# ISLAIS CREEK REINTERPRETED

## An Exploration of Restoration Design in the Urbanized Context of San Francisco

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## Abstract

In my initial inquiry into the environmental history of the Alemany Farmers' Market in San Francisco, I learnt of a creek – Islais Creek, the largest watershed in the city.

I measured and analyzed an 1869 U.S. Coast Survey to establish a representative baseline for the historical character of Islais Creek. Historically water accumulated on the shallow soils of the San Bruno Mountains and flowed into Islais Creek I used additional maps and surveys from the late nineteenth and early twentieth centuries to document the cultural settlement of the watershed and further discuss land use impacts on the creek. For the past one-hundred and fifty years urban expansion and development have severely altered the original character of the creek and disallowed natural fluvial dynamics to persist. Currently the creek serves as the infrastructural backbone to a combined sewer system located underground in concrete pipes and culverts.

In this repost I developed a restoration plan informed by an opportunities and constraints analysis of the existing conditions within the watershed. The plan gathers surface flows from a small subwatershed adjacent to the farmers' market site and uses the historical baseline condition to inform creek design. I used the rational method to establish a design discharge and discharge from the 200 acre subwatershed area and employed other standard hydrologic and hydraulic methods to estimate appropriate channel geometry for a two year flow regime.

The restoration of Islais Creek as proposed in this report represents an exploration of thought more than classic geomorphologic restoration; the landscape tells the story of the creek and restores its symbolic presence in the urban environment and in the minds of the people living and visiting the space. The proposed creek form builds an understanding of the fluvial process, enhances our knowledge of aquatic ecosystems and ultimately enriches our connection to place. We are restoring more than ecological systems, we are restoring our awareness and compassion for nature.

## A Creek Under the Market

While farmers' markets have increased ten fold since the 1980's small farms have been on the decline. And population surely hasn't increased ten fold. So to what might we attribute the increase in markets? My design thesis in landscape architecture explores and analyzes the meanings associated with farmers' markets. I have developed ten *dimensions* to pull apart the meanings and better understand these lively public spaces. Some of the key dimensions are the economic, the social, the cultural and the environmental dimensions. It is the environmental dimension that we will explore within this restoration plan, but the reinterpretation of Islais Creek will involve the educational and cultural dimensions as well.

The site for my design thesis, a five-acre property (see figure ) located near the historic lower reaches of Islais Creek, provides an opportunity to enhance the functions of the Alemany Farmers' Market and enrich the understanding of and connection to place. This paper is an exploration of thought and is not representative of any community goal. As restorationist working in urban areas we shouldn't impose an ecological rationale onto a community that does not desire such change. The restoration of Islais Creek must be coordinated and ultimately sanctioned by the communities within the market and the immediate neighborhoods. It is their will which must be respected.

The restoration of the largest creek within the heavily urbanized context of San Francisco might seem impractical if not logistically overwhelming; however, the creek does provide an opportunity to create a unique public space that raise awareness about the Creek's history and greater environmental concerns. (see figure )The restoration plan offers very little for true ecological habitat, there is no connectivity to other valuable lands. Monies for habitat restoration would not prioritize this site over other areas with a semblance of ecological function still persisting. That said, environmentalist have prioritized urban populations as imperative to their public campaign. It is along these lines that restoration within the urban context should be focused. Restoration should be interpreted and made more conspicuous in the urban environment. The goals and benefits of restoration can be made quite clear in the concretized urban environments where there is an almost complete degradation of ecological function. There is a lesson to interpret.

**Restoration Objectives**

Similar to the functions of the Alemany Farmers' Market, the restoration of Islais Creek is intended to enhance people's connection to the regional landscape and make the story of this place more conspicuous. The goal for the restoration of Islais Creek should not be the recreation of the natural environment prior to European settlement but rather to reinterpret the fluvial character of the current watershed and reflect the complex conditions of the urban environment, both cultural and natural. The main objective then is to make the natural and cultural history of Islais Creek more conspicuous in the urban environment.

Prior to the exploration of restoration design the historic character of Islais Creek and a brief discussion of the cultural settlement of the watershed and subsequent alteration to the riparian landscape and fluvial processes will precede any restoration proposal.

**Natural History**

Careful cartographic measurement of the U.S. Coast Survey of 1869 documents the historical attributes of Islais Creek and provides a wonderful reference point for the geomorphic character of the watershed. (see figure ) Historically Islais Creek began in the San Bruno Mountains, meandered through a small alluvial valley and spilled into a grand tidal marsh on the southeastern shores of San Francisco.

Delineation of the Islais Creek watershed yields an area of approximately eight and a third square miles or 5367 acres. From the highest mountain in the watershed to the open tidal waters of San Francisco Bay the main channel measures approximately 5.8 miles long. With the highest elevation noted as 847 feet the average gradient of the main channel calculates as approximately 0.02. (see figure ) The following sections describe the typical production, transfer and depositional zones of a watershed.

**Production Zone**

Characteristic of a sediment production zone in a watershed, the first 5807 feet of Islais Creek drop over six hundred feet in elevation from the northern slopes of the San Bruno Mountains. (see figure )The average gradient for the production zone is 0.11. A 1913 soils map produced by the United States Department of Agriculture labeled these soils as "*Altamont Loam and Clay Loams – rough broken phase*". (see figure ) The Natural Resource Conservation Service describes the Altamont series as consisting of "deep, well drained soils that formed in material weathered from fine-grained sandstone and shale"(USDA-NRCS "Entisols"). The NRCS further characterized the "rough broken phase" designation found on the map legend as an entisol – a soil order with an underdeveloped soil horizon and limited organic material.

