particularly important to emphasize the influence of two projects here, described in Appendix C. The first is Our World Gallery, a part of the June 1999 to 2002 ReGeneration vision; and the second is the Southeast False Creek neighbourhood (1995-ongoing). Each project developed exhibits and interpretative designs on themes related to sustainability. Designers and curators from both SEFC and Our World projects found their way into the design process of the OSE, which led to the creation of the TDET. These elements serve to explain the contested morphology of East False Creek and bring important context to the negotiations that followed.

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[43] The specific reasons the City of Vancouver's lack of commitment to this original vision were not clear from interview data. Further research is needed to explain the City's failure to embrace the earlier versions of the OSE although it may be simply problems with the concept of a fare-paying park (1999-2003).

[44] This important figure, Kevin Kearns, was unfortunately not interviewed.

4.3. Collaboration (2006-2008)

In 2007, after a gap of four years where the Outdoor Science Experience (OSE) and its public face, 'Breadcrumbs' (TDET), saw little to no advancement, the City of Vancouver renewed its interest in the project:

> BT: By this point [2007], all our discussions had indicated that our grandiose view of having [the Breadcrumbs] around the creek was not going to happen, but at least we [could] go around the building and that would all be free and open to the public, and it would hit the same topics of water, energy, transportation.

The vision had to shrink if it was to be executed and the fare-paying boundary implied by the OSE's Science Park, had to be reconciled:

> Interviewee 4: That's what [City personnel] were really hung up on. They would have let us build anything if the entire experience was free. But because we [couldn't] afford to do that, we had to make compromises for it. We [couldn't] make all the exhibits free. It's impossible. We have to make money we have to be able to pay to maintain the stuff.

The need to define both public and private space had existed from the beginning of the process, in 1999. Although Science World was a not-for-profit organization, it operated as a business and needed a source of revenue for facility maintenance. To charge a fee, space needs to be enclosed and its access restricted (Ford, 2012). This enclosure would need to include a fence. The privatized science park was the OSE's primary design problem. Yet, there were also many problems with the existing site of Creekside Park. The COV began to see an opportunity to resolve these through the OSE project.

4.3.1. Guiding Principles for an Outdoor Science Park (2007)

As stated, "in 2006/2007, the City of Vancouver agreed to undertake a process with senior staff from a number of City departments with a role in making decisions about Science World and its site on the False Creek waterfront" (City of Vancouver, 2010a, Appendix E, p. 5). The City agreed with Science World to direct their staff to form a committee to oversee development of the OSE:

> Through a series of workshops, staff of the Planning, Office of Cultural Affairs, Parks and Engineering Department met with Science World staff and consultants

to review the concept and its integration into City projects, policies and aspirations. (City of Vancouver, 2010a, Appendix E, p. 5)

NM: There were different levels of engagement with the City, and then the City actually reviewed [the OSE proposal] and gave the team a lot of feedback. The staff reviewed it not as an application but as a proposal.[45]

The City staff, reviewing the OSE as a proposal, prepared a set of guiding principles that emphasize the key design problems of the Creekside Park site: (a) decking, (b) pedestrian and bikeway paths, (c) transportation and parking, (d) drop-off, loading and queuing, (e) interface with park and waterfront, (f) built form and architectural treatment, and (g) community fit. "These principles provided the direction needed to plan the OSE in the context of its complex site to address key City issues" (City of Vancouver, 2010a, p. 5).

Figure 22: Satellite image Creekside Park in 2007, during these discussions
Source: Google Earth®

Seen in Figure 22, car traffic patterns appear to be emphasized in the site layout through a roundabout which also served as an Indy racetrack at the time.[46] The site seemed to represent a paradigm of car accessibility to every inch of urban public space, a traditional pattern of modernist design as described by Cullen (1961). The large roundabout seemed to lack a purpose in the public realm. In addition, a large berm turned the northeastern edge into a dead zone.

This satellite image does not fully illustrate the poverty of the public experience at ground level in the 2007 approach to Science World. For example, many conflicts existed between pedestrian

[45]The difference between them is that an application is the initial step in obtaining a development permit. A proposal is less formal and involves higher level discussions amongst parties.

[46] As seen in the roundabout in front of Science World, this served as a part of the Indy Races from 1990 to 2004 and provided funding to Science World in exchange (CBC News, 2004).

and bicycle pathways all intersecting problematically with the car drop-off zone.[47] With this lack of character, the space felt transitory, to be moved through, rather than a place to be *in*. Aside from a small playground, Creekside Park's large open vistas and empty greenspaces were passive, exemplifying Gehl's (1971) principle that "nothing happens in a public space, quite simply because nothing happens" (p. 77). Arguably, the Creekside Park space in 2007 was no less passive than many other edge spaces in Vancouver.[48] The principles for the OSE established in April 2007 by the City's committee sought to resolve these spatial elements by:

- reducing conflict between site users including pedestrians, cyclists, vehicles and Science World visitors,
- improving the aesthetic interface between Science World, park space and the Seaside walkways/bikeways,
- generating a more positive experience of the public realm in this area for all users, and
- enhancing connectivity between access routes, the Science World site and surrounding areas. (Facility Renewal Report, 2010, p. 5).

As Alexander (1964) states, "the form is the solution to the problem; the context defines the problem" (p. 21). If a gated park was to be built within the OSE, it would need to resolve design problems found in the elements of paths and edge (Lynch, 1960).

4.3.2. Workshops

With these guidelines, the City of Vancouver's committee began working through design scenarios with Science World. Figure 23 below, a product of these workshops, delineates potential areas for the OSE's semi-private zone, and the integration of this form into a plan for the public realm of East False Creek. As explained by Scot Hein, an urban designer with the City at the time:

> SH: The red stripes graphic was an attempt to identify all potential OSE/future indoor expansion site footprints. Declaring the larger potential first via the diagram was intended to compel more detailed investigations as to the most appropriate location of the OSE and how the future of the site might further

[47] In Cullen's (1951) words, "This is the traditional pattern at its clearest…elements at their most disorganized…in which both pedestrians and traffic suffer a diminution of their proper character" (p. 28).

[48] Berelowitz describes how these static platform spaces had become ubiquitous along Vancouver's seawall. "These static platforms reflect the centrifugal nature of public space in a city in which activity constantly tends towards the edges. Nothing happens in these spaces" (Berelowitz, 2007, p. 164).

develop should additional interior space be necessary down the road. We wanted to ensure that we understood how to best shape a public open space by being strategic about where new additions should go in our proactive work with SW staff.

As discussed, the City worked with Science World to create a fare-paying park that was integrated into a cohesive network of pedestrian and bicycle pathways (marked as green dotted lines in Figure 23). Science World had an interest in keeping the OSE connected to its main building, reducing the requirement for additional toll gates.

Figure 23: Example of a concept drawing from the 2007, 2008 Urban design charrettes Source: City of Vancouver Urban Design Studio
Reprinted with permission by Scot Hein

SH: The red dots represent important positions/locations, particularly for entries, to energize a new central/circular piazza anchored by a water feature in the middle. Of course, this all changed as we got into design development and the OSE program, but it was at least a place to start the conversation by recognizing the important urban design role that SW and the OSE would play

> in pulling together the disparate pieces at the end of the Terminal Street corridor/vista/axis.

As SH describes, the placement of the OSE was intended to resolve the park's poor configuration of elements. These workshops first aimed to resolve the problematic passive space described above. The red dots in Figure 23 marked elements that would reinforce the placement of the geodesic dome at the intersection of axials Georgia Street. and Terminal Avenue. This would then form part of a linear entry sequence to the Science World building. As defined by Ching (1979),[49] "it leads directly to a building's entrance along a straight, axial path. The visual goal that terminates the approach is clear" (p. 249). This linear sequence became a fundamental dynamic in the design of the OSE's spatial relationship with the TDET. One of the red dots aligns with the geodesic dome and the axial of Terminal Avenue, representing a foreground element that would resolve the passive space and establish an animated circular "Science World Plaza".

Science World's geodesic dome seemed to be a great landmark, yet its surrounding space lacked elements to announce it. Here, the Tower of Bauble, the first of the TDET's exhibits, found a new role as a design element within the OSE. Seen in Figure 24, it was reimagined in 2007 as an element that would provoke people walking long the seawall to stop. It seemed to be a great installation to initiate a new sequence of public exhibits, one that would fulfill the initial vision of "science in everyday life" (Science World, 1999),

Since 1995, the Tower of Bauble had been an exhibit just outside Science World's entrance.[50] It had been a source of animation and excitement, with dozens of billiard sized balls spiralling and propelling through various sound trajectories. Twelve years later, "the plan [was] to renew this exhibit and give [it] a new home in a prominent place at the beginning of the new entry sequence" (City of Vancouver, 2010a). The exhibit was now being positioned to accent Science World's frontal approach (red arrow Figure 25) and help to transform a transitory space

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[49] The Approach to a building is defined by Ching (1979) in his *Architecture: Form, Space and Order*: "Prior to actually entering a building's interior, we approach its entrance along a path. This is the first phase of the circulation system during which we are prepared to see, experience, and use the building's space." (p. 248).

[50] This kinetic sculpture was "created by New York artist George Rhoads in 1985 for a shopping center in Kamloops, Canada. It was then donated to Science World in 1995" (Fielding, 1998).

into a plaza. The Tower of Bauble animating this plaza would serve as a nudge (in purple, Figure 25) for pedestrians and cyclists to stop along a reimagined network of paths.

Figure 24: The mechanisms of the Tower of Bauble shown as they existed in 2007
Source: Luc Bagnérès

Figure 25: The Tower of Bauble would accentuate the axial alignment formed by Science World with Terminal Ave
Source: Luc Bagnérès

Designers in 2007 imagined a series of enclosures, one of which would include the fare-paying park represented as the red dashed area on Figure 25. These would create a more human scaled environment[51] within the larger Creekside Park. These workshops show the process whereby Science World and the City of Vancouver were able to create a common vision. In aligning interests, the OSE Science Park could be integrated into a reimagined public realm, where the Science World's relocated Tower of Bauble (soon to be part of the TDET) could serve as an element or incident, energizing Creekside Park.

4.3.3. Resolving the edge (2008)

Aside from paths, the most problematic element of the site was the decking, the first element to be dealt with in the City committee's 2007 design principles. The foundation of Creekside Park itself, the Expo deck was a challenge (shown in 4.1). It was deemed to be in poor condition during development of some scenarios for the shoreline's renewal. And it was

[51] The resulting park enclosures follow spatial dimensions of approximately 25m, described "immediately comfortable and well-dimensioned in a social context" (Gehl, 1971, p.165; Lynch, 1962, p. 60).

seismically unsafe.[52] Assessed in 2008: "the COV initiated a review of the deteriorating Expo decking at the east end of False Creek. Westmar Engineering, marine structures experts, and PWL Partnership, the City's landscape architects, were engaged to prepare options for consideration" (City of Vancouver, 2010a, p. 5).

Figure 26: One of three options generated in 2008, replacing the deck and reimagining the edge
Source: City of Vancouver Urban Design Studio. (PWL Landscape Architects)
Reprinted with permission Scot Hein

One option, (Figure 26) [53] of three created, removed the Expo deck and reworked the edge and network of paths in Creekside Park. The Tower of Bauble found itself as the key

[52] Discussed in correspondence with SH, he explained that initially they were going to have the deck serve as a place to park satellite trucks during the Olympics. When they tried to stabilize these trucks, they found that the deck could not handle the point loads.

[53] In option B, and C which is not shown, there was also evidence of a daylighted stream, referred to as the "China Creek connection". This indicates a desire to keep the context of the design problem alive, a process highlighted by Alexander (1964). A larger project integrating the OSE into the City's efforts to daylight other streams to bring fresh water into the area is still being discussed (City of Vancouver, 2019).

incident, marked as (8). These were prepared by designers from the City and PWL Partnership[54]. Marked faintly as bubble (9) is the placement of the OSE, in much the same area to the northeast of Science World. This demonstrates the way in which the City, alongside groups such as PWL, Westmar Engineering and marine experts, provided scenarios to Science World and its landscape architects, PFS, who responded in turn. "PFS was commissioned by Science World to respond to the CoV's plans for the park surrounding [Science World's] facility designed by PWL partnership on the City's behalf" (City of Vancouver, 2010a, p. 3).

Just *how* Science World and PFS would place their form in the complex territory of the Creekside Park site was undetermined in PFS's response. The City of Vancouver and PWL had provided illustration and guidance for potential OSE locations seen as acceptable to them. The Intervention Zone would need to be strategically placed to allow for the longer-term renewal of the edge by the City.

In terms of guiding principles, the first TDET exhibit, the Tower of Bauble, lay at the intersection of all but two. It followed principle (b) and (g) by anchoring a new configuration of paths in a new plaza replacing the roundabout. It resolved principle (a)'s concern with the Expo deck foundation by "leapfrogging" the deck type A (Figure 27). Positioned on solid ground, it would be removed from the deck's load-bearing constraints and thus free to announce the space architecturally with a larger canopy following principle (f):

> NM: [the Tower of Bauble] either had to be on [the deck] or off it, not in between. We pushed it out there because it's like a lighthouse almost. While you're lining up, or waiting for somebody… we were always joking internally "yeah, let's meet at the Tower of Bauble."

[54] PWL was also assisted the CoV in its development of the SEFC Public Realm Plan in 2006 (Appendix C.4).

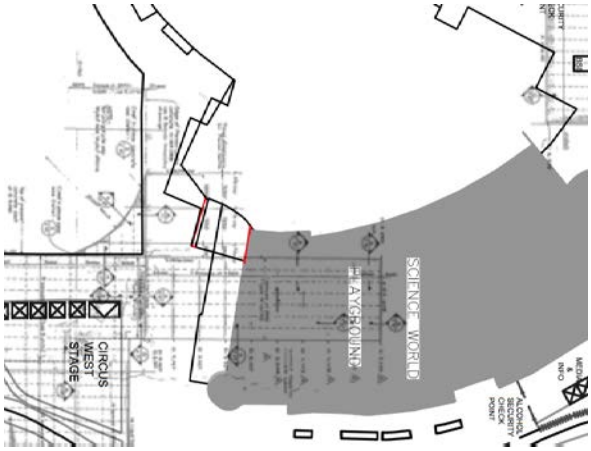

Figure 27: Final footprint of Ken Spencer Science Park revealing the Expo deck
Source: Reprinted with permission by City of Vancouver, 2017

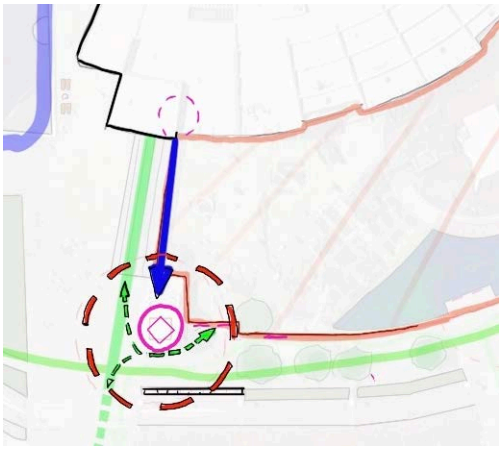

Figure 28: The re-positioning of the Tower of Bauble
Source: Luc Bagnérès

The Tower of Bauble was strategically positioned across the retained deck platform (Figure 28), serving as an incident along a major path and providing foreground animation for a new "Science World piazza". While elements like the Tower of Bauble improved the public realm, the OSE had still to contain some kind of fence: In response to these difficulties, PFS and SW began iterating a particular kind of fence:

> Interviewee 4: When you hear the word "fence," you hear "Oh yeah, we're going to build a park and put a fence around it" Naturally, everybody at the City's back goes up, like "Woah, are you guys building a prison yard?" We knew if we were going to create a barrier, that barrier had to be as soft, engaging and interactive as possible. It had to add value to the public space.

As much as this fence was to be a barrier, how might it also be a "seam" between the public realm and the semi-private science park? Figure 29 illustrates this potential.

Figure 29: Private and public space as an interface of different degrees of public access
Source: Luc Bagnérès

It was understood by the City and Science World that if the OSE was to shrink the public realm, Science World needed to provide significant

improvements to it which could begin with the Tower of Bauble's new placement. How might a set of scientific "experiences" be extended between the public and private realms as an interface?

4.3.4. The emerging theme of sustainability

During the workshops of 2007 and 2008 involving Science World and the City, a cohesive theme for the OSE emerged: sustainability. As discussed, what started off as "Water, Earth, Sun, Wind" in 1999 evolved to "Water, Air, Light, Gravity" in 2002. The former CEO of SW describes this theme evolution as it reached 2009:

> BT: [The resulting sustainability theme] was quite intentional, in response to reading the community…Rather than make it physics-based, as we had in our indoor gallery, let's talk about the world around us in that outdoor space, and that's how the themes came iteratively…. The connection between the OSE and the TDET came out of that desire to link science and experience to things that matter to people. It wasn't that Science World was advocating that the environment is important. It's understanding what our potential visitors think is important, and we have to address that.

Sustainability may have been the result of an evolving process of "reading the community", but another interviewee presented a contrasting perspective:

> Interviewee 4: At some point [Science World] realized they would need funding and support from the public, and specifically the city. To basically redevelop the land, it had to be about a topic that was more relevant to the rest of the community and add some kind of societal benefit. So then it became more about sustainability.

Would Science World change its theme of physics to one more acceptable, sustainability, to gain support from the City of Vancouver and fulfill its final guiding principle, community fit? A Science World executive claims it evolved iteratively from reading the community; a Science World designer claims it was more reactive, a way to gain approval for construction.

It is here that the influence of the City's 2005 South East False Creek (SEFC) neighbourhood development plan is felt. In his 2002 *The Vancouver Achievement*, Punter traces the design process of South East False Creek's policy statement (1999) along with its development plan. His research revealed that SEFC had become a testing ground for

sustainability policies that would inform future development projects in Vancouver.[55] The *Official Development Plan for Southeast False Creek*, adopted by City Council in July 2005, articulated social, environmental, and economic sustainability goals (Bayley, 2010). A correlation therefore exists between the TDET's sustainability theme and that of the SEFC neighbourhood just southwest of Science World. Further, SEFC was being planned to include the athlete's village for the 2010 Olympic games. The Strategic Plan for the Olympics states that:

> 'the City must educate the public clearly as to what the City is committed to and capable of delivering as one of many organizations responsible for planning and staging the Games, and for implementing various inclusivity, accessibility and sustainability commitment. (City of Vancouver 2006, p. 24)

In order to advance the goal of public education on Olympic sustainability, the City of Vancouver may have seen an opportunity to collaborate with Science World's OSE. In any case, the City developed an interpretive strategy within the SEFC Public Realm plan (City of Vancouver, 2006b, p. 26) that also had elements of sustainability education (See Appendix C.4). The SEFC Public Realm Plan provided direction for the neighbourhood's open space, streets, and pathways including an aim to "connect the entire site and link SEFC to the adjacent neighbourhoods" (City of Vancouver, 2006b, p. 4) The OSE project being adjacent to SEFC could integrate into its environment not only through public pathways but through sustainability education as well.

After the Guiding Principles and workshops of 2007 and 2008, further engagement and consultation took place with the Citygate[56] residents to the east, who were in favor of an OSE according to interviewee NM. By February 2009, the City of Vancouver announced its ambition to become the world's greenest city by 2020.[57] In July 2009, the theme of the OSE addressed

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[55] As Punter states, "the preparation of the South East False Creek Official Development Plan has delineated the wide range of issues that need to be addressed if the city is to realize the deeper commitment to sustainable forms of this development. The mega project will become a testing ground for new regulatory policies and sustainability targets, and a demonstration project for more sustainable building, new energy and building technologies, and new forms of neighbourhood management and economic development" (Punter, 2002, p. 387).

[56] The Citygate Development was a condominium project development (consisting of five 30-32 storey high residential towers) completed in the 1992 (BC Condos, n.d.)

[57] As stated, "Mayor Gregor Robertson launched the Greenest City Action Team, composed of 14 experts on environment and economy, with a mission to gather best ideas and practices and make recommendations to City Council" (City of Vancouver, 2009, p. 1)

"the content of the physical world, the living world, and incorporated a sustainability focus" (Science World, 2009a, p. 1). The City was still not in favour of a fare-paying park but was considering it a possibility. With dialogue established with the City, the Science World team was ready to work through some of the conceptions of an outdoor science experience for the public realm. Emerging from this dialogue was a document entitled the "Outdoor Science Experience Project Proposal: Schematic" (Science World, 2009a).

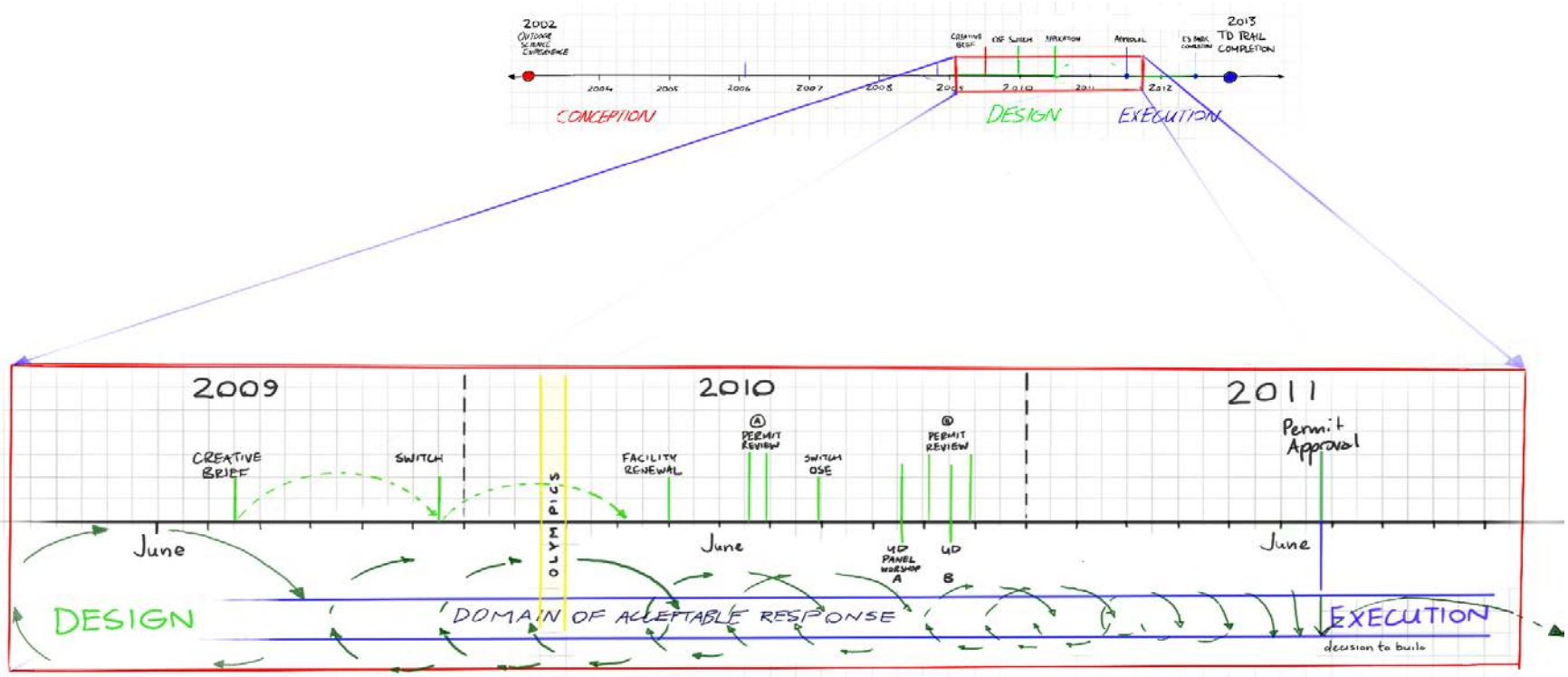

Figure 30: This diagram reveals how by mid-2009, the design process would take a turn towards presentations of the trail. (inspired by Zeisel, 1984)

Source: Luc Bagnérès

4.4. Phase 1: Three exhibits (2009)

In 2009, a more refined scale was achieved in the TDET design process (Figure 30 above). Several documents containing presentations of proposed TDET exhibits were produced in a short time. This refined scale was initiated through the imagining of three exhibits on the deck surrounding Science World.

> Interviewee 4: The original three exhibits were an initial stab at building outdoor exhibits about sustainability, as a good faith gesture to help garner support from the city, and to also, frankly, get practice developing outdoor exhibits. But they were made knowing that there was no guarantee it would lead to Development Permit approval for a future [semi-private] park.

These exhibits were developed as a way for the City and Science World to build consensus and therefore diverged from the intention of a fare-paying science park. Free-standing, and later added to the TDET, they were envisioned for the public walkway surrounding Science World, legally owned by the City of Vancouver. The exhibit curator from Science World's Our World gallery (Appendix C.2) was appointed as curator for the TDET. This proposal aimed to demonstrate to the City what they could accomplish on the outdoor site, while the larger land renegotiations were underway. The following sections will explain the genesis of the first half of the TDET exhibits in 'Phase 1' of the OSE Proposal. They will move through the sequence shown in Figure 31 below (under 'Task Name' column): 4.4.1 Project initiation, 4.4.2 Content Development, 4.4.3 Schematic Design and Development, and 4.4.4 Exhibit Production/Construction, ending in December 2009.

4.4.1. Project Initiation

Six members of Science World's interior design team initially refined the themes of sustainability in three TDET exhibits. Jodie Braaten, an exhibit designer from the team describes how this process started:

> JB: An initial brainstorming charrette is how this all got started. Coming up with a bunch of key words that would eventually branch out into associated topics related to nature and sustainability that could turn into interactive activity.

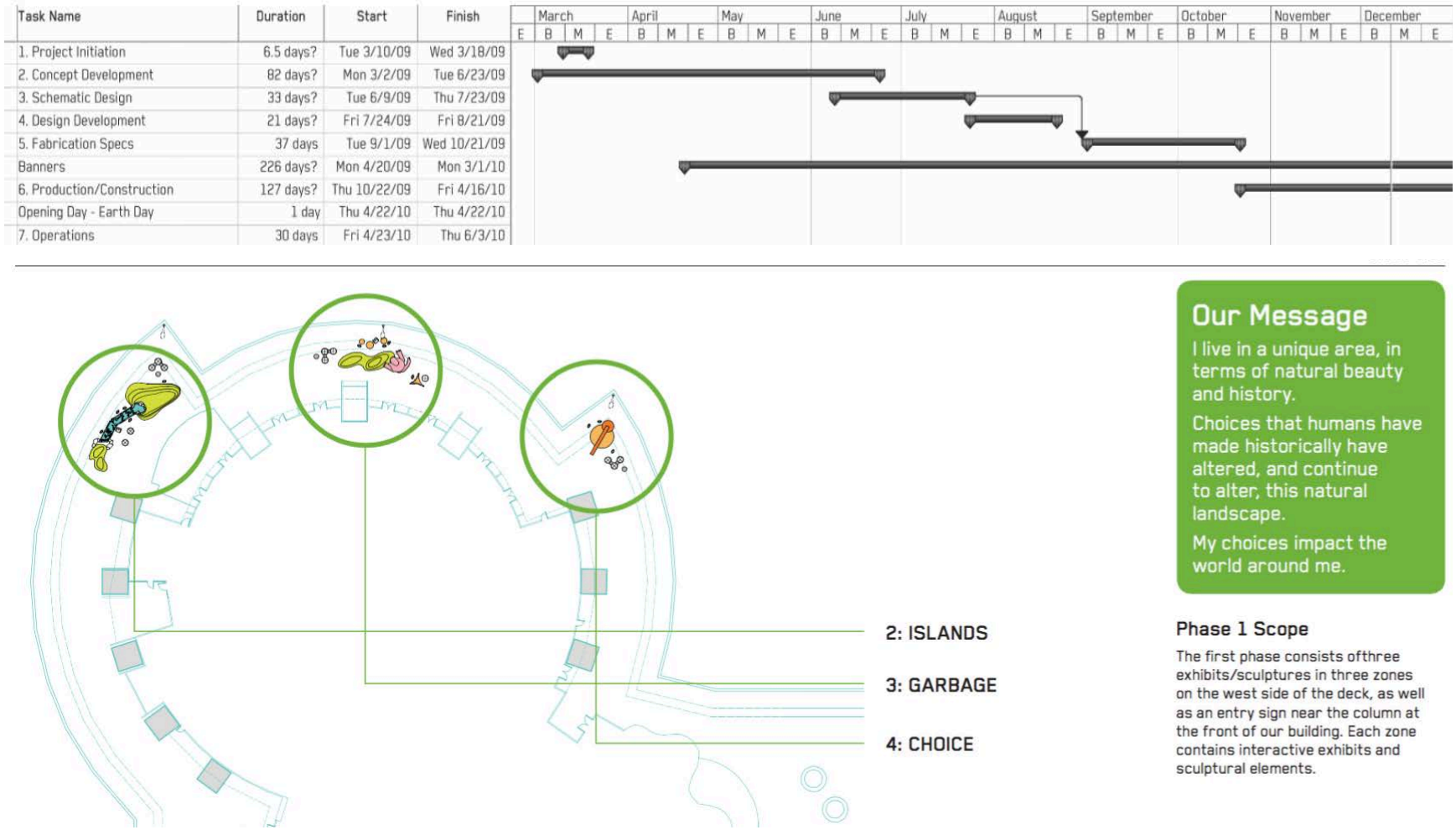

Figure 31: A timeline of the TDET design process and its 'first phase' exhibits, produced internally by the Science World three deck exhibits team. Source: 'SWITCH: OSE Presentation Booklet'(Science World, 2009b)

Reprinted with permission by Science World

The exhibits were set around the themes of sustainability and the environment, with sub-themes such as food, waste, and transportation beginning to emerge from the charrette.[58] This initial brainstorming in March 2009 led to a creative brief:

> Interviewee 3: The creative brief just helps people say "What is the exhibit going to be about", "How much is it going to cost?", "What is it going to do?", "What are some possible experiences we're going to have in it?", "What's it not going to be about?", "How do we know if we're going to succeed?"

A June 2009 Creative Brief then outlined these questions in a set of key criteria to pin down the OSE's evolving notion of the Environmental Trail. It included 1) Objectives 2) Target Audience 3) Location 4) Success Criteria and 5) Take Home Message.[59] For brevity two are outlined below:

> 2) Target Audience:
>
> a) Science World's core audience: families, grade K-7 b) Expand core audience: adults without children, teens c) Seawall users: tourists, commuters (p. 3).
>
> 4) Success Criteria:
>
> a) Include at least three elements that embody "iconic" (tall, large, statement piece) b) Include visual attractors to draw people to the area c) Recognize donors and contributors d)Stand-alone e) Represent the direction for the Outdoor Science Experience f) Address the content of the physical world, the living world and choices g) Incorporate a sustainability focus h) Completed and installed by 31st of December, 2009 i) Completed for $509,723 or less j) Be removable (2010 Olympics) k) Fall within the constraints of the deck (250 lbs/sq ft) l) Be durable, both to the elements and to visitors. (Science World, 2009a, p. 3)

As can be seen by "Success Criteria", the Creative Brief represented the beginning of a design program in Lynch's (1962) sense, with clear objectives and a budget. As Interviewee 4 explains, "there was a period where the City offered Science World free reign over the whole deck, but developing anything substantial on that deck would have been just as costly, and probably far more limiting". Exhibits from the interior Science World gallery, Our World (Appendix C.2) influenced these criteria. The target audience reinforced the earlier vision of

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[58] As the timeline /schedule states (Figure 31), concept development preceded project initiation by about a week. Whether this charrette was done in this first week of March or was part of "Project Initiation" is unknown. The interviews were conducted prior to reception of these documents and the dates on the schedule were never explained.

[59] For 5) Take home message is stated in the green bubble of Figure 31 (Science World, 2009b).

"science in everyday life" clearly presented to members of the public as well as an expanding Science World user base, rather than to a semi-private paying group.

During this time, 2008 to 2009, the Science World building envelope was also being expanded outwards towards the west, with plans to reset the interior volume after the Olympics. While the façade of Science World's facilities was being pushed outwards, the deck itself remained the same. The City of Vancouver reviewed these exhibits as they evolved in various design cycles, making sure that they would properly integrate their form with Science World's building renovation plans and the altered pedestrian seawall pathway.[60]

Dialogue with Toronto Dominion (TD) was in its initial stages in 2009 with no guaranteed funding. During the time of the Creative Brief, Science World established contact and presented exhibit designs where signs of TD sponsorship could be placed. The Science World CEO described how this relationship with the manager of TD's Friends of the Environment Foundation[61] was established in 2009-2010. However, they made sure that TD did not influence the content of the exhibits: "they could see it, they would have the right to review, but not create." (BT, interview correspondence). While designs may have been presented to the TD Bank, it served as an external stakeholder in the "test" phase, with imaging and presenting of design details kept within Science World's team.

4.4.2. Concept Development

The conceptual development phase of these TDET exhibits took place between March and June 2009. As can be seen in Figure 32 below, content description, while keeping to the theme of "exploring and enjoying science in daily life" is significantly refined from that of ReGeneration's 1999 initial draft. These exhibit concept descriptions are a great example of how designers can provide learning environments defined by pedagogical goals (Dewey, 1938/1998; Gislason 2007); e.g., "understand water flow and the ways we can interact and change it" and "comprehend the impact we have on the water cycle" were conceived by the Science World team

[60] Confirmed in correspondence with Scot Hein, April 2020.

[61] As stated on TD's website "Founded... in 1990, the TD Friends of the Environment Foundation (TD FEF) is a national charity that funds environmental projects across Canada."(Toronto Dominion Group, n.d.)

through their experience with a water-pumped ephemeral stream. Following "Content Objectives" was "Level of Engagement for Science World Exhibits" where exhibit objectives were aligned according to the level of engagement they were able to provide. An attainable level of engagement, for example, was "To inspire curiosity and active inquiry about science and technology". These then linked to one of three "Level[s] of Interactivity" described below by an Exhibit Designer:

> JB: There are three general categories for interactivity at Science World (a) Low level - initial attraction to get visitors interested in the content, e.g. flip panels, button pressing, matching game, (b) Mid [level] - more involved, you have to physically apply yourself to figure the interactive out, ex. viewing through a microscope, stacking things, holding onto a live critter, and (c) High [level]- full body experience, you are physically immersed, e.g. jump tester, hang time....Typically this level of engagement can be considered a challenge or become competitive. Whichever exhibit style is being considered, we are aiming to achieve the greatest amount of dwell time from our visitors. The longer they linger the greater the success for us.

The potential for interaction varied by exhibit, as shown in "Types of visitor interaction" (Figure 32), which may indicate an awareness of the concept of Active Prolonged Engagement by the initial TDET design team.[62]

[62] They generated "specific kinds of visitor-driven behavior, including questioning that generates exploratory activity… collaborating with others and searching for and reflecting upon causal explanations for exhibit phenomena." (Exploratorium, 2005, p. 3) Indeed, with the ephemeral stream, the objectives were for participants to "understand water flow and the ways we can interact and change it" providing the opportunity for "play with floating crafts, dams, and streams". This allowed experimentation and exploration, requiring "physical skill, knowledge and evaluation to meet a complex challenge". The concept of the Ephemeral Stream (which then became part of the TDET) was therefore one intended to deliver prolonged engagement.

