

Biophilic Regeneration of Brownfields

Towards Inclusive and Adaptive Landscape

Chalmers University of Technology
Department of Architecture and Civil Engineering
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“A new discipline needs to abstract its patterns as they appear. It is building its own foundation and logical skeleton, upon which future growth can be supported. Knowing its basic patterns early on will speed up the language’s development, and guide it in the right direction”

Nikolas A. Salingaros, 2000

Abstract

Brownfields represent complex challenges in contemporary urbanism. They are often polluted and socially neglected, yet they hold strong potential for ecological restoration, public space creation, and the reactivation of urban identity. As cities move toward more sustainable futures, these landscapes require approaches going beyond economic redevelopment. This thesis explores how biophilic regeneration can transform them into multifunctional public environments.

Drawing from brownfield regeneration theory and biophilic urbanism, the study identifies a knowledge gap in integrating biophilic principles into regeneration methodologies. While ecological restoration and cultural reuse are widely discussed, fewer frameworks examine simultaneously enhancement of heritage continuity and long-term adaptivity. Therefore, the study develops a biophilic regeneration framework based on ecological restoration, water and flood adaptation, green connectivity, spatial experience, multi-sensory, heritage legibility, and human–nature co-existence. These parameters are analysed through best practices to understand how design elements can act as practical indicators.

The framework is then tested on the Klippan waterfront in Gothenburg, where the future relocation of Stena Line creates a potential brownfield condition. QGIS-based mapping and historical analysis are used to identify access gaps, flood-prone areas, greenery needs, historical traces, and possible zones for intervention. The proposal translates the framework into spatial strategies through multi-sensory water-based design and and enhancement of maritime-industrial heritage.

The process concludes that brownfields can become adaptive green-blue urban landscapes when ecological, sensory, technical, and cultural aspects are designed together. Water functions as both flood infrastructure and multi-sensory experience, planting supports both biodiversity and atmosphere, and heritage becomes part of everyday public life through preservation and spatial memory. The framework can act as a base

guideline for biophilic regeneration of waterfront brownfields and can move beyond one site-specific proposal, while still requiring contextual analysis to become practical in each location. However, the research remains conceptual and mainly qualitative. Further studies could add technical brown-field parameters, stakeholder involvement, and quantitative indicators to measure the success of the framework across different sites.

Keywords: Biophilic regeneration, Brownfield, Heritage, Waterfront, Multi-sensory, Water.

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1. Introduction

1.1. Purpose

The aim of this thesis is to develop a biophilic regeneration framework applicable to brown-field and post-industrial sites, integrating multi-sensory biophilic design principles with the spatial, ecological, and structural realities of brownfield redevelopment.

The framework seeks to operationalize how post-industrial landscapes can be transformed into adaptive, multifunctional, and identity-rich public environments. Specifically, it aims to restore ecological systems, enhance human nature connection through visual, auditory, and tactile interactions with water, and manage flood risk. Furthermore, this study investigates the design of localized urban biotopes to establish active relationships with targeted urban fauna fostering rich human and non-human coexistence. Finally, it aims to integrate industrial and maritime heritage, such as factory remnants and historical sailing infrastructure, as spatial narratives that ground the site's cultural memory.

As Gothenburg continues to expand and densify, there is an urgent need to reintegrate nature into the urban environment. The city contains several post-industrial brownfields situated in critical locations within urban fabric, which can be transformed into public landscapes.

The framework's findings will be tested through spatial analysis and conceptual application within the waterfront context of Gothenburg. This will inform practical urban planning solutions that integrate biophilic principles to create more resilient and culturally rich public landscapes.

1.2. Research Question

1.2.1. Main Question

How can a biophilic framework integrate multi-sensory experiences and maritime/industrial heritage to transform waterfront brownfield sites into adaptive urban landscapes?

1.2.2. Sub-Questions

- Which indicators can be used to assess the biophilic and heritage potential of waterfront brownfields in Gothenburg?
- In what ways can biophilic water interventions support multi-sensory experiences and create multifunctional spaces, while simultaneously addressing flood adaptation in the local context?
- How can the selection of specific plant palettes (flora) create localized biotopes that actively support targeted urban wildlife (fauna), enhancing the non-human biophilic experience within a contaminated post-industrial context?
- How can industrial heritage elements enhance the biophilic spatial narrative and cultural memory, rather than conflict with ecological regeneration?

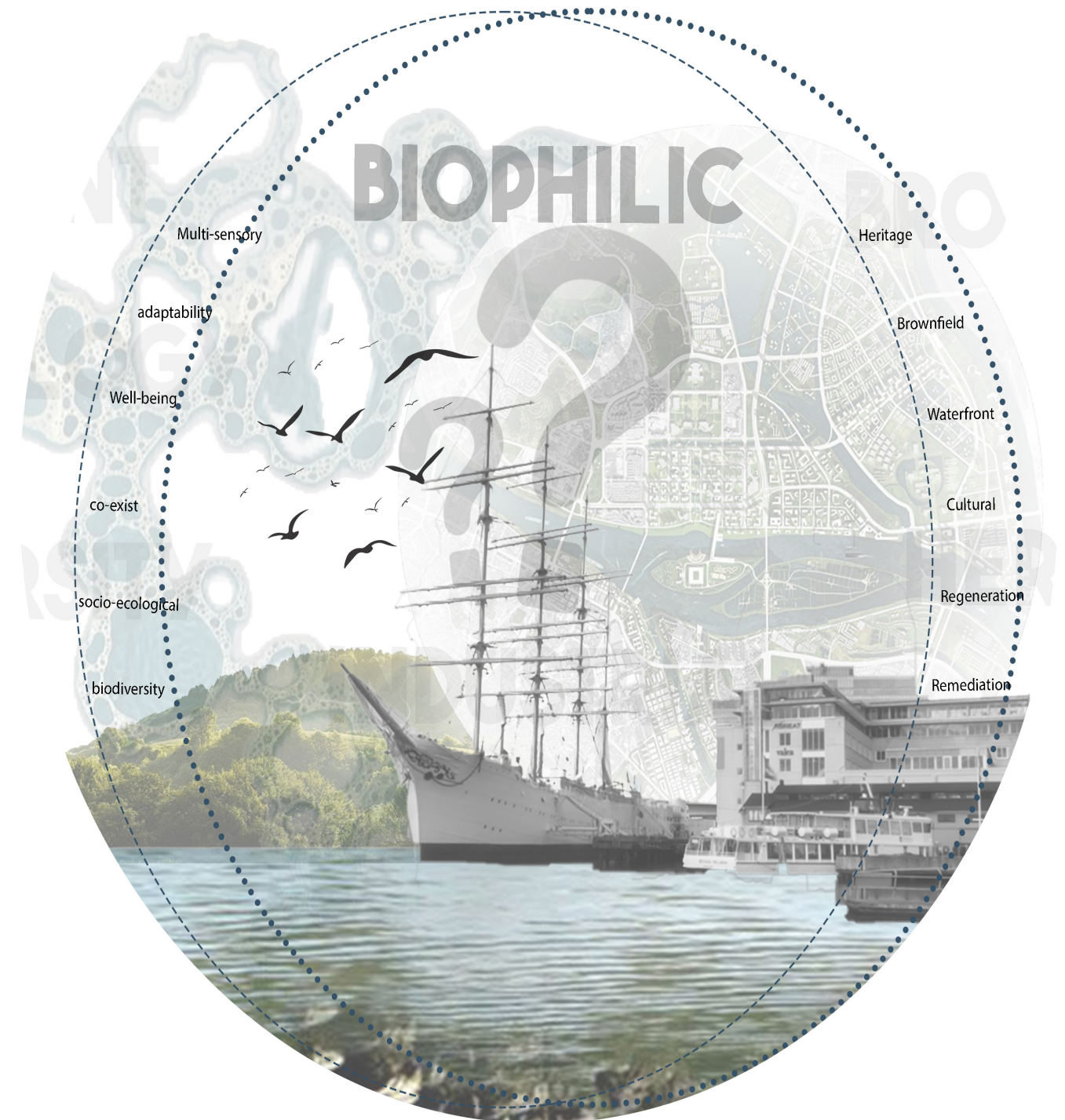


Figure 1, Thesis Question

1.3. Background

Across Europe and beyond, brownfields and abandoned industrial sites form a persistent layer of urban landscapes. Their history of extraction and production has left behind contaminated soils, deteriorated structures, and fractured neighborhoods (Zaletova, Ismagilova & Arsenteva, 2021; Nikolic & Arenas, 2014). At the same time, these sites hold immense potential for transformation, embodying unique cultural narratives and spatial opportunities. They often occupy central or well-connected locations, offering rare possibilities for green infrastructure, housing, or inclusive public spaces.

In the Swedish context, this challenge is particularly unique. While many Western European nations utilize brownfield redevelopment to combat urban sprawl, Sweden lacks an official national definition for these sites. Currently according to CABERNET/CLARINET (2006) report the «Sustainable brownfield regeneration», there are over 40,000 potential brownfield sites in Sweden. These areas are traditionally viewed through a narrow lens of contamination and technical remediation. However, as urban areas densify, there is a growing need to shift the discourse toward a «return to nature», re-envisioning these sites not as urban voids, but as critical testing grounds for ecological biodiversity and sustainable landscapes where natural and human factors coexist.

1.4. Discourse

Conventional redevelopment has historically viewed brownfields primarily as economic opportunities, focusing on remediation and real estate potential (Josef, Martinat, Tonev & Frantal, 2014). However, increasing awareness of climate change, ecological collapse, and social inequality has reframed these sites as opportunities for ecological and cultural regeneration (Rey, Laprise & Lufkin, 2021). Rather than erasing their industrial pasts, contemporary approaches highlight the potential to weave nature back into the urban fabric to foster a deeper human connection to nature while preserving memory and identity.

The specific contribution of this thesis is to extend biophilic regeneration to include heritage preservation, strengthening both ecological and cultural continuity.

1.4.1. The Dual Crisis: Resilience and Restoration

The shift to resilience is necessitated by a dual crisis facing modern densifying cities: the environmental threat of increasing flood risks and a growing mental health crisis linked to nature deprivation. Biophilic design, grounded in the human need for connection to nature, provides a framework to address both. By applying the 14 Patterns of Biophilic Design (Browning, Ryan & Clancy, 2014), regeneration can evolve from simple remediation to the creation of inclusive and restorative landscapes. Also, research highlights how green environments enhance ecological resilience (Beatley, 2017; Corner, 1999).

1.4.2. Multi-Sensory Restoration

Furthermore, regeneration must address more than just visual aesthetics. Utilizing Multi-Sensory Frameworks (Zhong et al., 2022), design can incorporate non-visual stimuli, such as soundscapes and thermal comfort, to maximize a site's Biophilic Quality Index (BQI) (Berto & Barbiero, 2017). This quantitative approach measures the restorative potential of a space.

1.4.3. Heritage as Spatial Narratives

A key tension in brownfield regeneration is the potential loss of local memory. Following CABERNET principles, sustainable regeneration should exploit the symbolic value of industrial remnants rather than erasing them. This thesis treats industrial infrastructure as Natural Analogues, spatial narratives that bridge the gap between a site's productive past and its ecological future and strengthening both ecological and cultural continuity.

1.4.4. Water as a Spatial Narrative

In waterfront contexts, this narrative is linked to water. Wijesooriya et al. (2021) argue for bridging technical water management with biophilic experience. By making water processes visible and audible rather than hiding them in drainage pipes, brownfields serve as high-performance landscapes. Water is transformed from a liability (flood risk) into a sensory asset that makes the invisible ecological processes of the city visible and restorative for the public.

1.4.5. The Gothenburg Context

In Gothenburg, brownfields are strategically located along the waterfront, with sites such as Frihamnen, Gamlestaden, and Klippan illustrating the tension between redevelopment pressures and the need for cultural continuity. To ensure these spaces function as vibrant urban landscapes rather than for new buildings, this study utilizes previous methodologies to detect sites with high socio-ecological value.

The specific contribution of research is extending biophilic regeneration to include heritage preservation, strengthening both ecological and cultural continuity. By selecting a waterfront brownfield in Klippan to test the developed Toolbox, the study demonstrates how a biophilic design strategy can be tailored to Gothenburg's ongoing transformation toward a sustainable, adaptive, and inclusive waterfront city.

1.5. Knowledge Gap

Although both biophilic design and brownfield regeneration are well-developed fields, they largely operate in parallel rather than as integrated frameworks.

Research on brownfield regeneration typically prioritizes remediation strategies, land-use feasibility, economic viability, and large-scale redevelopment planning. Ecological restoration is often addressed in technical or infrastructural terms, with limited attention to how regenerated landscapes foster human-nature relationships at the experiential and sensory level.

Conversely, biophilic design literature emphasizes psychological well-being, spatial qualities, and nature-based experience, but rarely addresses the structural constraints, contamination risks, governance complexity, and phased implementation that characterize brownfield contexts.

Three specific gaps emerge:

Lack of integration between biophilic design principles and brownfield regeneration methodologies. Biophilic patterns are rarely adapted to post-industrial conditions where contamination, heritage remnants, and infrastructural constraints shape design possibilities.

Under-theorized role of industrial heritage within biophilic frameworks. While adaptive reuse is discussed in regeneration literature, limited research explores how industrial remnants can enhance biophilic experience through materiality, spatial contrast, narrative legibility, and ecological succession.

Insufficient connection between experiential biophilic qualities and multifunctional, climate-adaptive brownfield landscapes. Flood management, blue-green infrastructure, and ecological corridors are often treated as engineering solutions rather than integrated biophilic spatial experiences.

1.6. Method

This research follows a research-through-design methodology, where spatial design operates both as analytical instrument and knowledge-generating tool to bridge theoretical biophilic patterns into waterfront brownfields.

1.6.1. Literature Review

The research begins with a systematic review of urban landscape and waterfront theories in biophilic design and brownfield regeneration fields. From each source (e.g., CABERNET, Browning et al.), specific intervention points are extracted to define the intersection between industrial site needs and biophilic solutions.