**Transfer Zone**

After the fast decent from the San Bruno Mountains Islais Creek decreased in gradient and joined other small tributaries to form a fresh water lagoon in an alluvial plain. (see figure ) Early European Settlers would later call this lagoon Lake Geneva. The transfer zone measures 8719' with a total loss in elevation of only 60 feet. The gradient equals 0.01. The

1869 survey indicates subtle sinuous pattern with a narrow meander belt; the creek meander pattern does not appear to close in upon itself or suggest major channel abandonment or avulsion. The meander belt seems fairly contained and narrow. The largest tributary measuring approximately 2314 feet in length joins the main channel in this reach.

The 1913 soil map indicates "*Antioch Sands and Sandy Loams*" for this reach. The NRCS Official Series report provides a informative description of the geographic setting for the soil classification, "Antioch soil are on nearly level to strongly sloping alluvial fans…Slopes are usually less than three percent"(USDA-NRCS "Antioch Series"). Clearly the measurements from the 1869 survey and the descriptions provided in reference to the 1913 soil map designation establish the physical characteristics of the transfer zone and indicate a fluvial geomorphologic process.

The channel geometry for this meander zone can be estimated from several sources.

At the northern end of the alluvial valley topographic features restrict creek meander and direct the channel between the hills – this would later be called the Alemany Gap. The gap portion of the creek measures 3518 feet with an average gradient of 0.02.

**Depositional Zone**

After the steep decent between the hills a grand meandering pattern appears on the 1869 survey. Even though we will discuss the restoration proposal later in the paper, this is a good point to introduce the project site. The creek meanders for 3524 feet from the gap to the site. The average gradient is 0.01The five-acre property is located on the lowest slopes of Bernal Hill with the western and eastern portions of the site approximately 20 and 10 feet above sea level respectively. The site was most likely not a creek but rather a transitional zone between hill slope and tidal creek, where surface flows from the subwatershed accumulated and drained into Islais Creek. (see figure )

Continuing downstream the creek meandered past the five-acre site for another 8981 feet, meandering through expansive tidal marshlands and then connecting to open bay waters. As Islais Creek enters the depositional zone the slope dramatically decreased to almost nothing. It is difficult to ascertain the exact slope for the last 20 feet of creek gradient because the zero-contour is not indicated on the 1869 survey. Since the slope of the water surface and creek bottom are quite difficult to calculate, any tidal influence on geomorphic function can not be accurately assessed. However, we may safely assume the presence of tidal influence based upon the map's designation of *tidal marsh* and the characteristic sinuous drainage pattern.

Tidal measurements will be discussed in the following paragraphs to more accurately characterize tidal influence on the lower reaches of Islais Creek and its associated fluvial processes. Vertical elevations within most maps are typically measured in relation to *mean sea level* (MSL). The zero contour line is then a reference to MSL. *Mean lower low water* (MLLW) is the average of the lowest tidal water height observed in a day for a given period of time. Conversely, the *mean higher high water* (MHHW) is the average of the highest tidal water height observed in a day for a given period. Based on the San Francisco tidal gauge readings from 1983 to 2001 the MHHW was 2.72 feet above MSL while the MLLW was -3.12 feet below MSL. The absolute highest tidal mark was listed 2 feet above the MHHW mark or almost 5 feet above MSL.

While it is difficult to ascertain the exact location at which the fluvial dynamic transitions to a tidal process, we can confidently assume that the dominant process on the restoration site was fluvial, given its elevation. Certainly high tidal waters may have increased the flood levels on the site or decreased the gradient and increased sedimentation rates but the daily process performing the most influential work on the site was fluvial.

**Cultural History**

As the city expanded southward and immigrants converted the natural lands for agricultural production, Islais Creek and the biological and fluvial processes associated with the Creek's history were severely compromised. Urbanization of the watershed and the industrial successes therein placed offal and other refuse into the channel and subsequently forced the creek into a concrete box below ground. This submerged combined sewer system persists today as Islais Creek.

The Muwekma Ohlone Indian tribes originally inhabited the coastal regions throughout the bay. Early Spanish explorers misappropriated the creek's name, Islais, from the Ohlone phrase for wild cherry – Is Lay Is. With wild cherries present in the watershed the shrubs depicted in the 1869 survey might well be Is Lay Is.

With the development of the Californian missions and the construction of El Camino Real settlers began to alter Islais Creek. El Camino crossed Islais Creek near Lake Geneva, paralleled the Creek along the eastern slopes for a mile and then crossed the Creek again at the northern end of the alluvial valley near the Alemany Gap. The 1869 survey actually indicates a small vertical control near the 100' contour at this last crossing. Perhaps the first culvert for Islais.

The first group of settlers used the land for agricultural and pastoral purposes. The Portuguese, Italian and Irish farmers used the valley alluviums and creek water for production of vegetables crops. (Alexander). Although it has been asserted by several local historians that Islais Creek provided the main water source for the City, no diversion dam, aqueduct or other physical alteration to creek morphology were evident in the review of several maps from the era. While the city experienced major growth from the gold rush the land use within the Islais Creek watershed remained mostly agrarian.

In the late nineteenth century the San Jose Rail Road easement was plotted along the western banks of Islais Creek, across the creek from El Camino Real. These arterial connections to the City maintained a northern bearing and abandoned the creek corridor as the Creek bent eastwards towards the Bay through the Alemany Gap.