EXHIBIT CONCEPT DESCRIPTION

Exhibit ID #: Zone 3.2 | **ECD Version:** 1.0

Exhibit Name: Ephemeral Stream WATERTABLE

Exhibit Target Audience Age (TA):
- Visual: all
- Water interactive: grades K-6

Content Topic
- Streams and their ephemeral nature, both natural and forced
- Water flow, currents

Content Objectives
- Understand water flow and the ways we can interact and change it
- Comprehend the impact we have on the water cycle

Levels of Engagement for Science World Exhibits and Exhibitions
- To stimulate participation in Science World experiences
- To inspire curiosity and active inquiry about science and technology
- To further understanding of science and technology
- To provoke action that enables science and technology to contribute to a healthy, prosperous and sustainable society
- To develop science and technology leadership that contributes to a healthy, prosperous and sustainable society

Level of Interactivity
2. The user can touch/handle an object or artefact
6. The user requires physical skill, knowledge and evaluation to meet a complex challenge

WOW Factor
- Passive, visually compelling, good for telling a story
- Interactive, and visually compelling

Type of visitor interaction
- Autumn, winter, spring: visual experience
- Summer: interactive, engaging experience

Can the visitor experience multiple outcomes? YES

Exhibit Benefits
- Allows for single or multiple users
- Season-dependent changes to the exhibit maximise use and experience while minimising cost

Level of design and fabrication
- Custom Fabrication, with precedence

Visitor Experience
- There will be an ephemeral stream during the autumn, winter and spring when people will not be likely to interact with water, and a pump system during the summer when water play will be a large attraction
- During the autumn, winter and spring visitors will see a dry river bed that will turn into a stream conduit when it is raining
- This will mostly be a visual experience
- During the summer a pump system will circulate clean water through the stream
- Visitors can splash in the stream, play with floating crafts, create dams and divert the water of the stream
- Play will be facilitated with some raised water tables at appropriate heights for children
- Information on the impact we have on streams and the water cycle will be provided

Exhibit Description
- A stream bed will be created to sit on top of the deck using cedar
- The stream bed will slowly descend on an incline from the shaped mound to deck level at the native garden
- The stream path will be winding and include an oxbow lake, raised water table(s) and a man-made straight channel cutting through the natural stream path
- The stream bed will be covered with river rocks, natural towards the native garden end and changing to concrete towards the shaped mound end

Reference Images

North Vancouver
http://www.nsmba.bc.ca/structures/naturalhigh/naturalhigh.htm
Mount Olympus
http://www.flickr.com/photos/24579410@N00/2542428101

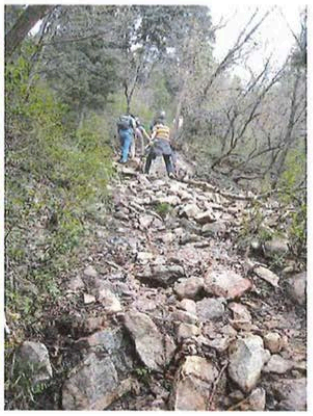

Figure 32: Content outline for the Ephemeral Stream exhibit, part of Waterways (June, 2009)
Reprinted with permission by Science World

Given the Ephemeral Stream's situation in the public realm, its potential for interactivity is an example of Gehl's (1971) principle of the self-reinforcing process.[63]

The exhibit description in Figure 32 was one of three integrated into the larger "Waterways" learning environment on the TDET . The other two exhibit descriptions were "Shaped Mounds" and "Strataface". The objective of Shaped Mounds was to allow visitors "to understand how often even the natural-looking landscapes have been shaped by our hand" and "to distinguish between true natural landscapes and man-made ones". Strataface aimed to allow them "to understand the geology of our landscape and the layers of rock beneath us" and "how we have impacted the local area by adding a layer of landfill to the geological strata"(Science World, 2009a, p. 9). These aims reflect an understanding of the context and substrate layers of False Creek (Appendix C.1). The geoslice was meant to "create a tie to the local area we were in" (Interviewee 3). In the form of man-made mounds, geo-slices, and a stream, then, Science World had designed (a) place-based learning opportunities (b) offering interactive experiences (c) within the public realm of the seawall.

4.4.3. Schematic Design and Development

During the months of July and August 2009, the preparation of "Schematic exhibits" shifted to the "Design Development" phase (see timeline in Figure 31). The three elements of the Waterways exhibit (Ephemeral Stream, Mounds and Strataface) were in need of simplification; A sculptural rain collection tree and a stump jumping log were removed. The remaining form was then further simplified: two mounds/islands became one and the length of the stream was reduced. The exhibit itself was then defined by the series of pulleys, gates, and wheels seen below:

[63] Gehl argues that it is not the number of activities that matter but their duration. The intention of the Ephemeral Stream to foster prolonged engagement is thus also one to hold participants in public space where they become catalysts for a self-reinforcing process.

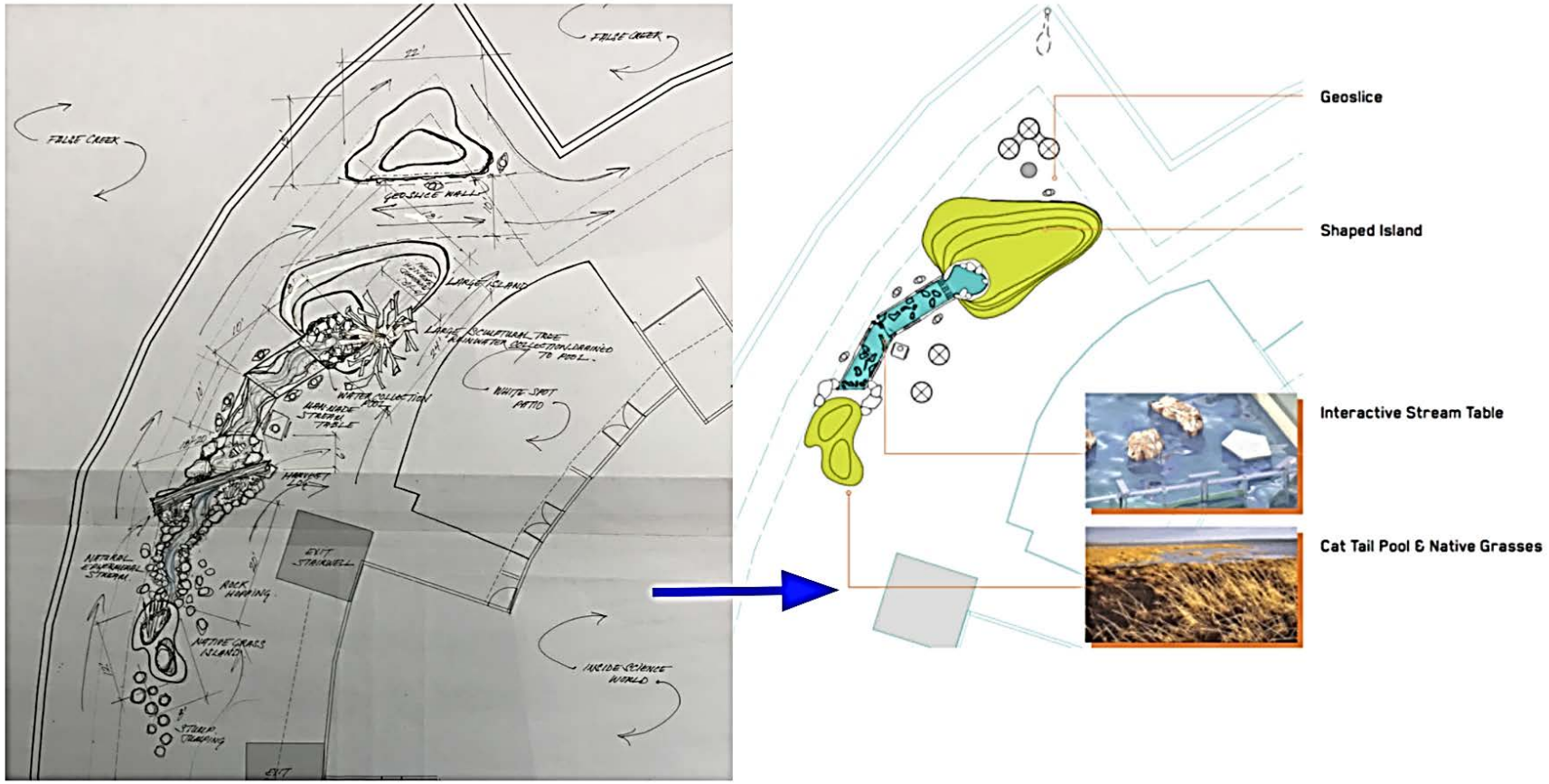

Figure 33: Initial sketches made in June 2009 were refined by December 2009 (Science World, 2009b)
Reprinted with permission by Science World and Jodie Braaten.

The exhibits were scaled back (Figure 33), according to JB, largely due to budget:

> JB: The way it ended up was time and money getting shrunk down the whole way. The original plan was way too ambitious, with a lot more interactivity. [We needed] to reflect upon what we're good at. In the end, it was such a blur…such a strong tempo just trying to get it done.

Choices as to which aspects of the exhibits were most important to retain were essential to the evolution of the TDET design. Scale is, after all, very much related to the client's ability to pay (Lynch, 1962). The ambitious aims of these exhibit designs needed to be managed within the $500,000 budget set by the creative brief.

4.4.4. Exhibit Production/Construction

Further concept development and design of the TDET exhibits continued from March through September 2009, leading to the "Fabrication Specs" stage shown in Figure 31. By December 2009, the three exhibits on the Expo deck were renamed the "SWITCH: Outdoor Science Experience". Interviewees 3 and 4, both part of the team, describe the process:

> Interviewee 3: It was a new area for us, we had not been designing things for outdoors. Some with the original team of Science Park, that was their first time building things outdoors. It was a very different beast. Costs are much higher, and you've got to weather-protect like crazy.

> Interviewee 4: [For the 3-exhibit deck], It turns out that the development of the content, the team, and the scope of the project was small. You get a sense of the kinds of signs we want or need, we develop a budget for it, some graphics with stretched content, and then basically [Interviewee 3] reviewed it and finalized it.

The Science World team of six thus refined the OSE concepts into tangible human-scale experiences, and then designs detailed for fabrication. The Waterways example is shown below.

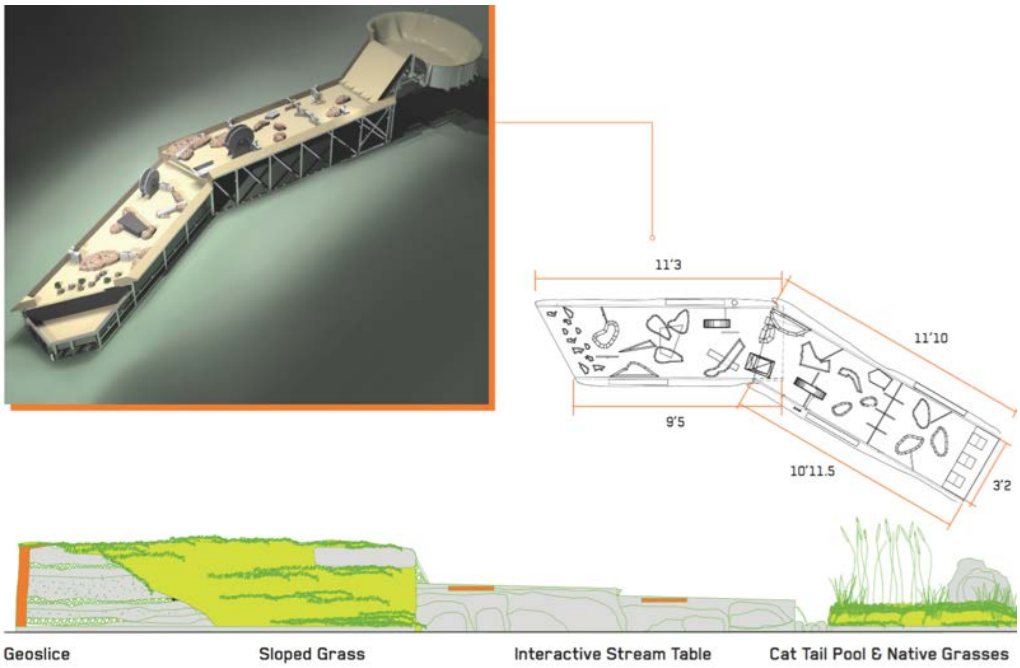

Figure 34: A part of Waterways exhibit, the Ephemeral Stream exhibit refined to an executable product
Reprinted with permission by Science World

A Science World exhibit designer describes the fabrication process:

> JB: Our exhibits are primarily designed by us [at Science World] but when it comes time to fabricate there are a few different ways we go about it: (a) design and build in-house, (b) design internally, hire an external contractor to fabricate it, or (c) purchase an exhibit and augment it to suit our needs.

An important shift in the design process is here underway, from tests conducted with the City of Vancouver and TD Bank to those conducted by the contractors themselves. A total of three contractors worked on the Waterway exhibit. The first, *Tom Egan – Artist with Water* from Salina, Kansas, constructed the ephemeral stream using a stainless-steel tube and frames. The second, *3DS Interactive Exhibits* from Vancouver, BC, created the artificial mounds and subcontracted *Wavestone Sculpture* also from Vancouver, BC to work with the rocks used to create the Geoslice. The Science World team worked with the external contractor to shrink the design into size, selecting the elements obtainable within budget. In Figure 35 below, we can see how significantly the "Choices" exhibit changed from conception to execution:

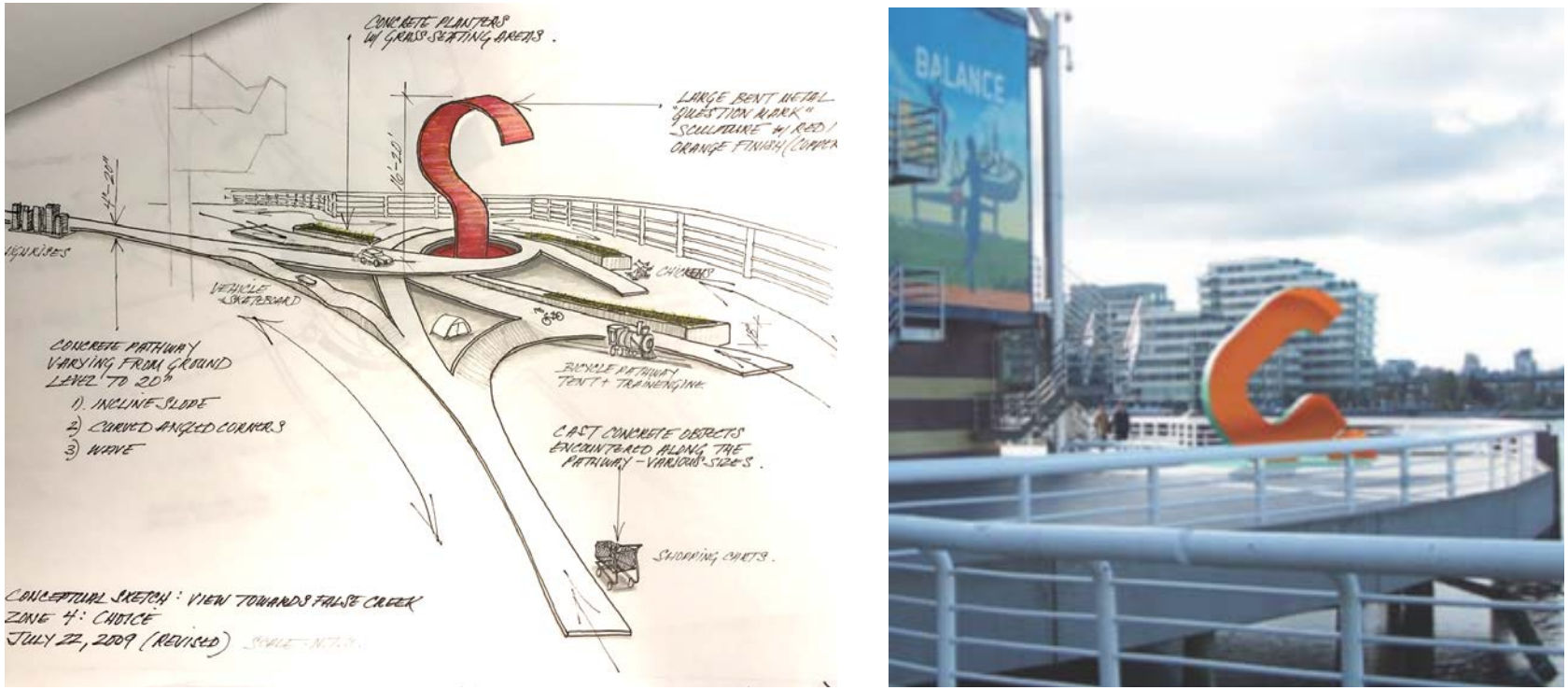

Figure 35: Initial design conception of "Choices" exhibit by JB, created July, 2009, then greatly simplified by December, 2010; by Interviewee 4. Source: Science World, 2009

Reprinted with permission by Jodie Braaten & Science World

> JB on conception of the "Choices" exhibit**:** The thought was to develop a road system that you would walk along and encounter situations along the journey (transportation theme). Pockets of green space would be incorporated to invite people to sit. Amongst this road system there was going to be a big question mark, acting as a sculptural landmark. This was to pose a large question, make people stop and consider their choices more closely. The thought of adding grass and light was to make it a more attractive space so people would stay longer. In the end, the final outcome always comes down to budget.
>
> Interviewee 4 on execution of Choices: The design, the form-factor of the question mark, people sitting on it, that was the intent. Let's keep it very simple, let's make a question mark that people can sit on. And be happy that people use it. That's all I wanted. I did the sign for that as well.

This process reflects the multi-scaled nature of exhibit design, whereby 3D exhibits intertwine with 2D interpretive posters. JB explains its conceptual design; Interviewee 4, its movement toward an executable design under budget. The initial conceptual sketch from July 22, 2009 is indeed significantly reduced, to a simple question mark, by the fabrication stage in December 12, 2009. [64]

The initial concept for Choices aligns with the "Take Home Message" stating "Choices that humans have made historically have altered and continue to alter this natural landscape" in Figure 31 earlier. It reminds us that "Choices can be made in a manner less intrusive to the environment", "Endless choices lie before us, yet to be made". To recreate the choice-making experience, the concept sketches a convergence of paths to form crossroads where the public can make "choices as to which junction they take when the road splits" (Science World, 2009b). The theme of choices represented as the physical elements of a crossroad was refined into a symbolic question mark accompanied by a poster[65], open to interpretation by those who pass by.

At the beginning of 2010, some of the exhibits, such as Choices, were being prepared for execution by selected contractors. While their scheduled time of completion was April 2010, however, some (e.g., Waterways) were not finalized until July 2012 (Wavestone Sculpture, 2012).[66]

---

[64] The Choices exhibit continued its design cycle with a local shop *MetalMart* in Langley, BC.

[65] The resulting poster explains how we can make the right choices when it comes to sustainability, by for example, recycling rather than simply throwing something in the trash.

[66] There is a gap in available research as to when the other two deck exhibits (Choices and Garbozilla/ music chimes) were installed. It could have been 2011.

> JB: The development of the first phase of the [TDET] was started before the renovation to the building and the addition of the Science Park had begun. It was completed later because some of the staff and resources were reassigned to the renovation and that part of the deck was affected by the building renovation. TD was added after the fact, when they hopped on board as a donor.

The installation of these TDET exhibits, then entitled "SWITCH", needed to coordinate with the 2010 renovation of the Science World building and so were stalled. But these 'Phase 1' exhibits represented minimal risk to the City of Vancouver: sustainability themed exhibits accessible to the public and removable in emergencies. Science World was clearly willing to invest in, and develop, exhibits within the public realm, not only for their semi-private science park. This built a consensus with the City of Vancouver and opened up possibilities for a larger OSE Science Park.

4.5. Science Park Interface (2010)

In 2010, while the internal Science World design team was in the execution stage of its Phase 1 exhibits (Section 4.4), higher level discussions continued between the City, PFS Studio and Science World. The PFS team was responsible for project management of construction of the remaining half of the Environmental Trail.[67] Negotiations in the workshops of 2007 to 2009 involved attempts (a) to integrate the proposed form of the semi-private science park with the False Creek renewal, and (b) to develop ways in which the resulting project could enhance the public area of Creekside Park, including provisions of learning experiences. During 2009 to 2010, as Science World was developing the three deck exhibits, PFS worked with Science World's executives to present an acceptable form to the City. This section details the evolving design of the fare-paying science park interface and how its boundary led to the second half of the TDET.

[67] NM explains that PFS would focus on this second portion of the TDET: "the portion of the Environmental Trail that we were closely involved in was immediately adjacent to the Science Park, however that's not where it stopped [3-exhibit deck]".

4.5.1. Olympic era

While the execution of the OSE Phase 1 exhibits was underway (Section 4.4), Vancouver again found itself on the world stage, with the 2010 Winter Olympics. The first phase of Southeast False Creek (SEFC; Appendix C.4) was selected as the athletes' "Olympic Village", lodging all athletes taking part in the Games between February 14 and 28, 2010. PFS Studio, responsible for design of half of the TDET, was appointed by the City to design and execute the Olympic Village plaza at the heart of the new SEFC development in 2008-2009 (PFS Studio, 2014).[68] The site of Science World became a prominent hub during the games, "transformed into the Russky Dome, which introduced plans for the 2014 Winter Olympics, to be held in Sochi, Russia" (Luxton & Associates, 2010, p. 5). A temporary Olympic streetcar was installed, with one of its stops at Science World.

Vancouver was celebrating as the rest of the world was watching once again, building on the performance of Expo '86. In the spotlight, livestreamed, for two weeks, "Vancouver was showcased as a walkable, temperate, livable city in a pristine natural setting" (Ryan, 2016). This was intentional. As explained by VanWynsberghe, Derom, and Murer (2012), "Vancouver decided to promote the hosting of the 2010 Games alongside its efforts to become the greenest city in the world. Thus, the Olympic competition resembled the greenest city competition, better known as the Green Capital Global Challenge" (p. 195). The Olympics was a big moment for Vancouver, leaving a post-Olympic glow which brought momentum to the Greenest City Action Plan launched in 2010.[69] The city's newly elected mayor, Gregor Robertson of Vision Vancouver, stated: "We are the greenest city in North America, and want to be the greenest city in the world by 2020" (Vancouver Sun, 2010).

This "greenest city" strategy is based on a competitive intercity agenda known as "the urban growth machine" (Molotch, 1976) intended to attract global investment. The agenda involved "branding the host city as world-class using a consumption-oriented, image-based,

[68] This demonstrates the working relationship between design teams of the OSE and SEFC, where PFS would bring their landscape architectural skills to assist the City and PWL Partnership in completing the public realm projects.

[69] As stated, "The Greenest City initiative was one of the 50 policies, programmes, projects, curriculums, or laws/bylaws undertaken among the City of Vancouver, Metro Vancouver, Resort Municipality of Whistler, Government of British Columbia (BC), and Government of Canada that was for, the result of, or prompted by, the 2010 Games" (VanWynsberghe, Derom, and Murer 2012, p. 188)

economic development strategy" (VanWynsberghe, Derom, and Murer 2012, p. 189). As stated in the 'Greenest City quick start recommendations' of 2009, the strategy positioned "Vancouver as a place where the world wants to live, work and do business, and supports our role as a Pacific gateway. It also increases our reputation as a tourism destination, creating jobs, and opportunities for residents" (City of Vancouver, 2009a, p. 58). The City's ambitious goals have yet to be fully realized. Nonetheless, their development around the time of 2010 allowed some to align with the themes of the TDET.[70] Appointed City Manager during formation of Vancouver's Greenest City team in 2009, Sadhu Johnston's prior role had been Chicago's Chief Environmental Officer. He became an important player in the TDET design process. His relationship, documented by Science World's CEO,[71] helped to solidify the themes of sustainability in the OSE that had been discussed in the years prior.

The Olympics served as leverage in the development of the Greenest City business brand and enabled the City to make changes that enhanced "its ability to compete internationally in the growing market of economic, environmental, and social sustainability" (VanWynsberghe et al., 2012, p. 201). As a result, the City was able to secure "provincial and federal funding to execute the economic development and branding program that may not have otherwise been available (VanWynsberghe et al., 2012, p. 189). This strategy made funding for the OSE possible "through the availability of federal funding to be matched by the province and Science World" (City of Vancouver, 2010c, p. 7).

Soon after the February Olympic Games, in April 2010, a Statement of Significance (explained in Appendix C.4) for Science World was released. As discussed in Section 4.4, the three exhibits on the Expo deck needed to be integrated into the renovation of Science World

[70] The opening statements in the GCAP2020 point to some underpinnings of sustainability: "Vancouver residents have an ecological footprint three times larger than the Earth can sustain. The decisions we make every day about how we move around the city, what we buy or eat, and how we deal with our waste means that we currently use far more than our fair share of the Earth's resources" (GCAP, 2012, p. 5). Such an understanding of sustainability as implicated in the 'decisions we make everyday' follows the theme of 'Choices'.

[71] BT clearly states: "Another player in [the OSE/TDET design process] is the City Manager, Sadhu Johnston. When he came, because when he came out of Chicago in the mayor's office, he was responsible for sustainability… although I don't say he made life working with City Hall 100% better, he was more responsive to what we were trying to do."

facilities. The goal of these renovations was to preserve the elements of the geodesic dome installed for Expo '86:

> The TELUS World of Science building is valued as one of only four permanent legacy buildings constructed for Expo '86. The building remains one of the significant physical legacies of the World's Fair, one of the largest international events in the history of Vancouver. (Luxton & Associates, 2010, p. 3)

This statement underscores the reasons for preservation of the geodesic dome, a "permanent legacy building". It seems to contradict earlier descriptions of the dome as designed for a temporary world fair, but it was designated to be a permanent landmark in a 2010 multilevel governmental Statement of Significance. Cannon Design's recommendations for building renovations are described below:

> The proposal is to upgrade the interior and exterior of the existing Science World cultural/educational facility, and add to the first and second levels at the western portion of the podium fronting False Creek. A new main entry lobby connected with an extended weather protection canopy system and… rehabilitation of the exterior façade is proposed; however, the iconic geodesic dome will not be altered (Luxton & Associates, 2010, p. 4).

The proposed canopy structure over the new main entrance to Science World was then integrated, via larger discussions of facility upgrades, into its vision for the outdoor science park. And as with Vancouver's Greenest City, Science World also used the Olympics as leverage point. As NM explains "It was the Olympics legacy rather than the Olympics themselves that helped the OSE budget move forward".

Funding support from the Provincial and Federal governments was given in 2010 through a Statement of Significance, initiating the renovation of Science World facilities. Some funding was also allocated for the OSE (Science World, 2010/2011). Details of how such funding was received and managed were not found in project documentation, but was pointed to in interviews.[72] Another important source of funding for the OSE was Ken Spencer, who had been a member of Science World's Board of Directors since 2001.

[72] Interviewee 4: "Basically, they had raised roughly around $4.5 million , partly from Ken Spencer, the provincial government and the federal government. That's basically when they gave the go ahead to say that ok, we're building this park".

> BT: Ken grew up in East Van and is a self-made man, and [between 2009 and 2010] he said he would like to create something, leave something behind. But he didn't say what. So we had to pitch to him… In terms of visibility, we had to sell him on why an outdoor science park. … It was the next [project] up on our list and we needed some substantial money. My recollection was that he gave a million towards the OSE.

Indeed, the Ken Spencer donation was officially announced in the summer of 2010, although at an unspecified date (Eagland, 2017). This was not a spur of the moment decision, however, as BT explains. Mr. Spencer had been present at evolving presentations ("tests") of the OSE. While TD was still in discussion with Science World about a donation of $500,000 for the three exhibits, Ken Spencer put a million dollars toward creation of the semi-private science park. Along with provincial and federal funding, the 2010 budget for the Outdoor Science Experience was, in the end, $4.5 million.

Figure 36 below illustrates how conditions conducive to action amongst the various players generated momentum for the Environmental Trail design process. Particularly important are the blue arrows marking "inter-organization connections". Starting with (a) the Olympics, we can see that the SEFC Olympic Village design team included PFS Studio in 2008-2010. With (b) the Greenest City Action Plan, the CEO of Science World and the City Manager were noted to have established a more effective working relationship. The (c) Statement of Significance generated funding from Ken Spencer, and the federal and provincial governments.

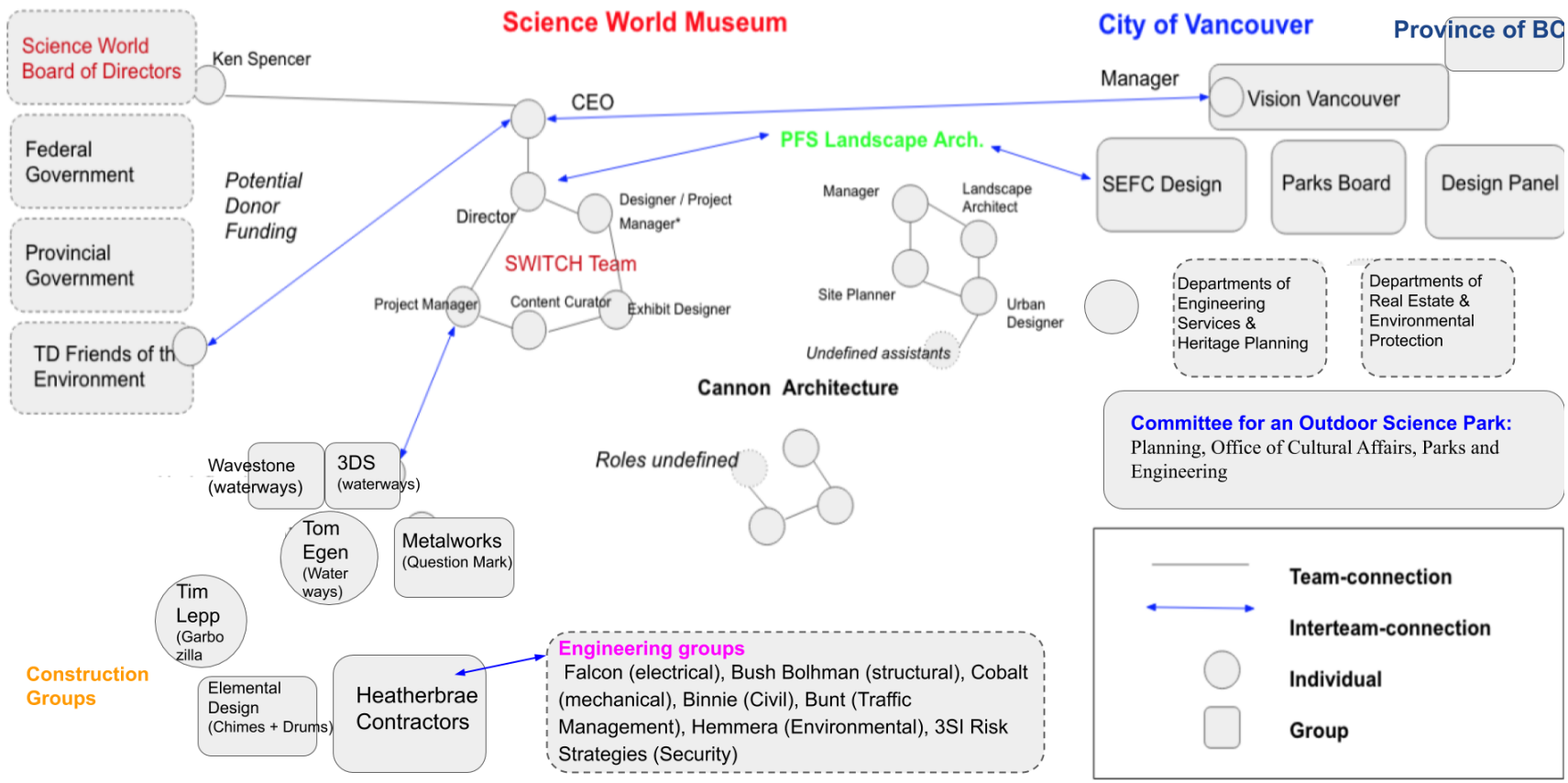

Figure 36: Socio-political map of TDET design process between 2010-2013, showing the actors and organizations evidenced by this research. Arrows mark connections made between the various organisations. The KSSP team from Science World is not present here

Source: Luc Bagnérès based on William Whyte's Street Corner Society (1943) diagrams of urban social groups

The PFS project manager describes[73] how conducive economic and political conditions led to the renovation of Science World facilities. PFS worked with Cannon architects on the renovations, "giving life" to the OSE's fare-paying Science Park design process. This supports Lynch's (1962) explanation of the importance of the design programming stage:

> This [design] program springs from the primary objectives and is influenced by site character, states the quantity, the budgeted cost, and to some extent the quality…Not even a sketch program can be prepared before basic objectives are clarified and before there is some idea of ability to pay, and of the limitations imposed by site. (p. 25)

Indeed, design programming marks one of the most important stages in the design process, moving from the conceptual to the concrete, in this case, with a significant budget of $4.5M and detailed objectives (Guiding Principles, 2007).

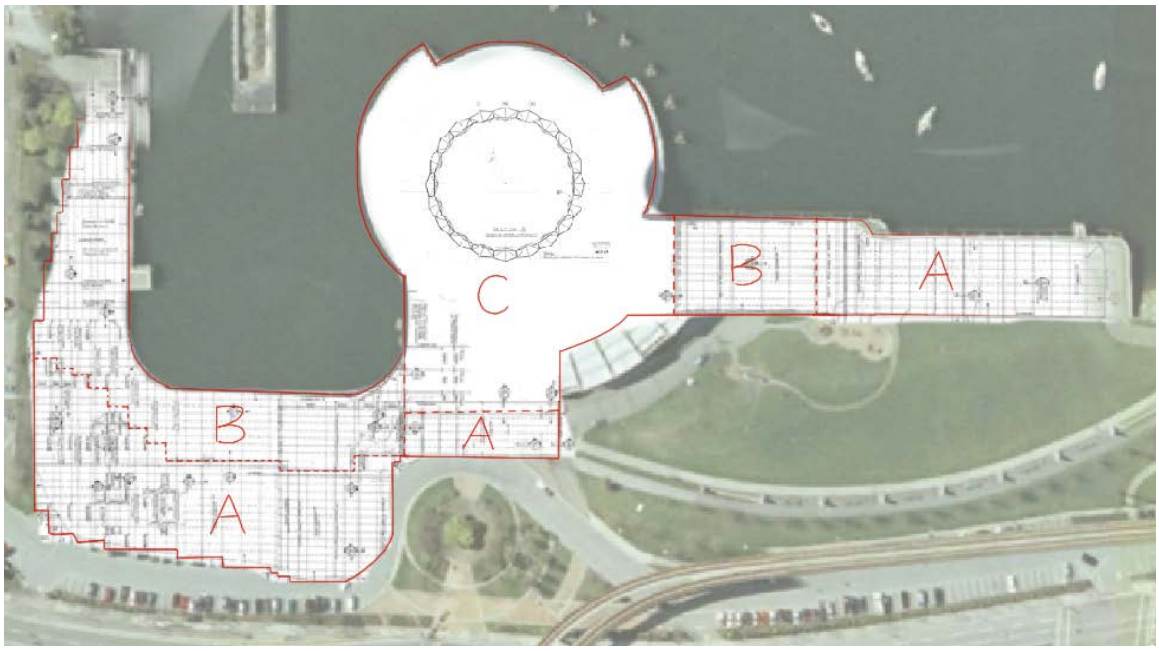

Figure 37: Boundaries of the original 1985 Expo deck shown superimposed on the 2009 site of Creekside Park
Source: Luc Bagnérès rendering superimposed Expo deck plans

[73] NM: "Cannon Design was brought on to do the work on the building. We [PFS Landscape Architects] joined the team, so we were supporting Cannon design on what they were doing on the building with the roof deck and all of that. And then the outdoor science park was given life basically, and became quite serious. They had a donor, they had funds, and they wanted to do it and there was political will on all sides to see it through. So then PFS took the lead as far as that [outdoor] portion was concerned, working with the rest of the team and Cannon design. So there was a bit of a dual relationship happening."

The limitations of the site included those of the Expo deck. As Figure 37 shows, the Expo deck, represented in white, imposed a complex set of limits (or 'limitations of the site', in Lynch's sense). These are marked Type A, B, and C, each with a different set of load-bearing constraints. NM explains how the deck was a determining factor as to where certain TDET exhibits could be placed, since their weight could not be supported at boundary of deck segments A and C. Finding an acceptable location for the science park was therefore challenging. The deck's position influenced the boundaries of the park and served as a "showstopper with the City".[74] While some conducive conditions existed, the science park remained an idea yet to find a fully acceptable location.

4.5.2. Acceptable location

The 2008 shoreline renewal scenarios generated by PWL Partnership, which included removal of the deck, fell through after the Olympics. This significant reimagining of the False Creek shoreline marks a stage where City plans for its renewal and stream daylighting are attempted, but not realized, due to lack of funding.[75] With no immediate funding in sight from the provincial government, the City needed to plan for the Expo Deck's removal at some point in the coming decades. On May 3, 2010, the release of the Facility Renewal Document outlining the City's long-term plan for the area (Figure 38) set the stage for integration of the OSE (and subsequently the TDET) into the longer-term planning and design of False Creek[76].

[74] As NM describes, "the main showstopper would have been the nature of where [the Science Park] would be located just allowing us to have this outdoor component".

[75] As the Facility Renewal Report (2010a) states: "Although the decking replacement project was not selected for capital funding, the project advanced the design thinking for the future for both the park and the intention to remove rather than replace the decking in the longer term." (Appendix E ,p. 5). Scot Hein explains how a budget had been allocated by the City to replace the entire deck but it ended up not being a viable expenditure. Interviewee 7 from City of Vancouver further support this stating "there was a plan originally a 15-year plan to bring this back to the original shoreline." (Correspondence, May 2019). Even in the absence of funding, there were still many plans for East False Creek, as shown in Appendix D.