1.6.2. Framework Development

The extracted data from theory is synthesized into a Biophilic Regeneration Toolbox. This framework has different parameters that bind the possible biophilic principles that can address brownfield regenerations in the common area. This toolbox acts as a bridge, connecting brownfield parameters (remediation, heritage preservation) with Biophilic Solutions (sensory nature, natural analogues) and have general practical solutions contained to the design phase.

1.6.3. Case Study Evaluation

Selected international waterfront case studies are analyzed through the lens of the Toolbox. By mapping their strategies against the proposed parameters, the research evaluates how these solutions manifest in existing practice, even when not explicitly labeled as biophilic. The selected cases vary in the main focus areas of multi-sensory design, heritage and post-industrial landscape, flood protected landscape , and local urban park in gothenburg to extract the practical solutions.

1.6.4. Site-Specific Analysis

Focusing on the local scale, the study utilizes QGIS to analyze flood risks and urban morphology by mapping ecological corridors, water accessibility, green corridors, urban accessibility, and green connectivity. Simultaneously, a historical archival study is conducted to identify the cultural memory of the site, ensuring that the design remains grounded in the local industrial heritage and to benefit from the history of place in design concepts as a main criteria of brownfield regeneration.

1.6.5. Implementation

The final stage involves applying the Toolbox to a selected Gothenburg brownfield. This is the Research through Design core: the conceptual design is used to test the Toolbox’s effectiveness, optimizing the site’s values by balancing ecological restoration with the preservation of cultural memory. For the conceptual design each parameter includes different solutions that are linking together to shape the whole multifunctional masterplan with different qualities in each section addressing the multi-sensory.

Theory

The literature study defines key concepts and identifies strategies from previous studies and frameworks to inform a research-based, context-specific design approach.

LITERATURE REVIEW

Best Practice Analysis

The study draws on international examples to identify practical biophilic strategies, multi-sensory design and heritage preservation in post-industrial sites. Through structured analysis by comparing to the framework, key insights are tailored to Gothenburg’s context, guiding a site-specific design that addresses flood mitigation and biodiversity.

REFERENCE ANALYSIS, COMPARATIVE ADAPTATION , MATRIX EVALUATION

Local Challenges

Identifies key areas for intervention and informs targeted design strategies.

GIS-BASED ANALYSIS

GUIDES

INFORMS

Theory to Practice

A framework is created which will help as a toolbox how the design gap can be addressed and how to connect biophilic principles with brownfield regeneration.

LITERATURE ANALYSIS, FRAMEWORK DEVELOPMENT

Implementations

Used to iteratively develop and refine the urban landscape proposal through concept development and reevaluating. Based on the GIS analysis, the literature study and best practice studies, the process ensures the design responds to Gothenburg’s environment and optimized the framework solutions.

ITERATIVE DESIGN DEVELOPMENT EVIDENCE-BASED INTEGRATION

EVALUATES

INFORMS

GUIDES

Figure 2, Method Process

1.7. Delimitations

The research focuses exclusively on the intersection between biophilic design and brownfield/post-industrial regeneration.

Broader urban development strategies, real estate economics, and detailed technical remediation engineering are outside the primary scope.

Environmental performance is addressed conceptually and spatially, not through laboratory-based contamination testing or hydrological modeling.

The study concentrates on urban brownfield sites, with particular attention to waterfront contexts, where blue-green infrastructure and flood adaptation are critical.

Large-scale infrastructural systems (regional transport networks, metropolitan governance frameworks) are considered only insofar as they influence site conditions.

Quantitative environmental measurements (e.g., soil toxicity sampling, hydraulic modeling) are not conducted.

The research relies on secondary GIS datasets and methodologies for brownfields, case studies, literature synthesis, and design exploration.

The final outcome is a framework and conceptual design application, not a fully engineered implementation plan.

Case studies are international and for each topic so parameters for biophilic design or brownfield regeneration can be conducted from.

Theoretical Foundation

The theoretical foundation of this study is structured around two primary bodies of knowledge around biophilic design theory and brownfield/post-industrial regeneration research to transform derelict sites into multifunctional urban landscapes. By exploring these theories, this chapter helps to show why brownfields can be transformed into urban landscapes and how these disciplines can address urban challenges like flooding and biodiversity while preserving the cultural memory of post-industrial environments.

2.1. Brownfields

In the European context, the definition of a brownfield extends beyond a narrow focus of contaminated site paradigm often seen in North American policy. According to the CABERNET (2006) Network, brownfields are characterized as sites that:

- Have been affected by former uses of the site and surrounding land.
- Are derelict or underused.
- May have real or perceived contamination problems.
- Are mainly located in developed urban areas.
- Require intervention to be brought back into beneficial use, regardless of whether contamination is real or perceived (Ferber et al., 2006).

This definition emphasizes that unused land becomes a problem specifically when barriers prevent its from the urban pattern. The need for intervention, rather than the mere presence of pollutants, is the common characteristic defining these spaces.

2.1.1. Scale and Context

The perception and scale of brownfields vary significantly across Europe based on population density and economic factors.

The Neighborhood Scale: The neighborhood is considered the most strategic laboratory scale for implementing and testing sustainability transitions, as it is large enough for collective ecological systems but small enough to foster community-led biophilic experiences.

The Swedish Context: Unlike Western Europe, where brownfields are a tool to combat urban sprawl, Sweden lacks an official national definition for these sites. There are an estimated 40,000 potential brownfield sites in Sweden (Ferber et al., 2006). These are traditionally viewed through a return to nature paradigm, where the understanding is that formerly used land requires remediation before being allowed to revert to a natural state.

2.1.2. Waterfront Brownfields

While the general definition of a brownfield focuses on derelict urban land requiring intervention, waterfront brownfields represent a distinct and critical typology within European metropolitan areas. These sites are characterized by their unique position at the city-water interface and their specific socio-ecological potentials. Waterfront brownfields are disused or underutilized industrial, maritime, or commercial sites such as former shipyards, ports, and docks that act as a third space between the dense urban fabric and natural water bodies. These sites require targeted intervention to be returned to beneficial use, specifically addressing the intersection of terrestrial and aquatic ecosystems (Rey et al., 2022).

Key Characteristics

- The City-Water Interface: These sites act as critical transition zones between the dense urban fabric and natural water bodies.
- High Complexity and Cost: Redevelopment often involves significant challenges, including higher remediation costs due to maritime industrial history.
- Strategic Centrality: Waterfront brownfields are frequently located in well-connected or central urban areas.

- Flood Risk and Climate Vulnerability: Due to their proximity to water, these sites are often exposed to flood risks, making them primary testing grounds for water-sensitive urban design and climate adaptation strategies.
- Sensory and Restorative Potential: The presence of water offers immense multi-sensory potential, providing auditory, visual, and tactile experiences that significantly enhance the biophilic quality and restorative value of the urban environment.
- Industrial and Maritime Heritage: These landscapes are often defined by heavy industrial remnants such as cranes, docks, and factory shells which serve as anchors for cultural memory and local identity.
- Ecological Connectivity: Riverside brownfields have the potential to fill critical gaps in green infrastructure, acting as green connectors that link fragmented habitats with aquatic corridors.

2.1.3. Heritage and Cultural Continuity

Brownfield regeneration is an activity that delivers sustainable places that enrich the lives of the people who live and work there.

There are different ways to preserve urban memory in brownfields:

- Preserving Local Memory: Redevelopment often involves the risk of destroying local cultural heritage and memory. Sustainable regeneration should exploit the symbolic value of industrial remnants rather than erasing them.
- Landmarks: Successful projects use existing industrial buildings as significant symbols to create positive perceptions of a locality.
- Heritage as an Asset: Preserving the memory of a site through its industrial architecture can increase property values and foster community identity (Rey, Laprise & Lufkin, 2022).
- Natural Analogues: Treats industrial infrastructure as Natural Analogues, spatial narratives that bridge the gap between a site's productive past and its ecological future.

2.1.4. Green Connectors

Brownfield rehabilitation has significant potential to serve as the foundational tool for developing a city's green infrastructure network (Adorjan, Pecze & Szilágyi, 2019). The green connector is possible based on the location and characteristics of location by following details:

- Filling Urban Gaps: In densely built historical city centers where development is restricted, brownfields offer the primary opportunity for green space expansion.
- Linking Fragmented Systems: Utilizing abandoned railway areas can connect fragmented green surface components, facilitating the development of non-motorized transport and green road networks (Adorjan, Pecze & Szilágyi, 2019).
- Ecological Potential of Riversides: Riverside brownfields can become integral elements of a new green infrastructure system, making the urban landscape ecologically valuable (Adorjan, Pecze & Szilágyi, 2019).

2.2. Biophilic Urbanism

Biophilic design is grounded in the hypothesis that humans possess an innate affinity for natural systems and processes as an essential for health and well-being. While biophilic design often focuses on buildings, biophilic urbanism advocates for a holistic approach, integrating natural elements into the larger urban environment (Beatley & Newman, 2013).

In biophilic cities green infrastructure such as wetlands and urban forests are used to provide essential services that help cities spring back from climatic shocks like storms or heatwaves (Beatley & Newman, 2013) which can help contemporary urban planning due to climate challenges. Also, meaningful interaction with the local environment acts as a catalyst for developing protective attitudes and adaptive capacity within the community (Beatley & Newman, 2013) and makes the new built biophilic spaces an active multifunctional urban area suitable for social events.

2.2.1 Co-existence

A core objective of biophilic regeneration is fostering active relationships between human and non-human inhabitants.

In biophilic urbanism, Beatley and Newman point out that Zoöpolis concept argues for the active cultivation and accommodation of animals in urban environments to re-enchant our cities (Beatley & Newman, 2013). The relation between animals and plant palettes are significant to have diversity and long lasting life-cycle. In order to reach that, the selection of specific plant palettes can create localized biotopes that actively support targeted urban wildlife. Also, expanding green space in urban areas supports climate adaptation efforts, as vegetation helps manage flood risks, moderate temperatures, and improve environmental quality.

As one of the principles of biophilia,a site’s derelict state often harbors high ecological biodiversity, which should be viewed as an opportunity for the community rather than something to be dogmatically reclaimed.

2.2.2. Multi-Sensory Restoration

To maximize a site´s restorative potential, design must address the full spectrum of human senses (Kellert & Calabrese, 2015). While the visual sense is dominant, other sensory responses like touch, sound, and smell are of great significance to human health and comfort. Non-Visual Connection like nature sounds can accelerate physiological restoration up to 37% faster than urban noise (Browning, Ryan & Clancy, 2014). Non-Rhythmic Sensory Stimuli such as Stochastic movements, like swaying grasses, provide the mental breaks necessary to reduce directed attention fatigue (Browning, Ryan & Clancy, 2014) which can help with repeated unfocused element that makes a biophilic design momorable. There is a quantitative tool named Biophilic Quality Index (BQI) that measures a space´s restorative capacity based on multi-sensory and experiential indicators (Berto & Barbiero, 2017). his method is useful for implementation of framework in the design phase.

2.2.3. Water-Sensitive Design and Flood Management

Water-based interventions, such as constructed wetlands and rainwater harvesting systems, further strengthen urban flood resilience by facilitating natural water retention while simultaneously enhancing ecological functions (Zhong et al., 2022). By bridging technical water management with biophilic experience, water processes like filtration and drainage are made visible and audible rather than being hidden in drainage pipes (Wijesooriya et al., 2021). this will engage the public with natural cycles.

In waterfront contexts, water must transition from a technical liability into a sensory and ecological asset (Wijesooriya et al., 2021). Biophilics studies show direct multisensory engagement with water bodies prompts tranquility and is physiologically linked to lowered heart rates and blood pressure (Browning, Ryan & Clancy, 2014).

2.3. Synthesis and Comparison

2.3.1. Key Theories

The following table briefly presents the main theoretical references that support the thesis in both biophilic design and brownfield regeneration. The theories explain general biophilic design principles, waterfront brownfield regeneration potentials, biophilic urbanism, and sensory experience.

Together, they form the foundation for the research on transforming brownfields into restorative and ecologically valuable. Each reference contributes either a biophilic framework in urban scale, qualitative and quantitative evaluation method, or strategy that informs the progress of the design.

Reference	Key Theoretical Contribution	Application to Thesis
Browning et al. (2014)	Established the 14 Patterns of Biophilic Design categorized into Nature in the Space, Natural Analogues, and Nature of the Space.	Provides the "Design Toolbox" for restorative interventions (e.g., P2, P5, P11, P12).
Kellert & Calabrese (2015)	Defined 3 Experiences (Direct, Indirect, Space/Place) and 24 Attributes. Emphasized the "Repeated and Sustained Engagement" principle.	Focuses on place-based relationships and the preservation of the "Spirit of Place."
Beatley & Newman (2013)	Scaled biophilia from buildings to the urban scale. Introduced "Biophilic Urbanism" as a pillar of city resilience.	Supports the "Zoöpolis" concept and the integration of nature for climate adaptation.
Berto & Barbiero (2017)	Developed the Biophilic Quality Index (BQI), a quantitative 0–100 scale measuring the restorative potential of a space.	Serves as the evaluation tool to measure the success of the proposed design.
Zhong et al. (2021)	Provided a critical review of multi-sensory contributions to well-being, specifically in high-density environments.	Informs the "beyond-the-visual" strategy (sound, touch, smell) for industrial sites.
CABERNET Network (2006)	Established the European consensus on brownfields as sites requiring intervention for beneficial reuse.	Provides the baseline definition and the "A-B-C" economic/social viability model.
Rey et al. (2022)	Positioned the Neighborhood Scale as a "laboratory" for sustainability and achieving "Zero Net Land Take."	Addresses the Swedish context and the adaptive reuse of industrial heritage to preserve "Urban Memory."
Adorjan et al. (2019)	Argued that "Brown is the New Green," positioning post-industrial riverfronts as primary green infrastructure links.	Directly informs the waterfront strategy for connecting fragmented habitats.
Wijesooriya et al. (2021)	Developed Biophilic Water Criteria, bridging technical water management with the sensory experience of water.	Transforms flood-management infrastructure into a biophilic asset.

Table 1, Key Theories

2.3.2. Synthesis

Waterfront brownfields are primary testing grounds for water-sensitive urban design, turning flood-management infrastructure into high-quality public spaces (Rey, Laprise & Lufkin, 2022).