As the City grew outward, the port at Islais Creek provided a valuable connection for the shipping and meat packing industries associated with the region. The area housed the meat packing warehouses and came to be known as Butcher Town. In the early years Butcher Town was a "prosperous community with many heavy industries, factories, slaughter houses and other businesses associated with them"(Palmer). However, any prosperity for local inhabitants was quickly lost as many of the "meat packers used the creek as a repository of blood and offal"(Cutler). The prosperity was clearly limited to financial gains only.

In a report to the City of San Francisco in 1893 Manson and Grunksy advocated for a sewer system that would use natural creek drainages as the infrastructural foundation for a combined sewer system. In their assessment of Islais Creek, they wrote,

> "The Islais Creek tidal basin will, as population in the watershed increases, be increasing in foulness from year to year, and unless systematic treatment of the drainage…is effected, the history of filth accumulation in Mission Bay and Channel Street will there be repeated. At the point where Mission Road [El Camino Real] crosses Islais Creek, two sewers…discharge through the

> top of the masonry culvert in which the creek flows under the road embankment. The upper portions of the Creek are fouled by refuse from the truck gardens, pig-pens and corrals on its banks and local sewage delivered to it in open ditches or temporary drains."(Grunsky)

Clearly the developments within Islais Creek watershed had severely degraded the natural landscape prior to the turn or the century.

With the promise of modernity at the dawn of the twentieth century and city planning theory of the city beautiful in full roar, San Francisco commissioned Daniel Burnham to produce a plan for San Francisco that would speak to the ideals of a new city. In his plan for the City Burnham proposed a series of grand axial boulevards and parkways. Amongst his many illustrations for the plan was Islais Parkway, a gesture to the natural character of the creek. Clearly the creek maintained a visible presence at the turn of the century.

One year after Burnham submitted the plan, the infamous earthquake of 1906 devastated the city. The major destruction of the City's infrastructure renewed the debate about the city's future and how to rebuild. Ultimately, the city was rebuilt as it was before and the Burnham plan remained unobtainable.

In the first quarter of the twentieth century the City championed several bond measures to fill the tidal marsh lands of Islais Creek and reclaim the land for more productive industrial use. The plot map of 1904 indicates the intention of urbanization more than the reality of the time. (see figure ) The industrial lands on these historic marshlands struggled with floods and subsidence. Flooding and subsidence still trouble development today.

Not until the thirties was Islais Creek placed underground in a series of concrete culverts and boxes. (see figure ) And if the creek wasn't already dead-on-arrival as a natural feature in the landscape the ensuing construction of highway 101 and 280 surely would have killed it.

**Current Context**

The current combined urban watershed or combined sewer system covers 7080 acres or eleven square miles. This thirty percent increase from historic watershed size is due to the conversion of tidal marshland and the inclusion of lands that previously drained directly into the bay but are now directed to the waste water treatment facility prior to discharge into bay waters. The development of a combined sewer system and the submersion and concretization of the creek channel create an almost impossible scenario for the future of Islais Creek. That said the exploration of a restoration project will serve as an interesting discussion point.

How might such a devastated creek be restored? What would it look like?

Using a geographical information system and several basic hydrology equations Jencks and Leonardson recommended specific channel geometries for the restoration or daylighting of Islais Creek at three distinct reaches. In response to the existing urban conditions within the watershed the authors used several equations to predict runoff volumes for specific storm events and the respective time of concentration. Their proposed geometries responded to flood concerns and the spatial limitations within the urban environment and did not rationalize the form as natural or historic but rather fluvial. The total widths for the three proposed channel geometries for Islais Creek were 169 feet, 522 feet and 1155 feet (Jencks and Leonardson).

Given the exorbitant property values in the city the acquisition of tens to hundreds of private properties on a 522 foot wide riparian corridor is not practical and makes any major restoration effort along watershed scale unlikely.

Given the constraints of a combined sewer system and the degree of private land within the watershed, this restoration proposal is based upon the surface runoff from the areas immediately adjacent to the five-acre project. It is not my intention to design the green streets for this system, but to show the possibility of flow accumulation within a subwatershed.

**The Plan**

The topographically delineated area measures approximately 180 acres and represents about the percent of the original watershed. Let us then explore the notion of making a smaller scaled version of the historic Creek and create a scaled channel that is two percent of the original size and depict the transition from production to depositional zones. If the watershed has changed dramatically and the possibility of complete restoration is unobtainable, then why not design a replica model of Islais Creek and tell a story?

This is not altogether unprecedented; restoration proposals for major rivers have scaled the channel geometry according to new flow regimes imposed by upstream dams and water diversion. Sediment is being augmented below dams in San Joaquin and other major rivers in central California.

The project is almost exclusively educational and instructive. This might be one of the most important components of the restoration movement. Without proper education and the telling of the story, in several decades people may think these restored systems are natural. This experiment should be viewed as another recipe for creek restoration that emphasizes the education and interpretation. While celebrating the ecological and natural, the plan does not promote itself as such.

**Method**

Of the total 180 acres, land coverage can be divided into four categories – roof, street, backyard and open park lands. The four categories can be further aggregated into two groups according to their representative roughness coefficients in the manning's equation. (see figure ) The natural areas contained 19 acres of parklands and 45 acres of backyard; and the urbanized contained 67 acres of roof and 50 acres of street. I assigned 0.95 as the roughness coefficients for the smooth impenetrable *urban* surfaces and 0.60 as the coefficient for the *natural* lands. Area was measured in AutoCAD.