[76] This would allow for deck "replacement with fill and a foreshore treatment that enhances public access to the water" (City of Vancouver, 2010a, Appendix E, p.5)

Integration into the False Creek Waterfront Longer Term Concept Plan

In order to ensure that any work undertaken around Science World will be readily integrated into the urban design of the end of False Creek, a longer term concept has been developed that illustrates:

- The continuation of the Seawalk from the already built section in Southeast False Creek; this extension is planned for completion when the Expo deck is removed south of Science World
- The removal of the Expo deck to the south and north of Science World and its replacement with fill and a foreshore treatment that enhances public access to the water
- The removal of the south parking lot to make room for the planned Downtown Streetcar as well as a station at Science World serving tracks in both directions
- The eventual relocation of the Seawalk to the north on fill in a new alignment near the waterfront.

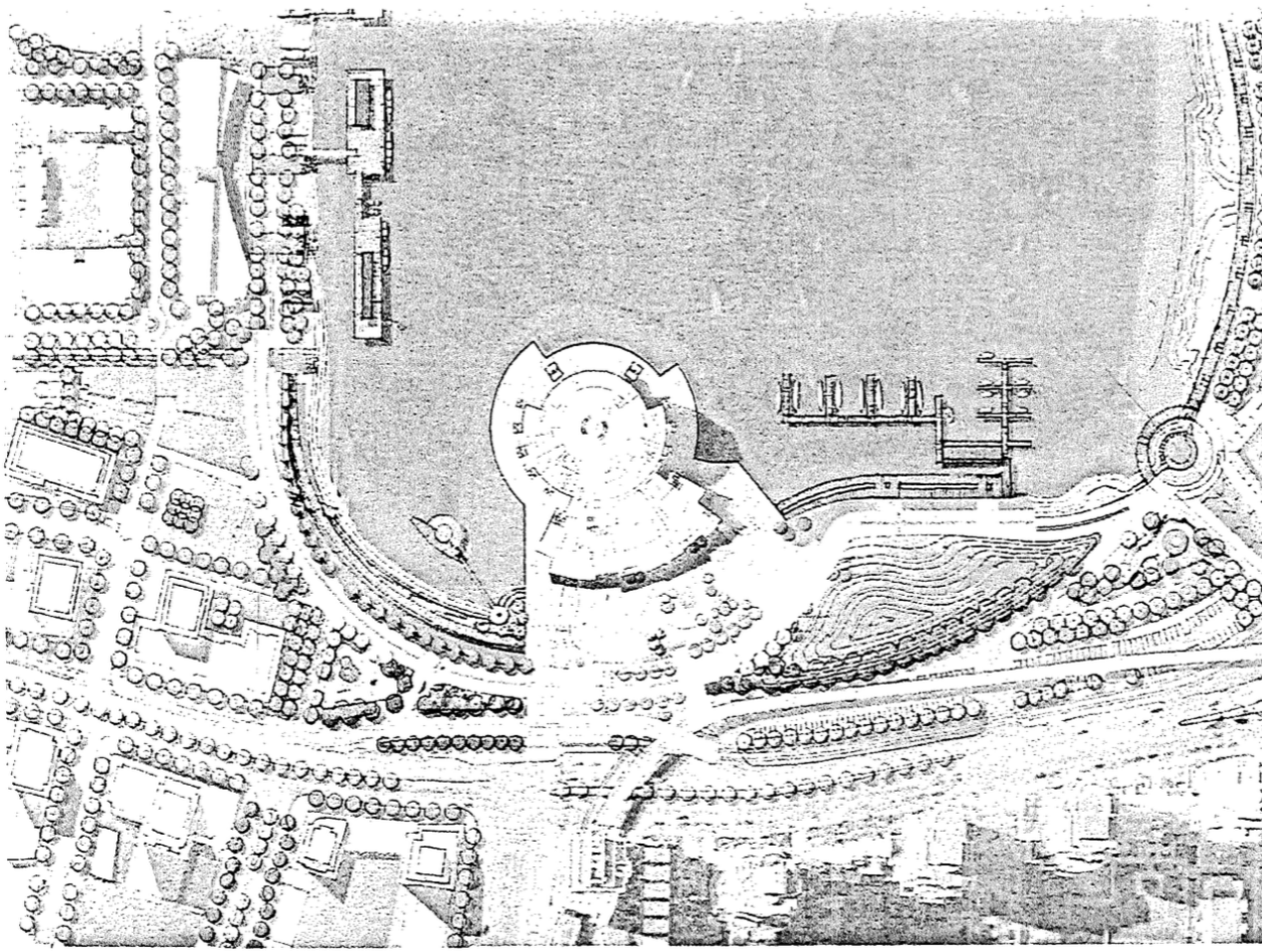

Figure 38: Long-term concept plan, integrating the Outdoor Science Experience with shoreline renewal
Source: Facility Renewal Report, 2010 reprinted with permission by the City of Vancouver

While the OSE integration into the long-term plan suggests that a compromise had been reached, the City's Facility Renewal report still saw the science park as a proposal. That it was part of the larger plan (Figure 38) shows that the City was interested in a compromise, but more refinement was needed. As stated by NM: "When the city became engaged, it was very good, because then we started chipping away at different potential issues that we could see, and dealing with them one at a time." One of these issues, as discussed above was the public-private interface:

> NM: In terms of private and public interface...that was one of the things the city was very interested in. A big chunk of their hesitation, as part of the process…was that this was going to be added to leased land… it's out of the public domain. [There] was a big discussion on how this is going to fit in a public environment.

The semi-private Science Park thus finally found its fitness with Creekside Park, through the evolving notion of an interface, consolidated in 2011 into the Environmental Trail. A compromise with the city needed to involve some kind of sustainability-focused learning environment (Dewey, 1938/1998; Falk, 2003; Gislason, 2007) within the park's fully public space.

The project mandate of the Science World facility renovations had three overriding objectives: the fulfilling of (a) functional needs, (b) aspirational goals, and (c) sustainable designs. Within each were goals related to creation of the OSE.[77] These were an update of the three purposes originally laid out for the OSE (described in Section 4.2.5) by Science World's CEO. Presentations of the OSE can be found as an appendix in the Facility Renewal document.

[77] As stated "1) Expand the public space available to accommodate growing attendance. 2) Provide a new, innovative, and inviting public face that outwardly expresses the mission and personality of the institution. Develop the OSE and directly engage in the topics of sustainability while expanding the Science World experience for visitors and the general public. 3) Provide a showcase of sustainable design and technology as well a living laboratory for new and existing sustainable products" (City of Vancouver 2010a, Appendix E, p.2).

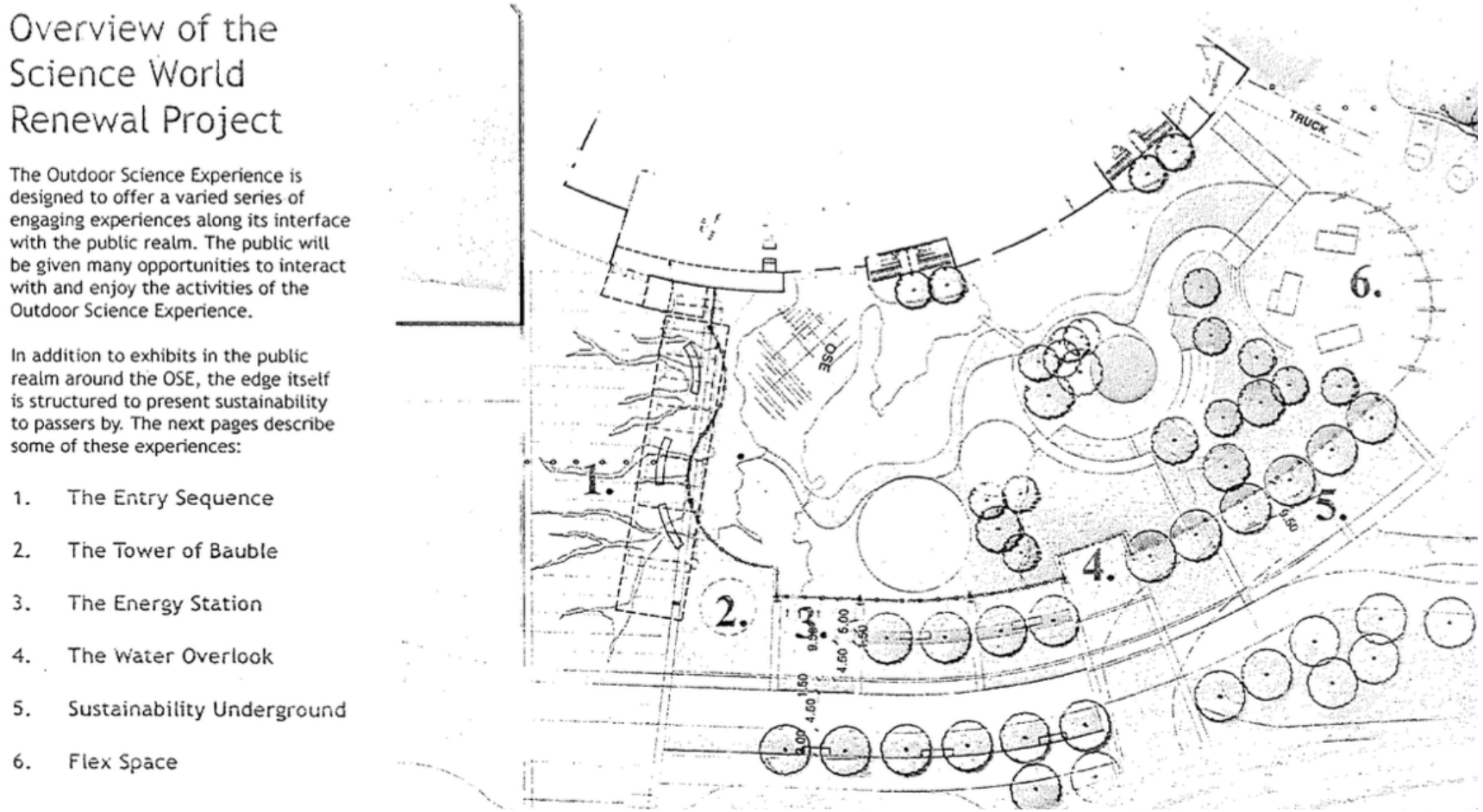

Figure 39: First refinement of the exhibits on the Science Park interface
Source: Facility Renewal Report, 2010 p. 14. Reprinted with permission by the City of Vancouver

Determining the shape of the OSE was a process guided by principles established in 2007: “improving the aesthetic interface between different paths” and “generating a positive experience for all users of the public realm” (City of Vancouver, 2010a, Appendix E, p.5). As seen in Figure 39 above:

> NM: The shape of it was really a factor of the various contextual elements and the aesthetic. You’re working with the shape of the building and all the movements around it, and always in both cases this entry sequence was a prominent feature. Some form of arrival experience, and weather protection [had to be built in].

The final shape indeed (a) echoed the shape of the building, and (b) emphasized an entry sequence aligning pathways and the Tower of Bauble with Terminal Avenue’s axis and pedestrian and cycling paths. NM described how the park shape accentuated the “swooping” shape of the bike and pedestrian paths finding alignment with the paths of Olympic Village. One aspect of the form, the shape of the park itself, and the larger design of the seawall pathways were therefore interrelated:

> Designers may find it more efficient to examine very large, very small and then very large questions than to progress linearly either from large to small or from small to large questions. Urban design decisions about street width may be followed by decisions about street hardware, which in turn are followed by decisions about the modes of transportation the streets will allow. (Zeisel (1984, p. 15).

Recognizing the practical necessity of a non-linear process designers use to resolve the various elements of a form, this chapter will, nevertheless, continue to present a vastly simplified account of the complex evolution of the OSE, focusing on the second half of the TDET’s design. For example, street hardware and transportation path configurations within the OSE will be touched upon only as they relate to the TDET.

4.5.3. Evolution of the Edge

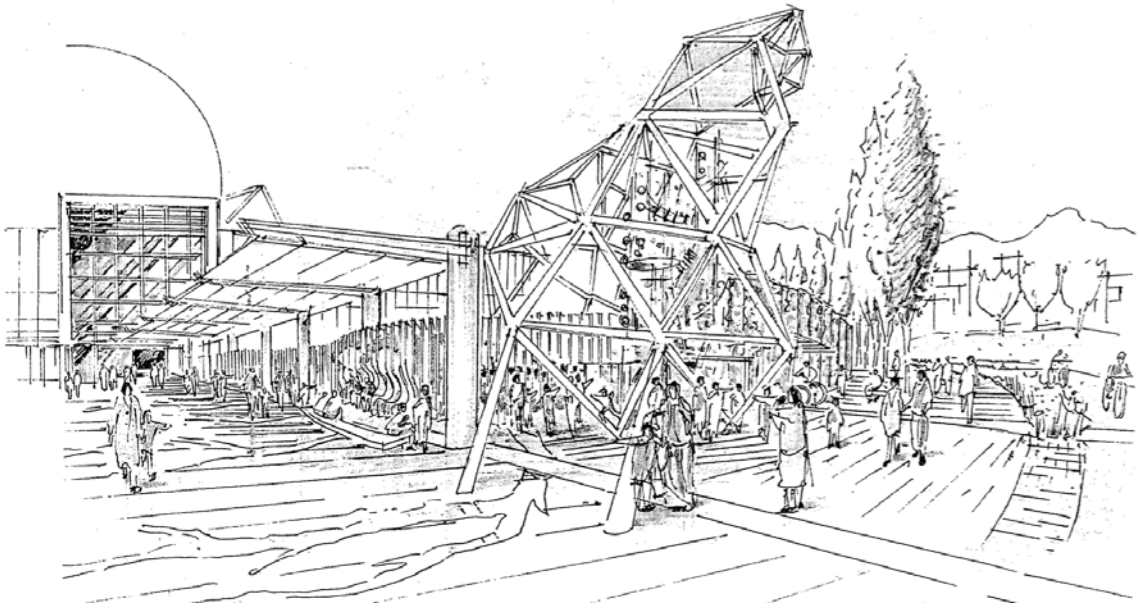

Figure 40: Presentation of the Tower of Bauble in a prominent feature within a new plaza
Source : Development Board Permit, May 2010 reprinted with permission by the City of Vancouver

Figure 40 shows the Entry Sequence and the Tower of Bauble. The entrance is clear and direct, typical of many "frontal" approaches (Ching, 1979). The large trapezoidal structure is designed to contain the existing Tower of Bauble exhibit, described initially in section 4.3. This serves as the "incident" (Cullen, 1961), placed to attract activity to the new public plaza. An initial design for the new physical canopy structure supports a solar-powered system meant to run the exhibit (City of Vancouver, 2010a). Experience (3) in the Overview (Figure 39), the Energy Station, iterates the sustainability theme: "Just North of the Tower of Bauble will be the Energy Station… A bike-themed exhibit will be offered free to the public, where they will have the opportunity to use bike-power to activate an exhibit or learn more about the efficiency of bikes in general" (City of Vancouver, 2010a, p. 9). Following this was to be (4) the Water Overlook (Figure 41) which subsequently gave rise to the concept of a wetland. The artificial wetland then facilitated a conceptual shift in the edge design. The barrier created by a marshland forms a natural edge. At the same time the water's edge would create an interface between public and private; a porosity allowing for members of the public to "visually enter" the Ken Spencer Science Park:

NM: "[The Marshland] creates a barrier without being a barrier, so this notion of a deck on a marsh means that deck could now have a normal old guard rail. We didn't need to fence it because the marsh is now that separation.

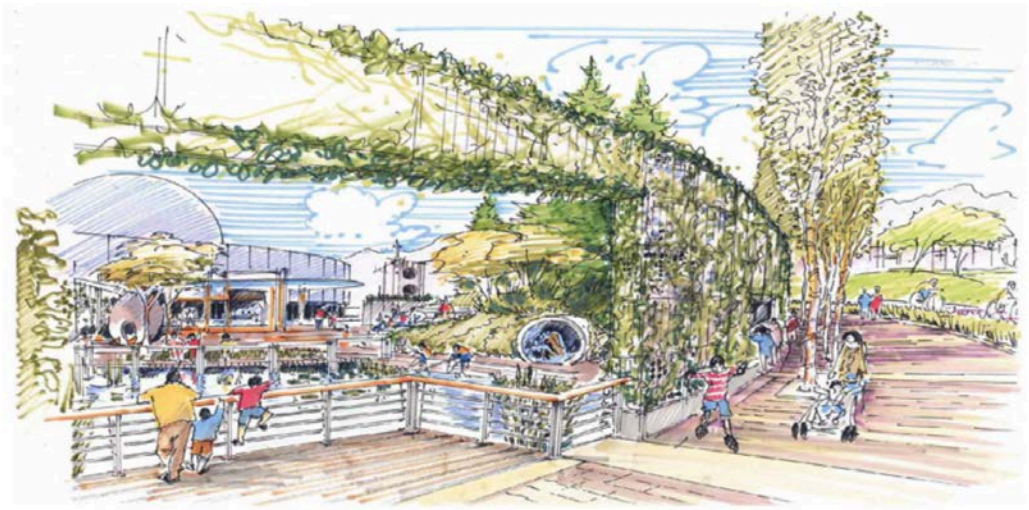

Figure 41: The Wetland exhibit, in its initial conception as the 'Public Overlook' along the edge of the Science Park, the second of two emerging learning environment typologies
Source: Development Permit, 2010 reprinted with permission by the City of Vancouver

This natural barrier is an example of Cullen's (1961) hazard. And this opened up other conceptual shifts in the design. The open sight lines into the Science Park led to the strategic placement of an outdoor stage:

Interviewee 4: The whole idea of making a wetland came from PFS. What if we broke up this fence line with a more natural barrier? That's why we pitched the stage there, because there's this opportunity to not only do outdoor demonstrations for the [fare-paying] visitors but also the public as well.

NM: The stage … had to do with the negotiations with the City and making this as publicly accessible as possible, although it's a fare-paying zone so to speak. So the decision was to put that stage in a manner so that if it faces the outside, and then this deck looks over the stage. There are speakers that basically amplify what's happening on the stage, and you can actually follow what's happening there.

This demonstrates how a series of conceptual shifts by PFS Studio brought design of the public and private interface to an acceptable response (Zeisel, 1984). A semi-public zone was initially conceived through the idea of a sliding gate creating a temporary fence. This led to another conceptual shift; the creation of a wetland provided a softer, lower boundary than would a fence. A final shift was made when the wetland boundary was seen to allow views of Science Park's interior and its stage if properly positioned (Figure 42). Positioning was negotiated by the City and Science World so that loudspeakers would allow public access to the events happening onstage. In its inclusion in the TDET, the wetland reflects a clear understanding of the Trail's historical context, alluding to those of False Creek's pre-twentieth century condition (Appendix C.1).

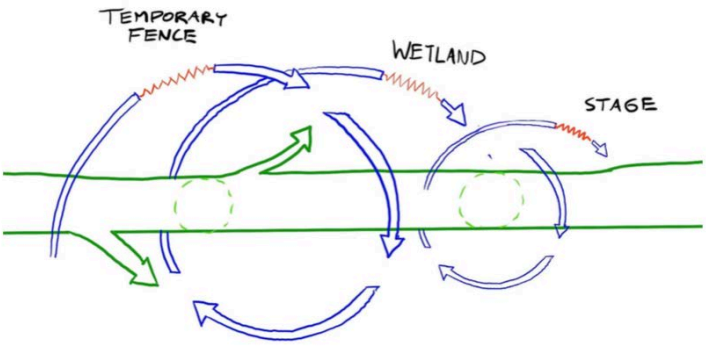

Figure 42: Image-present-test cycles with conceptual shifts bringing design closer to an acceptable response (green)
Source: Luc Bagnérès

As mentioned, the wetland's design skillfully used Cullen's (1961) concept of hazard: "The railing, water, planting, and change of levels. All these hazards permit visual access whilst denying physical access" (p. 56). Another form of hazard is (5) Sustainability underground, an OSE feature never created, which imagined a large landscape mound. In addition to creating a boundary between fare-paying and public space, it had three functions:

> It introduce[d] an area of green landscape to visually link two green spaces, provide[d] a sloping site for tiered seating for an informal amphitheater for science demonstrations, provide[d] an underground space of pipes and tunnels that children… [would] explore as they learn[ed] about sustainable choices....affecting the underground infrastructure of the city (City of Vancouver, 2010a, Appendix E, p. 12).

This system of underground tunnels could be peered into by members of the public. The exhibit was not deemed feasible for unknown reasons.

To recapitulate, the boundary of the science park was reimagined as an interface that allowed the TDET to emerge. The creation of transitional zones, neither public nor private, point to Ford's (2012) continuum. One was the Water Overlook, another, the Flex Zone. These kinds of semi-public zones, incorporating temporary fences that could open into public space, were being proposed to reconcile interests. The Flex zone would offer "experiences that change weekly to monthly" for both the public and visitors of Science World. While it was important to provide these flexible fences, the materiality of the fences was just as important.

The Facility Renewal Report proposed that the OSE implement three types of barrier/fence: 2.4 m high fence, 3 m high Green-screen; and 2.4 m Opening-Fence (temporary fence). NM describes two factors in the variety of these fence types, key components in "softening" the edge between public and private:

> (a) The utter transparency of that edge, as transparent as you can get while being secure; an aperture to see inside. (b) Being completely open, with sliding gates, with the deck. You're practically inside the park, that's the kind of notion that we were bringing to the table. Let's find a way of bringing people inside the park while they're still on the outside.

In terms of transparency, an aperture is explained as an "opening" to a view that would expose the inside of the park to the public realm, hence the need for transparency in fence design. The sliding gates led to the conceptual shift of the wetland, allowing the public to have a view onto the science stage. Working with these qualities along the fence line became a way to find fitness between the form of the science park and Creekside park. At this point, in 2010, the TDET exhibits were being defined along the edge by PFS, but were not yet tied to Science World's "Phase 1" exhibits on the Expo deck (Section 4.4). They were still being imagined as separate projects.

4.5.4. City of Vancouver Development Process (June, 2010)

As a construction project, the OSE with the TDET required a permit.[78] The OSE, as discussed in Section 4.7.1, was itself tied, as a proposal, to the renovation of the Science World

[78] The City of Vancouver requires a development permit to "undertake construction, renovation or change the use of a building or part of building" (City of Vancouver, n.d).

building.[79] Looking to receive their development permit, the Science World team, on June 29, attended the first of two development board reviews, during which they were indeed granted a permit for the museum's building renovations. The OSE was mentioned in the permit application, but not included in the permit itself:

> REQUEST: A related, adjacent and secured interpretive and interactive open space known as the Outdoor Science Experience (OSE) will be considered under a separate development permit application at a future date. Any reference in this report to the OSE is provided for information only (City of Vancouver, 2010b p. 4).

Interviewee 7's statement below shows that the City, in this review, was still considering the OSE a proposal, to be phased, later, into the renovation project:

> Interviewee 7: Certainly, when the project was brought forward to us, at a staff level and a team level, I recall that we [the City of Vancouver] knew [about] the whole project. It came down to the idea to break it up, rather than do both at the same time. There was something to do with timing and funding and so they needed to start that interior work to secure funding at some level.

While the development facilitator states that proposal status was related to a funding timeline, it may also have been related to the fact that the OSE was not yet seen as acceptable by the Park Board:

> This application shows an Outdoor Science Experience for reference only. Once submitted as a development permit application, Park Board staff will analyze the OSE proposal for its computability with the existing park and with future park plans. Approval of this current development application does not constitute approval of the OSE. It should be noted that the decision-making process required for the OSE is complex and will require the Park Board to give up a piece of park land. The Park Board will consider such a proposal only if it can be demonstrated that its significant public benefits outweigh the loss of park land. A thorough public discussion of this idea is needed (City of Vancouver, 2010b, p. 10).

For the Park Board (VBPR), the exhibits shown in section 4.5.3 were not deemed sufficient for approval. The public amenities, including exhibits, pathways, and landscaping did not outweigh the proposed privatization of land for a science park. This shows how variable the City department responses can be, and the problems that can be raised by each, all of which have

[79] The Facility Renewal Report dated May 2010, including the OSE, was inserted as an appendix to Science World's building renovation application (City of Vancouver, 2010a).

to be addressed. Following the June 2010 development review, members of PFS and Science World began to work out the "kinks" in the OSE design:

> NM: There's a lot of legwork that happens before we go to the city with an application. We meet with them multiple times, to get feedback, to get the kinks out, the major showstoppers out. And then when you take the application in, it becomes just a process.

Indeed, prior to submission of the actual OSE development application, Science World and PFS held an open house to engage the community in discussions about their plans for the outdoor area of Creekside Park.[80] The open houses of July fifth to eighth gave the public a chance to voice their opinions, thoughts and concerns. Previously, engagement had only been sought with the adjacent Citygate residents.[81] Figures 43 and 44 below show examples of the visual displays, which were refined presentations of earlier rendered plans. Interviewee 7, a City development facilitator for the project, attended the open house:

> Interviewee 7: We invited folks from the surrounding community, [asked] if they wanted to come to the open house and have a walkthrough of Science World, showing boards of what it would look like and what the ultimate goal was. I remember the feedback was fairly positive.

These initial open houses were the first step in the detailing of the OSE's initial development application. As stated by NM, "because they didn't see any back pressure from the public, [the City] started getting comfortable with the notion of an outdoor science park which is privately operated". As mentioned, the encouragement of public feedback then led to a development application for the OSE:

> NM: Up to that point… it was an idea still being shoved around and then we got the go ahead. The city said go on, give us an application. Science World now started engaging a full-on consultant team (with engineers, electricians) and it coincided with their upgrades on the interior of the building.

[80] Three open houses for the OSE took place on July 5th, July 6th and July 8th 2010, in three respective locations: Mount Pleasant Community Center; TELUS World of Science, and the Vancouver Public Library, (Kronbauer, 2010).

[81] Interview correspondence with Interviewee 7 and NM confirmed this.

Figure 43: Top view of second half of the TDET encapsulating the semi-private park
Reprinted with permission by the City of Vancouver

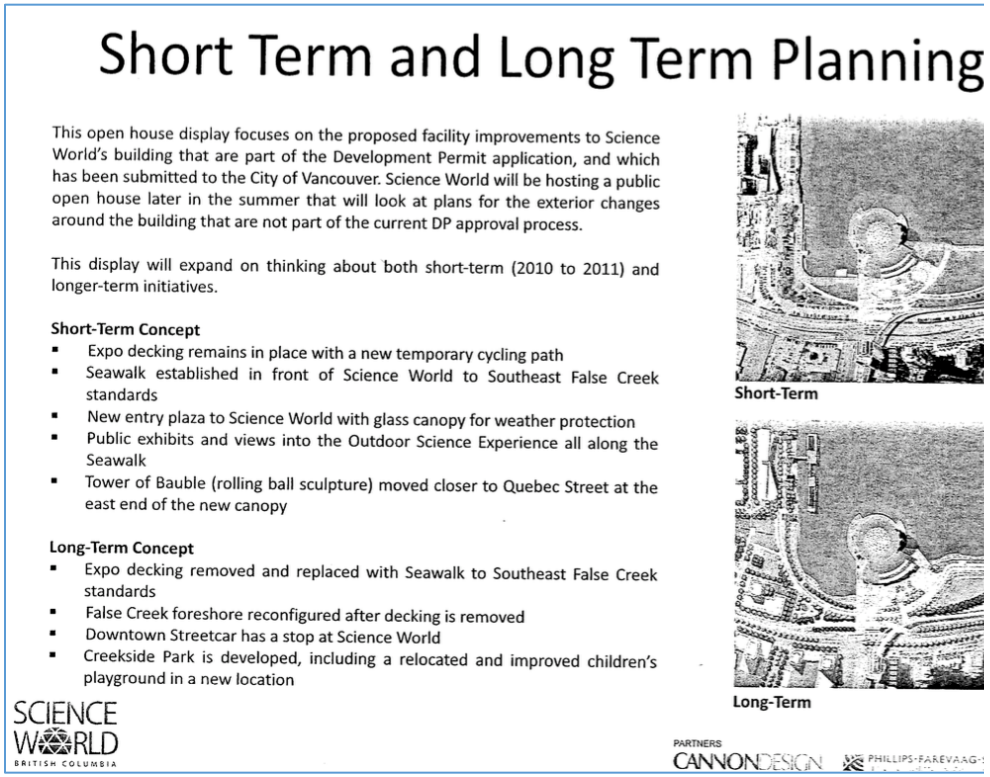

Figure 44: Two Panels by PFS studio iterated for the Open Houses in June 2010
Reprinted with permission by the City of Vancouver

The application was submitted in July 2010 (exact date unknown), soon after the open houses, concluding another stage in the design process.

During the period May to July 2010, the OSE fare-paying park became the puzzle piece needed to complete the jigsaw of the City's longer-term renewal plans: in exchange for approval, the OSE would provide public realm improvements. As stated by Interviewee 4, "you had to find a balance – no we didn't want to really build a bike path, but at the same time, it's not like we want a bad bike path there either, we want to improve the condition [of the surrounding area]". To strike this balance, the design of OSE underwent further refinements. By July 27, an updated plan for the Science World Renewal Project (Figure 45) was prepared. It is here that the name "Environmental Trail" was first used.

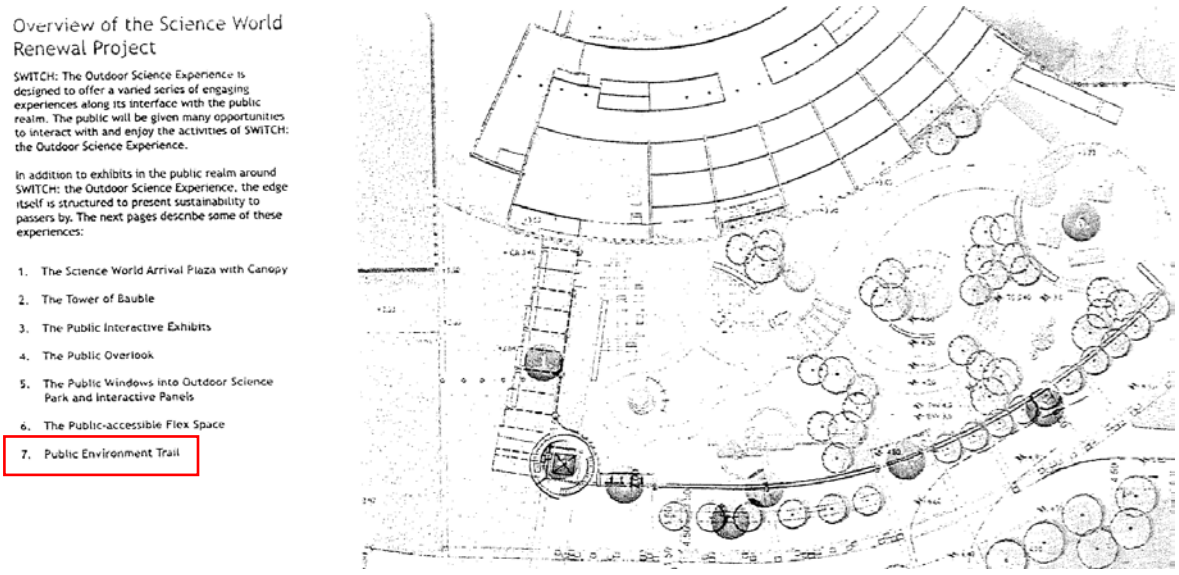

Figure 45: Evolution of Science Park edge in July 2010, where the concept of a 'Public Environmental trail' emerges
Source: City of Vancouver, 2010c reprinted with permission

Number 7 (see red box in Figure 45 above): "Public Environmental trail" shows the first instance of use of the name "TD Environmental Trail". Other "experiences" shown on the plan also found updated names: (1) The "Entry Sequence" became "The Science World Arrival Plaza with Canopy"; (3) The "Energy station" became "The Public Interactive Exhibits"[82]; (4) "The

[82] "A bike-themed exhibit will be offered free to the public, where they will have the opportunity to use bike-power to activate an exhibit or learn more about the efficiency of bikes in general" (Facility Renewal Report, 2010, p. 50).

Water Overlook" became "The Public Overlook"; 5) "Sustainability Underground" became "The Public Windows into the OSE and Interactive Panels"[83]; and (6) The "Flex Zone" became "The Public-Accessible Flex Space". The name changes were clearly carried out by PFS and Science World to reinforce the concept of *public* amenity. Slight changes were also made to the shape of the OSE (Figure 45), explained by NM: "The straight fence gives us a more efficient use of the land and also a better interaction with the canopy. It cleans-up the form; we had other opportunities to express organic forms." Simplifying the form created an even more direct frontal approach, seen now as the "arrival plaza", properly framed.

Two cross-sections of the public pathways and their exhibits are shown below. Comparison of presentations in May and July 2010, shows the Tower of Bauble to have been reduced as an exhibit. But while its encapsulating canopy has been simplified, its solar-powered component has been maintained. The dimensions of the pedestrian routes, bikeways, and trees remained consistent between Figures 46 and 47.

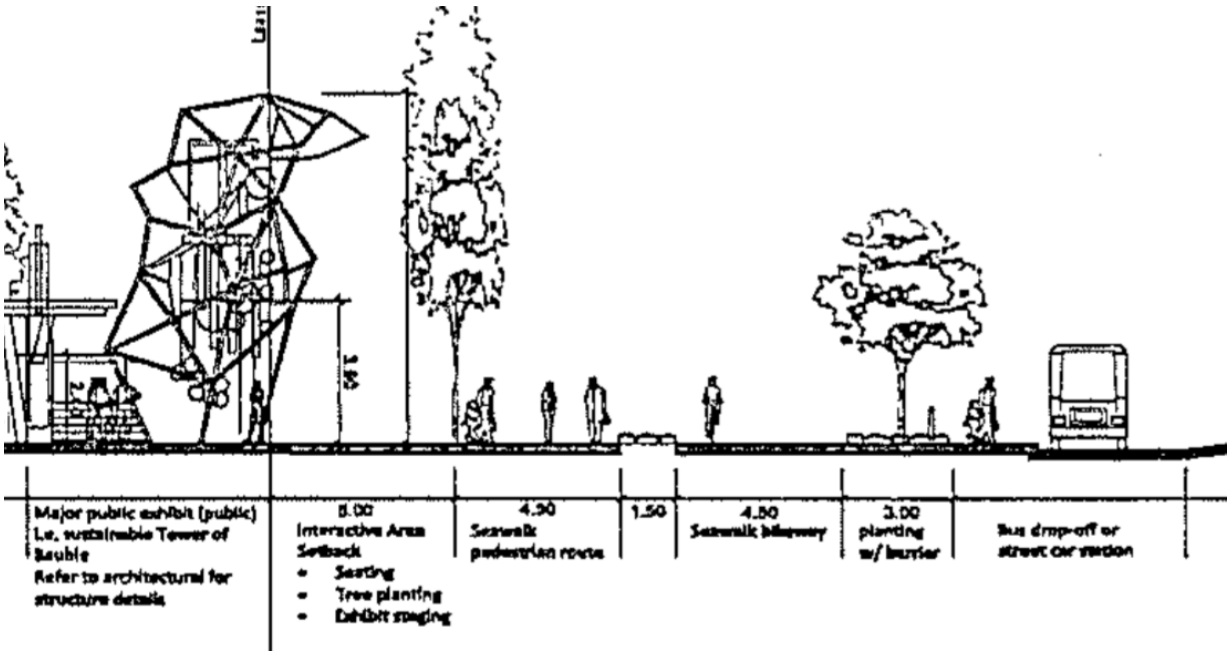

Figure 46:Cross-section of the Environmental Trail shown made in May, 2010
Source: City of Vancouver, 2010c reprinted with permission

[83] For the sake of brevity, "Sustainability Underground" is not part of this analysis. The exhibit was developed only as a concept, the edge imagined as a "large landscaped mound" serving several roles of which one would be the "interactive zone with the public realm": the public could peek into the underground tunnels of the indoor exhibit. (Facility Renewal Report , 2010, p. 12).