The literature review demonstrates that biophilic design and brownfield regeneration share complementary objectives but are rarely integrated within a unified framework. Brownfield regeneration research addresses environmental remediation, land reuse, and the adaptive transformation of post-industrial landscapes. These approaches often emphasize technical performance, contamination management, and large-scale redevelopment strategies (Rey, Laprise & Lufkin, 2022).

In contrast, biophilic design focuses on the experiential relationship between humans and natural systems, emphasizing psychological restoration, sensory engagement, and everyday interaction with nature (Kellert & Calabrese, 2015; Browning, Ryan & Clancy, 2014). While these frameworks demonstrate how natural elements improve human well-being and ecological awareness, they rarely address the complex spatial and environmental constraints of post-industrial landscapes, such as contaminated soils, or industrial remnants.

The comparison reveals that both disciplines address ecological aspects of landscape transformation. Brownfield regeneration focuses on restoring ecological and environmental performance, while biophilic design emphasizes human perception, multisensory experience, and emotional attachment to place. As a result, regeneration projects may successfully remediate land and introduce green infrastructure but still lack meaningful human-nature interactions, while purely biophilic environments may overlook the technical realities and cultural narratives embedded within industrial landscapes.

A second gap concerns the role of industrial heritage. In regeneration literature, industrial structures are often treated as obstacles or simply preserved as historical artifacts. However, within a biophilic framework these elements can act as spatial narratives and natural analogues, creating contrasts between natural systems and industrial materiality while preserving the identity of place.

A third gap lies in the integration of climate-adaptive infrastructure with experiential landscape design. Flood protection, water management, and ecological restoration are frequently implemented as hidden technical systems rather than visible. Biophilic design suggests that these processes can become sensory and educational elements, where water cycles, ecological succession, and biodiversity are experienced directly by visitors.

Therefore, the synthesis of these two fields suggests the need for a biophilic regeneration approach, where ecological restoration, heritage preservation, and multisensory human-nature interaction are integrated within adaptive post-industrial landscapes. Such an approach transforms brownfields from sites of remediation into living landscapes that support ecological resilience, cultural continuity, and everyday human experience.

This synthesis forms the theoretical basis for translating into design parameters, which guide the development of a biophilic regeneration framework.

	BIOPHILIC DESIGN	BROWNFIELD / POST-INDUSTRIAL REGENERATION
Core Focus	Human-nature connection and experiential spatial quality.	Transformation of contaminated or abandoned industrial land.
Primary Drivers	Psychological restoration, biodiversity integration, and sensory engagement.	Remediation, land reuse, economic feasibility, and adaptive redevelopment.
Spatial Strategy	Integration of water, vegetation, refuge/prospect conditions, and material authenticity.	Adaptive reuse, phased development, ecological restoration, and infrastructure integration.
Existing Structures	Often treated as neutral or aesthetic elements.	Industrial remnants are viewed as structural constraints or identity assets.
Ecological Role	Focused on enhancing biodiversity and ecosystem interaction.	Focused on restoring degraded ecosystems and improving environmental performance.
Implementation	Design-led and experience-driven logic.	Multi-criteria decision frameworks involving risk, funding, and governance.
Temporal Logic	Centered on seasonal change and dynamic environments.	Centered on long-term remediation and phased redevelopment cycles.
Identified Gap	Limited engagement with contamination and governance constraints.	Limited integration of experiential biophilic qualities.

Table 2, Biophilic Design and Brownfield Regeneration Comparison

2.3.3. Brief Comparison of table

Comparing Biophilic design and brownfield regeneration indicates that both fields prioritize ecological restoration and the integration of natural systems like water and vegetation. Biophilia approaches them through sensory experience and brownfields through technical performance. The main gap is biophilic design often lacks the technical framework, while traditional brownfield regeneration frequently neglects the restorative needs of the human inhabitants. This thesis seeks to bridge gaps by treating industrial heritage as a spatial narrative and transforming technical infrastructure, like flood management, into multisensory biophilic assets.

3. From theory to practice

3.1 Translating Theory into Design Parameters

To operationalize the theoretical insights identified in the literature review, the key concepts from biophilic design and brownfield regeneration are translated into spatial and ecological design parameters. These parameters represent qualities that enable post-industrial landscapes to simultaneously support ecological restoration and cultural continuity.

Rather than applying biophilic design as isolated aesthetic features, the parameters focus on creating integrated landscape systems where natural processes, heritage elements, and human experience interact. The extracted parameters therefore address three interconnected dimensions:

- Ecological performance
- Human sensory experience
- Cultural and spatial identity

Together, these qualities form the foundation of the proposed Biophilic Regeneration Framework, guiding how design strategies respond to the specific conditions of waterfront brownfields.

3.2 Key Qualities in Design

3.2.1. Multi-Sensory Engagement

Biophilic environments rely on sensory interaction with natural systems. Visual connections to vegetation, water, and seasonal change enhance restorative experiences, while non-visual stimuli such as sound, wind movement, and tactile materials strengthen emotional engagement with the environment (Browning, Ryan & Clancy, 2014; Zhong et al., 2022).

In design, this translates into viewpoints, framed landscapes, and dynamic vegetation, allowing users to observe ecological processes such as plant growth, water movement, and wildlife activity.

3.2.2. Repeated and Everyday Interaction with Nature

Biophilic urbanism emphasizes daily exposure to nature rather than occasional recreational contact (Beatley & Newman, 2013). Therefore, successful landscapes must be located along frequently used paths and public spaces, ensuring repeated engagement through everyday movement patterns.

In design, this requires strategically placing natural elements along circulation routes, gathering areas, and urban connectors to encourage continuous interaction. Also as a landscape urbanism design, choice of material and color can influence the interaction with nature. These choices both affect well-being and trigger the sense of connection to nature in urban fabric.

3.2.3. Ecological Biodiversity and Habitat Creation

Brownfield sites often contain spontaneous vegetation and emerging ecosystems that can support biodiversity. Instead of fully replacing these conditions, regeneration strategies should enhance localized biotopes that support both flora and fauna. Plant palettes can be designed to attract specific species, strengthening ecological networks while allowing visitors to observe natural processes within the urban environment.

3.2.4. Water as a Sensory and Ecological Element

Waterfront brownfields offer opportunities to transform technical water management into visible ecological systems. Water features such as wetlands, retention basins, and tidal landscapes can manage flooding while providing sensory experiences through sound, reflection, and movement (Wijesooriya et al., 2021).

Making hydrological processes visible helps visitors understand natural cycles while improving ecological resilience. Different forms and depths of water-based designs are creating habitat zones as ecological element that integrates different strategies.

3.2.5. Heritage and Sense of Place

Post-industrial landscapes contain structures, materials, and spatial patterns that represent the cultural memory of a site. Preserving these elements supports emotional attachment and local identity, strengthening the relationship between communities and regenerated landscapes.

Industrial remnants can be reused as landmarks, viewpoints, or spatial frameworks, allowing historical narratives to coexist with ecological regeneration.

3.2.6. Social Interaction and Collective Experience

Biophilic spaces also support social well-being and community interaction. Diverse activities, gathering areas, and flexible public spaces encourage interaction between people while maintaining strong connections with natural systems. Design strategies therefore integrate active recreational areas with ecological landscapes, balancing human activity with environmental protection.

The activation of this landscape urbanism works best when one is familiar with the site and cultural context. Cultural continuity in spatial experience strengthens the social interaction of locals in the urban design.

3.2.7. Adaptive and Self-Sustaining Ecological Systems

Long-term resilience is achieved when landscapes are able to develop and evolve naturally over time. Ecological succession, adaptive vegetation systems, and resilient hydrological processes allow regenerated brownfields to become self-sustaining environments.

These systems reduce maintenance requirements while strengthening biodiversity and environmental stability.

3.3 Key Qualities in Urban Context and the relation to Multi-sensory

The diagram shows how the key qualities identified in the theoretical review from Kallert (2015), Beatley (2013), Browning (2014), and Zhoung (2021) frameworks are filtered through an urban context. The following illustration limits and organizes parameters according to what can realistically be applied at the urban scale, particularly within public landscapes, waterfronts, and post-industrial brownfield sites.

It distinguishes whether each feature is a natural element found in the space, a spatial condition of the site, or a natural analogue that represents nature through materials, forms, patterns, or processes. Also, the diagram identifies which senses are activated by each parameter, such as sight, sound, touch, smell, and movement. This helps connect biophilic theories with practical design decisions.

By showing the features, and sensory engagement, the framework becomes a bridge between general biophilic principles and a more specific strategy for biophilic regeneration of brownfield.

3.3.1. Multi-Sensory Engagement

Sensory engagement is a key part of the proposed design strategy for biophilic regeneration. By mapping each design quality against the senses, the framework clarifies how possible brownfield features can support visual, acoustic, tactile, olfactory, and movement-based experiences within the urban landscape.

- Visual Experience: Visual engagement is created through direct and indirect connections with nature. Elements such as water, vegetation, animals, natural landscapes, seasonal change, and ecological processes strengthen the visual relationship between users and the site. These qualities support visual comfort, orientation, and a stronger sense of connection to the waterfront landscape.

- Acoustic Experience: Acoustic engagement refers to the sounds that shape the atmosphere of the site. It introduces calming auditory experiences, such as the sound of water, wind through vegetation, and local fauna that soften the industrial character of the brownfield. These sounds contribute to a calmer and more restorative urban experience within the post-industrial waterfront context.
- Tactile Experience: In design some design elements are only visible through the distance and some are reachable. Tactile engagement is supported through materials, vegetation, edges, and landscape elements that can be physically reached and touched. Natural materials, textured surfaces, planting, and interactive water edges can encourage the contact with the environment. This makes the landscape more accessible, and physically engaging.
- Olfactory Experience: Olfactory engagement is created through smell, especially through vegetation, soil, and seasonal planting. A year-round planting palette can provide scents during different times of the year, particularly during blooming seasons. These smells help create memory, atmosphere, and a stronger sensory identity for the regenerated brownfield to become part of the spatial experience.
- Movement and Temporal Experience: The fifth layer extends beyond the common senses and focuses on movement and passage of time. It includes the experience of walking through the site, following paths, and sensing changes in space. It also includes seasonal changes, climate change effects, water fluctuation, and the visible transformation of vegetation over time. Through movement and time, the site becomes a dynamic landscape.

Together, these sensory layers support a design approach in which natural systems are not only seen, but also heard, touched, smelled, and experienced through movement and time.

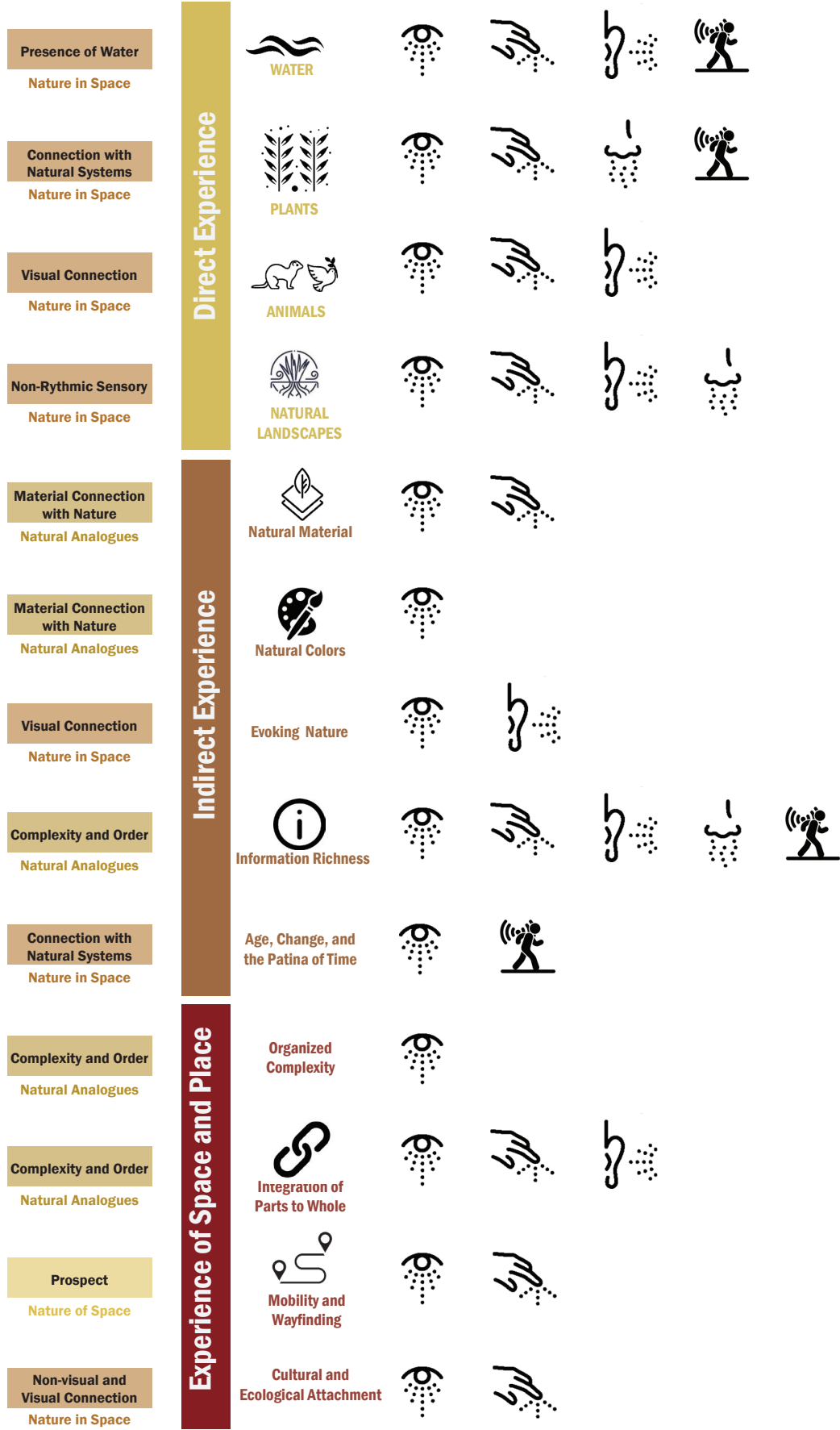


Figure 3, Key Qualities of Biophilic Urban Design and the Relation to Multi-sensory

3.4 Shared Principles

This framework brings together the key qualities of biophilic design and the main challenges of brownfield regeneration. The illustration shows how both fields can influence each other directly or indirectly and how their shared principles can form a common design strategy.