Using the rational method and storm intensity values provided within the Jencks and Leonardson report, I estimated the total discharge for the 180 acres. According to Dunne and Leopold the rational method should ideally "be used only for catchments of less than 200 acres" (Dunne and Leopold). So then, using the rational method where discharge volume equals the multiplication of drainage area, storm intensity and a roughness coefficient, possible discharge flows may be calculated. The time of concentration for natural lands with high roughness and urban lands with low roughness were listed at three hours and fifteen minutes respectively. I calculated the two year recurrence discharge at 163 cubic feet per second.

According to a Dunne and Leopold nomograph for average bankfull channel geometry, a watershed eight square miles in the San Francisco Bay region would yield a width of 36 feet, a depth of 2.75 feet and a cross section area of 100 square feet. Another nomograph for bankfull discharge provides an estimate of 400 cubic feet per second. Leopold acknowledges the inaccuracy but also the usefulness of averages when he wrote, "as usual, mean relations for rivers are drawn through points having considerable scatter, but the averages are useful tools in planning even though any individual place on a river may not agree closely with the mean"(Dunne and Leopold). These averages are expectedly quite different than the specific recommendations of the Jencks and Leonardson report. While these averages may accurately depict the historic channel geometry of Islais Creek, the Jencks and Leonardson report advocates a specific channel geometry in direct response to modern conditions within the watershed.

A 180 acre watershed when plotted into the Dunne and Leopold nomographs yields a width of 10 feet, a depth of 1 foot, a cross section area of 10 square feet and a discharge of 400 cubic feet per second. I chose to use the Dunne and Leopold geometry in the design of the channel form.

The plan contains a degree of urban complexity in addition to the historic model. The immediate discharge from subwatershed drainage pipes requires an energy dissipater. After a small pond the water will flow over a weir into the production zone to the transfer zone and ultimately the wetlands and then the combined sewer system. Visitors will be encouraged to place sediment within the production zone and take part in the fluvial process, watching sediments accumulate in the production zone during low flow periods and then pulse downstream into transfer meandering zone with the winter flows. The wetlands will have interpretative signage illustrating both natural landfill of the depositional zone and the cultural landfill since the eighteenth century.

**Conclusion**

The restoration of fluvial process in the subwatershed level provides great opportunity for interpretation and education. Restoration and preservation of natural resources is incredibly valuable and while cities do not have the natural resources to attract large scale restoration the opportunity to engage a greater population of people and interpret the significance of restoration is worth the investment. Urban peoples need a connection to the regional landscape. This is one reason why farmers' markets are so popular – they connect urbanites with the farmer, the age old steward of the environment. Urban restoration should follow the farmers' example and make a connection that is greater than physical and more interpretive.