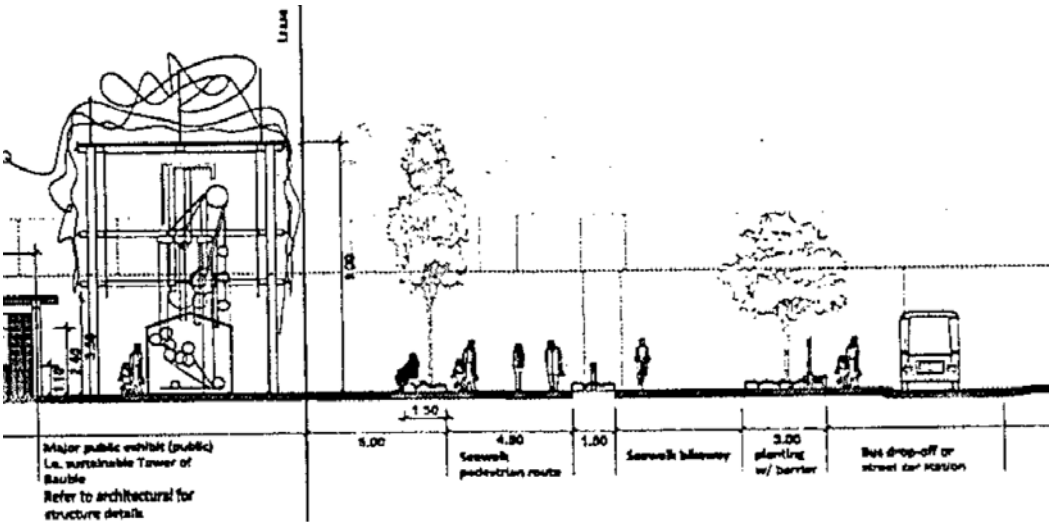

Figure 47: Cross-section of the Environmental Trail made in July, 2010
Source: City of Vancouver, 2010a reprinted with permission

NM and Interviewee 4 explain this conceptual evolution:

Interviewee 4: We knew there were at least three areas along the fence that offered some kind interactive or exhibit style component exhibit. We knew we were going to basically move the Tower of Bauble out there. We knew one of the fences would be temporary so we could open and close it and offer more value to the public.

NM: Those apertures were the brainchild of establishing this Environmental Trail, the city's seawall, and the required dimension for it. So, we introduced another widened pedestrian path and we always joked, that we had a movement zone, and a "dawdle zone". Because we want people to slow down and this is the environmental trail, so you allow people to have room, pause and interact.

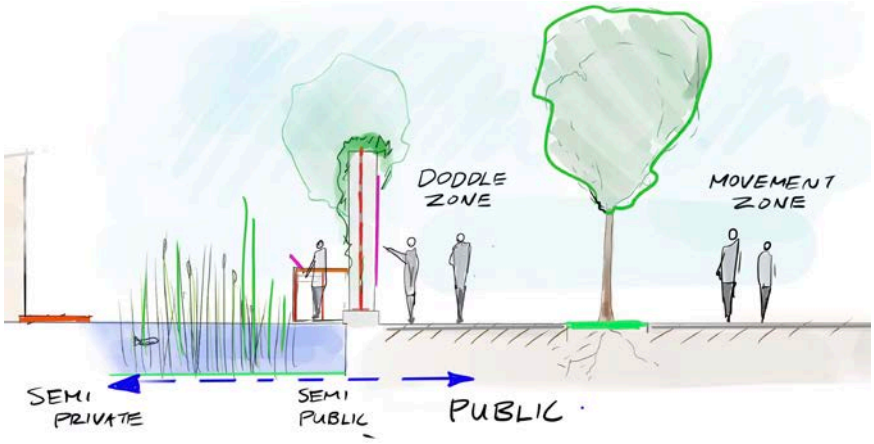

Figure 48: Illustrative cross-section showing the interface between the semi-private Science Park and the public Environmental Trail
Source: Luc Bagnérès

As NM explains, the visual openings between public and private zones provided by the apertures initiated a relationship with the public pedestrian paths. One of the two paths, informally named the "dawdle" zone, would be a slower zone where pedestrians could pause and interact, at a more meandering speed guided by their curiosity (Figure 48). This design concept for the "Public Environmental trail" appears to bring Lynch's concept of paths and edges together to form a public learning environment.

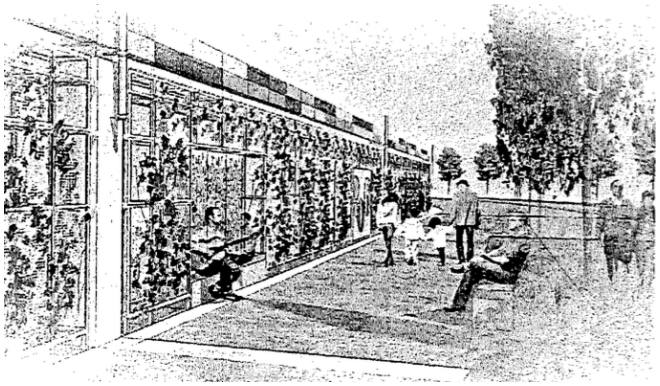

Figure 49: Dawdle pathway of the "public environmental trail", July 2010
Source: City of Vancouver reprinted with permission

Figure 50: Dawdle pathway by PFS Studio after refinement in 2011
Source: Science World, 2011

Figures 49 and 50 illustrate (5) "Public Windows into the OSE and interactive panels" from the updated plan for the Science Renewal Project (Figure 45)**,** where we can see places to sit and pause, interactive panels, and windows offering views into the Science Park. NM and Interviewee 7 from the City explain:

> Interviewee 7: I remember what we wanted to do at the time, was put engagement pieces on the exterior of the wall. We didn't want a blank chain-link fence. We wanted information educational piece: "There's something on this wall, and it should be interactive".
>
> NM: We were looking at that edge as a line, and the moments that are happening along this line that would make you stop; so you had the movement and these moments of pause and interaction.

Indeed, the "interactive panels" combined with the "dawdle zone" would form the experience of the "Public Environmental trail". This shows an evolution from the initial understanding of the possibilities for the fence in May 2010. They move from a series of disconnected exhibits and apertures to a connected trail "experience" via a series of windows and panels. In the dawdle

zone they contain multiple layers, providing seating, shade, and greenery: all favourable conditions for learning[84] (Gehl, 1971). NM describes this process:

> NM: There's a subconscious way of doing [interpretation], and more overt way. Subconsciously, we try to make sure there is a lot of layering. If you're trying to move people from point A to point B, take them so that they see things on the way that subconsciously relate them to their surrounding environment. The more overt way is interpretation. Just throw out as much information as you can. Even if they go by and remember one sentence of what you told them, it [will] eventually add up.

Here, interpretation is described as layered, tying in with Southeast False Creek's 2006 Public Realm Plan. Its Interpretive Strategy stated: "Interpretation can best be considered as 'layers' of experiences that complement and influence other related design components, including landscape design, urban design, and public art. While these layers must fit together seamlessly, they also each have their own needs and objectives" (City of Vancouver, 2006b, p. 23). As one moved along the Public Environmental trail, layers of experience would be provided by four systems of design:

- *landscape design*, through the strategic placement of flora; e.g. trees and wetland
- *urban design*, through the creation of a rich public realm with distinct places and well-designed edges and pathways, ensuring clear navigation for pedestrians moving along the seawall
- *public art*, as seen in the Garbozilla and Choices exhibits
- *interpretation***,** through posters explicitly describing each exhibit

This is an understanding of interpretation shared by the PFS team,[85] which conceived of a continuous interactive edge for the OSE, integrating larger exhibits such as the Tower of Bauble and the Overlook. Together, these integrated exhibits were argued to balance out the return received for the OSE semi-private zone. This document *SWITCH: The Outdoor Science Experience*, produced in July 2010, was later included in an appendix to the November 2010

[84] As per Gehl "Integration of various activities and functions in and around public spaces allows the people involved to function together and to stimulate and inspire one another. In addition, the mixing of various functions and people makes it possible to interpret how the surrounding society is composed and how it operates" (1971, p. 103).

[85] This not a coincidence. PFS referred to such an edge when designing the main plaza for the Olympic Village in 2010, as noted in section 4.8.1.

Development Board Permit. It shows that the second half of the TDET was developed as part of the public amenities provided.

4.5.5. Reviewing and Refining (September-November 2010)

On September 24, 2010, site signs marking the application were installed. As Interviewee 7, the City's Development Coordinator, explains: "The signs tell people that are walking by that [Science World]'s got an application. Here's [Interviewee 7]'s contact information, so they contact me; Here's the dates they come by for the DP Board review". The site signs gave the date of the Development Board Review (Section 4.5.8). 1,073 notification postcards were sent to the neighbouring property owners of Citygate, with a few feedback comments returned in response[86]. This section, however, will unpack the more pivotal process of testing that occurred prior to the Development Board Review: the Urban Design Panel reviews of October and November, 2010. They will be summarized in the following sections as they relate to the TDET.

4.5.6. Urban Design Review A

The City's Urban Design Panel "advises City Council and staff about development proposals… including all civic building projects "(City of Vancouver, n.d.). A significant series of tests would take place in this first Urban Design Panel review for the OSE and TDET:

> Interviewee 7: The [Urban Design Panel] is not a decision body. It's really around the idea of giving advice. I've been told it's like a test. Do we think this is good or we think this is bad? We want to have our outside experts: professionals, architects and so forth, give their thoughts on the application. Are we pushing [the fence] high enough? Is it too wide?

The panel at the time consisted of at least 12 members: six architects, two engineers, two landscape architects, one city planner and one artist, each with their respective credentials (City of Vancouver, n.d.). The first official design review for the OSE took place on October 20 and included two PFS members. Evidence could not be found of the specific design renderings and

[86] Feedback included "1) Concern over the loss of park lands; 2) Outdoor theatre will generate noise from both from speaker system and the general public attending events 3) Addition of picnic tables and interactive puzzles on the exterior walls would be an improvement to the park" (Development Permit Application, November, 2010, p. 10).

diagrams (presentations) that were reviewed and thus no images are shown here. However, diagrams would have been fundamental to testing within the design process (Zeisel, 1984).

The review began with an introduction to the project by City designer SH, followed by a request for advice on "a) the Edge condition [TDET] and its degree of publicness and permeability b) Programming regarding loading interface and shared zone and c) Publicness, programming and performance of space" (City of Vancouver, 2010). In response, a range of opinions and concerns was expressed by the Panel, most focused on elements of the public realm and the TDET:

> The Panel felt there needed to be a clear overlook into the paid space so that people could see the action taking place. They also thought more free things could spill out into the waiting area. One panel member noted that the concept of having as much activity as possible at the entry was important… Most of the panel liked the flex area but felt it could be a bit disappointing if nothing was going on in the space and the gates were closed. A panel member was concerned that the area would appear a little cage-like…A couple of panel members wanted to see the landscaping organized with various pieces that would create quiet places in the landscape. The screen wall is an interesting idea and knits all the pieces together, but several members thought it could be stronger and more remarkable… (City of Vancouver, 2010c, Appendix I, p. 2)

The Panel's consensus was that "they did not support the OSE proposal" noting that there were concerns. They listed key aspects needing improvement of which a few were related to the TDET.[87] The panel expanded, stating "the presentation was weak on what the edge was, as they didn't think it was well resolved" (City of Vancouver, 2010c, Appendix I, p.3). The panel thus describes the edge defining the TDET exhibits as still quite problematic and needing refinement.

4.5.7. Urban Design Review B

Following the urban design review, Science World and PFS Studio refined the conceptual design of the TDET to better integrate it with the Science Park boundary. Members of Science World and PFS attended a second of the City's Urban Design Panel Reviews on November 17,

[87] For example: "Design development to clarify and enhance the experiential quality, view and openness of the exterior fence" (City of Vancouver, 2010c, p. 3).

2010. Responding to the tests showing a lack of clarification of the exterior edge, they presented a refined image of the TDET, articulated as a series of themes:

> [PFS Landscape Architect] stated that a series of six themes have come out of discussion which include energy, transportation, water, food and agriculture, waste and housing. [Science World Director] stated that the focus of the park is on sustainability in the six themes as a way of helping people understand the implications of the choices they make. [PFS designer] described the overall plan and included a description of the six themes. (Development Board Permit, 2010, p. 7)

Themes related to sustainability thus began to emerge along the Expo deck edge, perhaps influenced by the Greenest City Action Plan goals and those of Science World's Our World gallery (see Appendix C.2). NM explained how the six themes of sustainability emerged, mirroring those found within the Ken Spencer Science Park.[88] As such, the larger themes established the sequencing of TDET features and exhibits (Figure 51). This refined presentation was further described by a PFS member in the Panel Review: [PFS designer] "The criteria for the public edge is to engage the public and to display curated and evolving content.

Figure 51: Sustainability themes are mirrored by interior Science Park exhibits along the TDET edge
Source: Luc Bagnérès

The public edge will include the:

> 1. Arrival Plaza is to be a staging area for groups and will have some weather protection and public seating. 2. Solar Tower of Bauble will be an iconic solar powered Science World experience. 3.Cycle Corner will be a public interactive exhibit along the bike and pedestrian pathway 4. Water and Food Pockets will have a modular and interchangeable graphic panel, a rain gauge, urban garden and Pipe Wall and Cellular Wall 5. Demonstration Deck, will serve as a public invite into the Switch with a view of the exhibits in the Demonstration Area and will overlook

[88] As described by BT: Thematically, [the KSSP and TDET] were meant to tie in. So, each of those experiences [of the TDET] was meant to mirror what we may do in more detail inside [the Science Park].

> the wetlands. 6. Waste Wall, will be constructed with re-used and recycled materials with modular and interchangeable graphic panels including a chalkboard and seating nook 7. Innovation Space, Unique Vancouver outdoor programmed space for sponsored programs, special events in addition to the current outreach and free admission opportunities 8. The C-Wall: will include a display illustrating impact of CO2 and climate change on sea levels and will be made of recycled concrete. (City of Vancouver, 2010c, Appendix I, p. 2).

What began as six "experiences" in May 2010 became seven in a "public environmental trail" in July 2010. In the urban design panel review of November 2010, eight experiences were announced, and the designation "Public Environmental Trail" was removed. The exhibits added were: (4) Water & Food Pockets, (6) a Waste Wall and (8) the C-Wall. Renderings done for the review were not found although the following illustration from 2011 (Figure 52) marking these refinements, may help the reader to visualize the scene.

Figure 52: Rendering by PFS Studio of the Science Park and its interface, the TDET, in 2011
Source: Talent Pun, 2020

The Solar Tower of Bauble remains similar in design to that from July 2010. Directly next to it is the Cycling corner which begins the sequence of the resulting Environmental Trail. Key comments from the panel on the TDET stated:

- Several Panel Members acknowledge the applicant for the six themes and how they will engage the public and they particularly liked the bike counter.

- The Panel thought there was a balance of permeability and screening and liked that the pedestrian route had been separated from the bike route which had helped the edge experience.
- Most of the Panel was concerned with the dawdle path and thought it needed to be treated the same as the rest of the path. (City of Vancouver, 2010c, p. 8)

Indeed, the panel "supported the proposal and thought the applicant had come a long way in creating some excitement in the edge" (p. 8). It cited key aspects to improve: "Consider a strong element to pull all the themes together; Design development to the dawdle walk to enrich the connective elements" (p. 8). In response, "[a PFS member] noted that there will be a number of exhibits inside the Waste Wall including a large black board and a series of shelves. They would like to have a bigger expression [for the TDET] but there is also a concern regarding costs" (2010c, p.9). This response is a foreshadow of what was to come: the OSE project eventually went overbudget by three to four million dollars (Section 4.6). The Development Board Panel used the Urban Design Panel's evaluation to inform their decisions. Interviewee 7 explains this process:

> Interviewee 7: [Urban Design Panel members] were worried about fencing and planting and having more flexibility. So that may [have been] a case where [the City development planner] would have written the design conditions based on those recommendations.

As explained, the quality of the TDET was mandated in the development permit under conditions 1.1-1.5

> For example, "Condition 1.1: design development to improve the qualitative experience for pedestrians and park users presented by the OSE's secured edge in consultation with the Director of Planning, General Manager of Engineering and the General Manager of the Board of Parks and Recreation. Note to applicant: careful attention to the OSE's public/private programming including opportunities for interactive engagement and animation, the provision of greater permeability into the OSE and out to Creekside Park, and the provision of substantive quality in the execution of all visible aspects of the edge are required to ensure that the general public's pedestrian experience is engaging, safe, and of high quality on a seasonal basis as landscape matures…". (City of Vancouver, 2010c, p. 3)

With conditions such as these, the Development Permit Staff Committee added to their recommendations to the Development Board "a list of conditions that must also be met prior to issuance of the Development Permit":

> A.1: Standard conditions: Park Board (A.1.1-3), Landscape conditions (A.1.4-6), and Real Estate Services conditions. A.2: Engineering Conditions and A.3: License & Inspections (Environmental Protection Branch) conditions; Standard Notes to Applicant (B.1) and Conditions of Development Permit (B.2). (City of Vancouver, 2010c, Appendix A, p.1-4)

Unlike those such as 1.1 above, these were standard conditions appended to the development permit, required to be met,[89] emerging from reviews with other City departments.[90] One of these, the Park Board (VBPR), stated: "The proposal will interfere with existing pathways, requiring a substantial reworking of an area of the park outside the OSE. Science World is obligated to do this work" (City of Vancouver, 2010c, p. 8). Unlike the simple mention of an OSE in Science World's June 2010 development application, the Park Board now provided detailed conditions to be met (a list of public realm improvements) for OSE approval.

4.5.8. Development Board Review – November 27, 2010

Having gone through the various City departments, the OSE application was to be reviewed by the Development Board Panel. The meeting minutes reported a total 21 people from the City of Vancouver at this Board review, with four from Science World and two from PFS Studio. The meeting opened with an introduction to the project by the City's development planner, SH. The review centred on the development permit application document of which each of the members received a copy. It described the purposes of the OSE project making City staff fully aware of the role that Science World could play in public education on sustainability. [91] However, the City understood that these improvements to the public realm would come at a cost: the creation of a fare-paying park space. As stated in the document:

> Of primary importance is the issue of park encroachment which totals approximately 36,000 ft.², and the resultant quality of such prominent civic assets in Creekside Park and Science World. Staff, who have been informed by the advice of the Urban Design Panel and general public, believe that the OSE proposal is

[89] As stated in the conditions subject to Council's approval: "2.0 That the conditions set out in Appendix A be met prior to the issuance of the Development Permit" (City of Vancouver, November 2010).

[90] These departments included, Engineering Services; Heritage Planning; Cultural Services; Real Estate; Environmental Protection; and the Park Board.

[91] Project Intent: "Science World has subsequently outgrown its current facility noting an acute need for more substantive exhibit space including the recognition of greater potential to engage the public with outdoor programming" (City of Vancouver, 2010 c, p. 7).

> worthy of the proposed encroachment into the park if the recommended design development conditions are properly considered and implemented. More work is necessary to ensure that the OSE's public edge, and the pedestrian experience for the park and waterfront, are very well executed and contribute to an improved civic context... .(City of Vancouver, 2010c, p. 8)

The development permit application stated (emphasis in original): DEVELOPMENT PERMIT STAFF COMMITTEE RECOMMENDATION: APPROVE. [92]

> Conclusion: staff support the initiative subject to the recommended conditions hearing. Staff believe that the OSE will be regarded as valuable civic asset if anticipated design intent, and quality, is properly implemented noting the need for on-going attention to maintenance. (City of Vancouver, 2010c, p. 8)

The Development Board Panel at this review was set to approve conditions 1.0 to 3.0 and standard conditions A.1 to B.2; it saw these as sufficient. Many comments by the Panel involved the TDET and its level of quality, however:

> The representative of the Development Industry "felt the edge condition had been emphasized with a variety of materials. Also, he thought a high degree and variety of plant materials were being utilized that would allow for the longevity of the project." (City of Vancouver, 2010d, p. 6)

As noted, the materiality of the fence and its transparency, as well as the variety of plants noted was crucial.

- [The Deputy City Manager] noted that the program will enliven the space in front of Science World as it is the front yard of the city and has so much potential. He thought the edge in its final form was exciting especially tying the water as a permeable feature. He liked the sustainable theme both inside and outside the fence line (City of Vancouver, 2010d, p. 7).
- [The Director of Planning] noted that the space needed to be visually public and thought the design had achieved that and thought the demonstration modules were the exciting part of the design. He added that he was pleased to support the application (City of Vancouver, 2010d, p.7).

[92] It continued stating "THAT the Board APPROVE Development Application No. DE414096 as submitted, the plans and information forming a part thereof, thereby permitting the development of a secured interactive, educational and sustainably themed, outdoor science experience (OSE) as an extension of the cultural Educational Facility (Science World) which includes a new public realm including replacement of the fronting roundabout, landscape improvements to the immediately adjacent Creekside Park and the upgrades to bike/pedestrian paths, subject to the Council's approval of the modification of the existing lease and the following conditions (Development Board Permit, 2010, p.2).

The meeting concluded with motions by the Board to amend some sections of the Development Board Permit. Refinement of the OSE was still needed, although they were close. Vancouver's development process was felt to be slow, with some researchers concerned with its inefficiency in issuing permits.[93] It would take another seven months (until June 2011) for the City to grant Science World its permit.

4.6. Execution of the TD Environmental Trail (2011-2013)

What is the transition between design and execution? For the TDET, it could have been the City's project approval, and its reception of a development permit. In Zeisel's (1984) terms, this indicates/initiates a "decision to build". But in this case, approval for construction rested not only with the City of Vancouver but also with the Province of BC.[94] Construction of the OSE and its exterior edge (the TDET), in other words, also needed an updated lease including boundary approval by the Province. The appendix to the OSE application included a "Memorandum of Understanding" dated December 2010 (City of Vancouver, 2010c, Appendix K), which made reference to this parallel process:

[93] As Punter stated: "There has been much recent debate about the efficiency of the permitting process and ways in which it can be made quicker, more predictable and more constructive…There are longstanding concerns about the speed of the permitting process, which is currently a minimum of four months for proposals going to the DPB" (2002, p. 278).

[94] As explained by NM: "The City owns land leased to the Province which leases to the City in return. That leased boundary had to be updated. So that was a parallel [process] happening at that time.

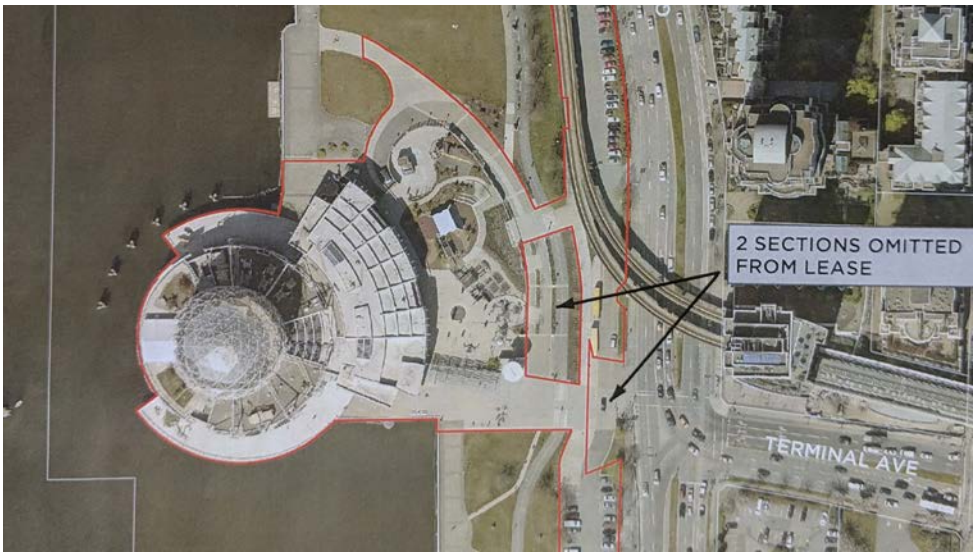

Figure 53: Modified Lease Boundaries (in red) for the OSE project in 2013
Source: Science World reprinted with permission

> **Agreements**: In order for the City to further its consideration of DP Application Number DE414096, the parties hereby agree as follows: a) that the Lease will be modified (the "Modified Lease") as follows: i) to adjust the area comprising the Leased Premises to include: 1. The OSE area, 2. the access areas, 3. the encroachment area, 4. the parking lots, collectively known as the "Adjusted Area"…(City of Vancouver, 2010c, Appendix K, p. 1)

This agreement, noting the updated boundaries of Science World's lease (Figure 53) needed to be signed by: (a) Her Majesty the Queen in Right of the Province of British Columbia, (b) the A.S.T.C. Science World Society, and (c) the City of Vancouver. These two approval processes (the development permit and the updated lease) in combination delayed project approval until June 2011. Between December 2010, and June 2011, no documented evidence was found for the OSE or TDET.

This phase of the design analysis, the execution of the TDET, remains the most difficult to fully capture. Research revealed evidence of it, but it is fragmented. With a jigsaw puzzle, many pieces can be lost, yet it can still be possible to make out the image. In this sense, while Sections 4.4 and 4.5 may have recorded 75 to 85 percent of key events and diagrams, this section was able to document something closer to 30 to 40 percent.[95] There is still a story to be told

[95] These are simply self-reported estimations and are not based upon any quantitative calculation.

although the gaps in the execution puzzle are large, identified as “missing evidence” in the hope that a more complete picture may be put together in the future.

4.6.1. Orchestration

The OSE, and subsequently the TDET, required a central orchestrating team, working under conditions set by the development permit, ensuring proper communication to engineers, consultants and contractors as they finalized plans for approval. Here, the form must be at its most precise, and most defined. The skills of landscape architects PFS studio made them best suited to coordinate the actors responsible for execution of the form. The many engineering teams were also instrumental to orchestration of the OSE construction.[96] Each engineering team worked with PFS and the City in separate image-present-test cycles to ensure the technical elements of the design were durable and safe:

> NM: This larger project had two components, although they were side by side, being done simultaneously, and in full coordination. In terms of leading the process, it differed. PFS took the lead and became the coordinating consultant and was kind of directing the work… It was like we were the orchestrators on the outdoor science park [OSE] and we were playing the instrument, second fiddle to the [building renovation].

This is a stage where documentary evidence is missing, but we have NM’s explanation. As she details, the full design orchestration encompassed the Science World renovation by Cannon Design from 2009 to 2011 and OSE development by PFS from 2010 to 2012. While orchestration of the larger OSE landscape was done by PFS, Science World also had an orchestration role, assembling a Ken Spencer Science Park team.[97] Science World had thus assembled a “team of teams”, co-ordinating both the multitude of KSSP exhibits as well as the

[96] These engineering teams are: “Falcon for electrical, Bush Bohlman for structural, Cobalt for mechanical, Binnie for civil, Bunt & Associates for traffic management, Hemmera for environmental, and 3SI Risk Strategies for security” (Talent Pun, 2014). Within the Science Park there would be many design consultants also engaged at various points prior to 2011, although for the sake of scope they are not mentioned until now.

[97] This team, composed of a few members of the initial three exhibit team was responsible for coordination of many external exhibit contractors, placed within the fare-paying park boundaries. These included: Turner Exhibits (Water & Transportation), Huttinger Exhibits (Energy), PFS and Duncan Martin (Food), R&S Productions (Waste), Public C + A (Housing), Urban Visuals (Bike Exhibit), Working Format (graphics), EOS Lightmedia (lighting) (Talent Pun, 2014).

TDET exhibits within the same budget. The OSE design process had finally reached the point of execution and the total scope of work was 11,359 m^2.

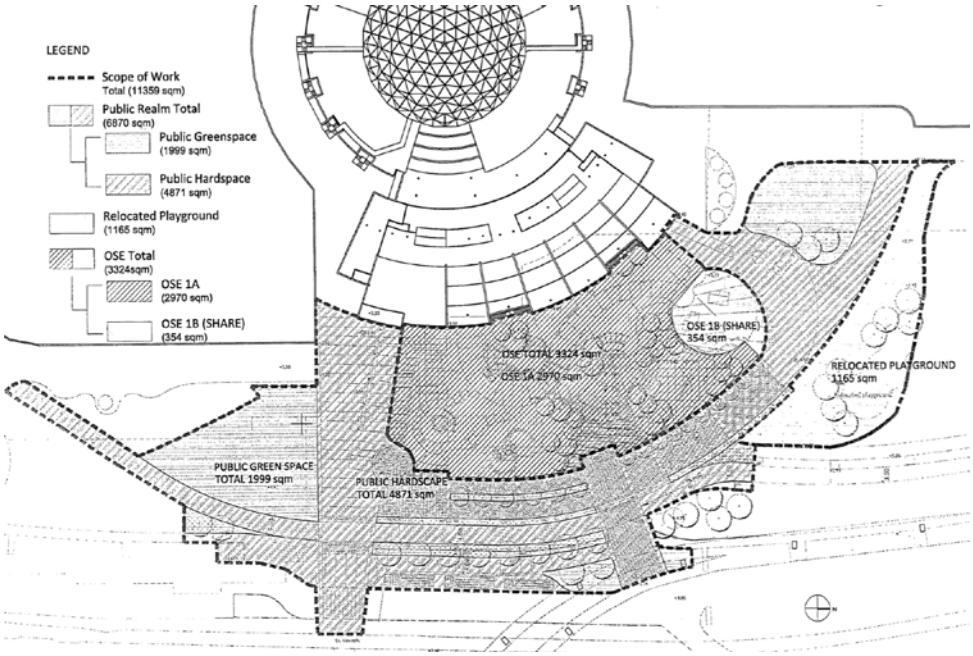

Figure 54: Full design orchestration area for the OSE which included the TDET as one of its parts
Source: City of Vancouver 2010c, Appendix H, p. 1 reprinted with permission

Figure 54 outlines the total site of intervention of the second half of TDET development. It shows the balancing of public amenities within the larger OSE project: hardscape, greenspace, and a relocated playground. The TDET, although not shown, was included within the 6,870 m^2 of improved public space. A 354 m^2 Flex Zone was also intended to be included for public programming (as mentioned above). City staff illustrate their intention to improve the surrounding 6,870 m^2 public realm:

> Interviewee 7: Really the idea of expanding out Science World [and the OSE] was to do these improvements to that walkway, improve the bike lane, improve the outdoor realm and the movement through that area.

Clarity of paths in the area along an extended a plaza was an important element in this compromise. The project management triangle (Figure 55) illustrates how time, cost and scope are balanced in maintaining the quality of the OSE. The increased scope (now 11,359 $m^{2)}$ of public improvements to be executed by Science Word necessitated increases in budget and time in the design spiral (Figure 56).

Figure 55: The project management triangle

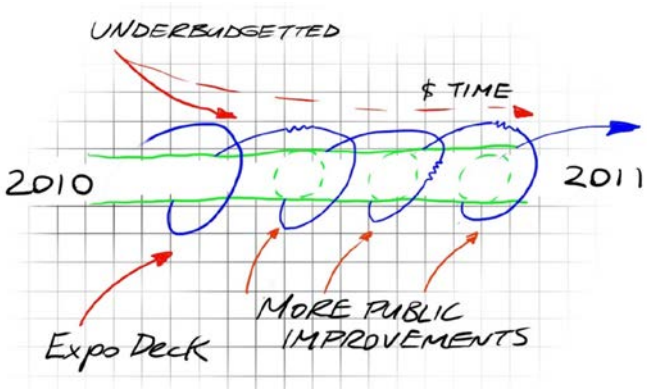

Figure 56: Illustration of design spiral as more public improvements were demanded
Source: Luc Bagnérès

> BT: My recollection is that total project was about $8.2 million. When we first started it was $3.5 million. That was not necessarily because costs escalated, but our dreams and our ability to raise money grew. Because we paid for it all.
>
> Interviewee 4: We overextended ourselves. [It was] not just ambitious, they raised money based on certain promises, because of the scale and scope of the exhibits. I mean there's a reason why the exhibits are so big and so singular: it's because that was part of the original pitch, it's like we're not only just going to make small experiences. We are going to make big monumental experiences. Once you increase the scale of an exhibit like that, the complexity of that, [the cost] goes much higher.
>
> Interviewee 3: This is where things get politically challenging. Let's just say that when you get land from the City, the City wants improvements made, and if you don't give them those improvements, they don't sign off on the projects.

An initial budget of $3.5 million from Ken Spencer and the provincial and federal governments would not be enough. From Interviewee 3 and BT, we can see conflicting reasons as to why the OSE development went overbudget, but the important point to note is that it did. This brought pressure to complete the eight "experiences" outlined in Urban Design Review B. The TDET public exhibits were among the many conditions of the development permit.[98] The continuously shifting budget created tension amongst donors:

> Interviewee 4: When I was brought onto the project, they told us that we have 4.5 million dollars. If you do the math on the cost per square foot for budget, it [was] ridiculously underbudgeted…They told us you've got to work with what you've got… and then it [got] out of hand [in 2010] with the renovations to the

[98] As BT from SW states "We had to take out maybe six trees. We had to find a new space for them, they were replanted and we had to pay for their upkeep for a period of "three years" [Unsure exact date].

> surrounding [public space]…That's when it became very tricky. Obviously [Ken Spencer] was concerned, because, "Ok…I gave a million dollars so we could do something that is interesting for kids and for my family, and to make Science World a better experience, not so we could like redo the bike paths for the city." So managing that relationship was very hard.

Interviewee 4 mentions how Science World had to explain to funders like Ken Spencer that he was funding not just the external coherence of Creekside park, but also the internal coherence of the Science Park (Alexander, 1961). What was presented to certain donors may have been different from what was presented to the City, leading to tests in the form of refutations due to lack of consistency. This is just the tip of the iceberg of the many design cycles required to bring this project to approval. Evidence that would allow a full picture to emerge is, unfortunately, missing.

4.6.2. Integration and Approval

The idea of a TDET had found its place in the 1999 "public pond and playground", "exploring science in everyday life". In 2002, it had become "Breadcrumbs" scattered across False Creek, leading to a physics-themed OSE. In 2009, there existed just three exhibits known as "SWITCH", communicating themes of sustainability and place. In 2010, additional exhibits were seen as OSE "experiences" and integrated into the Science Park interface. And while hinted at in 2010, the "Environmental Trail" was coined only in 2011, and done so strategically:

> Interviewee 4: The TD Environmental Trail basically became a way of consolidating all these free public experiences we were creating [the three exhibits on the deck and the Science Park interface] and had already created, into one theme and one story. It ended up helping us get approval for the development.

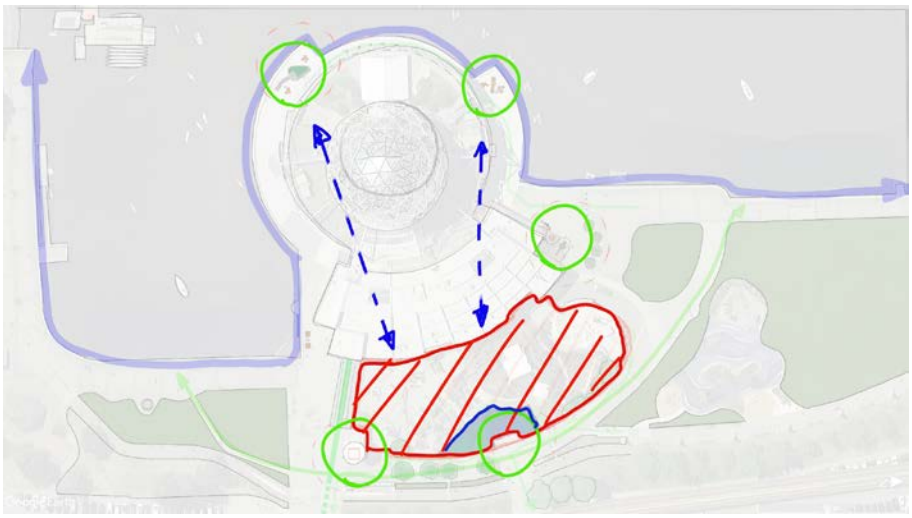

Figure 57: Representation of how the privatization of Creekside's public park would depend upon the TDET
Source: Luc Bagnérès

As Interviewee 4 explained, an acceptable response from the city wasn't achieved until the three Science World exhibits were tied to those developed along the Creekside Park edge, in one coherent narrative of sustainability, under the name of the TDET.[99] The connection of exhibits represented by the dotted blue arrows in Figure 57, in other words, became critical to the approval process for the Ken Spencer Science Park. The resulting Development Permit for the KSSP and the TDET project was granted on June 24, 2011.

> Interviewee 7: The development permit would basically give approval for the fence, the design, the public realm improvements, and… placeholders on the fence for [public] educational pieces.
>
> NM: [It was] a process of tying these exhibits fronting the park with exhibits on the deck. And also to the public front of that edge, this environmental trail.
>
> Interviewee 4: The TD Environmental Trail is the by-product of all these different decisions that we had to make just to get the project approved. … And then we realized, oh wait, in order for us to make this make sense, we can bring all these separate elements together and turn it into a trail.

The TDET came about as a way of consolidating exhibits into a single story. This gave the OSE project the development permit which eventually led to the decision to build. Designers

[99] The opening line of the introductory TDET poster states "Embark on a journey of sustainability on the TD Environmental Trail…It has never been more important to think globally and act locally. We know that inspiring positive environmental actions will result in a better future for our planet."

of Science World's Phase 1 exhibits (Section 4.4), however, had no input into it.[100] It was made by the design team responsible for the Science Park interface and was not communicated to the designers of the SWITCH exhibits on the deck. While the TDET may appear to be a cohesive project, it turns out to be extremely fragmented in terms of design decision making.[101]

4.6.3. Siting and construction

The three exhibits on the deck discussed in Section 4.4 were in production at the beginning of 2010 with the completion date aimed to be, Earth day, April 2010. As Interviewee 3 stated, these exhibits "were developed before the rest of the Science Park was being put together".