The middle part of the diagram represents the overlap between the two approaches. It shows that biophilic regeneration is not only about adding greenery to a neglected site, but also about creating relationships between ecological systems, water management, biodiversity, human experience, and cultural memory of brownfields. These elements work together to transform brownfields into active, resilient, and meaningful urban landscapes.

Water is one of the main connecting elements in the framework. In brownfield regeneration, water is often treated as a technical issue related to drainage, flooding, and site remediation. Through a biophilic approach, especially in Wijesooriya’s (2021) framework related to biophilic water criteria, these technical systems can become visible and experiential in the different patterns mentioned. Open water channels, basins, wetlands, and seasonal water movement can support flood management while also creating visual, tactile, and acoustic experiences for users.

Biodiversity is another central quality of biophilia. Brownfield sites often have limited soil depth, contamination, or compacted ground conditions, which affect the choice of vegetation and habitat creation. By working with these limitations, the design can introduce suitable planting palettes, new habitats, and ecological corridors. In this way, biodiversity becomes both an environmental strategy and a spatial experience. This topic was well argued by Adorjan (2019) by positioning the post-industrial waterfronts as a green infrastructure link.

Human experience forms the social dimension of the framework. A biophilic regeneration strategy should support everyday use, sensory engagement, and emotional connection to place. Multifunctional public spaces can make the regenerated brownfield as a part of daily urban life, while green connectors can extend ecological and social values into the surrounding urban fabric. This guideline was introduced by Wijesooriya (2021) by comparing previous biophilic frameworks and the development of a biophilic framework for sustainable design, adapted from Xue et al. (2019). In the mentioned framework, integration of work, life, play, and green space place-making emphasizes multifunctionality that can resemble daily life in urban areas. Memory and sense of belonging are also important. Post-industrial sites often contain traces of former uses, materials, structures, and local histories. Instead of removing these traces, the shared principles suggest reusing them as part of the design language. Existing elements can be transformed through material reuse, textures, colors, forms, and spatial references, helping the site maintain continuity with its past while gaining a new ecological and public role.

Together, these relationships define biophilic regeneration as an integrated approach. It combines technical brownfield solutions with sensory, ecological, and cultural qualities, creating landscapes that are resilient, restorative, and connected to their context.

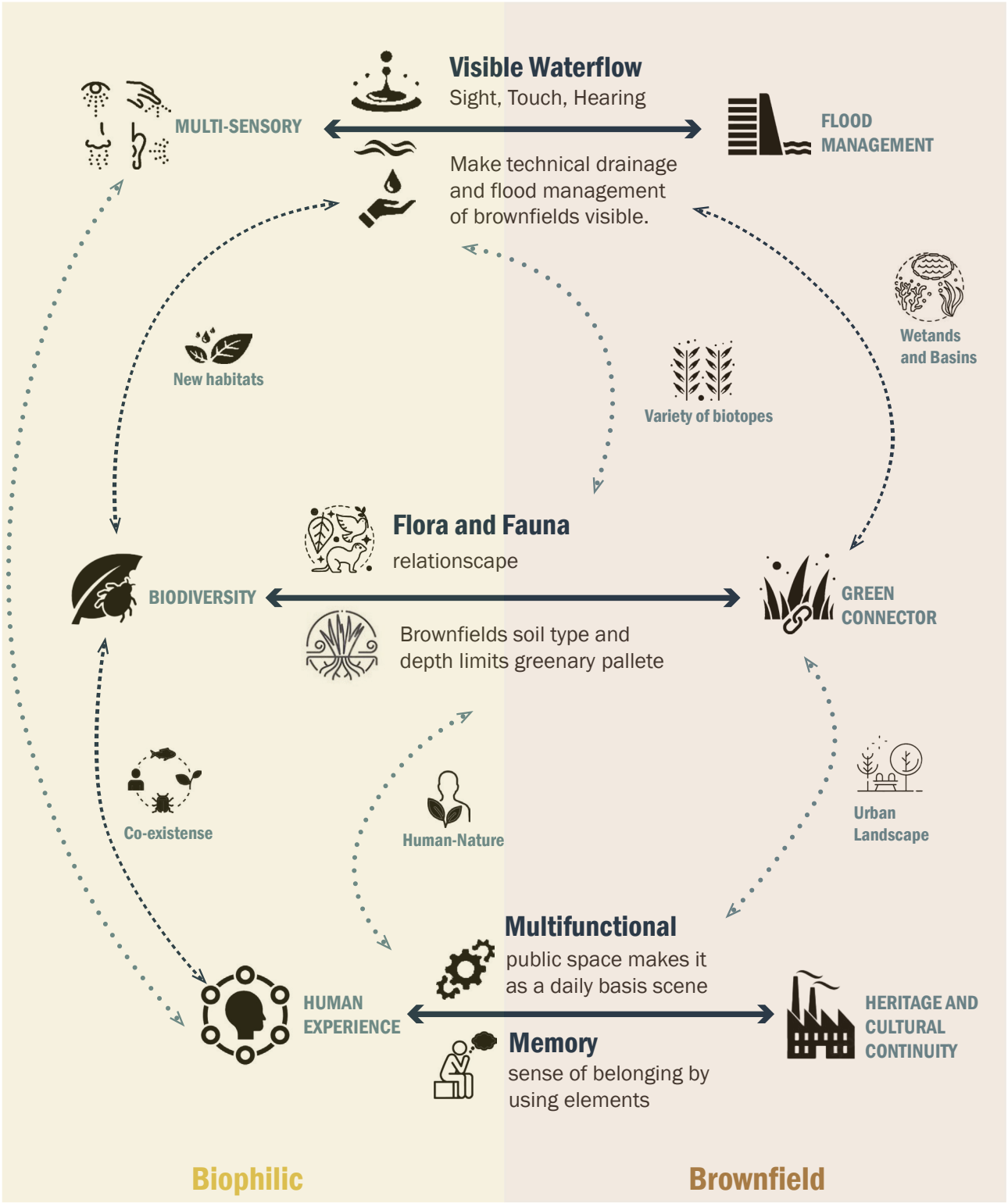


Figure 4, Shared Design Principles

3.5 Towards a Biophilic Regeneration Framework

The purpose of the framework is not to apply biophilic design as decorative greenery, but to translate it into practical strategies for waterfront brownfields.

Before defining the framework parameters, a set of general design factors is considered. These factors form the basis for site analysis, reference project comparison, and later design development.

- Natural elements
- Built and natural landscapes
- Time and seasonal change
- Spatial character, form, and shape
- Enticement and mystery
- Connection to place and sense of place
- Transitions between spaces
- Ecological mechanisms
- Habitat creation
- Social interaction
- Accessibility
- Activation
- Multifunctionality
- Historical preservation

These factors make the framework more specific by showing which qualities need to be analysed before design strategies are proposed.

The proposed framework links three layers of biophilic driver, brownfield condition, and possible design translation together through seven main design parameters that are both experiential and site-specific. These parameters are not fixed design solutions, but analytical categories that help identify the existing qualities, limitations, and transformation potential of waterfront brownfields.

- Ecological Integration focuses on the capacity to support biodiversity. It considers existing vegetation, soil conditions, habitat creation, ecological mechanisms, and seasonal changes.

- Water and Flood Adaptation addresses the role of water as both a climate-adaptive system and a sensory landscape element. Instead of treating flood risk and drainage as hidden technical systems, this parameter explores how wetlands, bioswales, basins, floodable zones, and visible water movement can become part of the public experience.
- Spatial Experience examines how people move through, understand, and emotionally respond to the site. It brings together spatial character, framed views, mystery, paths, barriers, and wayfinding in order to transform disconnected brownfield spaces into inviting public landscapes.
- Material and Heritage Legibility focuses on the cultural memory of post-industrial sites. Existing structures, industrial remnants.
- Green Connectivity positions the brownfield as part of a wider urban and ecological network. It considers green corridors, habitat links, waterfront access, pedestrian and bicycle routes, public transport, and transitions to surrounding neighborhoods, allowing the site to function as both a destination and a connector.
- Multi-Sensory Restoration ensures that the regenerated landscape is experienced through more than vision.
- Co-existence focuses on creating shared conditions for humans, plants, animals, water systems, and existing urban structures.

Together, these seven parameters allow the framework to work as a toolbox for analysing the site, evaluating reference projects, and guiding the design proposals for biophilic brownfield regeneration.

Framework Parameter	Biophilic Driver (Kellert/Browning)	Brownfield Context (Rey/CABERNET)	Design Translation	Evaluation Indicator
Ecological Integration	Biodiversity and habitat support	Ecological restoration of "spontaneous nature"	Native planting, targeted biotopes, and succession landscapes	Habitat diversity index and ecological connectivity
Water & Flood Adaptation	Presence of water and sensory variability	Flood risk management and waterfront suitability	Integrated wetlands, bioswales, and floodable public parks	Flood exposure overlay and experiential accessibility
Spatial Experience	Prospect, refuge, and mystery	Spatial legibility and safety in "urban voids"	Layered pathways, framed views, and adaptive reuse of structures	Spatial sequence analysis and user flow mapping
Material & Heritage Legibility	Natural materials and material connection	Industrial remnants as cultural identity assets	Retention of steel, brick, and concrete with ecological integration. factory elements in design	Heritage visibility scoring and interpretation panels
Green Connectivity	Daily doses of nature and urban scale biophilia	Linking fragmented green infrastructure gaps	Biophilic corridors and non-motorized transport networks	Green area network ratio and corridor continuity
Multi-Sensory Restoration	Non-visual stimuli (sound, smell, touch)	Reactivation of socially neglected landscapes	Soundscapes, fragrant plant palettes, and tactile surfaces	Biophilic Quality Index (BQI) and restorative mapping
Human-Nature Co-existence	Innate affiliation for all living systems	Transformation into inclusive public landscapes	"Zoöpolis" approach and targeted urban fauna habitats	Observational mapping of human and non-human use

Table 3, Biophilic Regeneration of Brownfield Framework

4. Best Practice Analysis

Chapter Overview

The best practice analysis serves as a vital anchor for the thesis, illustrating how biophilic principles can appear in brownfield and post-industrial waterfront projects, even when biophilic is not stated as the main aim.

By examining real-world examples and analyzing their design elements, we gain a deeper understanding of how multi-sensory and water-based solutions can be integrated into public spaces to enhance climate adaptation and promote ecological restoration.

The selected cases focus on waterfront brownfields and post-industrial sites, which aligns with one of the main delimitations of this thesis. The analysis of cases help to indicate the proposed framework factors in them. Each project is studied through its elements, design strategies, spatial qualities, and public impacts in order to understand why it functions successfully as part of everyday urban life.

By comparing international examples with a Gothenburg case study, we can acknowledge the differences in functions and values in landscape urbanism. This comparison supports a more site-specific understanding of social needs in urban landscapes and builds a foundation for the design interventions developed later in the thesis.



Figure 5, International Case Studies

4.1. Pirrama Park- Sydney

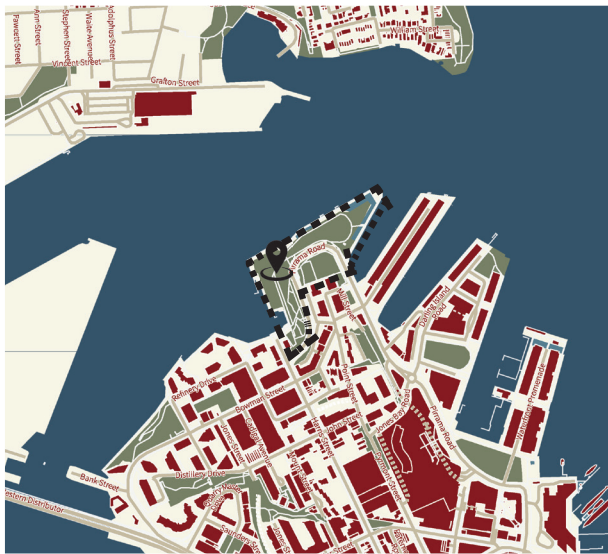


Figure 6, Pirrama Park Location

Location: Sydney- Australia
Area: 1.8 HA
Year: 2005 - 2010
Architect/ Landscape Architect:
Hill Thalys Architecture + Urban Projects
CAB Consulting
ASPECT Studios

Pirrama Park is a urban transformation of former fenced-off, post-industrial concrete slab which was previously used by the Water Police into a waterfront parkland (ASPECT Studios, n.d.). The design interprets the site's successive shorelines and rich maritime associations, and aims to heighten the experience of tidal water movement (Holmes, 2012).

The park restores the connection of city to the water and delivers waterside community facilities, innovative sustainable components and storm water (WSUD) initiatives (Hill Thalys Architecture + Urban Projects, n.d.). Also, multiple integrated active areas are considered in the design and become an attraction attraction for both locals and district visitors.

In the following text, frameworks parameters related to biophilic design and post-industrial sites are mentioned to study how these parameters were translated into design. This will help with going beyond theory and compare the terms to more practical solutions.



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4.1.1. Ecological Integration

Ecological aspects were achieved by making plant proposal and creating habitat with them for targeted fauna. The planting proposals for Pirrama Park were determined by study into the species endemic to the area. The flora was selected to restore the habitat required for both land and marine fauna.

80% of endemic trees were used and total of 150 new specimens were identified to be suitable for the Pymont Peninsula. Plants on land were chosen to compliment the new trees and to provide ground cover and swales. This flora restores habitats for urban fauna such as honeyeaters, lorikeets, and sulphur-crested cockatoos (Flannery & Smith, 2015).

4.1.2. Water and Flood Adaptation

Pirrama Park illustrates the critical water related environmental issues our city faces. The waterfront platforms and steps provide visual clues of environmental challenges such as sea level rise. Stormwater filtration zones and bioswales provide tangible opportunities to protect one of our most critical resources of water (Architizer, n.d.). A bio-swale forms part of a complex storm water filter and storage system. The harvesting and treatment of storm water provides the park with 80% of its irrigation needs whilst filtering and improving the quality of any water run-off into Sydney harbour (Flannery & Smith, 2015). To reach this range of supplies of water, the catchment-wide water strategy was used in the site and surrounding streets to treat, store and reuse water collected from well beyond its site boundary (Architizer, n.d.).