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Figure 1 – Islais Watershed

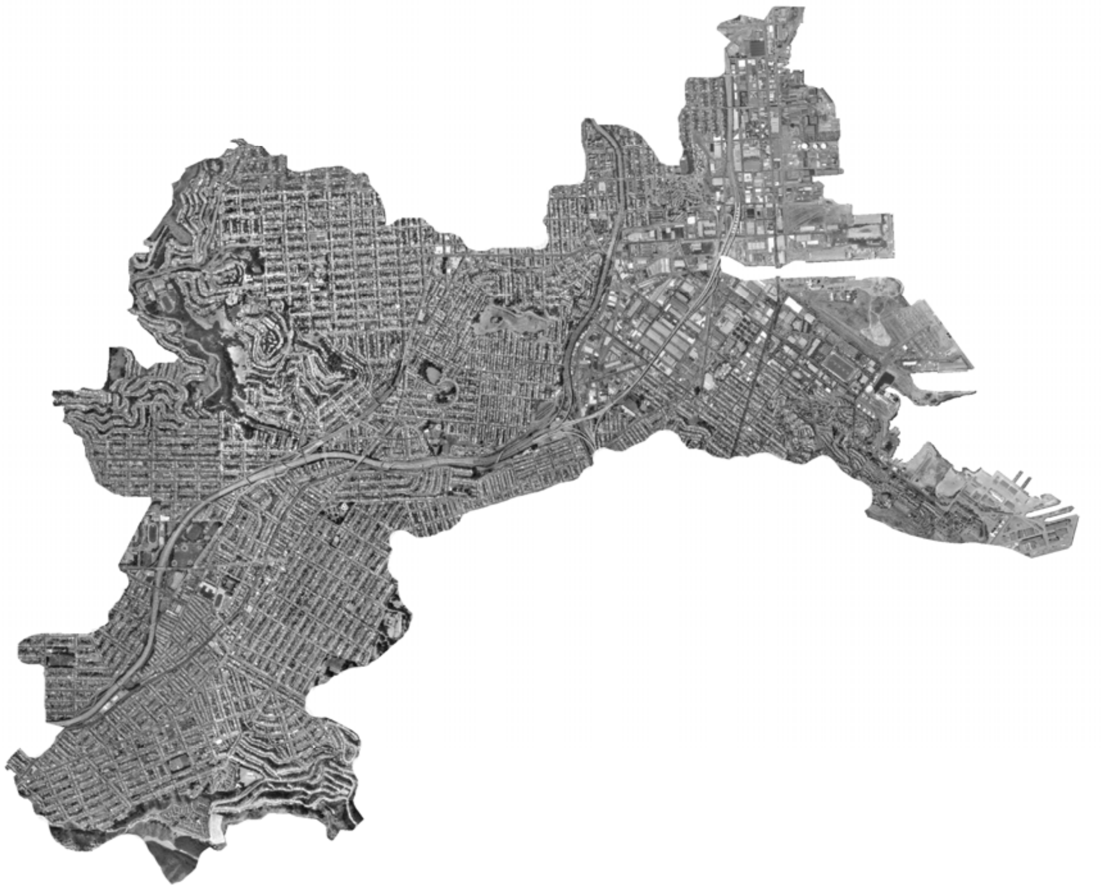

Figure – Islais Creek Watershed


Figure – 1869 San Francisco US Coast Survey