While the three exhibits were initiated as components of the larger OSE project, some were not finished until after completion of the Ken Spencer Science Park. The Waterways exhibit, for example, was only installed in the summer of 2012. According to Interviewee 4, while one contractor had completed the mound element in advance of 2012, the contractor responsible for the water table hydraulic system had stalled the project's completion.[102] This shows the complexity which enters a project when multiple contractors are responsible for executing a single piece of design upon which two exhibits depend, in addition to other factors.[103]

[100] As stated by Interviewee 3, involved in the first half of TDET: "To be honest I don't really know [why they changed the name to the TD Environmental Trail]. We weren't involved with it, we weren't asked to participate in it… I just know that one day it changed from SWITCH:OSE to the TD Trail."

[101] This reflects the demanding tempo necessitated by orchestration of something as large as the OSE, if it is to be delivered on time.

[102] As stated "I'm pretty sure the Waterway exhibit was delayed because the fabricator [Tom Egen], based in the US, blew past their deadline. The sculpture "grass" mound was done locally by 3DS, and was in storage for quite some time.

[103] While the deck exhibits were stalled due to contractor timing and OSE development permit approval, perhaps the delay was also due to lack of funding. The cost of renovating the Science World building in 2010-2011 may have prevented their installation. Or it may have been a combination of these reasons.

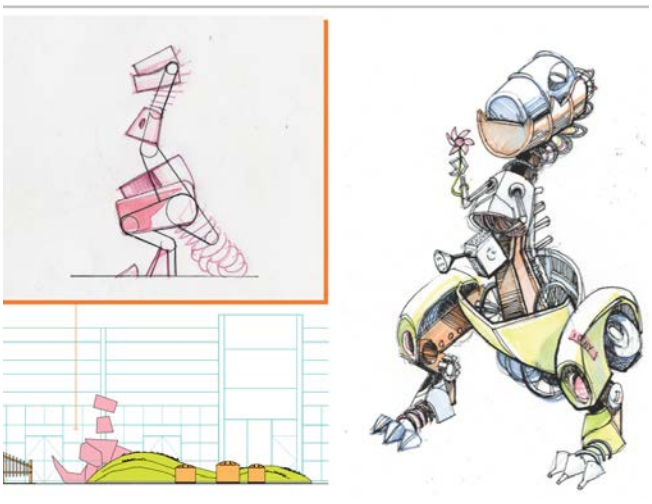

Figure 58: Garbozilla sculpture designed by Science World, 2009
Source: Science World reprinted with permission

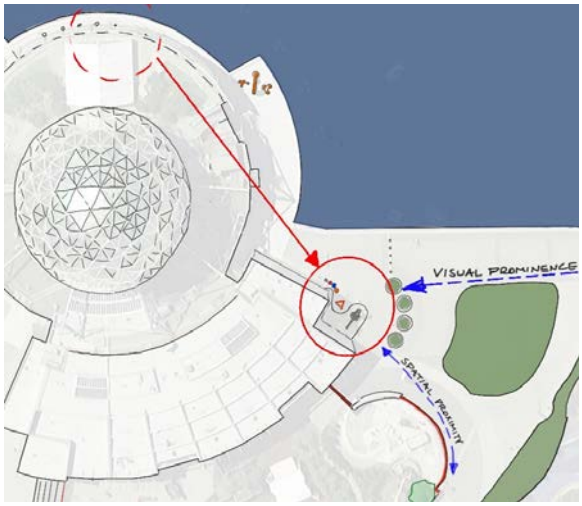

Figure 59: The Garbozilla exhibit was moved in 2011 for spatial proximity to the Science Park and visual prominence from the seawall
Source: Luc Bagnérès

Sometime in 2010 or 2011, Garbozilla', one of the three exhibits on the deck represented above, was moved to the location shown in Figure 59. This giant dinosaur was sculpted from local waste; surrounded by drums of recycled propane tanks, and a chime wall made from recycled pipes. These waste-fabricated instruments were intended to allow members of the public to perform and compose their own melodies. The green mound seen in Figure 58, intended to integrate into the Waterways exhibit, was removed during execution, indicating a refinement of the design cycles forced by lack of funding.[104] This reflects the challenging budget articulated previously. Science World designed Garbozilla, coordinating with a local artist, and PFS helped site the dinosaur in 2011 on just the right spot on the Expo deck:

> NM: [The relocation of Garbozilla had to do with] the load bearing capacity of the deck to some extent; that deck does not accept a lot of load. Also, we wanted it to be close to the Science Park, and that if you were on the seawall you could see it.

While load-bearing constraints were the most important considerations, two other design factors influenced its location: visual prominence (it needed to be seen from a distance on the seawall), and spatial proximity to the OSE Science Park (Figure 59). Siting of the Garbozilla

[104] As stated by Interviewee 7: "That dinosaur was supposed to be massive but [we] ran out of money."

exhibit required coordination, not only from the design teams of PFS and Science World, but also from structural engineers Bush Bohlman working with the City's Engineering Department.[105] Their collaboration brought the exhibit to life:

Figure 60: The Garbozilla, waste chimes and whale drums installed between 2011-2012
Source: Luc Bagnérès

The successful execution of Garbozilla depended on the coordination of designers and engineers with exhibit contractors: Artist Tim Lepp (Vancouver) for Garbozilla, and Elemental Design (Maine) for fabrication of the musical instruments. These learning environments (Figure 60), in other words, are composed of elements that needed to be shipped across the North American continent. The execution process required the location of appropriate materials, builders and transportation methods. While composed of re-used waste, the waste the Chimes were made from was shipped thousands of kilometres: clearly trade-offs were involved. It all points to the difficulty of deeming just what makes an exhibit "sustainably" developed.

The use of local waste in exhibit execution was improved by PFS and Science World when they connected materials from local demolition with exhibit construction. Rather than create the TDET fence-line from materials requiring transportation, PFS designed the wall so that it could use concrete from the demolition of the previous Creekside Park area, reducing

[105] For example, standard condition A.2.11 states "confirmation that the proposed works are either not on top of/over any decking structure of if over any decking structure that the deck is designed to handle all aspects of the loads proposed over it" (COV Development Permit, November 2011).

landfill costs as well. This may be evidence of a different kind of design spiral where the skill of the contractor, *Heatherbrae,* was essential:

> Interviewee 4: We were looking for opportunities to make the exhibits, make the way they were fabricated, tie into the theme of the exhibit itself.
>
> NM: At first the builders were intrigued, and then they got excited about the notion too. We had a lot of support from our building team…They couldn't just go with a loader and rip everything apart. They actually had to mark them in those dimensions, cut them and pick them up piece by piece, and store them somewhere when they were working on the rest of the park. So it was a lot of work for them.

This may be evidence of how learning opportunities can be integrated into the design process, although in this case, by a team of professional designers and contractors.[106] Part of the demolition involved the extreme care demanded by the Systems of Sustenance sculptures (see Appendix C.3), which were, in fact, carefully avoided.[107] Demolition also led to the removal of trees and Styrofoam, both of which needed to be relocated:

> Interviewee 7: They had put Styrofoam [into the initial Expo deck], and that all came out. This had been done by Park Board later on. Science World levelled this all out, got rid of the Styrofoam and cleared it up.

Styrofoam had been used to build the berms in front of Science World that had created the illusion of terrain in Creekside Park. The load-bearing capacity of the Expo deck could not have sustained actual soil. Just as the Mound exhibit was to develop pedagogical goals for exhibit users: the "ability to learn and distinguish between man-made and artificial landscapes" (Science World, 2009), it is nice to think that the construction team discovered Styrofoam in the berms. Perhaps it was simply a coincidence, however: it is possible that Science World designers knew what the berms were composed of all along. They were, in any case, removed.

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[106] This re-use of materials was never mentioned explicitly in the final interpretations of the TD Environmental Trail, and remained implicit: known only to the internal orchestration team. Interpreting this is one of the design suggestions contained in the conclusion to this thesis. It is a part of Design Suggestion 1 in Appendix D.

[107] Interviewee 7: "There was lots of discussion on [the Systems of Sustenance Indigenous sculptures]. I remember there was lots of concern: we didn't want to do much around them or to change them. But to reach out to find out who owned them? Like "Who's were they?" was a big discussion." This shows that the OSE team had no background information on the Systems of Sustenance project - on its spatial context - although information on its process was found through this thesis research (shown in Appendix C.3).

Figure 61: Construction of canopy to protect pre-existing Tower of Bauble exhibit into the TDET
Source: Science World, 2011

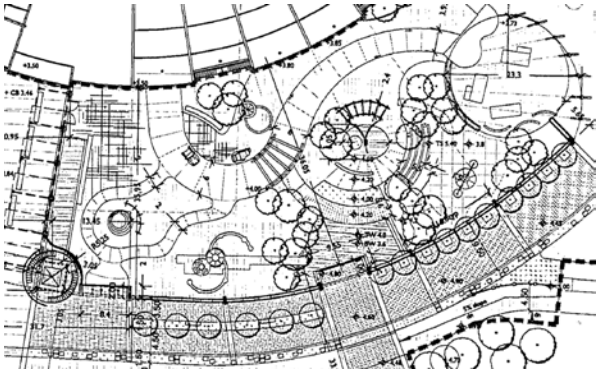

Figure 62: Execution plans for landscaping, pathways and the TDET
Source: City of Vancouver, 2010c, Appendix D, p. 10 reprinted with permission

The Tower of Bauble (Figure 62) was installed in July 2012, around the same time as installation of the remaining exhibits. Information on construction of the TDET pathways and fence line is missing, although Figure 61 above, the landscape plan, gives a good approximation of the construction documents used to execute the interface of the TDET. These integrate hard surface with trees, shrubs, cattails and other plants. Detailed ecological procedures were specified to create the artificial wetland, and planting of appropriate vegetation:

> NM: The challenge was to do an ecosystem but in an artificial environment so to speak, because this is a constructed marsh, an enclosed system with recirculating water infrastructure. With the sloped land marsh, you have different interactions with water: different plants like to be at different depths of water…You create the space of planted marsh and then animals just show up… You can't control the rest and that just happens on its own.

These pieces of the TDET's execution puzzle offer a glimpse of the challenges involved in bringing the TDET to life. There are clearly many gaps in the record to fill.

4.6.4. Exhibit Installation

The actors that put the TDET into place, through their imaging-presenting-testing cycles, show an evolution in their understanding, a process of learning from one another. Below is the final form of the of the Tower of Bauble exhibit (Figure 63). When it is compared to the sections and renderings from 2010 (Sections 4.5.3 and 4.5.4), it is clear that its design has been greatly

reduced, its canopy no longer containing solar panels or dazzling triangular forms but now forming a simple cover to protect the exhibit:

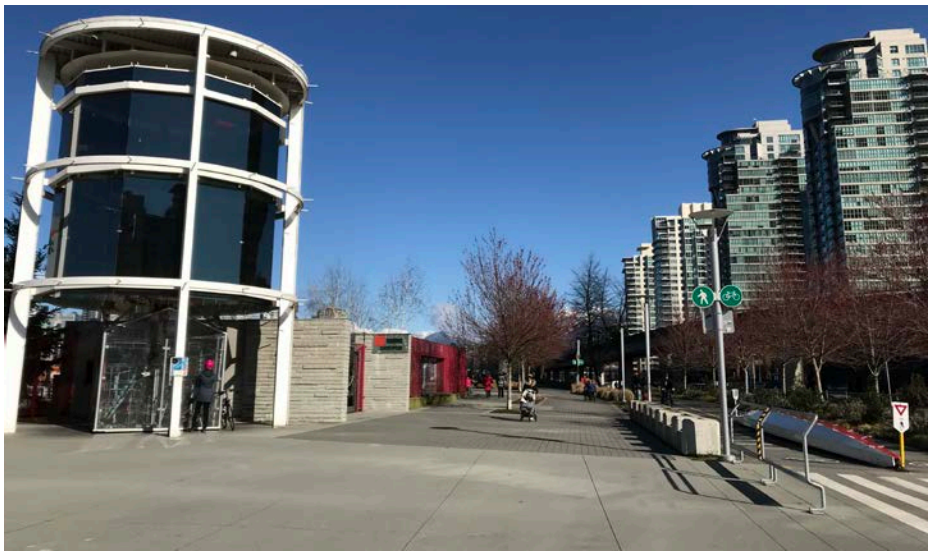

Figure 63: Resulting form of Tower of Bauble Exhibit and the public realm improvements of the Outdoor Science Experience
Source: Luc Bagnérès

In the place of an Indy race roundabout and car drop-off area, the Tower of Bauble exhibit, imagined as an incident (Cullen, 1961), now adds animation to a new public plaza around which Vancouverites can congregate and enjoy.

The spatial outcomes of the TDET's learning environments depended upon the design team chosen to bring them to life. The Science World team designed their components as a set of moveable objects with interactive features sequenced along the seawall deck. The PFS Studio landscape architects designed the southeastern part of the TDET as an integrative feature within the larger Ken Spencer Science Park interface. As a result, two contrasting learning environment typologies emerged (Gislason, 2007). The first, seen in the Wetland exhibit (Figure 64), is of a distinctive incident (an artificial ecosystem) integrated into a public and semi-private edge. The second, seen in Waterways (Figure 65), Choices and Garbozilla, is of exhibits as stand-alone objects, each smaller incident along a larger seawall path (Cullen, 1951).

Figure 64: Final Exhibit of Wetland as one peers into the Science Park and views the stage
Source: Luc Bagnérès

Figure 65: Final Exhibit of Waterways installed in 2012
Source: Luc Bagnérès

The interactivity of these exhibits leads to a variety of learning possibilities, and engage multiple stimuli through sight, sound, and touch, allowing the exhibits to be broadly inclusive. Their design draws and holds people of all ages and abilities. Some may read the posters, some may run around and touch their various mechanisms, and some may play music and derive feedback from the sounds they can produce.

4.6.5. Finalization

It is thanks to many groups and individuals that the TD Environmental Trail was created in 2012 on Vancouver's seawall and remains, in 2020, today. A large group of teams worked in an orchestrated effort to deliver the project (Figure 66) within a limited scope, with a limited budget and on a tight timeline. This project would not have been possible without the efforts of: Science World, PFS Studio, the City of Vancouver (Planning, Parks, Engineering, Cultural Affairs), Cannon Design, numerous engineers (their names and roles are listed in Section 4.6.1) and contractors (3DS, Heatherbrae, Tim Lepp Fusionworks, Tom Egen, Wavestone Sculpture, and Elemental Design). Some people have almost certainly entered/exited these organizations.[108]

Figure 66: Executed project: the OSE and TD Environmental Trail in 2012
Source: Science World

At some point between June 2012 and November 2012, the Environmental Trail was complete. The various contractors delivered (a) a renovated Science World facade, (b) a reinvented Our World Gallery on the ground floor of Science World, (c) the Ken Spencer

[108] The following quote by Interviewee 4 shows the complexity of, and shifting team involved in, the TDET's signage: Interviewee 4: "I had done the signage for the three exterior exhibits on the deck. That set up the basis of a brand and style guide for the signage. [SW Graphic designer] started building a full-on branding, and standardized the graphics. He was the one that took my initial work and made a full blown style guide. Then he left, and [the work] was taken over by an external contractor."

Science Park, and the (d) Environmental Trail which surrounds the structures. The Ken Spencer Science Park was completed before the TDET, although evidence is missing as to precisely when. The TDET posters at this point were still not up:

> JB: The TDET had two different phases, [the first being] the dimensional builds along the perimeter of the building on the seawall. The second phase was along the fence line (primarily graphic treatments) which encloses our Science Park, and then the Science Park itself. The dimensional builds primarily maintained the same team (permanent internal SW staff) with a few bumps near the end. The graphic phase was an oversight that was originally part of the Science Park scope of work. The team [was a] mix of SW staff, additional contracted staff and external contractors; architects, landscape designers. This entire team slowly dissolved over time, including the SW staff: the project was never completed by the team. That's when we, the remaining two from the internal team, JB & Interviewee 3, had to take on the second phase of the TD Trail.

Speaking simplistically, the "Science Park Interface Team" (see Section 4.5) passed the torch of the TDET design process back to the "Three Exhibit Team" (See Section 4.4). Interviewee 3, curator of the Waterways, Choices, and the Garbozilla exhibits, came back into the process to complete the KSSP fence line posters tying public education to the history of False Creek:

> Interviewee 3: Most of the team left before the park opened. [The project] was taken up by an interim group of project managers with [Interviewee JB] and myself doing most of the work [to] put the TD trail together. We went back and said "What were the themes that they [were working with?]; What do we do with it?" … And what we looked at was…what I looked at was, ok, here's the content that's in the science park: it has nothing to do with this particular place, it's very generic. I said, you know for the outdoors we have to talk about this particular outdoors, this area right now. It could use some relevance.

These designers in their creation of posters tied to environmental education (Orr, 1990) helped bring fitness to the form (Alexander, 1964).

In 2012, following project completion, the Toronto Dominion Bank (TD) donated $500,000 to rebrand the project.[109] Science World had settled on a contract with TD, to rename it the TD Environmental Trail. As explained by a TDET designer,[110] TD requested their logo and

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[109] Evidence is missing as to when TD came into the process, announcing its donation of $500,000 to Science World, and completing the TDET. Some have said 2012, although BT recalls that in it was 2011.

[110] As explained by JB: "What had happened is that we had done the work in 2012. TD came back to us and they wanted more, they wanted their name on more things: we added their name to everything. If you noticed on the outlook pond [the Wetland exhibit], we had to add that... Then you'll notice, we had to add additional panel graphics, in either

the name “TD Environmental Trail” be placed at the bottom of all interpretive posters and on signage specially created for the top of the Wetland railing. The TDET, as an integrated experience of the three deck exhibits and the Science Park interface, came about at the end of the design process. No performance evaluation criteria were set.

TD officially announced its donation in mid 2013. The Trail’s official opening was October 27, 2013, to which Science World invited partners at the TD Bank Group and TD Friends of the Environment Foundation. Mauro Manzi, Senior Vice President, Pacific Region, of the TD Bank Group, and Jennifer Ingham, Vice President of Development for Science World (who replaced Kevin Kearns in October 2012), shared the honour of cutting the TD Environmental Trail “ribbon” to formally open the Trail to the public (Science World, 2013).

4.6.6. Interpreting the Design Spiral

Zeisel’s design spiral is a device that allows us to visualize the empirical nature of design, and to articulate just how an ambitious vision shrinks into something called the TDET. However, there are a number of ways of interpreting and using the spiral as a framework for explanation of a past design process. I will briefly unravel these below.

1. The spiral’s first use here was as a means to understand approval of a development permit to change the physical and organizational use of public space. In the case of the OSE, the spiral was used as a framework to explain how the City agreed to build a fare-paying park on a public site. There was reluctance within the City to create a fenced and gated boundary that reduced the size of the public realm, yet it brought with it the opportunity for improvement of the deteriorating public space on the suspended Expo deck. In the seven years prior to the City’s involvement, the OSE design had been adjusted to integrate into longer-term plans for Creekside Park. The process had led to a 2008-2009 compromise between Science World and the City of Vancouver, where urban designers and landscape architects at PFS Studio and PWL Partnership clarified and aligned their interests. OSE actors thus prioritized certain design elements and agreed to

direction you’re coming, to see if people would hopefully connect with it... So we had to add a little bit more to make TD happy. This was the year later in 2013.”

leave aside secondary priorities to reduce the project's scope and achieve a fit with priorities of the City.

2. Secondly, the spiral shows the movement of the TDET's design iterations from visionary to practical, involving the realities of time, site constraints, budget, and scope as they followed the urban design reviews. Ambitions for the TDET were hindered by lack of funding: as Zeisel explains, less time is available for imaging in the later stages as more emphasis is placed on testing and presenting, reducing possibilities as budgetary and site constraints come into play.[111] It should be noted that the actions of imaging, presenting, and testing are a vast simplification of what designers do; for example presenting in an early stage could be argued as a vastly different action than presenting in a later stage. This simplification does not bring justice to the complexity of designing and one of the main weaknesses of the design spiral. *Design thinking (*1987) by Peter Rowe, better articulates the nuances and granularity that comes in designing and provides an important contrast to the design spiral framework.

3. Thirdly, the process of TDET's creation was not one, but a multitude of converging, design spirals. The OSE had many departmental reviews by the City (e.g., Engineering, Park's Board Planning, and Transportation) each with its own image-present-test (IPT) cycle and emergent TDET. The TDET became a way for the OSE project to reach a state of fitness in Alexander's (1964) sense for its context. The OSE was actually Phase 2 of the Science World dome 2010 renovations, intended also to integrate into the Southeast False Creek shoreline renewal. Although this analysis explains the design spiral linearly, it is evident, given the complexity of the design process, that many IPT iterations occurred simultaneously. The spiral should be seen as a map that helps guide a chronological design process.

4. Fourthly, the spiral, through its image-present-test cycle, illustrates the social nature of design. While this analysis explains the "how", just who was responsible for the TD

[111] As illustrated, "Major conceptual design shifts made this late in the process can be costly. When the design team feels that working drawings adequately presents its ideas, when regulatory personnel have checked that working drawings meet legal standards, and when specialist consultants have reported that their criteria have been met, working drawings are complete. At this point a contractor is hired to construct the building" (Zeisel, 1983, p. 4).

Environmental Trail design? A simple response would be a combination of Science World's exhibit designers, the PFS Studio landscape architects, and designers with the City of Vancouver. Yet, if understood through Zeisel's image-test-present-actions, these design teams may only account for authorship of "presentation". Efforts rested more heavily on tests from Science World executives, engineering consultants, the City of Vancouver's many departments, and funders such as TD and Ken Spencer. The process appears to be a complex interrelation of aspirations from numerous actors:

> Interviewee 4: You've got to understand… it's so hard to tell the story of this. Well because the aspiration to do something outside at Science World in the public space existed for at least 15 years prior to it actually happening. The CEO wanted it badly, it's part of the reason [Ex-Director of Science world] took the job, was to build an outdoor Science Park. And he worked on it, it took him 10 years, working with the City, convincing donors that it was worthwhile. The concept was floating around for a long time. A lot of people entered and exited the team. Basically, every curator there had pitched ideas for it or worked on it.

Interviewee 4 nicely summarizes this chapter: this was a project initially conceived in 1989, when Science World group moved into the Geodesic dome. Are those who conceived and defined this as a project also its designers? How about the funders and Park Board as they provided their tests and refutations? As has been shown, the project involved layers of engineering, design, art production, interpretation and planning. People entered and exited the teams of both Science World and the City of Vancouver, and other groups. While the sociopolitical map (in Section 4.5.1) defined a particular group of people responsible, the total number was much larger.

5. Fifthly, What the spiral diagram seems to miss is an understanding that a design is never completely finalized: that when built, more testing and improvement can occur leading to other phases in its development. The design of the TDET remains capable of further evolution; this is one of the framework's weaknesses. Tied to the question "Just who is the designer?" is that of completion of the design process. Zeisel attempts to draw the line somewhere, although his argument is descriptive and a little ambiguous.[112]

[112] As stated "The process of improving a design may stop, for example, when the allotted time and money have been spent and a design review team in the office judges that the product meets office standards… . There are innumerable

The TDET design process has been revealed here through Zeisel's (1984) design spiral model, crystalizing the way in which form is imaged, presented and tested. The process is ever aiming toward a level that is "acceptable" for construction to all actors, or at least the major funders, involved. The TDET only emerges as a cohesive project within this larger spiral: in reality it is a mish mash of the OSE and Science World's renovation projects. Its "final" form continuously shifted: elements presented in the Facility Renewal document such as Sustainability Underground (May 2010, Section 4.7.3), and the C-Wall from Urban Design Panel reviews (November 2010, Section 4.7.5), were removed from the executed "product to be maintained". Exhibits that *were* executed such as Cycling Corner (Figure 67), were simplified, perhaps as the project's scope was reduced, from earlier concepts of, in the case of the Cycling Corner, the Energy Station.[113] Its resulting form is shown below.

Figure 67: Cycling Corner exhibit in 2012 with a bike pump and a poster on how to change a flat tire
Source: Talent Pun, 2012

Figure 68: Cycling Corner exhibit in 2020, with the bike pump stolen
Source: Luc Bagnérès

> Interviewee 3: The bike pump [was] stolen and the bike tools, cut off. I did research with the City engineer on the various bike pumps that had been used in public spaces. There's a fair amount of vandalism in the area – we sit at the edge of the Downtown Eastside. At night time they would try to remove any metal that they could, it's scrap metal to sell.

ways designers can use their surroundings to help them decide when a project is acceptable enough." (Zeisel, 1984, p. 14)

[113] Rather than an opportunity "to use bike-power to activate an exhibit", it evolved into public education on the changing and pumping of a bike's flat tire. To its right, a bike counter is installed providing data on the number of cyclists passing by this spot along False Creek.

In 2013, just a few months after the TD Bank helped to inaugurate the Environmental Trail, the bike pump and flat tire stand from the Cycling Corner exhibit were stolen (Figure 68). This reveals a vulnerability in the installation of public learning environments. Does that make such thieves part of the design process as well?[114] Without funding, as the Cycling Corner shows, keeping these exhibits operating effectively as learning environments is significantly reduced.[115] The line between "conception, design, and execution", and the "maintenance" of a public learning environment, has yet to be defined.

[114] As we have seen with the Energy station exhibit, design is also about reduction. Without glorifying criminals as designers, people clearly not involved in Zeisel's "design spiral" showed up and reduced the range of possible interactions for Cycling Corner, without asking for a City development permit. From 2013 onward, Science World became steward of the KSSP and the TDET.

[115] The funding made available for the maintenance of the TDET was not found in this research.

Chapter 5. Conclusions

The Environmental Trail (TDET) is a project that has reshaped the public realm of Creekside park. It emerged in the design process that detailed Science World's 2010 OSE proposal to take its exhibits outdoors to a wider public: a compromise emerged separating the fare-paying Ken Spencer Science Park from the public TDET. The former entailed the elimination of approximately 3,300 square metres of public park area; the latter, the improvement of 6,900 square metres of the park's remaining public realm.

The process allowed a desolate deteriorating public space designed for car access to become an opportunity for reimagination by Science World. While a number of interpretations of this design process can be given, the goal of this thesis was to answer the question: How was the TD Environmental Trail conceived designed and executed? This is only one avenue into the OSE project of course but it is the avenue that best sheds light on its "public exhibit" scale and the actual formation of the TD Environment Trail. Articulating this opens out the process to a broader public, allowing more people to understand urban design as it unfolds. The TDET was not designed in just one visionary moment: its form went through an evolving process of reconceptualization, transforming finally into design capable of execution in the real world. While this thesis may have successfully articulated the design process undergone by the Trail, understanding its success, and capacity to educate the public on sustainability, remains a goal for future investigation. Some preliminary observations and survey research, however, may provide a good start.

5.1. Evaluating the resulting experience of the environmental trail.

This section will present the findings derived from observations made, and surveys conducted,[116] between March and July 2019. Appendix B describes the method of data

[116] A total of 25 surveys were completed, representative only of those who used the TDET exhibits. After participants had finished using an exhibit/reading a poster, they were given the choice to fill out the survey on their own, or to be read the questions aloud.

collection and includes the charts and tables referred to in this section. From my findings, I draw the following conclusions on the TDET's use.

1. The Environmental Trail is more often used by members of the public than by Science World attendees.

When asked "what brings you to this space today?" survey respondents (n=25) answered "just passing through" 52%, "visiting Science World" 20%, and "visiting the playground" 4%. This provides evidence that the dominant audience of the TDET are people simply passing through the area, as opposed to Science World attendees. [117]

An observation sample of the TDET, starting at the Tower of Bauble, is shown below:

> On March 22, 2019, at 12:57 pm, a family of six stopped; in six minutes, they spent time moving around the exhibit admiring its complexity, pointing at features and how its systems work. During this time, a woman with her two children joined for 30 seconds, before heading inside Science World. At 1:01, a crowd started to develop: two women each pushing a stroller and a child by their side stopped. While these women didn't pay too much attention to the exhibit, their children did, circling around the canopy structure to follow the moving balls, tapping against the glass asking their mothers to look.
>
> More clustering began at 1:02: a group of five joined in as the balls came crashing through the different bells and chimes of the machine. This group had two teens, two young adults and a child. As can be seen in Figure 69, one of the young adults began explaining to one of the teens how the billiard balls worked within the system, pointing at the features and mechanisms that led the balls to create the sounds that had nudged them into stopping. This group continued to observe and track the various trajectories, saying "so cool ". Unlike the rest, they not only admired the complexity of the exhibit but tried to explain to each other its systems with strong emotional responses. They spent a total of about four minutes and 50 seconds at the exhibit.

[117] This is confirmed by answers to a different question (Table in Appendix B) which asks "Are you going to or coming back from Science World?" in which 84% of respondents (21 of the 25) answered "it does not apply".

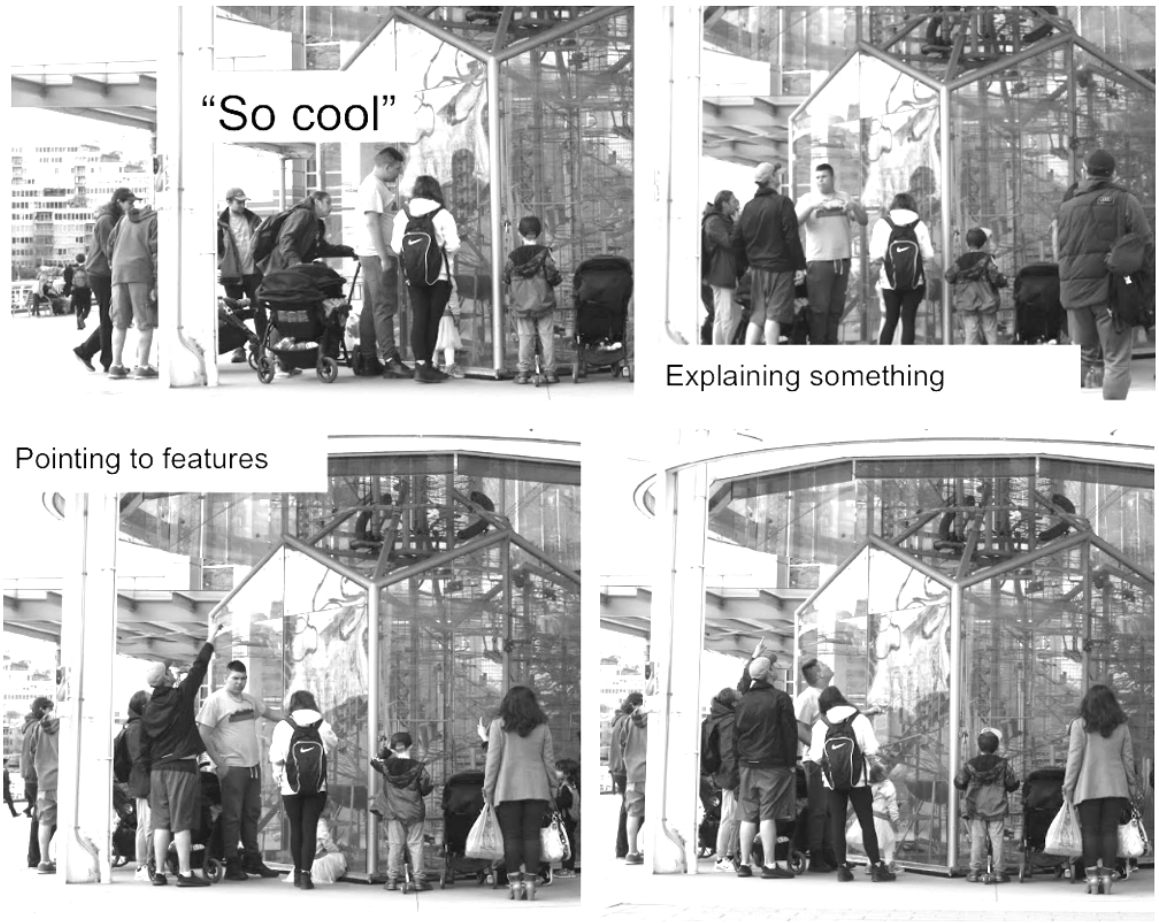

Figure 69: A sample experience on the TDET; a group of five curious citizens exploring the Tower of Bauble exhibit
Source: Luc Bagnérès

Rather than head inside Science World, this group went north to the TDET, moving along the Ken Spencer Wall to read a few posters. Two of its five members appreciated the intricate details of the waste wall, spending approximately two minutes reading the poster next to it. The other three moved along to Garbozilla, asking the other two to hurry up. The young adults pointed out the features of the dinosaur to the child. One of the teens decided to read the poster facing the dinosaur, out loud so the whole group could hear: "As societies grow and evolve, the garbage they produce also changes…"

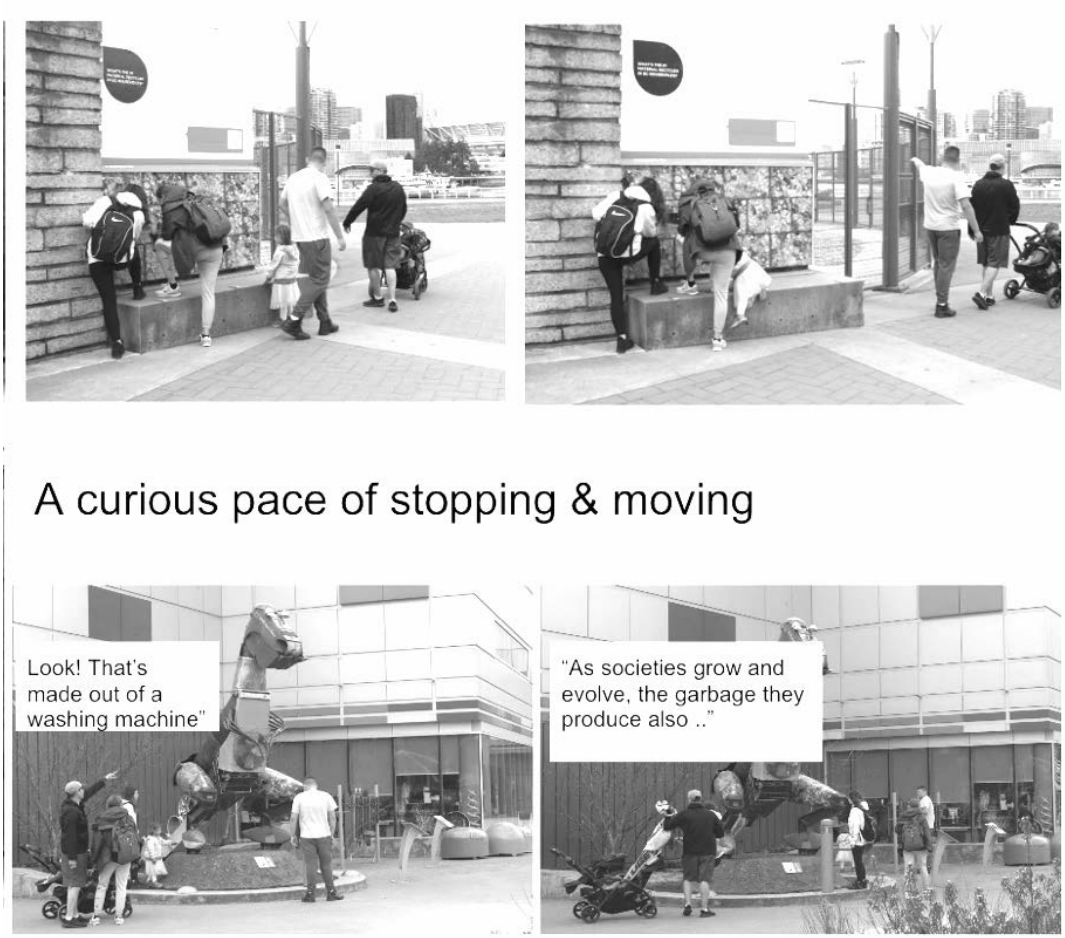

Figure 70: A sample experience on the TDET; a group of five curious citizens move through exploring the , Waste Wall and then Garbozilla, a giant life sized T-Rex made out of a trash
Source: Luc Bagnérès

Seen in Figure 70, this group of five spent six minutes and 20 seconds at the exhibit. From 1:13 to 1:19, they continued to admire the Garbozilla, with some beginning to play the recycled chime wall. Soon after, a woman with six children stopped and joined in on the music, each banging on the whale drums beside the exhibit. The group's music was more chaotic than melodic, and after about three minutes most stopped and went to look at the dinosaur, just as the group of five left to move north along the seawall. Two of the six children continue to play, however, and showed actual rhythm in their performance. The group of seven spent five minutes and 50 seconds there, before moving towards the Choices exhibit.