4.1.3. Spatial Experience

Pirrama Road forms the inland boundary of the park and is set against the backdrop of a durable old sandstone retaining wall, a visible reminder of Saunder's quarries. connection from Herbert Street was created by including a steel stair hung from the sandstone cliff (Architizer, n.d.). also, three shade pavilions, and the Pirrama Pavilion help defi-

-ning a landscaped square at the harbourfront termination of Harris Street Hill Thalys Architecture + Urban Projects, n.d.).

The park itself is organized into park rooms such as the Point and Green, the Grove, the Sheltered Bay, and the Community Square. Framed views, layered pathways, and the Belvedere viewing terrace along the Stevedore Walk promenade provide a rich sequence of prospect and refuge for visitors (Architizer, n.d.). In order to reach the integration and the transitions between open spaces, the waterfront promenade around the foreshore is the backbone of the park, and an important link in the 14km network (ASPECT Studios, n.d.).

4.1.4. Material and Heritage Legibility

Historically, the land has deep roots. The indigenous Eora tribe hunted and fished here in the place they called Pirrama. Following European settlement, the site became a center for sandstone quarrying between 1850 and 1931, with Pymont yellow sandstone used to build Sydney's landmarks. The park's creation was driven by the intention of keeping the land in the public domain. Today, it serves as a water-greenway that restores the city's connection to the harbor (Flannery & Smith, 2015). The challenge of the design process was to craft a response through a reading of the site, both past and present (ASPECT Studios, n.d.).

Another historic reference is the alignment of the promenade named Stevedore Walk, crossing the park to the original shoreline. the promenade creates a vital link in the 14 kilometre chain of open space running from Rozelle to Rushcutters Bay. The route is designed to be shared by walkers and cyclists and forms a corridor connecting the various activity or rest rooms of the park (Flannery & Smith, 2015).

Maintaining and keeping the site's rugged maritime and industrial character has been accomplished by Materials like wax-sealed concrete, micaceous iron oxide-protected steel, and recycled timbers. A wax sealant concrete with micaceous iron oxide protects the steel from the sea air, and an oil finish ensures that the plantation and recycl-

-ed timbers endure in the marine environment (Flannery & Smith, 2015). Also, designers utilized reclaimed sandstone from the Pymont Bridge and existing industrial artifacts, such as a durable old sandstone retaining wall from former quarries (Holmes, 2012). the sandstone features are found in the playground that once adorned Pymont Bridge. In the waterfront, significant marine engineering at the harbour edge created a sheltered bay and reveals the former shoreline of the site (ASPECT Studios, n.d.). These elements are directly addressing the sense of place by reusing materials and elements of historical site and factory.

To reach the sense of maritime history, sometimes resembling forms or the same materials can bring it back. The Canopy, providing the grand entry to the park, is one of the examples of using old factory materials such as steel and thick pieces of wood. It provides generous shade and shelter to the elements and becomes the architectural symbol of the park. Sheltered by its copper parasol, the undulating timber-battened soffit follows the section of the alternating profile of the trusses (Architizer, n.d.). The trusses are an additional touch that gives the industrial feeling to the design of the urban landscape.

4.1.5. Green Connectivity

The park acts as a vital link in a 14-kilometer chain of open space running from Rozelle to Rushcutters Bay. By bridging fragmented urban gaps and adding a planting palette and the creation of new habitats, it allows the site to function as both an ecological destination and a transport connector. New pedestrian and cycling paths strengthen the connectivity to the water edge and make the urban landscape a green-blue connector in this fragmented area.

4.1.6. Multi-Sensory Restoration

Multi-sensory is achieved through non-visual stimuli, such as the tactile surfaces of recycled timbers and the visual glow of sandstone walls that changes with the day's light. A solar installation on the pavilion canopy provides 80% to 90% of the



park's lighting requirements, serving as a visual reminder of Pymont's history as a power source. Also, the water play area and the steps to the shoreline make the waterline touchable, and by having tidal cycles, the sense of time passage can be activated.

4.1.7 Human Nature Co-existence

The park restores a relationship between the city and the waterfront. While waterside community facilities are used by humans for cultural events, markets, and festivals, the waters edge is designed for a variety of crustaceans and colonies of mollusks to thrive (Flannery & Smith, 2015). The park fosters an approach by creating shared conditions for humans, plants, and animals.

Framework Factors

The following table gives information about how each factors were applied in the design phase. This will help with moving forward from theory to more practical solutions with biophilic principles applied in post-industrial sites.

Framework Factors	Design Translation
Natural Elements	• endemic flora • experience of tidal water movement
Built and Natural Landscapes	• contrast of man-made structures and ground planes with heritage sandstone cliff face
Time and Seasonal Change	• seasonal planting • monthly and annual tidal cycles

Framework Factors	Design Translation
Spatial Character, Form, and shape	• shaped by curve of the Pirrama road • modular park rooms • shaped by multiple new paths • flat and and tectonic base, with barely 1-2 meters of variation across the site
Enticement and mystery	• layered pathways • sheltered platforms • framed harbor views
Connection to Place and Sense of Place	• rooted in Eora indigenous history • Saunders' yellow sandstone quarrying legacy • reused materials or reused materials or with the same visual aspects
Transition between Spaces	• hung steel stairs from cliff • stairs to devide flat areas
Ecological Mechanisms	• stormwater filtration zones • bio-swaes • renewable solar energy generator
Habitat Creation	• planting and water edge contidion for birds and targeted marine fauna
Social Interaction	• public square, regional scale play-ground, sheltered pavilion for events • backdrop to urban life, to quiet solitude and happy socialisation
Accessibility	• grand entry at the Canopy's north end • south end extends over to provide elevated viewing terrace. • shared pedestrian and cycle path
Activation	• cultural events and performances, meetings, markets, and festivals • support by cafe, toilets, event-ready square, and recreational areas
Multifunctionality	• multiple recreation opportunities • public square, the canopy, pavilion and indented bay (rooms). • civic park, water filtration, energy source
Historical Preservation	• reusing sandstone articafts • activities resembling maritime • aligning pronomede to original shoreline

Table 4, Framework factors- Pirrama Park

4.2. Hudson River Park's Gansevoort Peninsula - New York

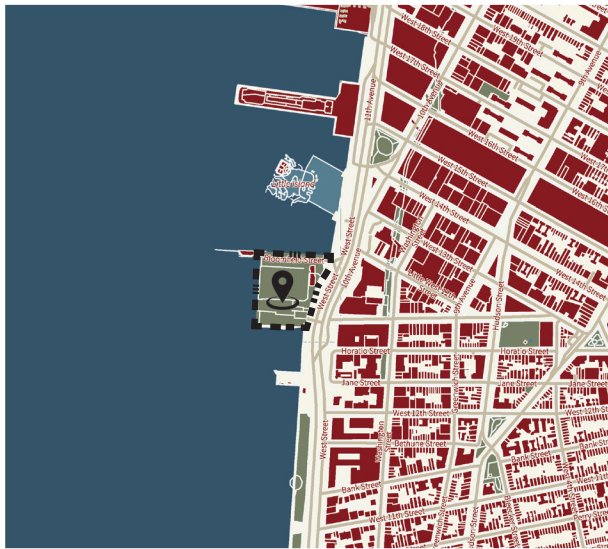


Figure 7, Hudson River Park Location

Location: New York- U.S.A
Area: 5.5 Ha
Year: 2023
Architect/ Landscape Architect:
Field Operations

Hudson River Park's 5.5-acre Gansevoort Peninsula transforms a former industrial waterfront site into an ecologically, economically, and culturally active public landscape (Carr, 2008). It is Manhattan's first public beach and salt marsh, creating a shoreline that invites New Yorkers to engage with the Hudson River (Field Operations, n.d.).

The park was designed to reclaim disused maritime piers and abandoned industrial areas, serving as an urban interface that restores the public's connection to the estuary with environmental and recreational benefits (Hutcheson et al., 2018). The park is shaped by community input and balances active and passive spaces for lounging, relaxation, and recreation while drawing visitors to its varied edges (Field Operations, n.d.). Recent segments, such as Pier 26 designed by OLIN and Gansevoort Peninsula by Field Operations, act as living laboratories that blend urban resilience with Manhattan's first public beach (Hutcheson et al., 2018). This specific segment transformed a formerly inaccessible Department of Sanitation site into the park's largest green space (Architizer, 2025).



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4.2.1. Ecological Integration

The park utilizes native vegetation to restore biodiversity and to stand harsh coastal conditions (Field Operations, n.d.). Native species like Pitch Pine, Spicebush, Little Bluestem, Cardinal Flower, and New England Aster are planted to increase biodiversity, add seasonal interest, and withstand wind and salt spray (Landezine, 2025). This ecological restoration has successfully attracted rare fauna, such as the marsh wren, which had not been previously observed in the park (Architizer, 2025). Also, the salt marsh has notably served as a precedent for future resilience projects throughout New York City (Field Operations, n.d.).

4.2.2. Water and Flood Adaptation

The northern edge features a salt marsh, along with submerged aquatic habitats that include reef balls and gabions seeded with 20 million juvenile oysters, providing valuable habitat, improving resiliency, and water quality (Architizer, 2025). A series of balconies and get-downs allow visitors and student groups to get closer to the water and support the Park's estuary education programs (Field Operations, n.d.). Additionally, the design of the shoreline transects to the north and the south features intertidal and subtidal elements such as the salt marsh, tidal pools, reef balls, and oyster reef-cages. The shoreline has served as a precedent for permitting upcoming and future resilience projects throughout New York City and its surrounding waterways. (Landezine, 2025). Another approach for protecting the beach from changing tides and rough waters is river boulders, concrete blocks, and rip rap (Architizer, 2025).

4.2.3. Spatial Experience

Topographical movement is utilized to create diverse environments, transforming urban voids into inviting landscapes (Landezine, 2025). The park sequences varied programming, including multi-use sports fields and meditative porch swings (Field Operations, n.d.). The design also celebrates the 13th Avenue Promenade, preserving the only remaining one-block stretch of this historic avenue (Architizer, 2025).

Another defining spatial characteristic of the project is how the design embraces each side of the peninsula and offers new ways to engage with the river, elongating the transition from land to water and contributing to a healthier and more resilient shoreline (Landezine, 2025). On one side, the approach is by having access to water, and on the other side, the habitat creation on the water edge defines the borders.

4.2.4. Material and Heritage Legibility

Gansevoort Peninsula illustrates how urban waterfronts can evolve to meet 21st-century challenges by pioneering new permitting pathways, while honoring their industrial heritage (Field Operations, n.d.). Formerly an inaccessible working edge, the peninsula is transformed into a public beach, salt marsh, promenade, and green open space, while still referencing the memory of piers, maritime infrastructure, and the rough character of the former Hudson River shoreline (Carr, 2008).

The park embraces the appeal of ruins, preserving stable fragments of industrial port infrastructure as a reminder of the city's maritime past (Carr, 2008). David Hammons' Day's End sculpture, commissioned by the Whitney Museum, frames the beach as a reference to New York's industrial past and Gordon Matta-Clark's 1975 artwork that cut openings into the Pier 52 shed that once occupied the site (Landezine, 2025). These elements maintain the cultural memory of industrial era while transitioning to public use (Architizer, 2025).

The 13th Avenue Promenade also recalls a rare remaining fragment of Manhattan's lost waterfront grid, giving historical memory a new everyday use through seating, gathering, and views toward the river (Landezine, 2025). Gansevoort Peninsula's design gives it a new purpose, transforming a former inaccessible sanitation operations site into Hudson River Park's largest green space, reflecting the neighborhood and its needs, celebrating its history, and imagining a new future for the river and estuary (Architizer, 2025).

The sense of belonging is created through both memory and access. different zones invite people to inhabit the site in different ways. The beach edge, tidal pools, salt marsh, and planted areas reconnect visitors with the Hudson River as a living estuary rather than a distant industrial boundary. In this way, the design becomes a layered public landscape where ecological restoration, cultural memory, and community use come together.

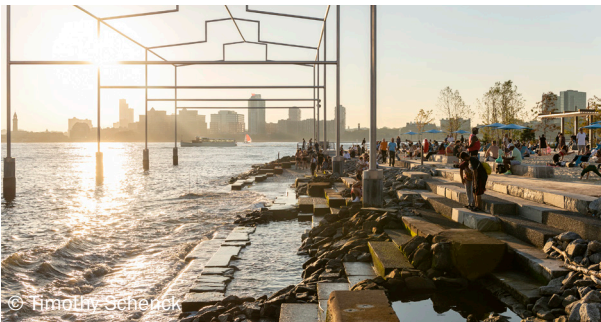
4.2.5. Green Connectivity

A five-mile continuous bikeway and pedestrian pathway form the backbone of the park, linking fragmented neighborhoods like the West Village and Chelsea to the river (Carr, 2008). The corridor functions as both a destination and a connector, providing residents with new access points and a continuous chain of waterfront transit (Field Operations, n.d.). These transitions continue at the water edge and connect the park and its habitat to nearby parks such as Little Islands.

4.2.6. Multi-Sensory Restoration

Diverse tactile surfaces, from the urban beach sand to granite walkways, provide a rich multi-sensory environment (Field Operations, n.d.). Multi-sensory restoration is also achieved through sound of rustling grasslands and the scent of native Pine Groves (Architizer, 2025). In the southern edge, the Upland Sandy Bluff meets a sequence of descending hardscape platforms, both steps and terraces, sliding into the Hudson River and allowing visitors to engage directly with the water’s edge (Landezine, 2025).

To convey a sense of movement and the passage of time, the tide advances and recedes, and water interacts with the horizontal planes, generating an ever-shifting dialogue between solidity and liquidity, stability and flux (Landezine, 2025). Additionally, the design incorporates cooling mist features and architectural wind shadows to extend seasonal usability for visitors (Architizer, 2025).