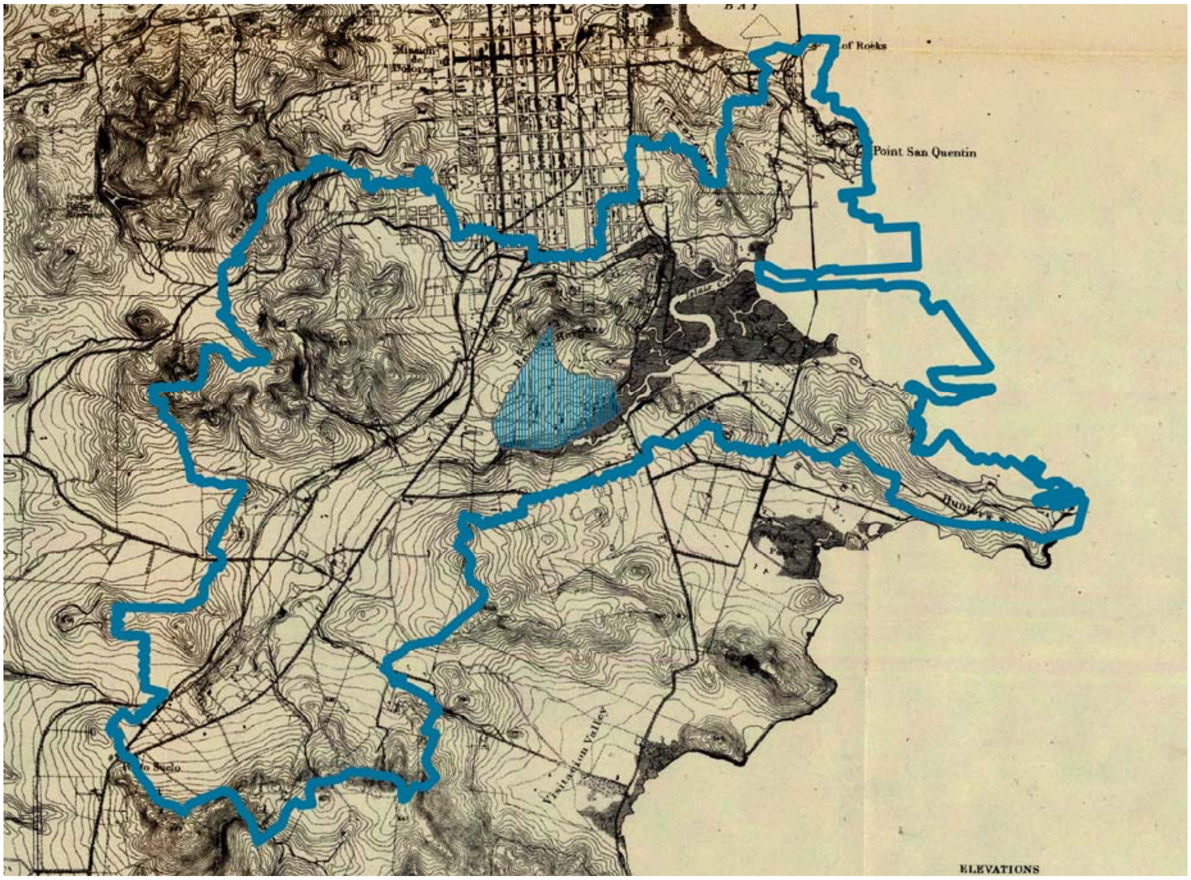


Figure – 1869 Islais Creek Watershed


Figure – 1013 Soil Map

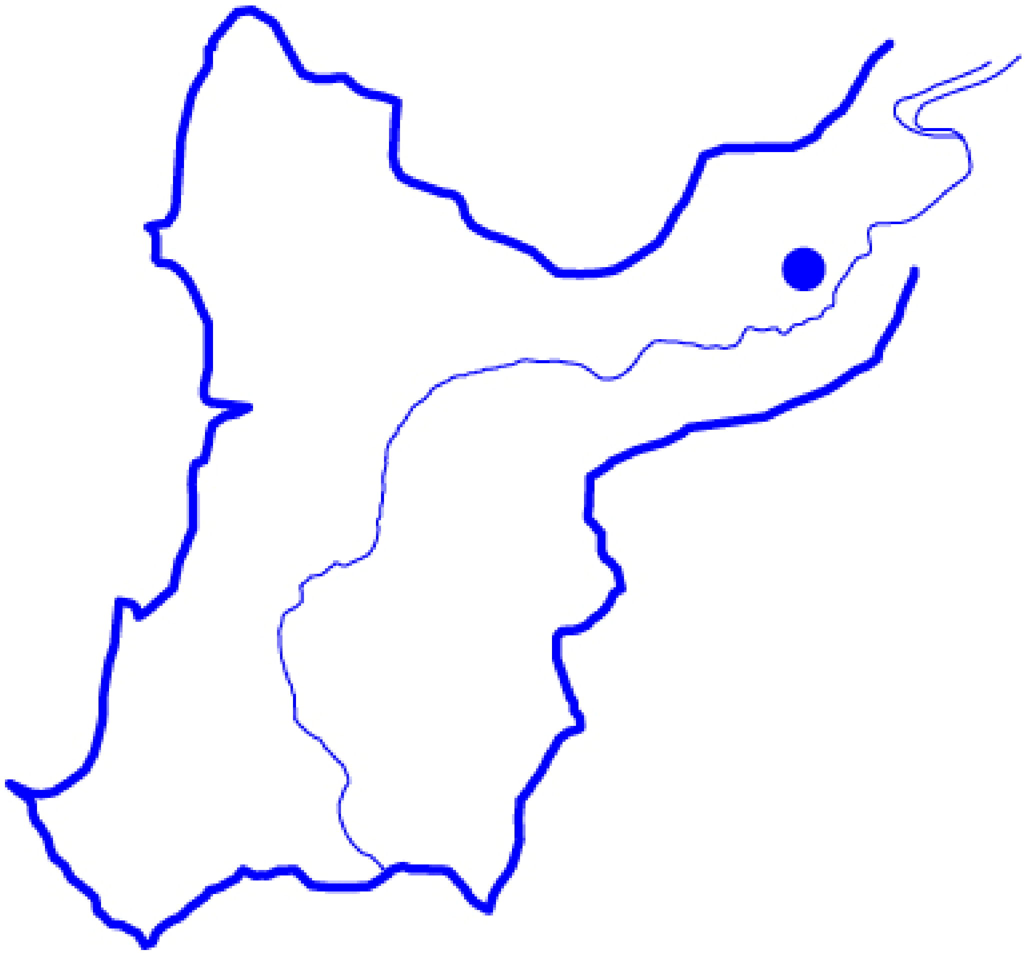

Figure – Islais Creek Watershed (Dot is project site)