At 1:24 PM, with nobody left at the exhibit, an interesting encounter occurred. A couple passed by the dinosaur; however, the man had a spurt of curiosity, and jogged over to take a look at it, reading the posters for 25 seconds. His partner continued to walk at a slow pace, before he caught up to her. They then continued to move along the seawall heading north.

This is one of the more unique bits of observation I made during the months of March to July 2019: unique because more often than not, pedestrians experienced the TDET in snippets, rather than as a continuous experience.

2. The Environmental Trail is experienced in fragments rather than as a continuous experience.

Perhaps the most significant of survey findings is the fact that very few people know they are actually on the TD Environmental Trail (12%), and that while participants do recognize multiple exhibits, they do not understand them as a cohesive set of experiences (see Figure B1-B2 in Appendix B). The reason why the TDET lacks cohesion has been amply discussed: it was only conceived as a whole in 2011, after the exhibits had been designed and developed by two quite different design teams. Interviewee 4 explains how this lack of continuity was followed up with a quick low-budget attempt at reconciliation: large banners that lasted just a few months.[118]

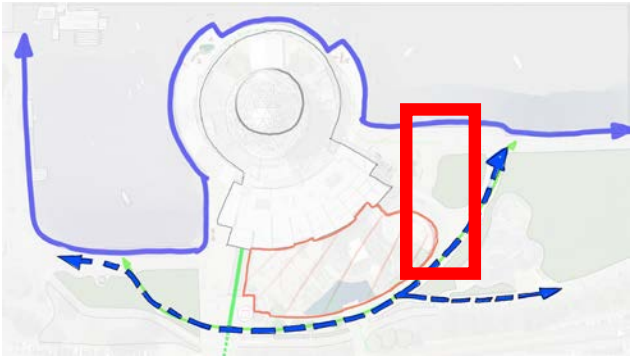

Figure 71: The flex zone with gates that open up
Source: Luc Bagnérès

Figure 72: Two alternative pathways moving through Science Worlds public space
Source: Luc Bagnérès

Another important factor contributing to the fragmented experiences, though, may be the configuration of pathways along the seawall (Figure 72). The exhibits on the Expo deck, and on the Ken Spencer Science Park interface, can be seen as two options to those moving between the

[118] As Interviewee 4 explained when asked why people don't recognize that they are on the TDET: "It's kind of a by-product of the concept of a trail manifesting itself later, after some of this stuff had been developed, and also, just a lack of budget in strengthening that continuity. There was a period where we actually had big vinyl banners that was supposed to help with the continuity. They were only up for a few months." These vinyl banners were thrown into False Creek before the experiment was terminated.

northeast and southeast portions of the seawall. If we recognize the survey results that most TD Trail users were not frequenting Science World (84%), then the pathway configuration becomes even more important. A first design suggestion is to bring alive this northern section of the TDET (Appendix D). If the Flex Zone were opened (Figure 71), it would potentially create a stronger connection between the two distinct areas of the trail.

3. Fifty-seven per cent of people surveyed reported that they had learned something new on the TDET.

When asked: "Did you learn anything new from the TDET today?" respondents answered "yes" 12 of 21 times. Two answers to the question referred to specific posters, e.g., "land-use change", which supplied the fact that the location of the TDET was once under water. However, when asked to describe what they learned, they were, at times incorrect. For example, the fact that "the harbour seal is the only animal native to False Creek" was not remembered correctly from a poster of the Marshland exhibit. There is no way to test the effectiveness of learning over the long term. Prior to implementation of more of these exhibits, it would be wise to set criteria for learning success, something that was not done in this case. The other preliminary conclusion shown in Appendix B is that:

4. Exhibits have shown evidence of Jan Gehl's self-reinforcing process.

In sum, the concept of free choice learning as it applies to sustainability has not yet been fully tested, and the true success of the existing TDET is not fully understood. More incisive questions on how to assess the success of public learning environments require further research; their answers will allow these environments to be more easily translated into design policy.[119] Returning again to Zeisel's design spiral, this kind of evaluation is one example of the research that can improve design of the next phase of the TDET.

[119] For example, are we measuring duration of time, number of people at the exhibit, or the number of people who pass by versus number of people who stop?

5.2. Understanding Sustainability as Layered

Sustainability was neither defined nor investigated in the literature review provided here (Chapter 2). It was, instead, considered critically as it emerged within the design process of the TDET. What I found was that integration of sustainability into this project was layered.

First, sustainability was understood within the context of Science World's site infrastructure. It is not only that the dome was intended to be temporary, but that the Expo deck was constructed as temporary as well, and needed to be reinforced after the fact. While there were plans to remove the deck in 2008, the structure was retained serving as a supporting platform of the TDET exhibits. The TDET (as well as Science World) falls partially on the ephemeral Expo deck structure although their more robust elements (e.g., the Tower of Bauble and the Ken Spencer Science Park) needed to be located on more solid ground. Sustainability in this case depended upon the structural capacity of the deck and potential collapse of its foundation. The TDET and KSSP were designed to allow for the future removal of the deck structure and subsequent shoreline renewal.

Second, sustainability may be understood as a series of trade-offs.[120] As was explained in Section 4.6, the recycled chimes and whale drum exhibits were manufactured in Maine (USA) and shipped to Vancouver. While the material was recycled from waste, the energy cost of its transportation may have been extensive. Also part of the TDET, the concrete of the pre-existing Creekside Park site was recycled in the making of the KSSP boundary. Understanding sustainability through the energy costs of TDET's design and construction itself is complex and requires further research.

Third, sustainability was an overarching theme and mechanism of integration for the educative exhibits, manifested in the exhibits themselves and their interpretive posters. This played a political role in the design process as the mechanism that aligned the interests of the City of Vancouver and Science World and allowed negotiations on the creation of a fare-paying KSSP to proceed. Its sub-themes of water, waste, energy, housing, transportation, and food were

[120] Within the Our World Gallery (Appendix C2), the exhibit entitled Dogzilla vs.The Carbonator illustrates the notion of trade-offs critical to an understanding sustainability.

at the very least influenced by the Greenest City Action Plan formulated in 2009-2010, as discussed in Section 4.5.1. Nonetheless, the exhibits and themes of the 2002 Our World Gallery (Appendix C.2) contributed to the conceptualization of the initial three TDET exhibits. The sub-theme of water seemed to have been maintained throughout the TDET design process from 1999 to 2013. Initially, in 2002, water was understood through the lens of physics. The final, constructed, TDET educates on issues of water availability and use through the lens of sustainability, illustrating hydroelectricity and hydraulic systems, the underground water networks, and lost streams. The only exhibit related to the immediate context of False Creek's water quality, however, the 'C-Wall' (in Urban Design Review B), was not realized. Other elements like sea level rise seemed to have been left out of the picture entirely, perhaps because they were not seen as a threat at the start of the decade.[121]

During the TDET design process, the theme of sustainability could not remain insubstantial; a narrative linking sub-themes and supported by educational materials needed to be defined. This process was not exclusively done by Science World. That narrative was consequently related to the interests of the negotiating parties, and reflected their particular perspectives on the surrounding environment. The City of Vancouver's council and staff, for example, may have seized an opportunity: how the TDET could play a role in shaping perceptions of the city held by its residents, investors, tourists and citizens, and could subsequently strengthen the value of its "green" brand.[122] In 2015, that brand was valued at $31 billion.[123] If an oil spill were to reach the Burrard Inlet, it could impact the city's brand to a value of $3 Billion, [124] a threat to the economy and to its marine ecology (Ryan, 2016). A TDET narrative that articulated the current risks of sea level rise, liquefaction of the Expo deck

[121] Sea-level rise was not given as much importance during the OSE design in 2009-2010. It was out of their scope of work as confirmed by NM.

[122] This point is further supported whereby the Deputy City Manager noted "the space in front of Science World as the front yard of the city and has so much potential" (City of Vancouver, 2010d, p. 7).

[123] In an independent market research study by Edgar Baum of Brand Finance Inc. (2015), a series of questions about brand strength and perceptual brand equity was given to international business stake holders. In questions such as "What is your overall impression of the following cities as a place for sustainability?"(p. 4) Vancouver significantly outperformed the other five cities.

[124] Brand Finance explained how the value of the "City of Vancouver brand would be at risk should an oil spill occur. The impairment on 10 the brand value is between $1 billion to $1.7 billion in a conservative 11 assessment; $1.5 billion to $2.3 billion in a mid-level assessment; and $2.3 billion to $3 billion in an aggressive assessment" (2015, p. 20).

substrate, or the high E. coli levels of False Creek, could negatively impact the City's brand. The power of interpretative design and narrative in the public realm should not be underestimated: it can shape subconscious perceptions of a city and its brand, especially when information is strategically selected.

Branding also takes explicit form through TD's sponsorship of the Environmental Trail. Additional interpretative panels were requested by TD between 2012 and 2013; "We had to get a content connection and it had to be environmentally related/educational, we had to add a little bit more to make TD happy" (Interviewee JB). One of the panels created, shown below states "Imagine a world that is sustainable, prosperous and healthy. We are." (see red box, Figure 73) TD's narrative of sustainability is one-sided, however: it showcases rather than engages the public. As a result, tension was created, and in mid-2019, the image was tagged with the response "No we are not". The tag has been removed .

Chalkboards were imagined along the waste wall in Urban Design Panel B (City of Vancouver, 2010b), but never implemented for reasons undocumented. The way in which cities and corporations impose branding onto public learning environments can clearly have negative effects.

Figure 73: A TDET panel added in 2013 at the TD Bank's request
Source: Luc Bagnérès

Kohn (2004) described[125] how "commercial ventures are gradually taking over more and more public space" (p. 4). Further research needs to be conducted to provide a better understanding of the role of sustainability branding in the public realm. Updating the sustainability themes remains a very important recommendation in the next stages of TDET development (Design Suggestion 2, Appendix D). After all, its graphic panels were designed to be modular and interchangeable (City of Vancouver, 2010c):

> Interviewee 3: You have to have a way to change the stories, you have to have a way to keep your content current, which is very difficult for any sustainability exhibit. When you've got something that is in very dynamic flux, like sustainability and recycling, re-use re-purpose, recover… they change very quickly.

In the creation of a more open-ended narrative on sustainability, a design suggestion would be to add panels that invite participants to share feedback and suggestions for the TDET and on the topic of sustainability in general (Appendix D).

5.3. Possible trails of East False Creek

Decisions concerning the future of the Expo deck not taken during the TDET design process have yet to be addressed. One of main concerns about the deck and its foundation is that they are not seismically sound. Another relates to its vulnerability to storm surge and sea level rise, with the deck potentially flooded by 2040-2050 (CFRA, 2018). While the deck was initially set to be dismantled in 2010, plans for its removal are again being made. The re-development of East park and Creekside South as a part of the Southeast False Creek (SEFC) development, propose the removal of the southern deck (Vancouver Board of Parks and Recreation, 2020); planners for the Northeast False Creek (NEFC) development (City of Vancouver, 2018) are proposing a reinvented deck for the north side of Creekside Park. While NEFC does not have an interpretative plan like that of SEFC (City of Vancouver, 2006b), some of their policies from "11.5 – Environmental Education" relate directly to the TDET.[126] This set of policies may be the

[125]As Kohn (2004) illustrates "Big corporations have paid tens of thousands of dollars to emblazon their logos on Times Square-style digital billboards while citizens were arrested for drawing peace signs in chalk on the plaza. This process is so widespread that commentators have coined the term "café-creep" (p. 4).

[126] As stated "11.5.1 Demonstrate for the general public, on an ongoing basis, how the neighbourhood has worked toward the goals outlined in various policies to create a cutting-edge sustainable neighbourhood.11.5.2 Integrate signage, public art, wayfinding and environmental design to illustrate sustainable systems and design principles at

beginning of a system of "signage, public art, wayfinding," and interactive exhibits that form a cohesive network of learning infrastructure.

The City of Vancouver Park Board and Science World could consider collaborating in design efforts to expand the TDET. In 2002, at the beginning of the design process, a significantly larger vision for the Environmental Trail was introduced, stretching it toward the Cambie Bridge (Section 4.2). In 2009-2010, it was reduced to the loop around Science World. While the time to engage East False Creek developers might not have been ripe in 2002, perhaps it is now. The definition of False Creek's shoreline remains unsettled in the NEFC plan and the False Creek to Fraser River plan (City of Vancouver, 2019b). Councillor Wiebe is proposing a first phase of creek daylighting to connect Trout Lake to False Creek (Appendix D4). This strategy also includes an integration with local schools.[127] One of my design suggestions is to consider how an expansion of the TDET could align with these efforts (Appendix D).

Within the decolonizing process of Northeast False Creek, Coast Salish artist Cease Wyss proposes clam beds and shell middens to help nourish the creek and the marine life (City of Vancouver, 2018). This bio-remediation project could serve as an opportunity for environmental education programming using Science World students as stewards.[128] Strategies of this nature could align with goals introduced in the Park Board "Rewilding Vancouver, From Sustaining to Flourishing. An Environmental Education & Stewardship Action Plan" (Vancouver Board of Parks and Recreation, 2014). Post Covid-19 education with local schools could be facilitated through the process of reconciliation, introducing more public learning environments like the TDET and art projects like Systems of Sustenance (Appendix C.3).[129] This thesis research took place by and large prior to the Covid pandemic. However, it may have accidentally provided

work in the area.11.5.3 Seek opportunities to educate residents and visitors about the sustainability and resiliency design features of the area and their benefits" (NEFC Plan, City of Vancouver, 2017, pp. 90-93).

[127] As stated, "the Vancouver School Board approved the first ever Environmental Sustainability Plan in 2019 to advance five key themes: sustainability in education, green spaces, resource conservation and climate change, sustainability transportation and leadership in sustainability. Multiple schools will have connections to outdoor learning on the blueway, with Nootka Elementary having the potential to enhance a portion of the creek on VSB land" (City of Vancouver, 2019, pp. 2-3).

[128] Such stewardship projects exist with K-12 students and marine life restoration is already underway with the Billion Oysters Project in New York City (2016).

[129] Reichstein's "The Classroom in Open Air. Outdoor environmental learning in Vancouver parks" (2018) should be considered when researching ways that school teachers may engage with public learning environments in the future.

some insight into creating more public learning environments in the future. These environments may be rather complementary and adaptable for teachers and students to use during class hours. Public learning environments are a good way forward in converting under used urban areas into small scale pilot projects for the underprivileged.

A final design suggestion is that the City and Science World consider expanding the TDET onto the water through floating architecture as an immersive engagement tool (Appendix D). Emily Carr's "Float School" as well as the Blue Cabin, located in NEFC, could provide interesting opportunities for collaboration.[130] Here, Science World could better engage with the theme of water, which is not only a problematic dynamic for future designs in East False Creek, but also an intriguing opportunity to adapt and learn from.

5.4. An acceptable response?

This research is the clarification of one project, the Outdoor Science Experience (1999-2013) from which emerged the TDET. It may provide insight for the next steps along the East False Creek shoreline. Gaps remain in the temporal evidence documenting TDET development between the years 2002 to 2005 and 2011 to 2013. Evidence may exist that reveals the design chronology in a more refined way, perhaps reframing the conclusions presented here. This is the nature of research; it continuously evolves.

As mentioned earlier, the story of the TDET's design process is just one avenue into the larger phenomenon of learning environment creation through a lens of public-private urban design. The only way I could make sense of the case study was by reconstructing the Trail's design process. Entering this project, the research findings did not add up; there was much conflicting and confusing information about the nature of the TDET, the date of its initiation, and its designers. I wanted to resolve these contradictions and so dropped my initial research question (see Appendix A.3). This thesis evolved into the study of a unique and complex

[130] As stated in the Blue Cabin report: "FLOAT school embarks on collectively imagining diverse multiple futures of the role that art, public engagement, and learning can play in various communities, and promoting access to these conversations through numerous public events. We envision working with Blue Cabin Floating Artist Residency to launch a two-part research and prototype stage of the Floating School's approach to public programming"(2016, p. 22).

development process for an equally unique exhibit-filled public space. It is not easily transferable to the design of other public spaces. Nonetheless, its experimental nature may have produced information of value to larger assessments in other contexts: urban design, landscape architecture, public education, or the existence and well-being of not-for-profit institutions.

An important topic of these contexts is the practice of public space privatization, which, this study shows, must always be considered in a wider frame. In this thesis, a public space was made fare-paying but achieved in return a renovated park space with improved bike lanes, landscaping and the TD environment trail. A Vancouver-based non-profit organization, Science World, led the entire project.[131] To remain financially sustainable and to meet its ambition of public engagement on topics of scientific concern, Science World enlarged its facilities, expanding its exhibit space into the Ken Spencer Science Park. As stated in its development permit: "While staff believe the proposed improvements, subject to the design development conditions presented herein, will be a demonstrable improvement to the park, staff continue to remain mindful, and monitor, the question of Park space reduction in the larger False Creek context" (City of Vancouver, 2010c, p. 8). Greater research attention should be paid to the expansion and reduction of public space: it is a civic right. Is what matters preservation of public space area or improvement of its quality? In the OSE project, while quantity was reduced, the quality of public space was improved through skillful design of relationships, and properly used hazards, incidence, and enclosures (Cullen, 1961), each providing better definition of Science World as a landmark (and of its footprint within Creekside Park and along the seawall). This improved quality has enabled bewilderment and curiosity into a landscape that was static. In terms of the design of learning environments, process here might not be as transferrable as the content of the exhibits themselves. If we take a step back and consider how the project came to be, it is likely that we can agree with Interviewee 4 that the process was organic.

> Interviewee 4: The goal posts of the project moved all the time: we were constantly trying to adjust and fit things into scope. I wish I was able to describe this beautiful elegant thoughtful design process where everything [was] a waterfall. Where you have a year of content development; then going into a

[131]Science World receives no on-going support from any level of government. As stated "[Science World is] principally self-funded with the majority of our funding coming from site generated revenue - ticket sales, parking, gift shop, food services"(City of Vancouver, 2010c, Appendix J, p. 2).The fare to enter the KSSP contributes to a not-for-profit science museum that provides tourists a fun place to go, families the chance to bring their children on a rainy day, and field trips for the children across the Lower Mainland.

> production phase of a couple years; and then you get your development permit, your instructions. The [number] of constant changes and developments required just to make the project happen was immense.

It contrasts sharply with the more straightforward implementation of other interpretative strategies (Appendix C.4 shows examples of the SEFC, and the Edmonton River Valley). The TDET was an emergent project. With the competing interests of the City of Vancouver, its Park Board, Science World, and the TD bank, the design of its public learning environment was fractured. In its efforts between 2003 and 2006 to get the City's attention, Science World was treated as just another developer. It was instead a non-profit educational institution that sought to provide real benefits to the public realm.

One difficulty was the lack of information available on the impact of public learning environments. As shown in section 5.1, definition of the success of learning outcomes from exhibits in public space is still in its early stages. This had to make it harder for Science World and the City to translate their development into policy and thus funding priority. And in the end, their full learning potential was compromised by a lack of budget at every turn. Left as the final piece of the larger OSE intervention, the visionary design of the learning exhibits was significantly reduced. A lack of understanding of their effectiveness shifted concentration from actual learning outcomes to branding potential: no performance criteria were found. Personal observations in 5.1 and Appendix B show that people are learning from these exhibits and engaging with one another in novel ways. I believe they represent a promising avenue for public space design. The improved quality of the TDET was also meant to provide education about important environment-related issues. However, evidence of long-term learning was neither explored here nor found in other research. Whether this free-choice learning on sustainability is effective remains to be seen.

Finally, the complexity of PFS's orchestration of the OSE's landscape architecture, alongside Science World's co-ordination of exhibit construction in both the KSSP and the TDET, was considerable. Their efforts should be applauded for realizing this experimental project. The resulting experience was completed under an extremely tight budget, complex political forces and on a challenging Expo deck site. If the TDET isn't already a successful example, then the analysis and design suggestions provided show that it could certainly evolve

into one. Whatever the case, the TDET provides a unique set of interpretive and interactive exhibits, animating the public realm in ways that are rarely found in Vancouver.

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Appendix A. Empirical background

Below are the people that I interviewed. Some desired to remain anonymous.

1. JB - SW Exhibit Designer 1 – Jodie Braaten

Exhibit Designer for the three exhibits on the deck integrated into the TD Environmental Trail (TDET). Since 2005, Jodie still works for Science World at the time.

2. RN - Science World Exhibit Designer 2 – Raymond Nakamura

Exhibit Designer for the Our World Gallery (Appendix C.2) which served as an inspiration for TDET. Raymond was not part of the TDET design process.

3. I3 - Science World Employee

This interviewee has chosen to remain anonymous and their position in the project is not described.

4. I4 - Science World Employee

This interviewee has chosen to remain anonymous and their position in the project is not described.

5. NM - PFS Studio Landscape Architect – Nastaran Moradinejad

Project manager and designer for Phillips Farevaag Smallenberg (PFS). Nastaran's team orchestrated the design development of the Ken Spencer Science Park and part of the TDET.

6. DB - Systems of Sustenance Project Artist - Dan Bushnell

Lead Artist/project manager for the Systems of Sustenance project (Appendix C.3). Dan worked with the Squamish and Musqueam band leaders. This project, also in Creekside Park, provided context to the TDET.

7. I7 - City of Vancouver Employee

This interviewee has chosen to remain anonymous and their position in the project is not described.

8. BT - Science World Chief Executive Officer – Bryan Tisdall

CEO of Science World between 1995-2015, Bryan played a pivotal role in bringing the TDET to life. Bryan was part of the original team creating the vision of the Outdoor Science experience and helped secure funding for the project.

9. SH- City of Vancouver Urban Designer – Scot Hein

Development planner for the OSE project, Scot was essential in integrating the TDET vision with the City's SEFC plans for the area. He contributed to the creation of the development permit reports with I7, advising the COV's development board.

A.1 Sample Interview Questions

SFU SIMON FRASER UNIVERSITY
ENGAGING THE WORLD

Evaluating the educational potential of public space around Science World

Questions for Thesis Interview: Interviewee 7

While some might be added/removed, here is a list of what I'm interested in asking you. These questions may be asked at various stages. Please indicate if you are uncomfortable answering any questions mentioned.

Outdoor Science Experience

- When were you brought into the process of negotiation with Science World?
- Who comprised of your team at the City of Vancouver working on this project? Who were the main actors from Science World and PFS you engaged with?
- Who were the public groups engaged in the consultation process?
- Describe to me the process of public consultation and engagement for the Outdoor Science Experience.
- How did feedback from such engagement play into the negotiation process? Was any documentation written of public feedback of which was mandated?
- When was the Science Park project approved and what was agreed to be delivered?

The TD Environmental Trail

- Was the City involved in any creative input into the public realm elements such as Environmental Trail?
- What was the role of the TD Environmental Trail in the process of negotiations for the outdoor science experience?
- Was the 3-exhibit installations on the Science World deck (the SWITCH) built before the larger Science Park was approved?
- Do you think this project is successful to the promises it aimed to deliver?
- Do you think the consultation process was well shown in the final result?

A.2 Evolution of Research Question

When I began researching for a thesis topic, I was living in Mount Pleasant, ten minutes from Science World. I often frequented the exhibits of the TD Environmental Trail, and I was curious to study their effects on the public; It was a unique set of design objects that I had rarely seen anywhere else in the city. Reading Zeisel's book *Inquiry by Design*, I was interested in creating research that would be helpful for designers in the future. These were the very intentions of Zeisel when he developed the design spiral where researchers may intervene within the design process in three areas:

> The day-to-day practice of design offers at least three occasions for research and design cooperation: 1) user needs programming research for designing a particular project; 2) design review to assess the degree to which designs reflect existing EB research knowledge; 3) evaluation of build projects in use. Each occasion can contribute to the fund of basic EB knowledge, improving our general ability to solve design and research problems. p. 36 (Zeisel, 1984 p. 36).

Therefore, in beginning my research, my goal was to provide an evaluation research study on the environmental behavior (EB) from the TDET. Therefore, I entered my thesis with a different research question: *Did the TDET succeed at educating the public on sustainability discourse?* I developed quantitative and qualitative criteria, engaging with Science World and their exhibit research team at the beginning of 2019. I discovered they had not performed any research on the TD Environmental Trail, and they were supportive of my desire to contribute to research. At the same time, I had the opportunity to interview two designers from the TDET project. What I discovered from these interviews were two conflicting stories[132]. This motivated my final research question. I continued my interviews later discovering that the KSSP and the TDET exhibits were actually part of one larger project know as the OSE. I followed the format of Zeisel's Evaluation Research stage.[133] In answering my refine research question, *how was the (TDET) conceived, designed and executed?* Will therefore better inform a more complete evaluation research study which answers my initial research question: *How do citizens learn about sustainability in the public space around Science World ?*

[132] JB gave me five people, TP gave me two projects with this group of not five but six people. It was confusing and the process did not make sense. Who designed the TD Environmental Trail?

[133] As Zeisel states "Another occasion for designers and researchers to cooperate is when a building or other setting is in use. Such evaluation research answers questions like these: what were the designers' original intentions, and how did they try to implement them? What is there in the design that influenced use of the setting in ways that designers did not intend? (1984, p. 46).

Appendix B. Supporting Evidence

B.1 Surveys

Out of the 25 surveys, 19 were answered orally and 6 were completed in written form. Surveys were used strategically *only once* a pedestrian has become a participant who engages with either an exhibit or a poster. Therefore, survey data shown in this paper is only representative of those who use the exhibits rather than a general representative sample of those who use the whole public space in its other uses. This appendix provides supporting diagrams for the conclusions listed in Section 5.1.

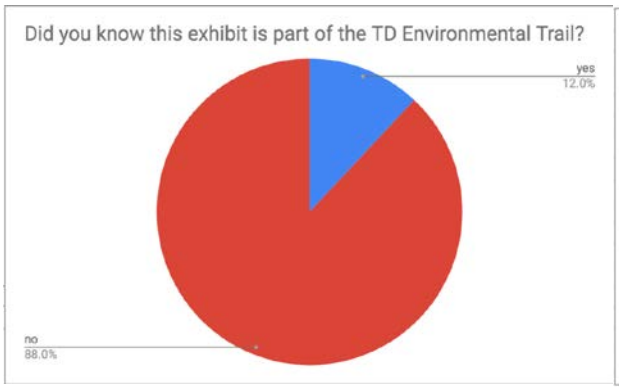

Figure B1: Survey Response

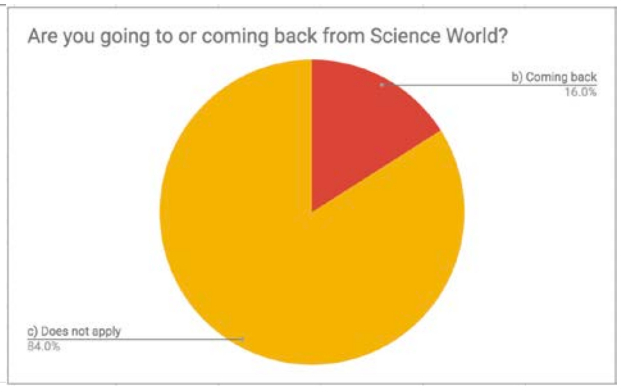

Figure B2: Figure showing how most TDET users do not attend Science World

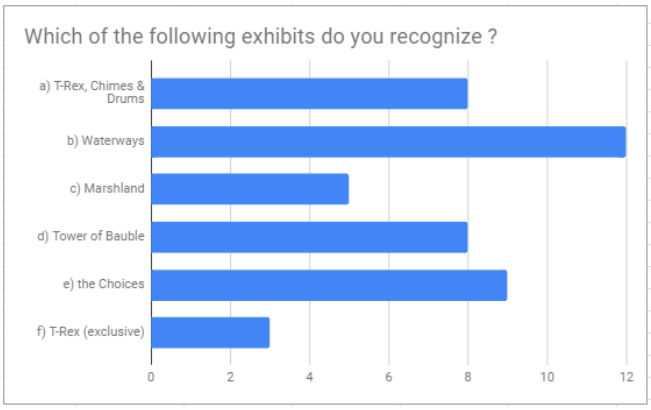

Figure B3: Survey Response Asked in Conjunction with Photographs on right

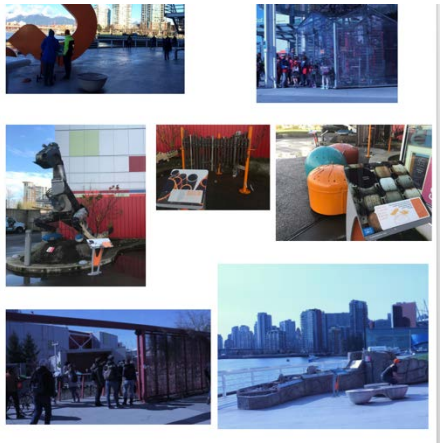

Figure B4:TDET Photographs Shown to Survey Respondents

Figure B5: Frequency of Visits

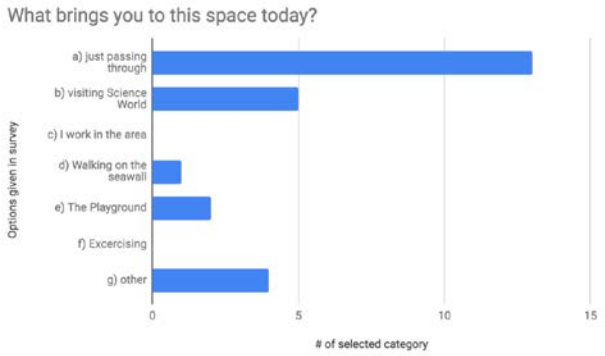

Figure* B6*: Motivation for Visiting the Area

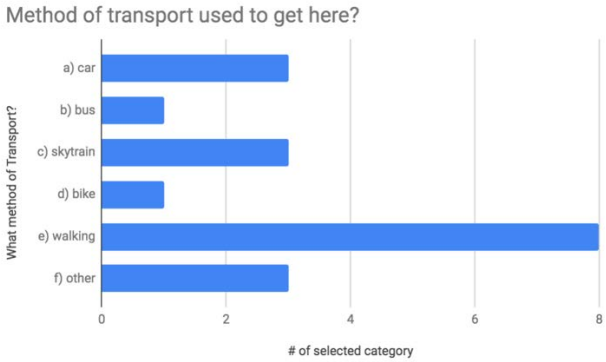

Figure B7: Methods of Transportation

The left Figure B1 reveals that only 16% of respondents who were using the TD Environmental Trail were actually attendees at Science World museum. The right Figure B2 shows that 5/25, marking 20%. Perhaps a mistake. Nonetheless, it reveals that TDET users by and large users are ‘just passing through’ the area between point A and B.

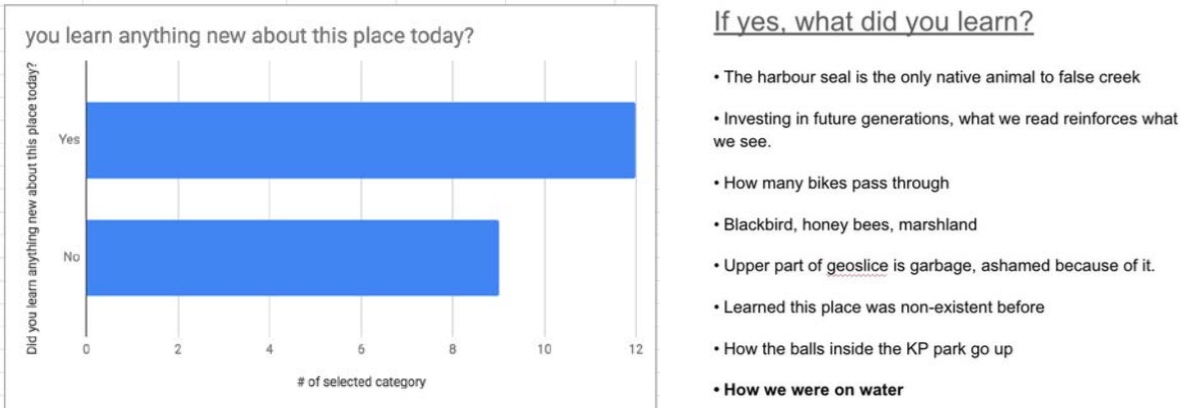

Figure B8: Survey responses asking whether participants of the TDET felt as if they learned something after using an exhibit

This question gave preliminary evidence of how 57% of respondents said they learned something new. Examples not discussed in the conclusion include "Upper part of Geoslice is garbage, ashamed because of it". This respondent's answer refers to TDET's Waterways exhibit recreating a 3D Geoslice with its top layer as discarded phones, calculators and other sources of garbage as well. The designers would indeed find subtle ways of communicating these hidden truths of the surrounding area. The designers understood the layers of False Creek (shown in Appendix C.1) and the infill of the False Creek flats of 1919 where garbage was covered into the mudflat. The respondents learned about this interesting fact[134].

B.2 Observations

These observations were conducted between March and July 2019. I placed myself at a reasonable distance, so behaviours observed were not influenced by my presence. The framework *Who-What-When-How?* by Jan Gehl & Bridgitte Svarre (2013) was used initially to gain better understanding of the site as a researcher. For example, in the newly created plaza made possible by the OSE, I collected the location of pedestrians at any one given moment at noon seen in the Figure B9 below.

The encircled exhibit below (Figure B9) is Tower of Bauble which has created a clustering effect accomplished through a self-reinforcing process, as explained by Gehl (1971) in Chapter 2. This figure introduces the interrelation of the exhibit use with the surrounding public life.

[134] False Creek in this context was perceived as an area of economic expansion, but also a landfill: "Sir: Why is there all this fuss and trouble about the garbage dump on False Creek Flats There are thousands of people living close to the flats and this ill-smelling property is at their very back doors." (History of Metropolitan Vancouver, 1938)

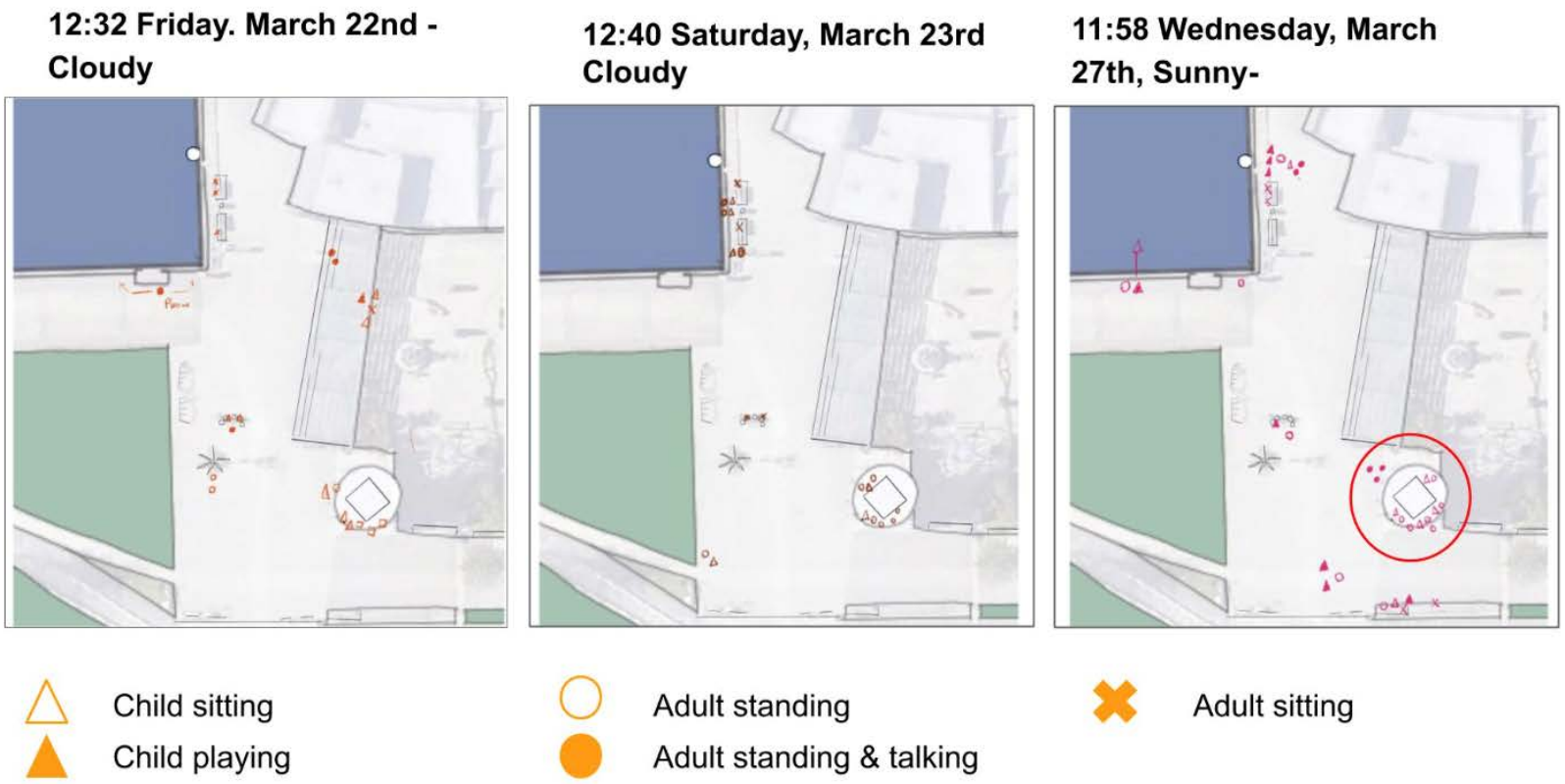

Figure B9: Observations done at Science World Plaza following Gehl and Svarre's framework (2016). Encircled in red, is the Tower of Bauble Exhibit

4. Exhibits have shown evidence of Jan Gehl's self-reinforcing process.

There is significant evidence that the TDET's interactive exhibit design leads to active prolonged engagement (Gehl, 1971; Humphrey, 2005). What is also particular about this series of exhibits is how they activate multiple senses in a self-reinforcing process. Significant evidence was collected that showed the interactive design of these exhibits reinforced their ability to hold people's attention. For example, curiosity about the dinosaur prompts them to stop. Once stopped they may start playing the chimes, the sound of which may in turn activate a process of reinforcement. It is from this low intensity contact that learning can emerge. As Gehl stated in this regard, the number of minutes spent outdoors is more important than the number of people involved. Another observation captured on June 1, between 2:43 and 2:53 at the Waterways, illustrates this in a different way:

> At 2:43pm, two women approached the Waterways exhibit and started to pull on different knobs and pulleys. They moved around and read the posters facing it. After about two minutes, they left and a group of two younger men stopped to re-adjust the pulleys and water gates. These two started to strategize, hypothesize, and change the water currents for about six minutes and 50 seconds. As they continued to create different water flows and build up dams, other groups joined in. A couple spent three minutes observing the two. A dad with his son then stopped for about 30 seconds proceeding to climb the adjacent artificial mound. The self-reinforcing process continued as a group of three adults stayed for about 50 seconds, reading posters, and joining in, adjusting the pulleys in the lower half of the exhibit.
>
> Then, at 2:49 pm, a group of four young men stopped for about three minutes and 30 seconds. Here, they began to strategize; their goal was to make the water wheel turn. They discussed with one another how to divide the tasks as they coordinated the adjustment of pulleys. Soon after, they managed to align the water flow making both wheels turn at the same time, one of them exclaiming "there we go". A child with his dad looked on; the child was intrigued, and as the four young adults left, the child took over, harnessing the flow of water in different ways. As he was doing this, two young women approached the exhibit and started to read the adjacent posters. The self-reinforcing process continued after recording of this ten-minute segment.