4.2.7 Human Nature Co-existence

Hudson River Park fosters a shared environment for humans and nature, where recreational activities occur alongside estuary restoration (Hutcheson et al., 2018). While the Great Lawn and urban beach accommodate social gatherings, the salt marshes provide essential nourishment and habitat for local birds and marine life (Architizer, 2025). Also, marine science programs for the public further enhance the cultural significance of the estuary (Hutcheson et al., 2018). these programs try to educate childrens from schools about ecology and also engage all the visitors with the natural habitat of New York waterfront.

Framework Factors

The following table shows how each factors were applied in the design phase. This information mostly is helping with multifunctionality and social interaction in urban landscape. This interaction is mostly possible due to variation of water edge spaces that activates the park. Some of the spaces contain passive situation which is used mostly for relaxation and rest, while the rest are active zones both for adults and children.

Framework Factors	Design Translation
Natural Elements	- Restoration of oyster reefs and salt marshes - experience of tidal water movement - restoration of coastal flora
Built and Natural Landscapes	Integrates massive urban furniture and structures, like the pavilion, with rugged, naturally evolving ruins and soft shore-lines.
Time and Seasonal Change	- Daily tidal cycles - extend seasonal use via wind protection - different seasonal sports zones

Framework Factors	Design Translation
Spatial Character, Form, and shape	- rising topographical mounds - linear promenades, and the unique footprint of industrial piers - stairs and rocks in water edge
Enticement and mystery	- winding woodland paths - framed glimpses of the harbor
Connection to Place and Sense of Place	- preserving ruins of old harbor - pre-colonial imagery of Manhattan’s shoreline
Transition between Spaces	- sequence of hardscape platforms - all zones are engaged by water by sliding towards the edges
Ecological Mechanisms	- salt marshes and reef balls - defense against rising tides and coastal flooding - rain garden
Habitat Creation	rocky tidal zones and submerged aquatic habitats are designed to sustain endangered sturgeon and oysters.
Social Interaction	- programs for children and adults - multi-use sports field, urban beach, dog park, gardens, and outdoor gym, social deck
Accessibility	- adding separate bikeway and pedestrian pathway - new entry points for small boaters and kayaks
Activation	- educational field trips - marine science festivals - everyday recreational play - support by concession stand, restrooms
Multifunctionality	- viewpoints, ecological zones , salt marsh, boardwalks, topographic lawn, picnic area, recreational zones - flood buffer, public hub, and marine science platform
Historical Preservation	- stabilizing old pilings - preserving the cultural landscape’s character

Table 5, Framework factors- Hudson River Park

4.3. Färjenäsparken - Gothenburg



Figure 8, Färjenäsparken Location

Location: Gothenburg- Sweden
Area: 15 Ha
Year: 2020
Architect/ Landscape Architect:
Mareld Landskapsarkitekter



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Färjenäsparken is a city park located on the island of Hisingen at the northern abutment of the Älvsborg Bridge in Gothenburg. The project transforms a post-industrial landscape into a vibrant recreational space for everyday life and large-scale regional events with further development by involvement of the City of Gothenburg (Mareld Landskapsarkitekter, 2020). The site holds immense historical significance as the location where Karl IX founded the first version of Gothenburg in 1603, and the park aims to restore the powerful relationship between the urban fabric and the River Älv.

4.3.1. Ecological Integration

The park design focuses on the preservation and development of the surrounding forest by utilizing two eco-designed forest edges, which help with several important factors such as enhanced biodiversity, wind protection, shielding, and experiential values (Mareld, n.d.). During construction, approximately 35 large trees were moved to the site using pumice skeleton soil to ensure optimal root oxygenation and moisture (Bara Mineraler, 2021). The forest palette is created to strengthen the human-nature connection by restoring natural habitats and introducing bird-rich environments (Mareld Landskapsarkitekter, 2020).

4.3.2. Water and Flood Adaptation

Water is integrated as a functional and aesthetic element, with specific paths designed for water collection and management within the park's topography (Mareld Landskapsarkitekter, 2020). The paths are made from natural materials and creates natural form of kanal to direct water through the forest area and in floodable zones.

Also, the direct access to the River Älv shoreline creates habitat zones for birds and other local wildlife, integrating the water as part of the public experience (Mareld Landskapsarkitekter, 2020). In this area the water can be touched and the habitat created is reachable for human experience.

4.3.3. Spatial Experience

The park's central feature is The Pelouse, a massive open lawn designed to accommodate up to 20,000 people for live shows and events (Mareld Landskapsarkitekter, 2020). In most parks in Sweden, three zones of dense forest area, a flat, clear area, and a recreational area for mostly children are recognized. In this case, the recreational zone is near residential areas and more accessible to public transport. Then, using natural materials and elements like grass, the transition to a more natural flat area or forest is evident.

The spatial layout near waterfront provides a clear transition from the mystery of dense forest path-

-ways to open greenery with framed views of the Älvsborg Bridge and Stena Line ferries (Mareld Landskapsarkitekter, 2020).

4.3.4. Material and Heritage Legibility

The design acknowledges the site's history as an old harbor while transitioning it into a modern urban park (BRA Mark, 2021). On the waterfront and near a parking space, the old deck is preserved and will be developed in the next phase of design development.

Culturally, it was shown in old pictures of the park and more green areas of Gothenburg that the flat green zones give multifunctionality and freedom of activity to users. Regarding that, the park honors its post-industrial context and its status as the city's 1603 founding site by maintaining a sense of place grounded in Swedish cultural usage of large flat areas for public recreation (Mareld, 2020).

For material, most elements in the design were made of natural materials such as wood or reused materials in the playground section. Even, the exercise zones for adults and the facilities were made out of wood. The only man-made and more hard surfaced area is near the water edge to engage and continue the path from nearby residential zones, and also for reinforcing this zone at the edge due to the risk of flooding in Gothenburg's edges.

4.3.5. Green Connectivity

The park serves as a vital connector between nearby residential neighborhoods and the waterfront (Mareld Landskapsarkitekter, 2020). There are some parks along the river which are divided by residential areas, and by adding small greenery in each street or adding courtyards to these areas, the connectivity of greenery is preserved.

It utilizes natural pathways and ensures a minimum built area within the greenery so that natural transitions remain the dominant urban interface for pedestrians and cyclists (Mareld Landskapsarkitekter, 2020).

4.3.6. Multi-Sensory Restoration

The forest interior acts as a restorative acoustic space filled with bird sounds, while the shoreline provides a dynamic sensory experience of the River Älv (Mareld Landskapsarkitekter, 2020). On the waterfront, there are decks that give the visual connectivity, and also a sand surface slipping into water, which is more a habitat for birds and docks to have nests there. Also from the shoreline, the bridge, Stena Line, and old harbor elements are visible and make the whole shoreline design a visual, touchable zone that brings the sense of place.

Eco-designed forest edges provide critical wind protection, creating shielded microclimates that improve sensory comfort in the exposed coastal environment (Mareld Landskapsarkitekter, 2020). This comfort and relaxation feeling is wafted into the sound of birds in the forest area, and in contrast to the waves breaking at the water’s edge.

4.3.7 Human Nature Co-existence

By separating the park into departed calm and active zones, the design preserves natural habitats alongside high-energy recreation areas (Mareld Landskapsarkitekter, 2020). Habitat zones at the shoreline and forest interior ensure that biodiversity thrives even as the park hosts large public gatherings (BRA Mark, 2021). The forest is mostly encouraging the coexistence by the emotional feeling of being in a natural area, while on the shoreline, the coexistence is more visible and a direct relation between humans and non-humans is valid.



Framework Factors

The following chart is mostly by the information gathered at site visits and in close relation of creation of urban parks in gothenburg, Sweden. It is showing how factors related to biophilic are translated to design in swedish context and in a more sustainable natural way.

Framework Factors	Design Translation
Natural Elements	Parks, Open green space
Built and Natural Landscapes	- minimum built area - allow the natural landscape to dominate
Time and Seasonal Change	- The forest edges provide year-round usability by shielding against winter winds - lack or existence of some fauna

Framework Factors	Design Translation
Spatial Character, Form, and shape	- shaped by curve of the Pirrama road - modular park rooms - shaped by multiple new paths - flatand and tectonic base, with barely 1-2 meters of variation across the site
Enticement and mystery	- open viewpoints to the bridge and Stena Line - natural forest pathways
Connection to Place and Sense of Place	Grounded in the site's 1603 founding ferry terminal legacy
Transition between Spaces	- visible natural path transitions - departed calm and active zones
Ecological Mechanisms	- water canals - minimum built area in greenery
Habitat Creation	- Targeted restoration of bird and polli-nator habitats - endemic forest and shoreline planting
Social Interaction	- event spaces for live shows - everyday recreational spots - shoreline walking path
Accessibility	- pathways link directly to Gothenburg's transport hubs - link to residential areas - biking and pedestrian path in shoreline
Activation	- shoreline active zone and cafe - event-ready Pelouse - recreational and sport spots
Multifunctionality	biodiversity sanctuary, a historic landmark, and a major regional event venue, local recreational center
Historical Preservation	Site landmarks and the old harbor

Table 6, Framework factors- Färjenäsparken

4.4. Findings from Best Practice Analysis

By studying Pirrama Park, Hudson River Park's Gansevoort Peninsula, and Färjenäsparken, the chapter identifies how ecological integration, water adaptation, spatial experience, heritage legibility, green connectivity, multi-sensory restoration, and human–nature co-existence can be translated into spatial strategies.

Although the selected projects differ in scale, context, and design focus, they all demonstrate how post-industrial waterfronts can become active public landscapes. The studies help to move from theoretical parameters toward practical design interventions. It highlights which strategies have already been transferred and can be adjusted for the Gothenburg context.

4.4.1. Opportunities

The selected case studies show that post-industrial waterfronts can be transformed from inaccessible industrial edges into active public landscapes. Across Pirrama Park, Gansevoort Peninsula, and Färjenäsparken, water, ecology, heritage, and public life are designed together rather than treated as separate layers.

One main opportunity is the use of water as both infrastructure and experience. Bioswales, wetlands, basins, tidal edges, floodable edges, and visible water movement can support flood adaptation while also creating sensory qualities such as sound, reflection, touch, and seasonal change. This is relevant for Gothenburg, where waterfront design must respond to sea-level rise while addressing the multisensory of biophilic design.

The case studies also show how waterfront brownfields can become green-blue connectors. Continuous promenades, cycling paths, planted corridors, and ecological edges can reconnect fragmented urban areas to the water. Habitat creation is an opportunity in the green connector. Shoreline planting, salt marshes, bird habitats, and local biotopes show how public waterfronts can support non-human life while enriching human experience.

Another opportunity is the reuse of heritage as part of spatial identity. Existing materials, harbour structures, old alignments, and industrial fragments can become landmarks, seating, viewpoints, pathways, or material references. The same materials can be reused or by resembling the same texture and color it can be done. In this way, heritage becomes part of everyday public life and strengthens the sense of place.

Färjenäsparken shows how waterfront parks in Gothenburg can combine ecological qualities with everyday recreation and regional public life by highlighting the importance of climate comfort and seasonal usability, which is important for applying the framework in a Nordic context. These strategies help translate the framework into design interventions.

4.4.2. Challenges

The case studies reveal challenges that need to be considered in the Gothenburg site. One main challenge is balancing public access with ecological protection. People should be able to approach and experience the water, but sensitive habitats need calm and protected zones. This requires careful zoning between active public areas, quiet ecological spaces, and protected biotopes.

Another challenge is integrating flood adaptation. Raised edges and protective structures can reduce flood risk, but they may also disconnect people from the river. Therefore, flood protection should be designed as part of the landscape through terraces, slopes, planted edges, and floodable public spaces. This allows flood protection to become part of the spatial and sensory experience rather than a purely technical edge.

Heritage reuse also requires care. Industrial and maritime remnants should not become only decorative objects. They need to be connected to function, movement, material experience, or public program. This allows the history of the site to support a new public and ecological role.

Brownfield conditions create further limitations. Former industrial waterfronts often contain compacted ground, hard surfaces, shallow soil depth, and fragmented ecological conditions. These factors can affect planting, water infiltration, habitat creation, and maintenance. The design must therefore use suitable plant palettes, raised planting areas, controlled habitat zones and water-sensitive solutions.

Lastly, the cases show that successful waterfronts need both activity and flexibility. Over-programming can make the landscape too fixed, while lack of activity can make it feel empty. For the design phase, this means the framework should be translated into layered interventions that support recreation, flood adaptation, access, heritage, and sensory experience at the same time. Another related point in this integration is connectivity. Even well-designed waterfront landscapes can fail if they remain isolated from surrounding neighborhoods, public transport, pedestrian routes, and cycling networks. For Majorna/Klippan, this means that the future design must connect the existing urban fabric to the river, rather than only improving the edge condition.

4.4.3. Conclusions

The best practice analysis confirms that biophilic brownfield regeneration is most successful when ecological systems, water management, heritage, and public life are integrated rather than treated separately. The three cases show that waterfront brownfields can become adaptive urban landscapes when technical systems are transformed into visible and meaningful public experiences.

The findings help translate the framework into design interventions for the implementation chapter. Ecological integration can become native planting, biotopes, and succession landscapes. Water and flood adaptation can become wetlands, basins, bioswales, floodable public spaces, and visible water flows. Spatial experience can be developed through layered paths, framed views,

and transitions. Material and heritage legibility can be translated into reused industrial materials, preserved harbour traces, landmarks, and historical routes. Green connectivity can become continuous pedestrian and cycling links, planted corridors, and ecological transitions. Multi-sensory restoration can be addressed through water sounds, tactile edges, seasonal planting, and direct contact with the river. Human–nature co-existence can be supported through habitat zones, bird-friendly planting, shoreline biotopes, and recreational ecological edges.

Therefore, the best practice studies act as a bridge between the theoretical framework and the design proposal. They clarify which strategies are transferable to Majorna/Klippan and which require adaptation to local climate, flood risk, brownfield conditions, and cultural memory. Moving forward, these findings guide the design phase by showing how the framework can become functional, and site-specific within the future Stena Line waterfront.