# Figures

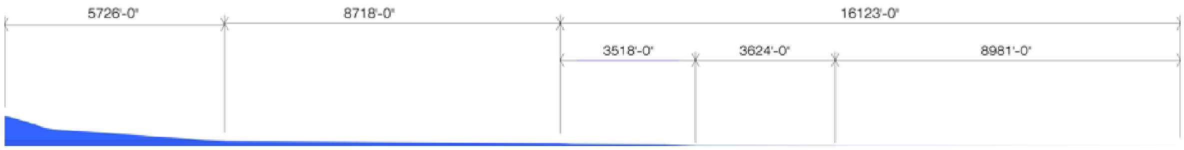

Figure – Islais Creek Historic Profile

Figure – 1904 Plot Map

Figure – Subwatershed and Site indicated

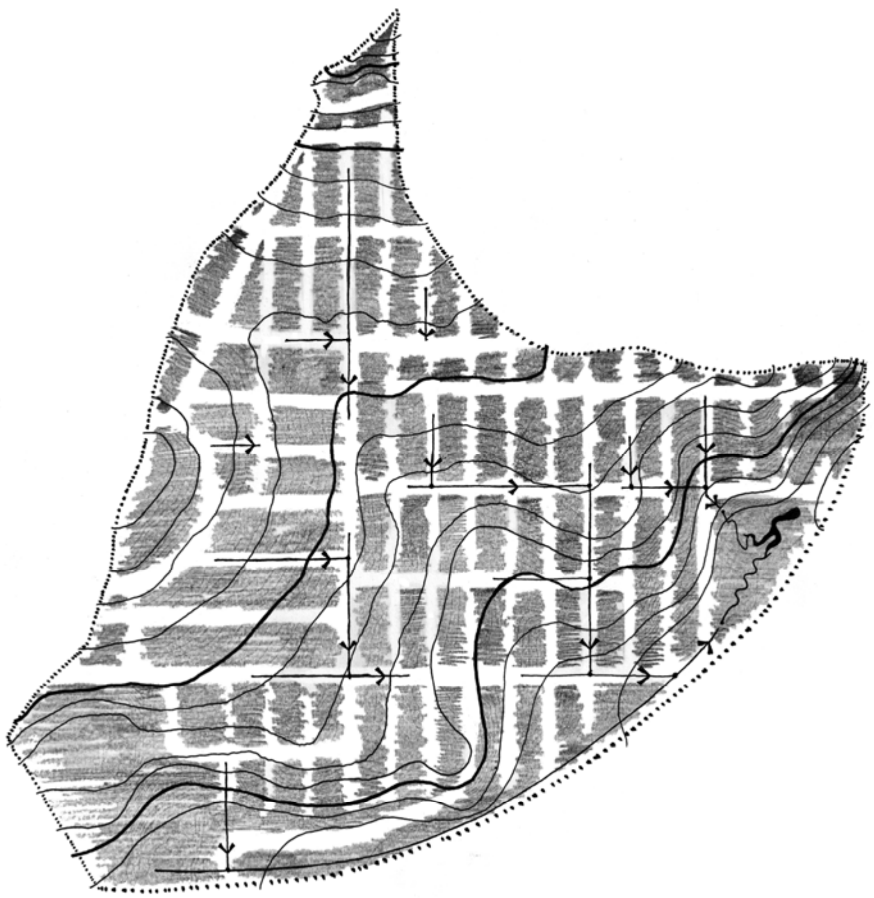

Figure – Restoration Concept – 180 Subwatershed

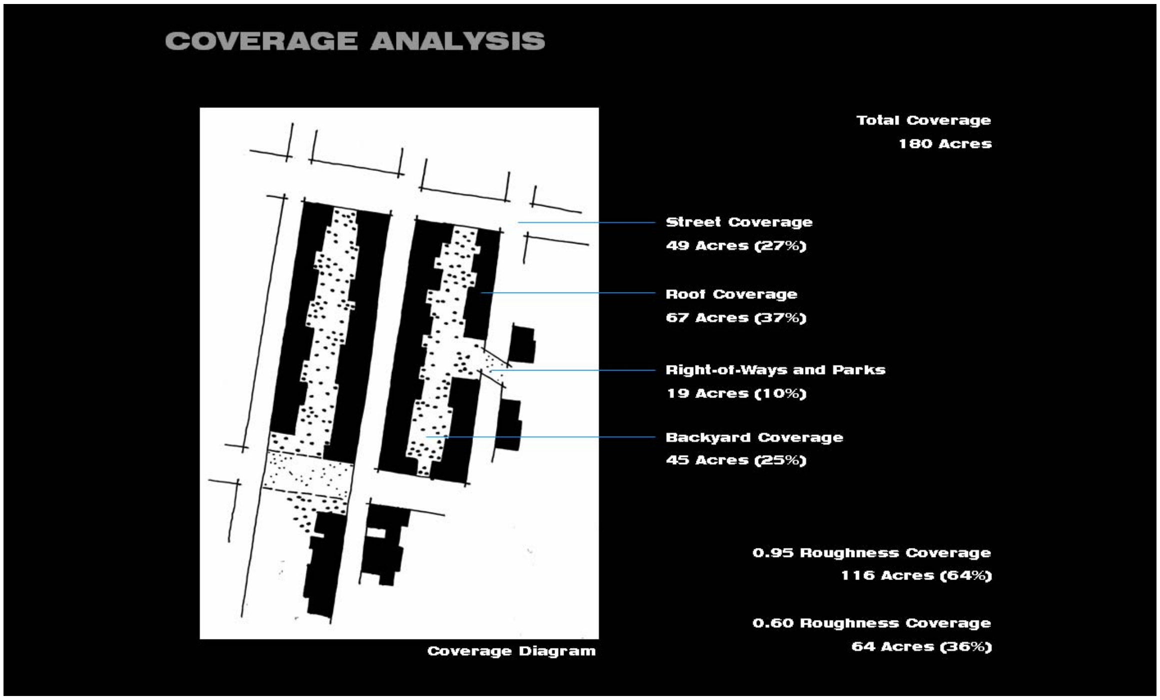


Figure – Subwatershed Coverage Analysis