Table B1: 10-minute observation segment presented in section 5.1 done on June 1st, 2019 for Waterways Exhibit

Waterways Exhibit			INITIATION					TRANSITION					BREAKTHROUGH			
Duration of use	Age Category	Sex	Knobs Twist (d	Reading Graphi	Touching Water	Observing othe	Misc	Repeating	Pointing	Moving Around	Coordinating	Emotional resp	Acknowledge R	Seek/Share infc	Involvement/En	Flow
June 1st (Saturday)																
185	Y Adult	F	1	1		1										
185	Y Adult	F	1	1		1										
410	Y Ad	M	1		1		1	1		1					1	1
410	Y Ad	M	1		1		1	1		1					1	1
180	Adult	M	1					1								
45	Adult	F	1													
30	Adult	M	1													
30	Child	M	1													
50	Adult	F	1	1												
45	Adult	F	1													
45	Adult	M	1	1												
110	Child	F	1													
110	Adult	M	1													
210	Y Ad	M	1		1			1		1		1			1	
210	Y Ad	M	1		1			1		1		1			1	
295	Y Ad	M	1		1			1		1					1	
295	Y Ad	m	1		1			1		1					1	
295	Y Ad	m	1		1			1		1					1	
295	Y Ad	m	1		1			1		1					1	
350	Child	M								1					1	
	with Father who	M														
105	Y Ad	F	1	1				1								
105	Y Ad	F	1	1				1								

This snippet translated into Table B1 above is perhaps one of the greatest successes found in observations of Waterway , not only in the time people spent and the number of people involved, but also in the ways in which they interacted with the exhibit. There were not only quality exchanges between people in their respective groups, but intermingling among groups. A child was learning from young adults who were coordinating the water flow to make the wheel turn. He then used their strategy to make this process happen himself. This shows the complexity and potential of learning experiences derived from these environments. While they may not educate on topics of sustainability, they do indeed facilitate learning.

In a span of 10 minutes, 23 people stopped for an average of three minutes and 2 seconds (see Table B1). Eight dedicated significant time to strategizing, exactly the goal of its designers in their Creative Brief (Science World, 2009a). In total, the Waterways exhibit was observed for 14 ten-minute segments. Visits lasted an average of 38.1 seconds when the water system was off, and two minutes and 28 seconds when it was on. The number of people recorded averaged 7.6 overall, and 7.9 per ten-minute segment. Waterway's success lasts just a third of the year, however, as it does not collect rainwater as initially intended (Science World, 2009a). This puts into question the notion of public learning environments that change with the seasons. To compare Waterways with the other exhibits, the Tower of Bauble had an average engagement time of two minutes and 27 seconds, and an average number of people of 18.27 per ten-minute segment (n=10). Garbozilla, in combination with the Waste Chimes had an average engagement time of 2:39 two minutes and 39 seconds, with 4.76 visitors per ten-minute segment (n=13) (see Figure B9).

The structure of my formal observations revolved around the collection of 10-minute segments at three exhibits at the TD Environmental Trail. For the Tower of Bauble, there was a total of 11 recorded segments; for Garbozilla, 14; for waterways, 15 (See Table below).

TDET Exhibits	Avg. Participant Time	Avg. # People/10 min.	Total Time Recorded
Tower of Bauble	147 sec.	18.3 persons	110 min.
Garbozilla+Instruments	159 sec.	4.8 persons	140 min.
Waterways	169 sec.	7.9 persons	150 min.

Figure B10: Compiled data for three exhibits of the TDET during months of March to June 2019

For each of these segment observations, I also categorized the types of activities that unfolded at these exhibits. I followed the Visitor Engagement Framework (VEF) also used by Science World in assessing their interior exhibit. The Visitor Engagement Framework (VEF) is tool aimed at assessing exhibits for science centers. Its focus is on measuring the behaviours occurring at individual exhibits. As Barriault & Pearson explain, this assessment tool is "based on the premise, supported by learning theories and research, that the level to which a visitor is engaged

by an exhibit is a direct indicator of the learning taking place." (p.90, 2016). They classify exhibit engagement into three different stages: 1) Initiation 2) Transition 3) Breakthrough[135]

- **Initiation:** Behaviour categories of Initiation stage: 1) *Doing the Activity* 2) *Spending Time Watching Others Engaging in the Activity.*
- **Transition:** Behaviour categories of transition stage: 1) *Repeating the Activity*2) *Expressing Positive Emotional Responses in Reaction to Engaging in the Activity*
- **Breakthrough:** Referring to past experiences while engaging in the activity2) Seeking and sharing information3) Engaged and Involved: testing variables, making comparisons, using information gained from activity

The figure below shows 20.6% of participants of the Tower of Bauble with breakthrough behaviours by activity type described in the table (Figures B11-B12). The other two exhibits were also recorded with behavior categorization (see Figure B13-B14)

[135]This framework emphasizes the importance of breakthrough activities, as they guarantee longer durations spent at an exhibit. In the case of the waterways, breakthrough activities would be acknowledging relevance verbally with another person or showing deep involvement with the activity as was the case here.

Tower of Bauble	Activity Type	# of participants
Initiation	Doing Activity (Observe)	162
	Reading Graphics	1
	Observing others/exhibit	2
Transition	Pointing	38
	Emotional response	29
	Move around	26
Breakthrough	Acknowledge Relevance	1
	Seek/Share info	14
	Involvement/Engagement	23

Figure B11: Visitor engagement activities for Tower of Bauble.

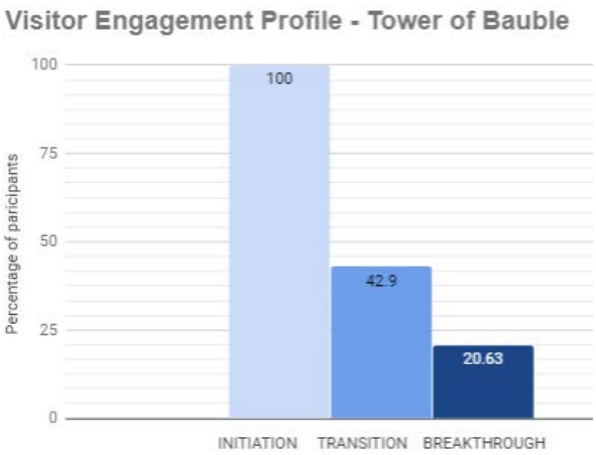

Figure B12: Visitor engagement profile based off activities compiled from observation.

Chimes + Drums + Garbagezilla	
Total Participants	81
Playing Instruments	51
Reading Graphics	11
Observing exhibit & Others	19
Misc	14
Repeating	25
Emotional response	18
Pointing	2
Acknowledge Relevance	2
Seek/Share info	0
Involvement/Engagement	13

Figure B13: Visitor engagement activities for Garbozilla.

Wateways Activities On	Participants #
Total Participants	95
Knobs Twist (doing activity	74
Reading Graphics	18
Touching Water	31
Observing others/exhibit	8
Misc	4
Repeating	32
Pointing	2
Moving Around to change differ	31
Coordinating	7
Emotional response	14
Acknowledge Relevance	2
Seek/Share info	8
Involvement/Engagement	26
Flow	6

Figure B14: Visitor engagement activities for Waterways when water is turned on .

Appendix C. Context of Creekside Park

C.1 History of East False Creek

This section will briefly describe how this land, where the TDET project was constructed, was only made possible through the drastic human intervention of infilling False Creek. This soil that supports the TDET covered up the waters of a pre-existing estuarine wetland[136]. False Creek was a nitrogen-rich area once nourishing many Coast Salish nations for centuries ; a series of creeks fed an estuarine marshland named 'Skwah'chays' seen below :

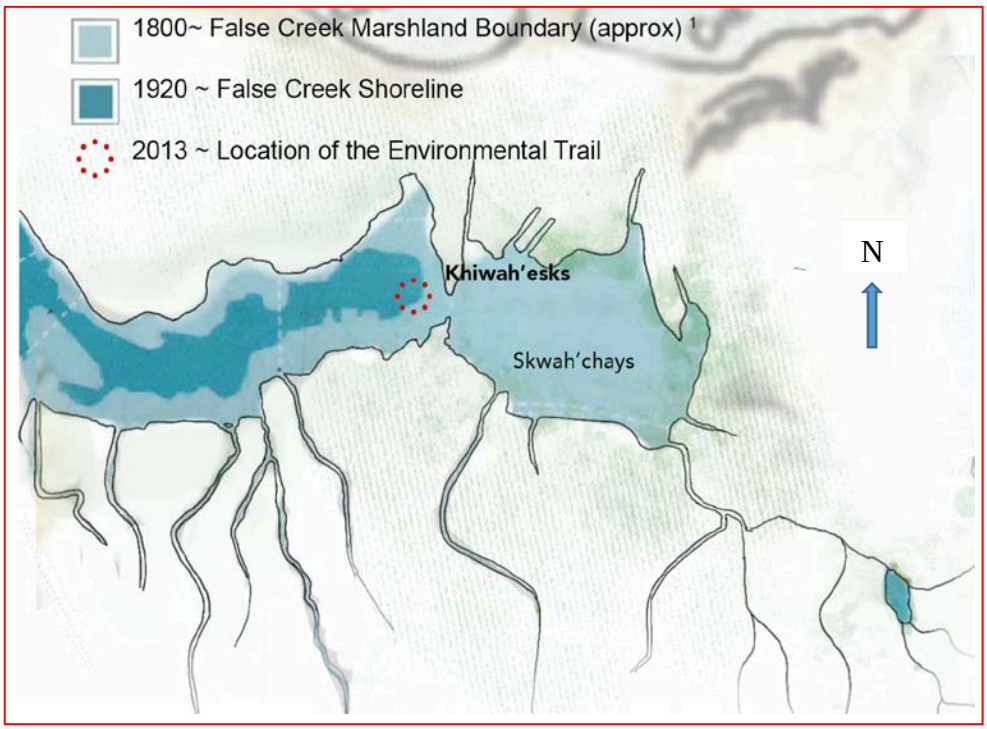

Figure C1: This personally adapted map of the geography around ~1800, overlaying the previous shown Squamish map with the network of streams. Source: Vancouver's Old Streams Map *(*1969)

As seen in the map above, the TDET was located near Khiwah'esks. This name derives from the Squamish language translating to "two points exactly opposite" (Burke, 2010). This was the name given to the two fingers of land in Figure C1, acting as a gateway for a salt marsh

[136] Named by the Squamish as Skwah'chays, this estuarine ecosystem would have dozens of creeks feeding from the Fraser River. The estuary that would be infilled compromised of approximately 64 hectares connecting to the larger ocean body of 'False Creek'.

lagoon (City of Vancouver, 2018). After the initial voyage of Captain George Vancouver, the British colonial settlers slowly built their settlements surrounding areas such as Skwah'chays and Khi'wahesks (Figure C1). The estuarine inlet would be coined False Creek in a 1856-63 expedition [137]. By 1918, 157 acres of water from False Creek were reclaimed with soils and garbage from across the lower mainland[138]. Land was seen as an economically valuable resource by European Settlers. Coast Salish Nations embodied a vastly different relationship of land upon the British explorers' discovery, at odds with the 'European' idea of private property. [139] By infilling the Skwah'chays waters, the new shoreline would terminate exactly at the Khiwah'esks peninsulas, defining a new edge (Lynch, 1962). The periods of industrial expansion altered the False Creek landscape, vastly different from its preceding layers. Figure C2 recapitulates land use change:

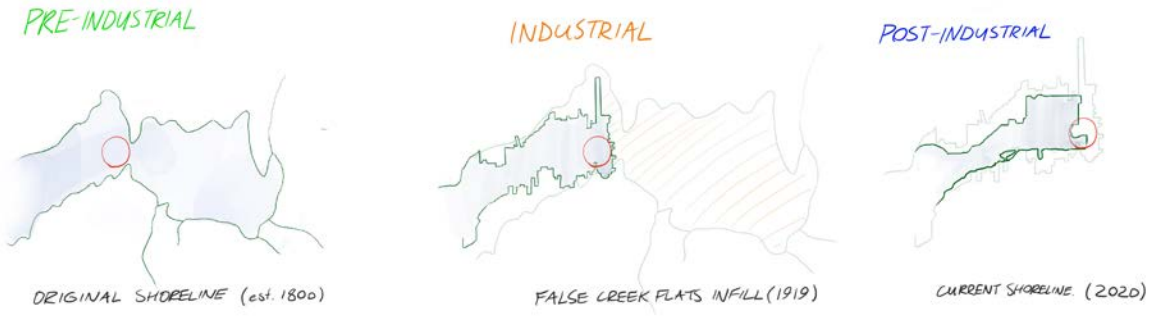

Figure C2: False Creek's shrinking shoreline between 1800-2000. The red circle points to the site of the Environmental Trail. Source: Luc Bagnérès

By the 1960s, the industrial activity around False Creek was in decline. A period of post-industrialization saw False Creek move from an industrial site to a commercial, recreational and residential district. [140] They would succeed in transforming the False Creek area into an area of

[137] Hydrographic survey by George Richards: "He thought he was going up a creek while traveling the south side of the Burrard Inlet, but soon discovered his mistake, hence the name 'False'" (Sullivan, 2013)

[138] Filled with 20,000 cubic yards of soil brought predominantly from Chilliwack and from the Grandview Cut, financed by Henry Thornton, the general manager of the CNR (Burk, 2010).

[139] Of course, each of these understandings are simplified and for the sake of scope cannot be dived into fully. A more well-rounded effort found with Blomley (2003) and Thom (2009). Although these coast Salish nations are not the same as the Musquem, Squamish and Tsleil-Waututh, they may suggest the way settlement relates to surround environment: That their practices of boundary making were the same as those interior coast Salish is an inference. However what's important to note is they had a relationship to land that was tied to their movements with the seasonal fertility of the local landscapes which consisted of Skwah-chays marsh and Khiwah,esks. This is confirmed by practices of the Heilsuk nation where they state: "The pattern of living that had developed over the millennia was characterized by people moving from place to place (winter villages to food gathering camps) throughout the year and harvesting a variety of sea and land resources that were seasonal in different places at different times of the year." (Brown & Brown, 2009, p.47)

[140] Jacopo (2009) gives a more sophisticated description of False Creek in 1960-1980 in his thesis "Visions of False Creek: Urban Development and Industrial Decline".

post-industrialization. Between 1980 and 1984, in preparation for the World's Fair, the Pacific Place Remediation Project would attempt to treat the toxic pollutants from the waters of the preceding industrial False creek. They were only partially successful (City of Vancouver, 1986).

C.2 Our World Exhibit Gallery

Within fifteen years, an exhibit dome designed for a temporary World's Fair 1986 was repurposed to make room for an ongoing science education center, Science World. This science center constructed 'Our World', an interior gallery exhibition, focused on the themes of the environment and sustainability. Its original name, "the Living Planet" can be seen in the ReGeneration plan (4.2.1) on Level II, the second floor of the Science World building. Its vision, drawn by the author of the Urban Treehouse vision (4.2.2) in November 1998, can be seen below.

Figure C3: Initial Image of Our World then known as the Living Planet (1999) with resulting exhibit space finished in 2000 reprinted with permission by Science World

Figure C4: Our World Exhibit with its initial image in 1998 and its completion in 2002 reprinted with permission by Science World

As seen above (Figure C3), the design process would start with the initial image of 1998 eventually leading to a decision to build the resulting exhibit space (Figure C4). Opening in 2002, it was the first true exhibit space in Science World which aimed to communicate themes of sustainability, or at the least, how humans relate, shape and affect their environment. Its resulting interactive exhibits and posters would focus on four themes: **Energy, Food, Waste, Water.**

Energy was represented with the archways in the middle of Figure C4 manifested by 'the robot band' exhibit. It demonstrated the different ways that one could generate electricity, including solar panels, wind, and hydro-electricity. The goal would be to coordinate all these different sources of energy to make the full robot band play together:

> RN: Rather than just a meter [for the electricity generation], we wanted something that showed it – and that it wasn't just one controlling everything. There were different members of the band controlled from each different energy

> source. It was also the idea of cooperating in order to get the band playing altogether.

As Raymond describes, the robot-band was an interactive exhibit requiring a coordination of different band members. This exhibit is a great example of a learning environment (Dewey 1938; Gislason 2007), communicating abstract themes of sustainability (immaterial) through different simulated renewable energy sources (physical) relying on people working together to make the band play music (social). and the notion of active prolonged engagement intending to communicate abstract themes kinetically.

Food would be represented through a giant burger with a small theatre hosting a documentary inside showing how a burger was made and the distance travelled. **Waste,** seen to the left of the burger, was represented through a big garbage dump illustrating the approximate volume of waste produced in a year by a single person. **Water,** placed in the adjacent corner from the burger, was represented by a giant toilet. The aim was to illustrate how much water would be consumed in a year.

Not only would each of these themes find their way within the Environmental Trail, but many elements of the exhibits themselves are similar. This should not come as a surprise as Our World's content curator (RL) would also be the content curator for the Environmental Trail. Exhibit designer RN describes his experience of conceiving these sustainability exhibits:

> RN: There were no models I could draw on which tackled all those things [Food, Water, Waste, Energy]. I had very hard time find any material to base it on.

For the exhibits of sustainability that did exist, they were seen by the team as too serious:

> RL: The exhibits that I saw in the States – the Pacific Center in Seattle, they looked like they got put together by the Public Service Center – It was very serious and matter of fact, pedantic. Lots of finger pointing. We said, look, that's not our style, we thought, let's put a tinge of humour to this. RN's a funny guy, [Exhibit Director] was a funny guy.

Indeed, the team, using a giant burger, a giant toilet, a robot band, and even whack-a-mole showed a different approach to exhibit design, communicating themes of sustainability in a fun and playful way. Another Our World exhibit, whack-a-mole, would use garbage bins and toilets to be whacked instead of moles, alluding to the ideas of limiting their impact as part of the sustainability imperative. Each of these more playful exhibits with something "for the parents to read" – two-line entry panels with the 3 different bullets – money, people and nature. This was based on the three-legged stool model of sustainability – social, environmental, economical.

We may understand the exhibits themselves as seeking to reconcile the three legs of the sustainability stool in their design and execution. Economically, Our World would require funding to realize its conceived exhibits. As described by BT, Science World would target companies related to each exhibit in order to bring Our World to life. For example, they obtained funding from the Greater Vancouver Regional District for the Water and Waste exhibits. Agriculture BC would fund the Food exhibit.[141]As the entire gallery space was an artificial

[141] This is confirmed through correspondence with RN, I3, and BT

environment and not an accurate depiction of the 'Living Planet' (initial name for Our World), such sustainability themes would be communicated in a more illusory form of design:

> RL: The electricity stuff from the Robot Band was all fake. When you cranked the thing, you weren't actually generating the power to it, you just triggered something which activated the mechanism. It was totally illusionary.

Indeed, as RL describes, the energy exhibit of the Robot Band aimed to give an interactive component using wind, solar panels and hydroelectricity. This notion of feedback by the user to generate the power of the marching band was simply triggering an actual energy source from the electricity grid which would power the marching band. This brings a touch of irony to Our World's notion of communicating sustainability to a wider audience; the intended interactive experiences can be ahead of the technology that is being designed to engage and educate its audience. The technology to generate electricity directly from the exhibits may not have existed during Our World. Budget could also have been a factor in this design choice. Therefore, when produced within an indoor Science Exhibit center, the process of designing exhibits on sustainability may lead to a certain degree of artifice:

> RN: The theme of sustainability is challenging because in itself it's very abstract. Science Centres are more based on physics and the repeatable interactivity of it. Issues of sustainability are inherently abstract, you end up creating models to get the point across and that makes them more linear rather than open ended. In the ideal science center, you can start from anywhere and explore from there. With sustainability tends to be more message based, so that was a thing we kind of wrestled with.

As RN describes, sustainability would be communicated abstractly in the Our World gallery with illusionary electricity generating exhibits in its interactive exhibits within its artificial environment. While the design could have been accomplished a different way, it did not necessarily practice what it preached. Yet, such artifice to create interactive experiences may be justifiable if it brings the general public a more critical and systematic understanding of the environment (Orr, 1990). Our World's team, in making these sustainability themed exhibits, would have in itself a trade-off of using external energy sources to power the artificial wheels. This notion of trade-offs is actually communicated within one of their exhibits known as Dogzilla and the Carbonator.

Part of Our World was an interactive video kiosk with a trackball giving one the option to play the Dogzilla vs. the Carbonator. Described in its opening lines: "Evil Dr.Dos has created the Carbonator to produce mega-carbon emissions to choke out all humans. The Carbonator eats carbon emissions and then spews out double that amount. Your mission is to help Dogzilla.[142]

[142] Fortunately, there still remains a web-version of this game for those interested http://littleguitararmy.ca/music/carbonator-offline_version/

Figure C5: Dogzilla vs the Carbonator in-game screenshots

First Dogzilla must be powered by an energy source, you get to choose which one – would it be Natural Gas, Oil, or Hydroelectric Power? At each stage there were three choices, each of these choices were represented with trade-offs, between usefulness and carbon level seen in Figure C5 above. If your emissions were too high, you'd have start the game again. Such a framework begins to show the early development of sustainability-based gaming exhibits which aim to communicate the power of choices and trade-offs.[143] Tradeoffs is the essential theme of Dogzilla, where choices on which energy sources and which transportation methods are made by the users. From a different perspective, this notion of tradeoffs would be found in the very design process of the Environmental Trail. Choices of materials would be made to assemble in the design form of the Environmental Trail some requiring larger transportation cost, other materials with the ability to be recycled.

C.3 Systems of Sustenance

Systems of Sustenance (SoS) was being developed around the same time of 1998-2000 as Science World's Our World gallery. SoS would be a public art project unfolding upon the site of Creekside Park adjacent to Science World's Environmental Trail to the south. Most of SoS's art pieces still remain to this day.[144] These would include two tree-stump sculptures, a molded concrete salmon tail, a 'spinal whorl' and 350 aluminum salmon (Figure C6) installed on the wooden piles suspending the Expo deck.

[143] John Robinson, part of this design project, concluded in a research article a few years later that "providing information about sustainability in terms of trade-offs and values was critical". (Robinson et al, 2006, p.5).

[144] This project was developed as part of a larger Art-based project called Collective Echoes which funded many public art projects across Vancouver during that time

Each of the art pieces installed in Creekside Park next to the TDET followed the themes of sustenance, relating to the notion of Coast Salish traditional salmon spawning practices.[145] In total, this project took about two years to complete and was finished by the year 2000.

> DB: We walked into it as artists with no defined project. We walked in blind, we had no idea what we wanted to create. The process of meeting people, and talking to people is when we developed the work that was going to be there.

Their team began their process by engaging with surrounding residents of Citygate rather than with a pre-existing conception. From DB's recollection, these residents were not too interested in participating in the process. Instead, these artists engaged with archaeologists, biologists, paleontologists and Coast Salish groups such as the Squamish and Musqueum nations:

> DB: [Creekside Park] has been traditional territory for a number of nations that have now all been amalgamated into three. All three nations have some stake-holdership there. So that entire site was about the process. We were looking at the pollution in False Creek.

Originally an estuary, this land was territory of the Coast Salish people using this area as a source of food and a source of medicine prior to the British settlers. [146]The Systems of Sustenance artist group began their design process by learning of the context through the traditional histories of the Coast Salish who used the area. It is through their engagements with the various Coast Salish groups and the actual site itself that an initial image was then formed:

[145] This project weaves the narrative of salmon return throughout the stumps (sculptures holding salmon), the spinal whorl, and the silhouette of a salmon tail.

[146] The area of which Creekside Park and the Environmental Trail was coined Khi-wah-esks by the Squamish nation as was discussed earlier in Appendix B.1.

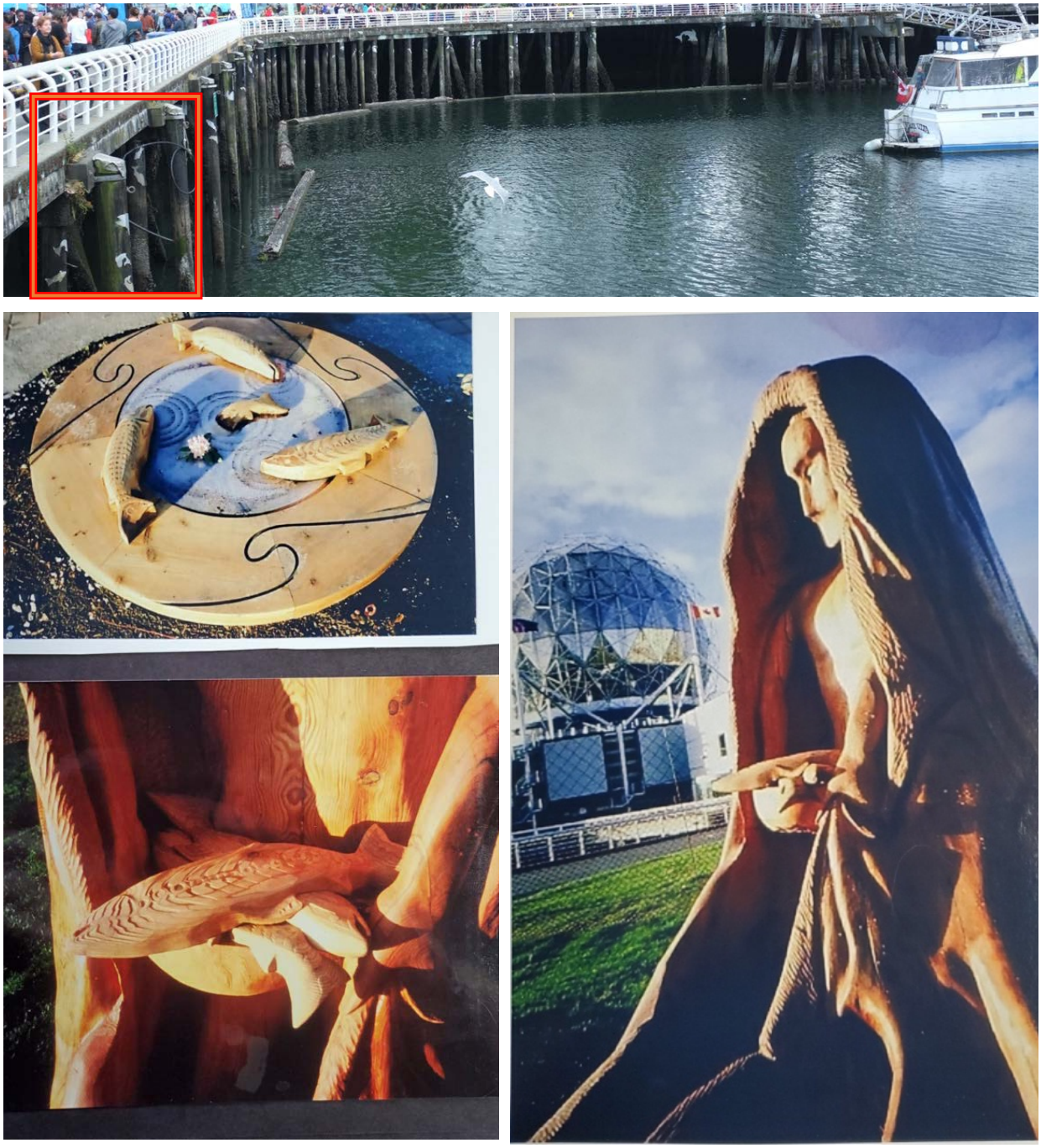

Figure C6: The artworks created as part of the Systems of Sustenance project in 1999. Reprinted with permission by Dan Bushnell

DB: We were looking at the Salish tradition of returning the Salmon Bones to the water, so that the chief of the Salmon people could bring them back, assuring a return of the salmon. Of course, with False Creek, the pH in the water is so high, that it can't support that kind of life anymore

As DB explains, this Coast Salish tradition of returning Salmon Bones into the waters of False creek to assure the return of the Salmon was a ritual performed for hundreds of years.[147] This pollution which would unfold during the 20th century as the area of False Creek became an industrial hub. From this, their team began to work with Coast Salish students from the Musqueum schools and Squamish schools of Vancouver:

> DB: We spoke to the [Coast Salish] kids about what the salmon were doing there, what the traditional land use was and the fact that it's too polluted to support that anymore. So then, what we did as part of the process…we taught these kids a song, and taught them the dance that went with the song. And then we took each salmon that they had done, and we cut them out of aluminum, and those are the salmon that are underneath the deck currently.

As is described by Bushnell, their team engaged with children of Coast Salish schools, about the history of the area and the polluted water of False Creek bringing learning experiences to all members exploring this context. From their discoveries, they would iterate themes of sustenance asking each student to make their own salmon art pieces, decorating them and taking it through the spawning ritual. These 350 salmon art pieces would be placed at the legs of the Expo Deck. During this time, they would go through a series of physical 'tests' (Zeisel, 1984) exposing a few trial aluminum salmon into the waters at the foot of the deck. DB describes how the aluminum was corroding only after three days due to the toxicity of the water, proving just how polluted and dirty this water actually was. [148] Their following experiment consisted of molding salmon bones out of a bicarbonate-based material in order to neutralize the acidic water:

> DB: We had everybody together walk up to the water's edge and showed them the pH of the water. We dropped these salmon bones into the water. When they hit the water, we tested the pH of the water again and showed that it had been neutralized. Briefly by working together, we were able to demonstrate that we were able to change the water's pH and make it habitable again. While the effects were temporary, we just wanted to do a visual demonstration of what was possible.

Their goal was to show how a group of school students could collectively work to change a site's ecology. The polluted water communicates the ecological challenges of this area, while alluding to deeper traditions of the Coast Salish in returning the salmon bones to the water. They shared a vision of cleaner water in False Creek where salmon and other important wildlife may find their habitat once again. This is just one example of the many art processes that took place in the SoS project.

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[147] As DB explains "Salmon spawning rituals are a Salish tradition. All three of the nations we spoke to [Musqueam, Squamish and Burrard] it was part of their practice."

[148] Qualitative evidence by interviewee DB and his team ensured that they had engaged with Marine Biologists to ensure the aluminum used would not further pollute the water of the area in any way. If we are to look at data from 2019. Quantitative evidence Vancouver Coastal Health frequently reports East False Creek as significantly higher in E.coli – 5,000-12,000 ppm. (June-August 2019)

The Systems of Sustenance project had a firm understanding of its local context, as its conception recognized how these lands used to serve the Coast Salish peoples as a source of food. In contrast, Our World would find itself addressing a more global context of the 'living planet' and sustainability. DB would be asked to explain reasoning behind the name Systems of Sustenance:

> DB: We were focused on the fact that that area used to provide foods for entire groups of [Coast Salish] people for an entire civilization… When we talk about sustenance it was really about things that allow people to heal themselves and feed themselves.

As described, sustenance here would be the ability for local systems to reproduce and nourish the peoples that inhabit the surrounding lands. These learning environments would lead to the creation of 350 aluminum salmon made by Coast Salish students themselves, part of the final form of its art project. A diagram representing how these two projects differ in how they integrate learning opportunities within the design process is shown below (Figure C7).

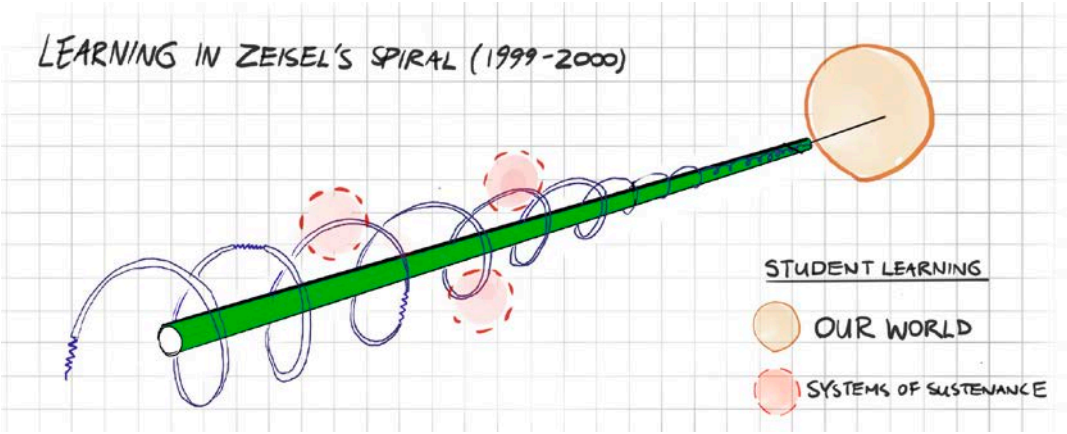

Figure C7: Learning opportunities (encircled) understood within a design process or as designed within an end-result, seen through Zeisel's framework (1984). Source: Luc Bagnérès

Systems of Sustenance artists would integrate learning opportunities with Coast Salish school students on the themes of sustenance and the toxicity of False Creek as part of their process of making its resulting form. Each of these learning environments serve as contrasting methods of approaching the design process of public learning environments (Dewey, 1938; Zeisel, 1984). Just like Our World, the TDET, while producing many learning opportunities for the designers, did not integrate K-12 students in its design process. Instead, both Our World and TDET show how designers intend a form of a more permanent nature (3-6 years), with K-12 students as recipients. Zeisel (1984) explained how articulating the design process allows for researchers and designers to better collaborate at different stages of the process in the future. How could this be taken one step further, where researchers, designers and teachers with students also be part of the

design projects themselves? How could school education programs integrate as a phase within design projects?[149] The Systems of Sustenance project illustrates steps in this direction.

C.4 SEFC Public Realm Plan

Between 1999 and 2006, the City of Vancouver, alongside many consultants, began to refine and shape the design of South-East False Creek neighbourhood. Immediately adjacent to Science World's TDET, SEFC released its public realm plan in 2006. Within this plan contained an interpretative strategy for the area.