5. Implementations

Chapter Overview

The implementation chapter applies the proposed biophilic regeneration framework to the selected waterfront brownfield in Majorna/Klippan. Based on the previous chapters, the seven parameters are translated into spatial design interventions. The aim is to test how flood adaptation, green connectivity, heritage continuity and multi-sensory experience can work together in one adaptive waterfront landscape. Through mapping, design strategies, and conceptual proposals, the chapter explores how the former Stena Line area can shift from an infrastructural edge into a public green-blue connector that reconnects the neighborhood with Göta älv.

5.1. Gothenburg Overview

Gothenburg has historically developed through its relationship with Göta älv. The city’s riverfront has functioned as an important working landscape for shipping and industrial production. The waterfront has therefore not only shaped Gothenburg’s economy, but also its spatial identity and cultural memory as a port city.

During the twentieth century, large parts of central waterfront areas were occupied by harbour functions and transport infrastructure. These functions created a productive river edge, but also limited public access to the water. The decline and relocation of several harbour and industrial activities toward outer locations gradually changed the role of these central areas. As a result, several waterfront sites have become available for urban transformation (Port of Gothenburg, n.d.-a).

Älvstaden is based on the idea of expanding the inner city on both sides of Göta älv and strengthening the relationship between urban life and the water (Göteborgs Stad, n.d.-a). The transformation of former harbour and industrial land is Gothenburg’s future development which also contain challenges such as hard surfaces, fragmented accessibility, flood exposure, and the risk of losing maritime memory through redevelopment.

For this thesis, Gothenburg’s waterfront is understood as a layered post-industrial landscape. It

contains both physical traces of former industrial use and future potential for public and ecological adaptive transformation. This makes the waterfront a relevant context for testing how brownfield regeneration can support biophilic principles.

5.2. Site Selection

Since the theoretical framework focuses on green-blue infrastructure within brownfield regeneration, the selected site needs to be a brownfield with the potential to become an urban landscape rather than being developed only for real estate purposes. The site should support ecological, social, and spatial connections while responding to the existing challenges of the waterfront.

The QGIS mapping shows that the future Stena Line site is located within a missing link in the green-blue connectivity of the city. Flood-risk and flash-flooding analyses also indicate that some areas near the current Stena Line terminal for German shipments are exposed to a high possibility of flooding. This makes the site suitable for testing a water-based design strategy that combines flood management with multi-sensory biophilic experiences.

According to the Älvstaden waterfront vision, transport and accessibility are planned along the waterfront from Stenpiren to Masthugget, and further from Klippan to Röda Sten. The selected site sits within this larger industrial zone, which currently contributes to disconnection along the waterfront and needs further planning after location change of Stena Lines. At the same time, the land-use analysis and mapping of urban voids identify the area as a missing piece in the urban fabric.

Therefore, the site has strong potential to become a green-blue connector that transitions between nearby residential areas and a more recreational waterfront landscape. The following diagram combines the layers to highlight the main potentials and weaknesses of the current situation that proves this site has the potential as urban landscape.



Figure 9, Layered Site Selection

5.3. Municipality Planning

5.3.1. Flood Management

Flood risk is one of the main planning challenges for Gothenburg’s waterfront. The city is located at the mouth of Göta älv, where sea-level rise, high river flows, storm surges, and cloudburst events can overlap. Göteborgs Stad identifies rising water levels and increased flooding risk as key climate adaptation issues, especially along Göta älv and the inner waterways (Göteborgs Stad, n.d.-b).

Göteborgs Stad’s High Water Protection Programme coordinates planning for protection along Göta älv, Säveån, the canals, and other inner waterways. The programme focuses on reducing flood risk through measures such as high-water protection, raised ground levels, protection gates, and pumping stations (Göteborgs Stad, n.d.-b). The climate adaptation timeline states that the goal is to reduce flood risk between Älvsborgsbron and Marieholmsbron by 2040, while longer-term strategies also include broader protection systems for rising water levels (Göteborgs Stad, n.d.-c).

For waterfront design, this means that future public spaces must respond to changing water levels. Instead of treating flood protection only as technical infrastructure, the landscape can integrate floodable zones, raised edges, basins, visible water flows, and adaptive planting. In this thesis, flood adaptation is therefore considered both a safety requirement and a biophilic design opportunity.

5.3.2. Älvstaden and Södra Älvstranden

Älvstaden is Gothenburg’s largest urban development vision and one of the largest projects in the Nordic region. The vision aims to expand central Gothenburg on both sides of Göta älv and create a more inclusive, green, and water-connected city (Göteborgs Stad, n.d.-a).

Within this wider vision, Södra Älvstranden plays an important role. Göteborgs Stad states that the relocation of ferry terminals creates new conditions for urban development along the southern riverfront, where city life in Majorna and Linné can eventually meet the river (Göteborgs Stad, n.d.-d).

In this thesis, Älvstaden provides the larger planning background for understanding the site. The selected waterfront is not an isolated area, but the current ferry and infrastructural edge limits the connection between the existing urban fabric and Göta älv. The design proposal can therefore contribute to the city’s long-term goal of reconnecting urban life with the water while addressing green-blue infrastructure.

5.1.1. Stena Line relocation

Stena Line currently occupies important waterfront land in central Gothenburg, including areas along Södra Älvstranden. The relocation of Stena Line’s ferry operations to Arendal is part of a broader restructuring of harbour. According to the Port of Gothenburg, the relocation will move ferry operations from central Gothenburg to a location better connected to port logistics, while the areas currently used by Stena Line can be returned to the city for future urban development (Port of Gothenburg, n.d.-b).

The relocation is also expected to reduce heavy traffic in central Gothenburg, as the current terminal is connected to significant truck movement. This creates new possibilities for transforming former ferry and harbour areas into more urban, public, and accessible waterfront environments (Port of Gothenburg, n.d.-b).

The Stena Line area is therefore important because it represents a future brownfield condition, a site moving from infrastructural and transport use toward possible public, ecological, and mixed urban functions.

5.4. Majorna and Klippan Context



Figure 10, Stena Line Location

Majorna and Klippan have a strong maritime and industrial identity. Located along the southern riverbank of Göta älv , unlike newer waterfront redevelopment areas, the area has long functioned as a harbour-related landscape shaped by trade, shipping, defense, industry, ferry movement, and working-class urban life. Klippan is one of the oldest parts of Gothenburg and is connected to the city’s early harbour history, the former Älvsborg fortress, and later industrial development along the river edge (Göteborg & Co., n.d.).

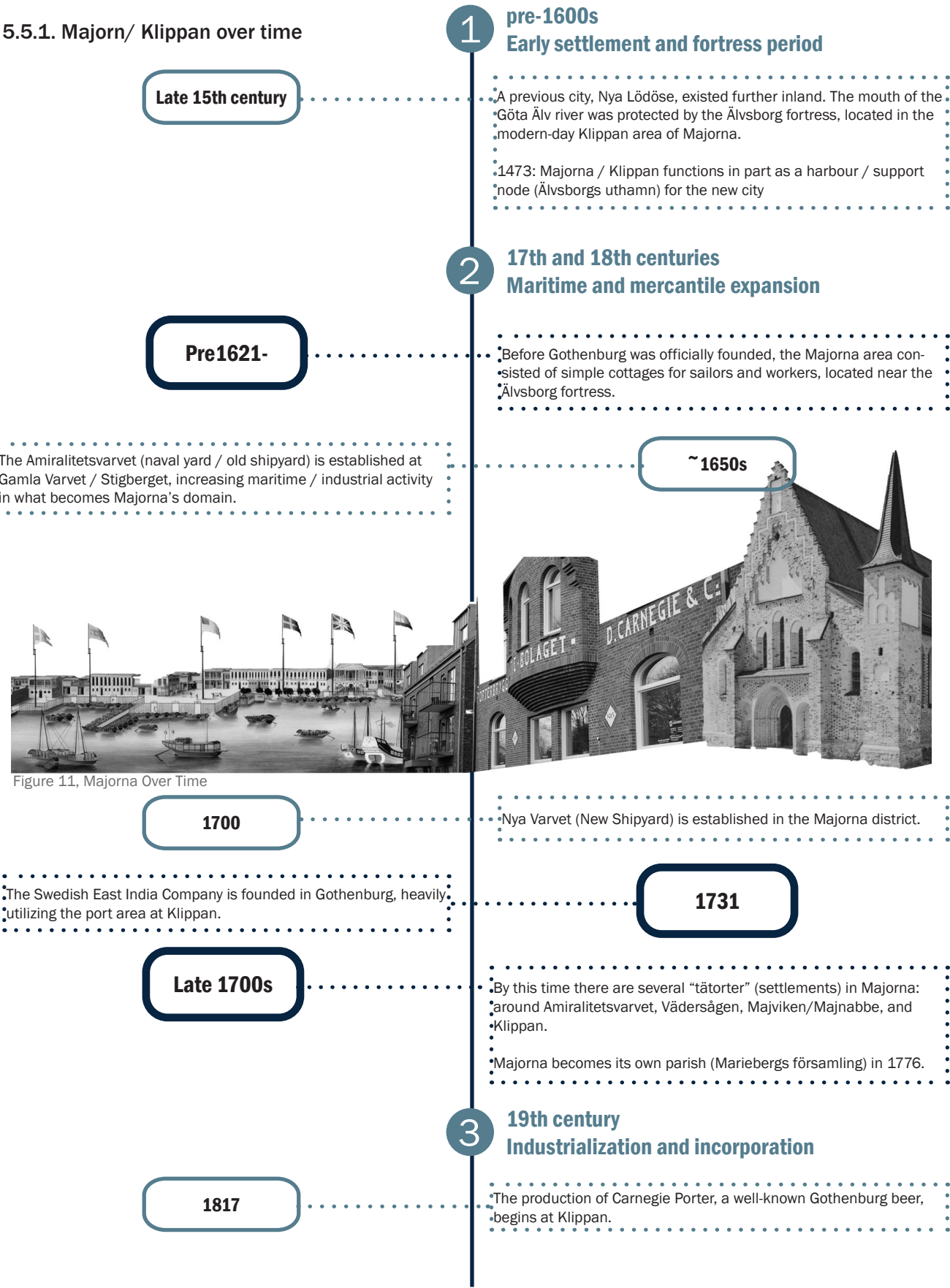
The identity of Majorna and Klippan is strongly tied to the relationship between the inland neighbourhood and the waterfront. The selected site sits between inland urban fabric and the current infrastructural waterfront. Inland Majorna contains a recognizable urban fabric with housing, local streets, cultural life, and historical buildings, while the river edge has been shaped by harbour functions, ferry infrastructure, quays, and industrial activities. This creates a strong contrast between the everyday neighbourhood and the infrastructural waterfront.