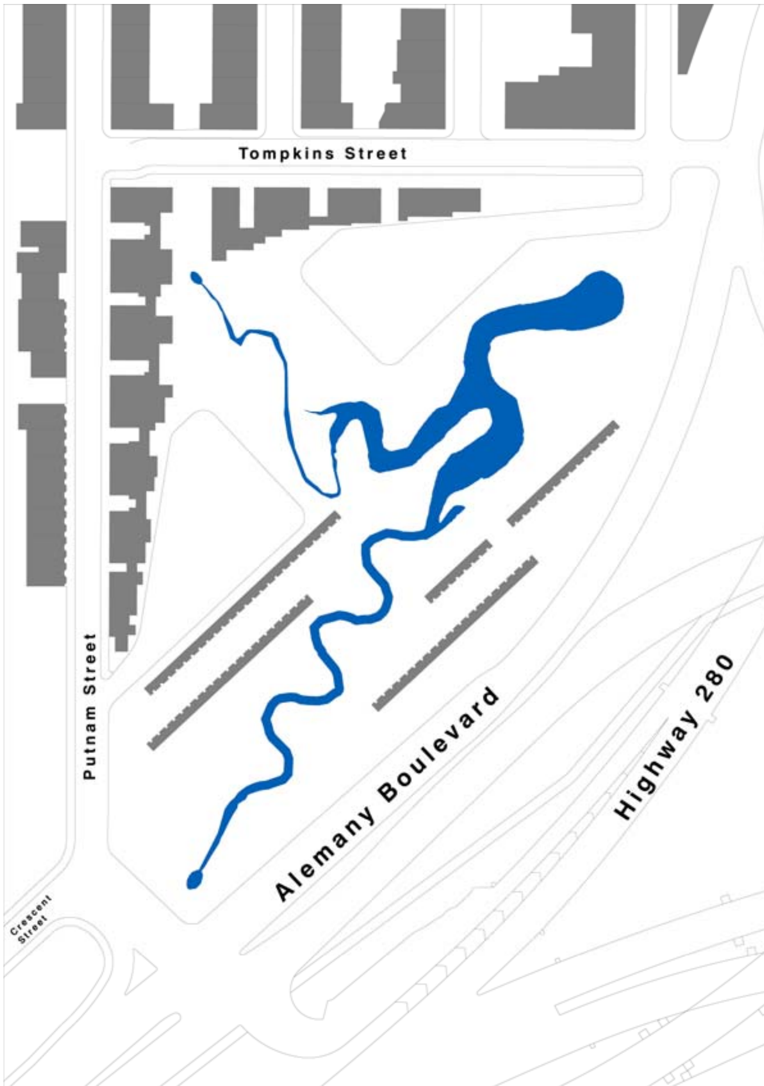

Figure – Islais Creek Restoration Plan

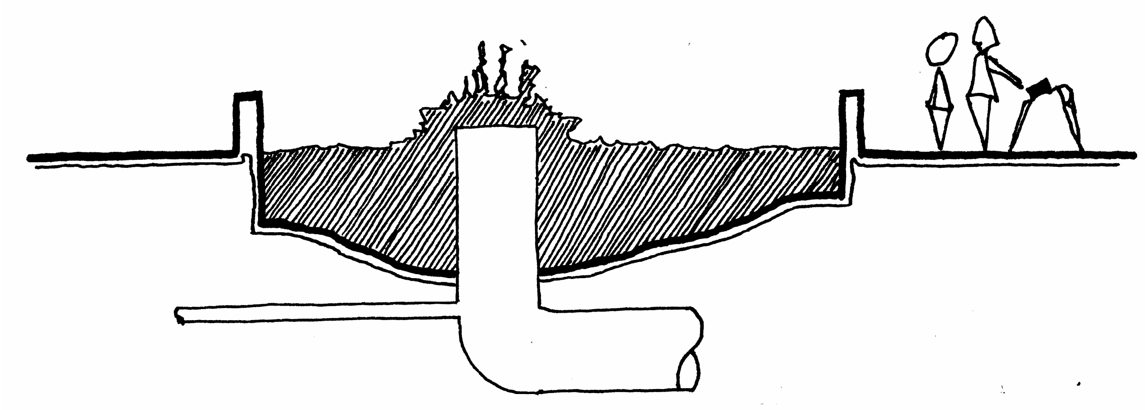

Figure – Energy Dissipater

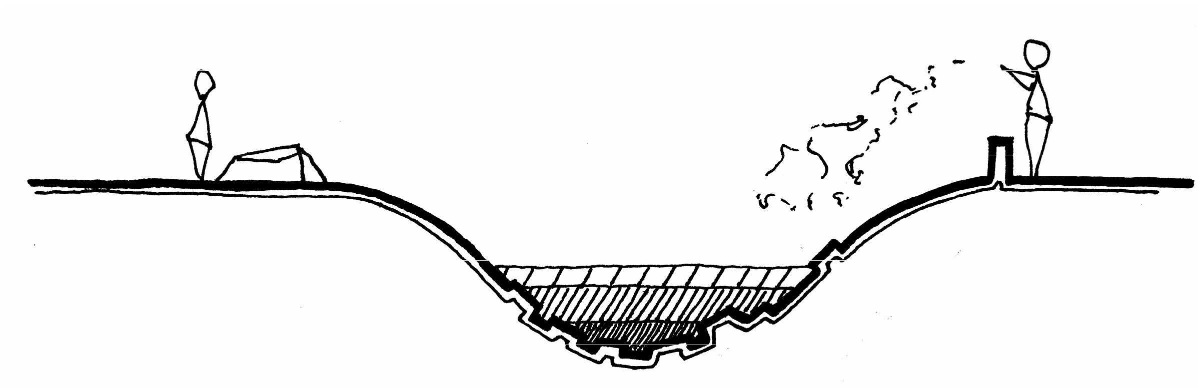

Figure – Production Zone

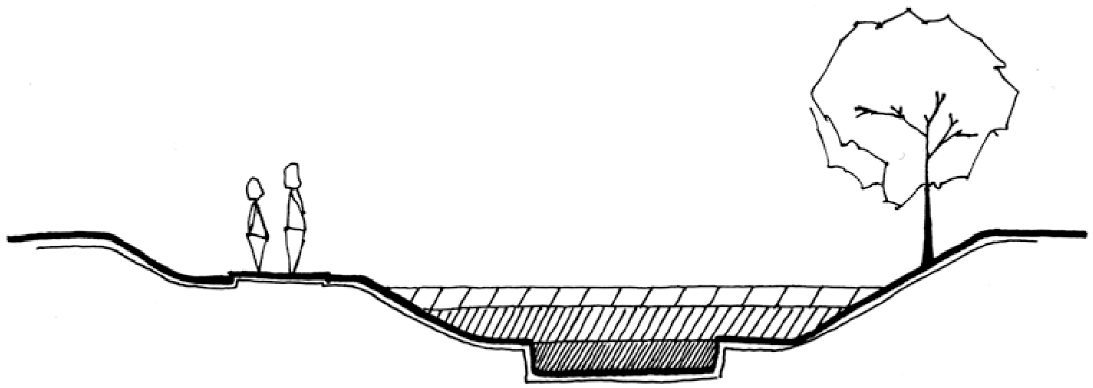

Figure – Transfer Zone

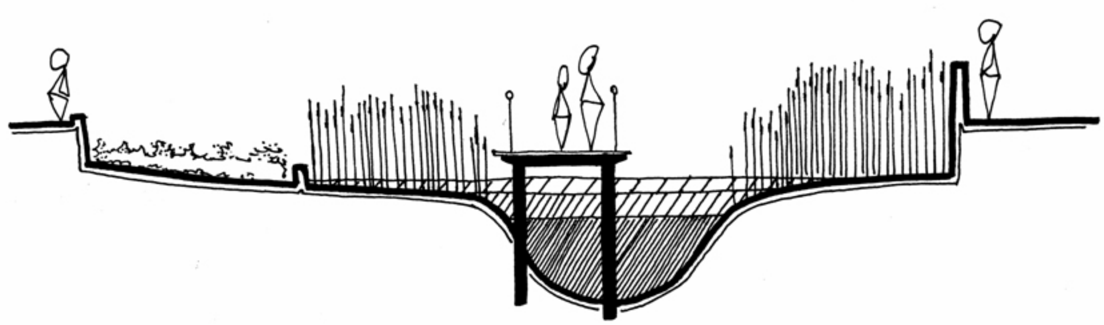

Figure – Depositional Zone