Interpretation according to the National Association for Interpretation (NAI) is defined as: "A mission-driven communication process that forges intellectual and emotional connections between the interests of the audience and the inherent meanings of the resource" (NAI, 2018). They are often developed when dealing with conservation areas such as national parks or with historical resources in museums. These strategies determine how an institution will communicate with its visitors, and what types of learning theories are to be utilized: what objects, artifacts, and exhibits or programs will be used to deliver content? The theoretical framework of an interpretative strategy is rooted by Freeman Tilden in his book *Interpreting Our Heritage* (1957) [150]. These interpretative strategies often integrate within the process of situating and formulating Lynch's five elements (1960).

An interpretative strategy may often include a Statement of Significance (SOS), bringing heritage value to a particular site or building. A SOS is a succinct way of expressing heritage value, workable for the many jurisdictions across the country, and can be described in three parts: a brief description of the historic place, an identification of the key heritage values assigned to the historic place, and a list of its principal character-defining elements (BC Heritage Branch, n.d.). A SOS was developed for both Science World (2010), the False Creek Flats (2013) and the South East False Creek development (2006). In SEFC, the interpretive strategy informed the public realm plan which then informed the official development plan. The socio-political conditions for the TDET were influenced by the larger SEFC site planning strategies.

The SEFC Interpretative Strategy demonstrates how interpretation and public education typically found in museum settings fits into an urban design and public realm plan: "This interpretive

[149] it may be understood the importance of defining the design process of the TDET, showing that within those 14 years there could have been opportunity perhaps for students to participate in the form-making of such exhibits.

[150] Tilden lays out six key principles to interpretation, with its first stated as: "Any interpretation that does not somehow relate what is being displayed or described to something within the personality or experience of the visitor will be sterile." This principle demonstrates how interpretation embeds with the principle of environmental education (Orr,1990), and Dewey's principle of continuity (1938) As a result, interpretative panels can often be most successful in outdoor physical settings, including public spaces.

strategy articulates how the unique history of Southeast False Creek will be communicated to the public. The interpretive strategy informs design and is manifested in all aspects of planning" (City of Vancouver , 2006, p.13). This plan highlighted the current artifacts ranging from bollards and bridge footings, to buildings, each to be tied into the public realm of this neighbourhood development project. Therefore, the interpretative strategy determined the kinds of heritage resources that were to be represented within a district in the future of an area. This strategy's main goal was to "articulate the unique history of South East False Creek" to citizens in the public realm. It synthesized the SEFC's site history with a diversity of media "that address participants interests, knowledge and preferred learning styles" (City of Vancouver, 2006, p.13). From this, seven 'levels' of interpretive design media would be developed:

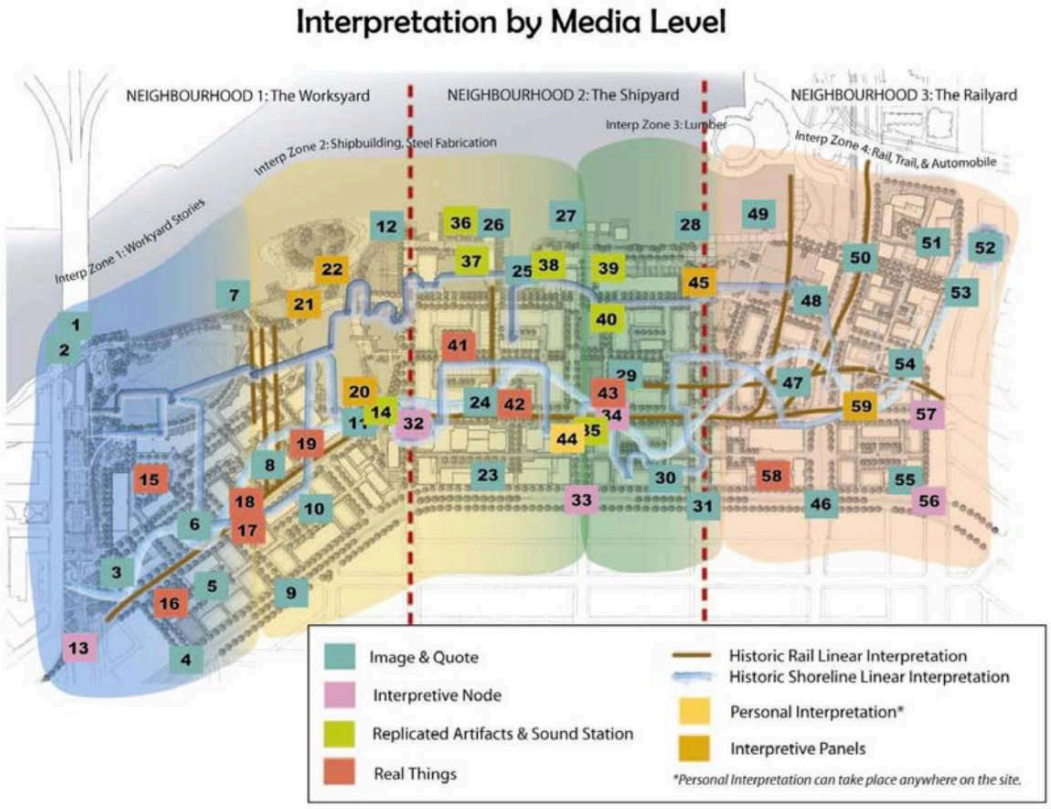

Figure C8: SEFC Interpretative Strategy map (2006). Source : City of Vancouver

Figure C8 above demonstrates how the principles of interpretation (Tilden, 1957) are defined into design media then mapped spatially along pathways and nodes of the site of SEFC (Tilden, 1957). The shifting shoreline of False Creek is also mapped. This brings an interesting notion to the idea of learning environments (Dewey, 1938; Gislason, 2007), mapped out into a matrix of levels across the proposed SEFC public with larger neighbourhood themes; the shipyard, the workyard and the railyard. These design media would integrate into the Public Realm plan as "layers of experience which complement and influence the other related design components, including, landscape design, urban design, and public art" (2006, p.19). Within the

document, each media type from Figure C8 would be expanded with a description and examples. This is an example of how the practice of urban design may interweave the concept of public learning environments within its process. A more recent example of interpretative strategies is the Edmonton River Crossing Plan of 2017.

Appendix D: Design suggestions

Below are design suggestions expanding on arguments made in the conclusion. Within each design suggestion are strategies and tactics marked with different time scales of implementation (e.g. 6-12 months; 3-5 yrs.).

Design suggestion 1. Activate northern section of the Environmental Trail

1.1 To energize and connect the North Side of TD Environmental Trail, create opportunities for more openings in the semi-public 'Flex Zone'. (3-6 months)

Observations shown in Chapter 5, found that fragmentation remains between the two halves of the Environmental Trail. This first suggestion seeks to better integrate elements of the TDET with Creekside Park.

Figure D1: Design suggestion showing how north end shows potential as key activation zone. Source: illustration by Luc Bagnérès

While people recognize exhibits, most do not realize (80%) they are part of one continuous trail experience. Between March 2019 and March 2020, there have been few days where this intended semi-public space has actually been open to the public. Its possibility for more frequent openings in the OSE reviews was discussed:

Mr. Chung commended the applicant for a job well done. He suggested the Outdoor Science Experience should be free once a month for families that otherwise couldn't afford to use the facility. Ms. Bozorgzadeh supported the application and said she too wished it was free to use (City of Vancouver, 2010b)

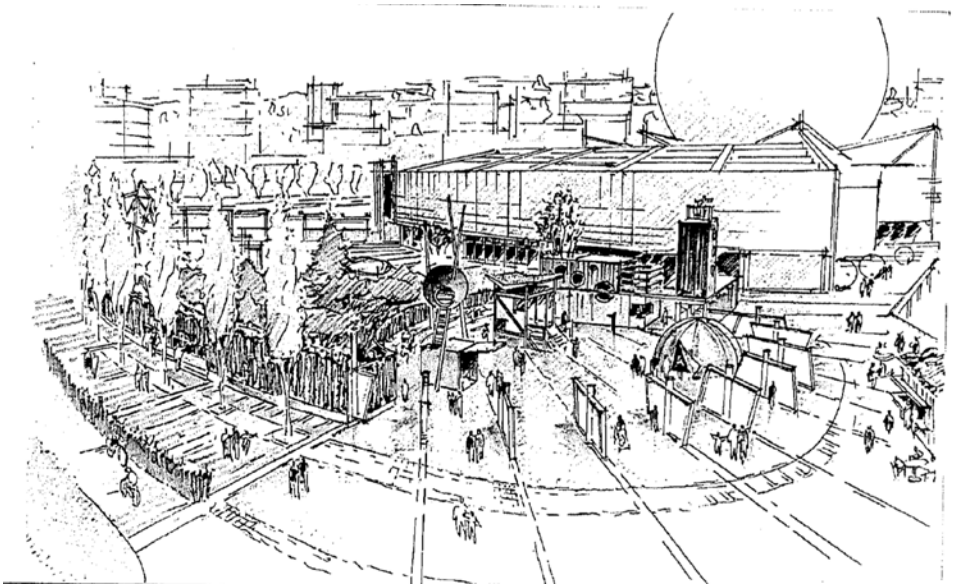

Figure D2: Flex Zone as imagined by PFS studio, creating interface between public and private space. Source: City of Vancouver, 2010 reprinted with permission

If the Flex Zone was opened once or twice a month to the general public, what possibilities may exist? The current path of the TDET between Garbozilla and the Waste Wall interpretative posters could be strengthened with an opened flex zone. Opening the Flex Zone has potential to create synergy between the surrounding TD Environment exhibits with the recent opening of the Creekside Park Playground (marked as C in Figure D1) in 2017. This playground has had extraordinary success in animating Creekside Park (Figure D4) yet its activity does not naturally feed into the TDET exhibits.

1.2 Consider creation of 'innovation zone' as pop-up programming and workshop space with students (6-12 months)

As was shown in the urban design panel review, #7 innovation zone was proposed by PFS and Science World, although it never came to fruition. The current northern end of the TDET shows potential for more tactical activation. The Sound Commons made by the Exploratorium in 2018 is a precedent for what an innovation zone could look like (Figure D3), showing the science behind music in an outdoor public setting. In this project, citizens can test the amplifications of

their voice through the contraptions of tubes. The existing xylophones in the playground and chimes and drums in the TDET invite such possibility.

Figure D3: Sound Commons exhibits set in the public space of downtown San Francisco by the Exploratorium science museum (2018)

Figure D4: The Creekside Park playground (Vancouver Sun, 2017)

1.3 Add interpretative poster explaining how the fence line was made of the site's prior waste (3-6 months)

The Waste Wall exhibit (B. represented in Figure D1) also seems to have missed opportunities in what it communicates interpretively. As has been seen, a significant part of the fence between the TDET and the Ken Spencer Science Park was made of re-used concrete from the demolition of the prior site (4.6). However, the interpretative panels do not represent this very interesting fact to the audience. Instead, a simulated waste wall made out of cans is emulated. There is an opportunity to install simple posters as seen in Figure D5 for the citizen to better understand the materials that were used to actually construct this wall; through recycled concrete from the site itself (see section 4.6.4).

Figure D5: Suggested location to install new interpretative panels for the TDET. Source: Luc Bagnérès

1.4 Add Recycling and compost bins to Creekside Park as TDET exhibit close to waste poster (6-12 months)

The City of Vancouver, Park Board (VBPR) and Science World should find a way to provide more than just garbage cans in the public realm of Creekside Park. The TDET talks about how we should reduce waste and recycle, but there are no recycling nor composting cans at all in Creekside Park. This should be implemented, perhaps even designed into an exhibit where trash and recyclables become part of a gamified experience.

Design suggestion 2. Update & Expand the Environmental Trail

2.1 Update discourse on sustainability to gravitate towards regeneration of False Creek (1-2yrs)

This suggestion was previously discussed in the conclusion so comments will be brief. The discourse of sustainability is dated to the years of 2011-2012, and re-imaging its significance as public discourse should be considered. How can we bring more awareness to dynamics of False Creek's water as an opportunity, a design problem to be resolved in fun new creative ways?

Figure D6: Design suggestion showing how TDET may integrate with new shorelines of East False Creek. Source: Luc Bagnérès

2.2 Create posters to invite participants to share feedback on trail, and share suggestions of their own (6-12months)

As pedestrians move along the seawall, chalkboards or magnet boards could be installed. This is another suggestion argued in the conclusion. There is a lack of opportunities for the public to leave their mark on the TDET; some people resorted to 'tagging' to express their opinion. The next phase of the TDET could be informed by the public, providing their input passively.

2.3 Expand length of Environmental Trail to engage with developers and NEFC and SEFC plans as part of public amenity contributions (3-5yrs)

We saw how what started off as a significantly larger vision for the Environmental Trail in 2002, stretching to the Cambie Bridge was reduced to a loop around Science World from conception to education.

> BT: Our concept was to create the top end of false creek, from Cambie Bridge to Science World, as the Environment Zone. We wanted the Trail to be the south and the North Trail, that whole thing would be the Environment Trail. Our concept of the environmental trail was to create that whole area and because hopefully there would be echoes of that leading back from the shoreline and as those areas all developed it would be developed in an environmentally aware way.

While the time to engage the developers might not have been ripe in 2002, perhaps now is a better time. False Creek is in flux–the entities organized around the shifting boundaries of land and water have changed over time. The definition of this future shoreline remains unsettled. How could the Environmental Trail break out of its loop and engage with either NEFC or SEFC in helping integrate these two fragmented phases of East False Creek's shoreline? Now in 2020, the City of Vancouver has other plans for this South False Creek Area. It is now planned for redesign as discussed in the conclusion:

2.4 Integrate Expansion of the TDET into the public realm of a redesigned Creekside Park (3-5yrs)

If we consider the removal of the Expo deck as part of this East Park redesign (Figure D7), what are important policies to consider? From the North East False Creek plan we can see a clear emphasis on sea-level rise. [151] Each of these policies may address the future of how the False Creek basin is managed over the next 80 years. For section 11.2, water is addressed as a threat with 'flood defense' ensuring levels at 4.8m for any new decking that would come to Creekside park ensuring resilience. The City of Vancouver completed their Coastal Adaptation Plan in 2018 also released the same year as the NEFC map showing this area's risk of being submerged once again. More immediate concerns are its cleanliness. East False Creek (EFC) is significantly polluted[152]. How can the upcoming East Park and South Creekside Park redesign integrate with the TDET in improving False Creek's water quality?

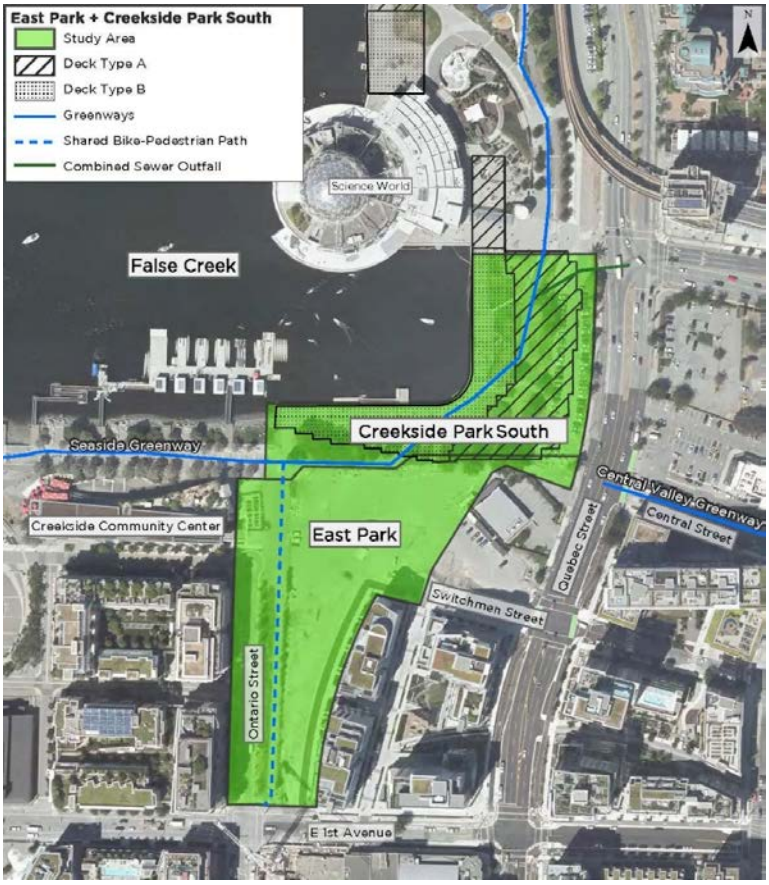

Figure D7: Location boundaries of upcoming East Park and Creekside South Park redesign in 2021, immediately adjacent to TDET. Source: Park Board, 2020

[151] For example, Climate Change Adaptation and Flood Protection states: "11.2.3 Any flood management infrastructure put in place to serve as flood defense (e.g. seawall) will be built to the appropriate structural standards to meet Provincial requirements."(City of Vancouver, 2016)

[152] EFC has the most E.coli ppm in the metro Vancouver region spiking during summer months as boats begin to be used. Vancouver Coastal Health recommends no swimming with waters above 400 E.coli (MPN/100ml).

2.5 Consider opportunities to align TDET with the Fraser River to False Creek daylighting strategy (3-5 yrs)

Councillor Wiebe is proposing of a creek daylighting strategy (City of Vancouver, 2019) to connect False Creek with the Fraser River (City of Vancouver, 2019B). The first phase proposed is Trout Lake to False Creek. [153]

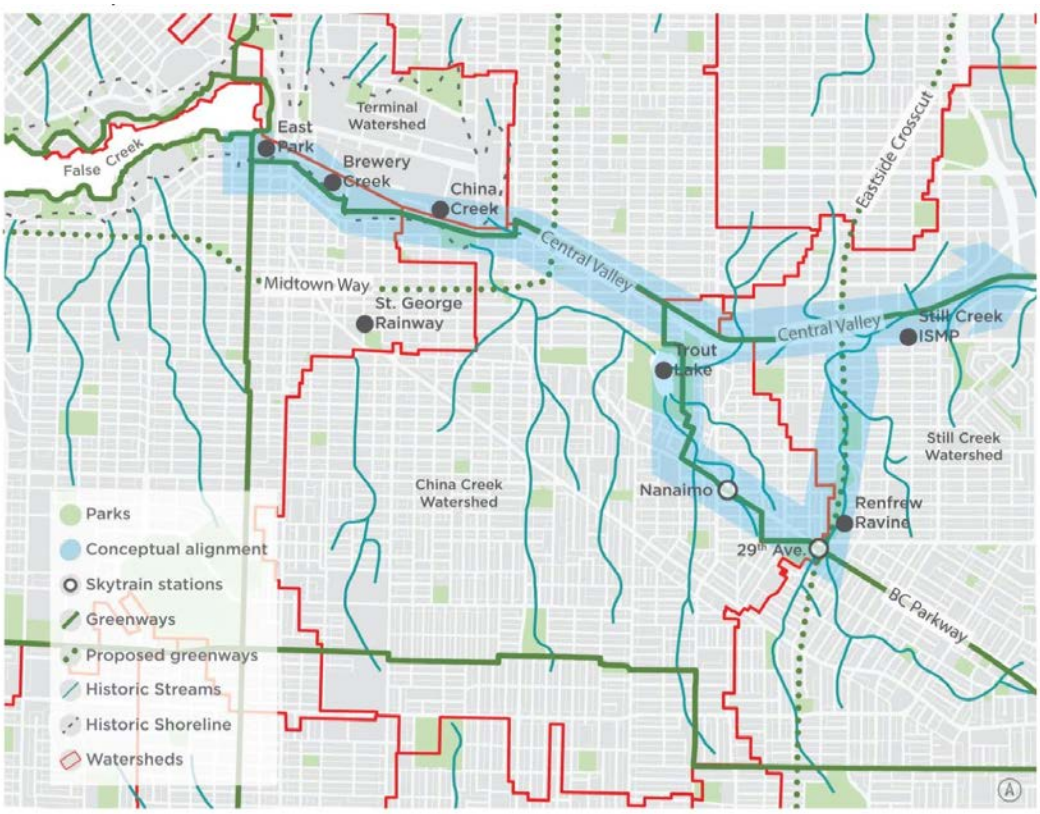

Figure D8: Phase A of Fraser River to False Creek daylighting strategy proposing the connection of Trout Lake and Still Creek with False Creek. Source: City of Vancouver

In this strategy is also imagined an integrated effort with local schools:

> The Vancouver School Board approved the first ever Environmental Sustainability Plan in 2019 to advance five key themes: sustainability in education, green spaces, resource conservation and climate change, sustainability transportation and

[153] As stated in the Motion to Formalize the False Creek to the Fraser River Blueway: "6. The majority of work that remains lies in daylighting China Creek in Vancouver, expanding natural ecosystems and habitats along the entire blueway, and connecting it to other green spaces along the way. The first step is developing a blueway transition plan to ensure the retention and protection of Vancouver's existing natural assets and real property along the route. The plan will aim to daylight creeks, expand biodiversity, create amenities and public spaces, and develop sub trails connecting it to other natural assets such as Trout Lake and Renfrew Ravine. There are many opportunities for different stakeholders, cities, regions, and nonprofits to join in a collaborative effort to realize a complete Blueway from False Creek to the Fraser River (City of Vancouver, 2019)"

> leadership in sustainability. Multiple schools will have connections to outdoor learning on the blueway, with Nootka Elementary having the potential to enhance a portion of the creek on VSB land; (City of Vancouver, 2019, p. 2-3)

The Shore to Core strategy aims to align with many schools starting with those in between Trout Lake and False Creek. [154] Although a massive undertaking perhaps costing billions of dollars, Wiebe is proposing this blueway strategy integrate with VSB as part of their recently launched Sustainability program as seen above. It strikes at many points from the literature review, although is most strongly seen as enacting Orr's principles of Environmental Education (1990).

Whether an eastern creek daylighting connection or a southern one (See Figure D9) with the St. George Rainway and Vancouver's Blueway strategy (2019), the important thing to consider is just how teachers and students may fit into this design process of daylighting shoreline renewal and how Science World as an organization may facilitate this.

These daylighting strategies may resolve East False Creek's design problem; polluted stagnant water risking sea level rise and liquefaction. The relationship of land and water in EFC are detrimental in its current form of Creekside Park's edge. Changing the idea of a 'False Creek' towards an estuarine creek tributary is a potential vision to resolving such concerns and bringing opportunity to the urban geography of this area.

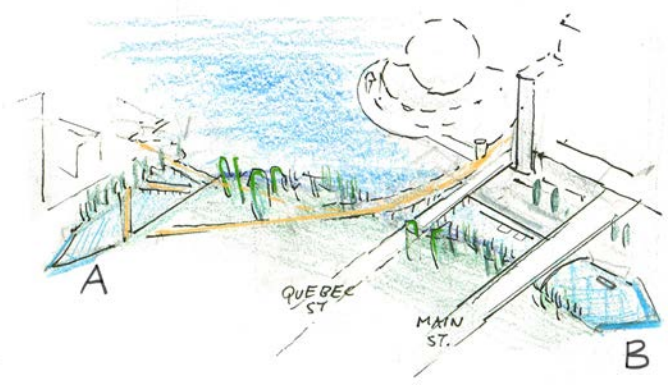

Figure D9: Two daylighting pathways that have been found from evidence in renewal projects of Creekside Park by the City of Vancouver (2019). Source: Luc Bagnérès

2.6 Consider creation of exhibit 'C-wall' as an intersection of art and science (1-2yrs)

These long-term daylighting strategies could take decades to enact. Why must an urban design agenda for shoreline renewal be framed for so far into the future? Simpler tactics to kickstart such processes could revolve around building unrealized exhibits such as the C-wall that was proposed in the urban design panel review.[155]

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[154] These schools include: Mount Pleasant Elementary, Florence Nightingale Elementary, and Queen Alexander Elementary.

[155] As stated in the development permit "the C-wall will include a display illustrating impact of CO2 and climate change on sea levels and will be made of recycled concrete" (City of Vancouver, 2010b, P.9)

Design Suggestion 3: Floating structures as tactic for shoreline renewal

The notion of floating architecture seems appealing as a more immediate tactic within these longer-term shoreline renewal strategies of False Creek. As Beatley explains in his book *Blue Urbanism* (2017), the design problems in our urban environment should be recognized as a system of relationships between land and sea that must be understood and reconciled. Floating learning environments may easily be transmutable to any shoreline in the future of East False Creek and may serve as a better platform to engage with the contentious dynamics of water (Figure D10).

How can learning programs help the City of Vancouver's shoreline renewal integrate and reconcile this unceded territory that nourished Coast Salish people since time immemorial? (Appendix B.1). The full potential will be determined by strategies from the level of the Province.[156], building alignment for longer-term shoreline renewal. The dock as an investment is a cheaper, lighter and quicker form of urbanism (Lydon, 2016). Its investment is absolved; the advantage of docks is that they can integrate into any shoreline proposal and still serve as a programmable space in the long-term for multiple valuable design programs[157]. I give two design suggestions in how this floating architecture may be harnessed with the TDET.

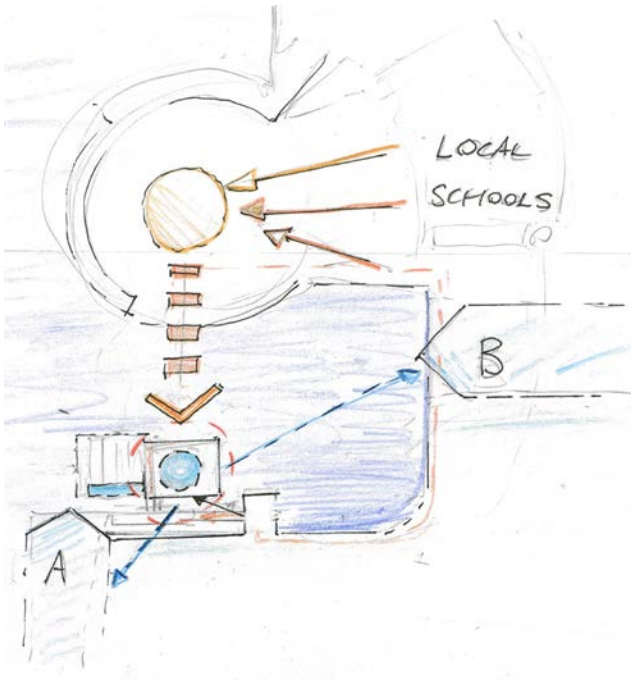

Figure D10: The dock provides a platform for discussion. Local schools may become integrated into processes of shore renewal. Source: Luc Bagnérès

[156] Fraser river to False Creek plan has shown funding sources of billions of dollars as suggested by Wiebe. We may consider partially combining Province of BC's fiscal budgets for education (p.14) and educational facilities (p.136), with infrastructure, contaminated sites, and health sciences research grants (Table 4.3, p.94) (Province of BC, 2019). These may integrate into Vancouver School Board's recently launched sustainability program and the Shore to Core renewable strategy (Wiebe, 2019). The first phase of this strategy would connect Trout Lake to False Creek with investment of floating structures as engagement platform.

[157] For example, it may work as a space for marine science presentations with Science World or an extension of the chicken and food garden concept at Ken Spencer Science Park. The potential integration into schools projects for K-12 is great.

3.1. Consider creation of performative dock structure as engagement platform for discussion on daylighting Creekside South and East Park. (1-2yrs)

There are three precedents in considering a dock as an engagement platform:

1) The Rotterdam's Rijhaven Pavilion: This highlights the City of Rotterdam's bold new strategy for their marine harbours, creating new city zoning to accommodate floating structures in their urban harbour. This floating Pavilion, built with innovative materials, is an innovative platform space for the City of Rotterdam to engage with its citizens on future plans. It also includes an interpretative zone for sustainability. This Pavilion has become a platform for conversation, and discussion of its potential future with water (Lisa, 2013; Beatley, 2014)
2) The Palm Beach Living Docks in Florida are "designed with in-water planters containing native mangroves, Spartina grasses and a visible oyster reef set into the deck" (Singer, 2009). This lounging space is an extension of the City of Palm Beach's public realm, where citizens may relax, nap and enjoy see how oysters filter water.
3) 'POOL light' was installed in New York City's harbour in 2019. It enables NYC residents to gauge the water quality of the East River in real-time, reconnecting residents to their public waterways.

The ownership circumstance of Vancouver's shorelines is quite complex. The near shore under federal jurisdiction, the foreshore is under provincial jurisdiction, and local governments only serve to manage land-use and housing.[158] However, The Blue Cabin launched in 2019, has established important jurisdiction policies to allow for
its mooring in False Creek. Floating structures near Science World could follow suite.

3.2 Consider role of hyperaccumulators oysters, clams, bivalves, and herring farming as learning program for Science World and local schools (1-2yrs)

Floating structures may become a breeding ground for species regeneration with essential food building blocks like herring, phytoplankton (Eaglen, 2019) and hyperaccumulators that filter out E.coli and toxic chemicals through clams, bivalves and oysters (Cummings, 2016). In so doing, floating structures may take a turn towards a 'wetlab' where marine scientists and students could collaborate.

[158] As explained, the federal Department of Fisheries and Oceans is responsible for managing and protecting fish populations and fish habitat under the Fisheries Act, including shoreline "riparian" habitats, as well as for maintaining maritime safety through the Coast Guard. Transport Canada is responsible for preserving the public right of navigation under the Navigable Waters Protection Act**. (**Green Shores 2009)

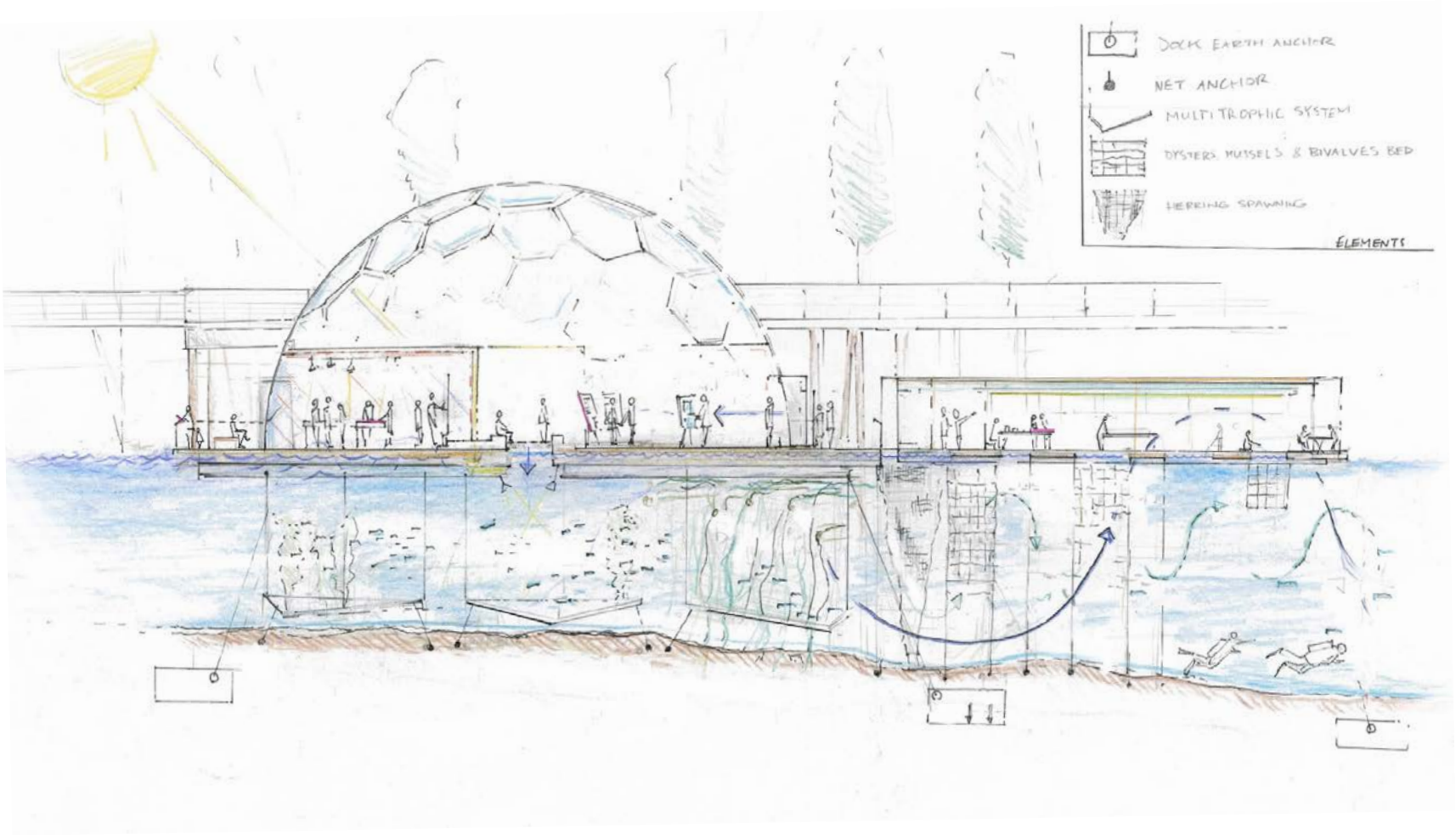

Figure D9: Example of floating learning environment incorporating engagement platform and marine wet-lab. Source: Luc Bagnérès inspired by *Red herring impetus* McFaul, S.J. (2019).

Cummings' research (2016) on False Creek's water quality shows East False Creek Water Quality at very high E.Coli levels. She would provide a set of valuable recommendations including the suggestion of bivalves to filter large volumes of water[159]. These organisms and plants such as bivalves, mussels, oysters, kelp are termed as hyperaccumulators. How can the practice of shoreline restoration become an agenda for school programming? Beginnings of this are already being implemented in False Creek by Jonn Matsen, part of the Squamish Streamkeepers Society, in Fisherman's Wharf near Granville Island. Over the last five years, he has been testing artificial nets mimicking the eelgrass spawning habitats of herring, playing an essential role in the ocean food chain. These nets could be installed around the existing wooden piles of the False Creek docks (see Figure D9). McFaul provides a conceptual precedent in his thesis. With the concept of floating architecture as herring habitat and kelp farming, designed within a multitrophic system (2019).

Another important precedent is the Billion Oysters Project (BOP), a citizen science project founded in 2008 for the New York City Harbour. This project demonstrates the combination of K12 education with ocean restoration through marine restoration-based STEM education programs. The BOP has already restored 45 million Oysters with the help of six thousand students (BOP, 2020). A landscape architecture firm SCAPE has coordinated with the New York Harbor School engaging thousands of school children. A similar program could be implemented into False Creek.

By framing the learning opportunities within the appropriate environments, students could take part in shaping the design process. Learning and work may intersect, as has been done by Brian Davis working alongside SCAPE and BOP in the NYC harbour:

> Indeed, the work becomes itself a means of discovering what we want the future to look like. That actual experience of students and technicians and educators and designers collaborating with clams and shorebirds and recycled concrete reefs and tidal currents is what matters. Working towards what should be implies working out the question, not merely the implementation of an answer. In this context, proposal become more like highly informed, finely tuned hypotheses – responding to new information, constantly subject to testing and evaluation, modification and adaptation through presentations and modeled scenarios, as well as pilot projects and prototypes. (Davis, 2017, p.233)

[159] As stated, she states in recommendation 5. "Remove or improve dispersal of E. coli throughout False Creek. E. coli is locally sourced or gets trapped along the edges of east False Creek. Changing the shape or improving water circulation would dilute high concentrations by dispersing E. coli throughout False Creek. Another option is to use bivalves, which filter large volumes of water, removing particulate matter including chemical contaminants, bacteria, and phytoplankton, which then accumulate in mussel tissues or settle out as excrement. Native species of mussels could be placed targeted locations around False Creek, restoring ecological functions while removing both biological and chemical contaminants" (Cummings, 2016, p 1).

Here landscape architect Davis emphasizes the process of landscape design as learning programs where student, educators, technicians and designers collaborate. He shows how a critical informed citizenry could be engaged with the urban marine environment. There are many Vancouverites who are ready to learn, experiment and engage with iterative nature of design. Public learning environments could reframe our city conversations around a 'blue urbanism' lens as Beatley describes (2016). Science World's location and infrastructure seems a great place to start this agenda towards a blue urbanism.

As a suggestion, Science World, in their social mission[160], could connect with VSB's Sustainability program. Design processes slower and more variable in nature may allow educational programming to take place. While these programs would slow the speed of design processes, the process of learning may be enriched. An extension of the TDET could serve as "an agenda for more work", a way to engage and discuss the possibilities that lay in East False Creek.

Of course, this is all up for discussion. These design suggestions 1, 2 and 3 shown above are simply immediate and long-term suggestions highlighting opportunities that emerged in the process of conducting this research.

[160] As stated on their website: "In January of 2017, we embarked on strategic planning aimed at answering a single, overarching question: Over the next generation, what pressing social role should Science World serve for our community?" (Science World, n.d).