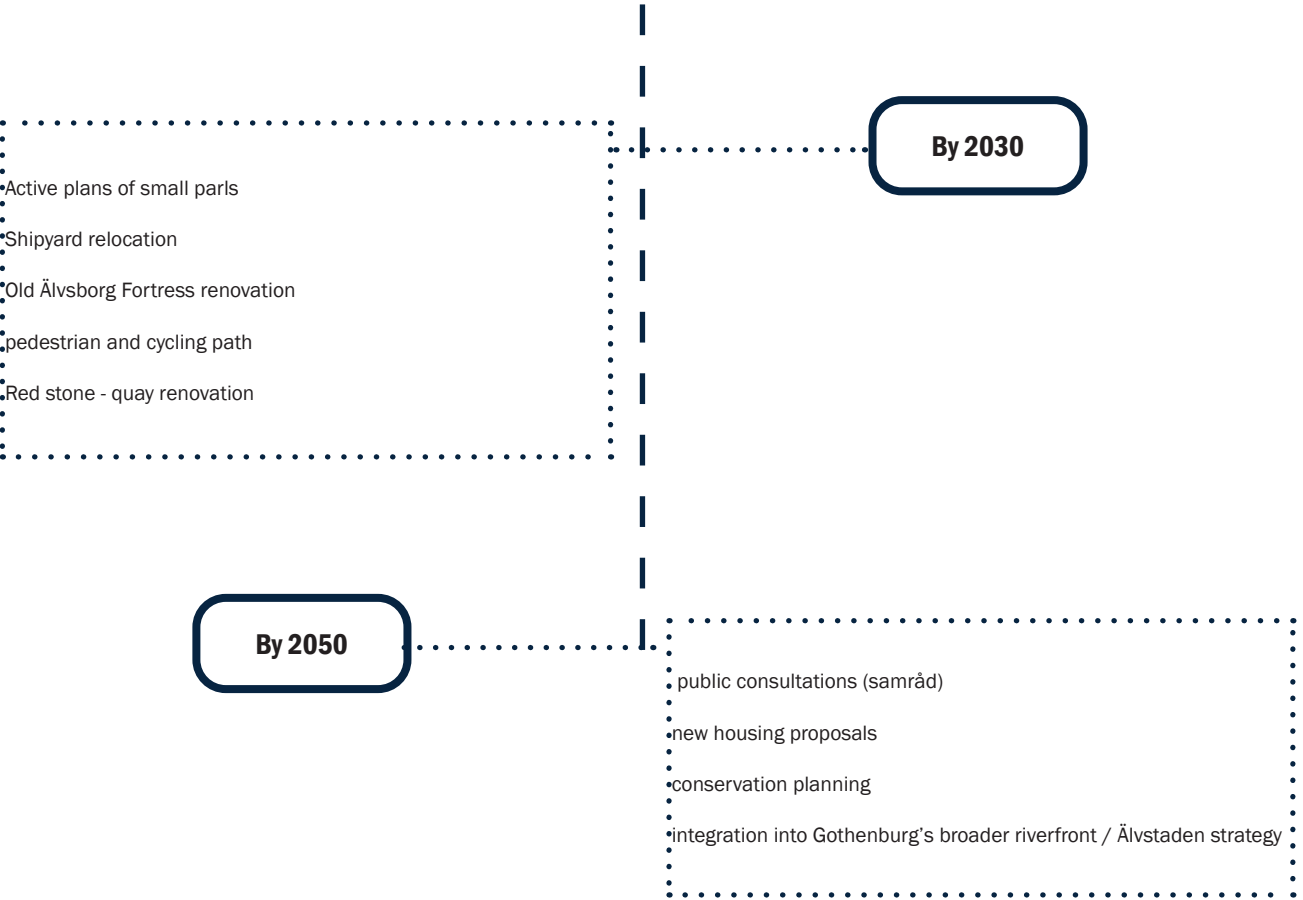
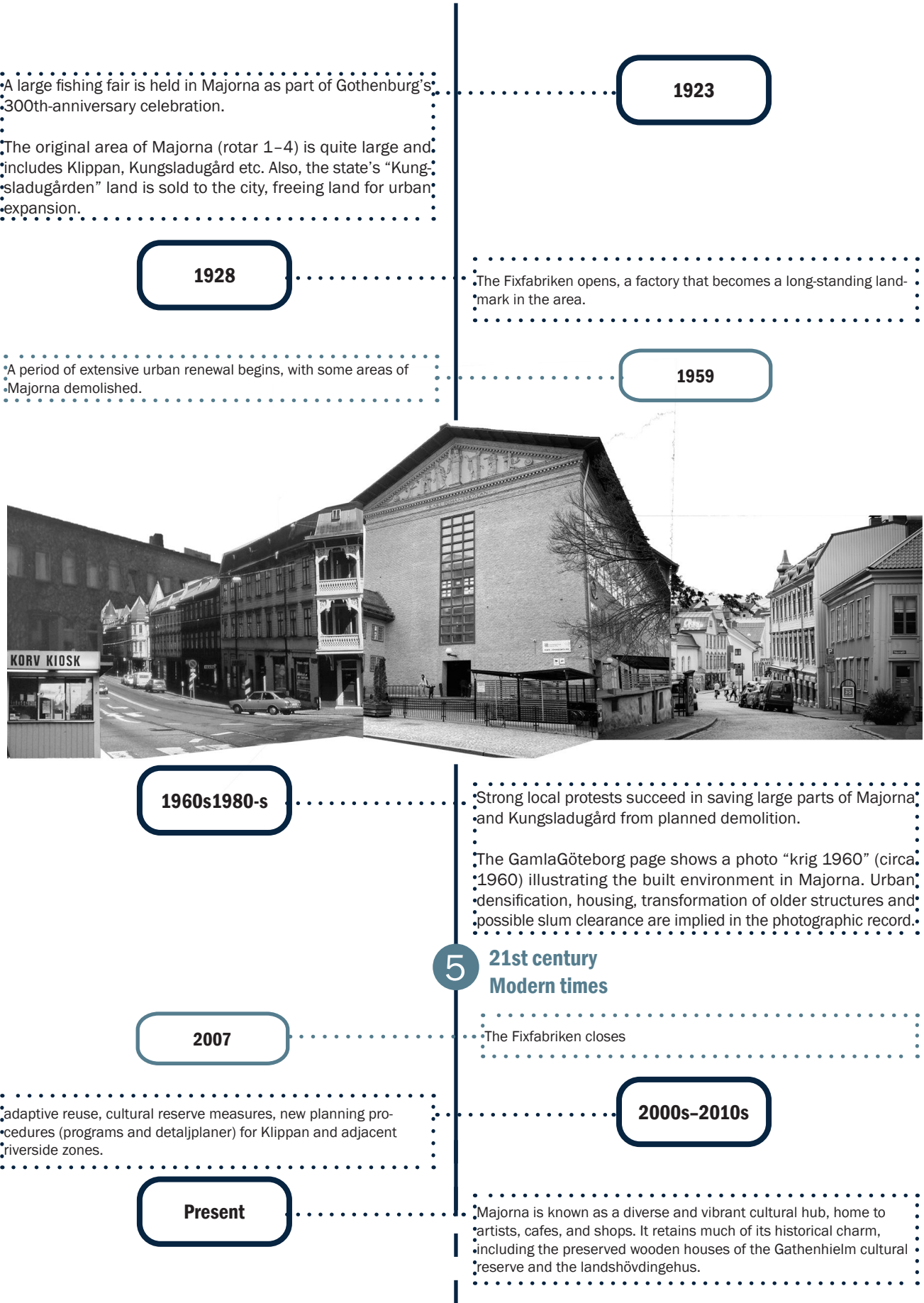
Therefore, the site has the potential to become a transition zone between neighbourhood and river, past and future, industrial memory and ecological public landscape. The planned relocation of Stena Line makes transformation of the southern riverfront into a more accessible urban landscape possible (Stena Line, 2023).

The following historical study will further examine the development of Majorna and Klippan over time in order to identify the spatial memories, material traces, and waterfront relationships that can inform the design proposal.

5.5. History of area

5.5.1. Majorn/ Klippan over time





5.5.2. Outcomes of Timeline

The historical timeline shows that Majorna and Klippan have continuously developed through their relationship with Göta älv. From early settlement and fortress-related functions to harbour activity, industry, ferry movement, and working-class housing, the area has always been shaped by the river. The waterfront was not only an edge of the city, but a productive landscape connected to movement, maritime exchange, and local identity (Port of Gothenburg, n.d.-a).

This history creates several design values for the future waterfront. The old harbour traces, quay lines, stone edges, industrial materials, and visual connections to the river can be used as spatial references in the design. Rather than removing the industrial and maritime character, the proposal can represent it through pathways, seating, landmarks, water access, material reuse, and public programs.

The timeline also shows a shift from a working waterfront to a future public landscape. As industrial and ferry functions move away from the central waterfront, the area gains new potential to reconnect Majorna and Klippan with Göta älv. This transformation can support not only public access and recreation, but also flood adaptation, biodiversity, and green-blue connectivity (Göteborgs Stad, n.d.-d; Port of Gothenburg, n.d.-b).

Therefore, the historical reading becomes a design tool. It identifies which memories, materials, and spatial traces should be carried forward into the proposal. The future waterfront should act as a transition between past and future: preserving the identity of the maritime-industrial landscape while transforming it into an adaptive, ecological, and inclusive urban space.

5.6. Historical Maps

The historical maps show that the water edge of Majorna/Klippan has been gradually constructed and extended over time. In the 1888 map by Ludvig Simon, the shoreline appears more irregular and natural, with several cuts where the water entered further into the land. This indicates that the earlier waterfront was not a fixed hard edge, but a softer transition between land and river, shaped by small inlets, harbour-related activities, and the natural movement of Göta älv. Also, multiple harbour elements prove that this region was mostly used for ship industries and it was the main function of area.

The 1960 map shows a later stage of transformation, where many of these earlier water cuts had been filled or covered as the harbour and industrial edge expanded. Many of harbours were removed and replaced by factories and inner residential areas were developed to create a separate center for workers of marine industry in this location. However, the circled area still appears as a protected lower shoreline condition. Based on current site observations, this area remains lower than its surroundings and is often filled with water. It is located in front of the current Stena Line area, close to the parking space, which confirms its floodable character and historical connection to earlier water structures.

Along the waterfront, the maps also show a gradual shift from a natural and irregular river edge toward a more constructed harbour landscape. Quays, filled land, and man-made edges have changed the relationship between the city and the river. This has created more usable industrial and transport land, but it has also made the waterfront more exposed to flood risk. By narrowing and hardening parts of the river edge, rising water levels become more critical and visible along the constructed shoreline, which we are now seeing the results of. Also, by comparison of maps and topography, in earlier plans, the water runoff was directly headed towards the river, while over time, with more construction and highways as a main barrier in between, the water flow got disrupted and possibly increased the flash flooding.

This historical reading highlights the need for future flood adaptation along the Majorna/Klippan waterfront. The municipality's planning for high-water protection and future flood barriers responds to this long-term transformation of the river edge. For the design proposal, the historical maps therefore become a tool for identifying where water once moved into the land, where floodable areas still remain, and where new adaptive edges, basins, wetlands, or flood barriers can be integrated into the landscape.



Figure 12, Historical maps - 1888, 1960, 2025

5.7. Site Analysis

The site analysis uses QGIS-based mapping to understand which conditions should guide the design intervention. The maps were selected to show main issues of access to the waterfront, movement and activation potential, green infrastructure, and flood vulnerability.

The distance to waterfront, angular integration, and public transport maps help to understand access, movement, and activation potential. They show where Majorna/Klippan is physically close to Göta älv but still disconnected by infrastructure, topography, and land use. These maps help define where new entrances, pedestrian and cycling links, visual corridors, public nodes, and active waterfront spaces should be placed.

The greenery and distance to greenery maps are used to study green infrastructure and access to public green space. They show whether greenery exists around the site, but it is fragmented and not always usable as public park space. This helps identify where new planting, habitat zones, green corridors, and accessible green spaces are needed to strengthen ecological connectivity.

The flood-risk and flash-flooding maps were used to locate vulnerable water-related areas. They show where the waterfront and Stena Line buildings are exposed to flooding and where flash-water accumulation occurs. These maps guide the placement of wetlands, basins, bioswales, floodable zones, raised paths, and adaptive shoreline strategies.

The age of buildings map is used to understand cultural continuity. It shows historical axes and how older buildings and historical traces are mainly connected to inland streets. This helps to guide material reuse, landmarks, and maritime references to be brought into the design.

Together, these maps support the application of the framework. These layers explain where the framework can be applied spatially, which areas need the strongest design response and what role each intervention should have.

5.7.1. Flash flooding

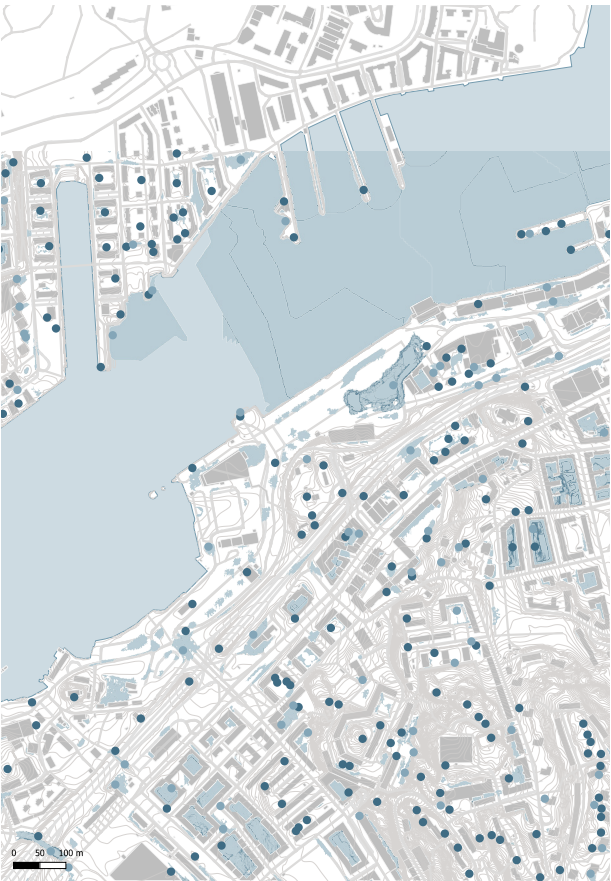


Figure 13, Flash Flooding QGIS

- Main flash flooding near Stena line building
- Peak points on the natural hill
- Breaking points near waterfront in shipping area
- Linear flash flooding near water edge
- Pond-shaped accumulation areas form continuous line

5.7.2. Distance to Waterfront



Figure 14, Distance to Water QGIS

- Center of activities in Karl Johansgatan has less accessibility to water
- Access to the hill is not providing access to water.
- Majnabbegatan is one of the few accessible roads connecting the neighbourhood to the waterfront.
- The waterfront is physically close, but spatially disconnected from everyday movement

5.7.3. Flood risk

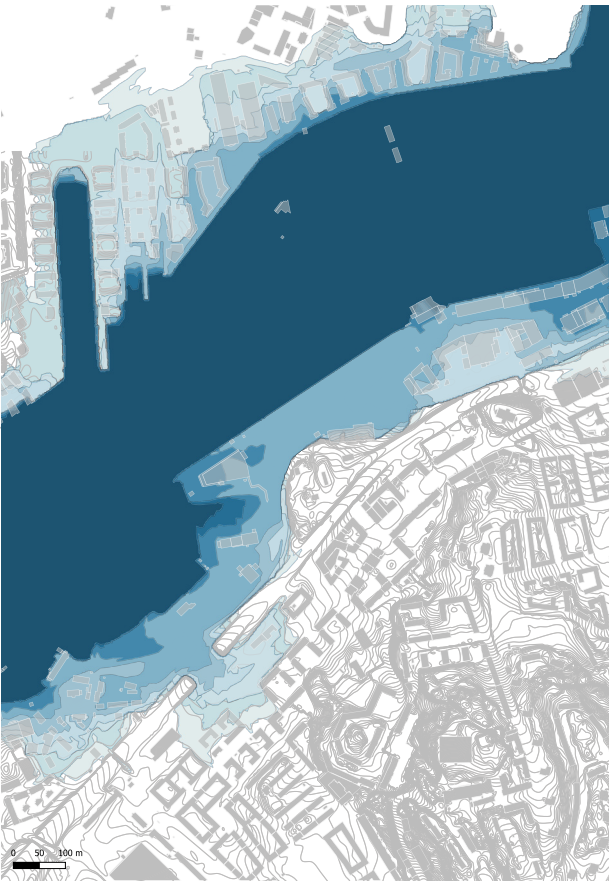


Figure 15, Flood Risk QGIS

- High risk of flood between buildings of Stena line
- The urban fabric has lower flood risk, reflecting the historical water routes
- Higher risk of flood in the waterfront
- The highway and infrastructural edge separate the flood-prone waterfront
- The flat area in front of hill has lower risk than other sections of waterfront

5.7.4. Greenery



Figure 16, Greenery QGIS

- | | |
|---------------------|--------------------|
| Greenery | BASE LAYERS |
| ● Green Entrances | ■ Buildings |
| ■ Parks Green Areas | — contours |
| | ■ Water |

- Greenery visible in analysis is not park only
- Most of greenery are non-planned
- Different entrance points near larger greenery
- The historical and old natural hill is not considered as greenery
- Connection of seperated greenery is lost in the water edge as a connector
- The study area can make both horizontal and vertical line as green connector

5.7.5. Attraction reach - Greenery



Figure 17, Attraction Reach to Greenery QGIS

- | | |
|---|--------------------|
| Number of Greenery on Walking Distance of 500m | BASE LAYERS |
| ■ 0 - 0 | ■ Water |
| ■ 1 - 2 | |
| ■ 2 - 4 | |
| ■ 4 - 6 | |
| ■ 6 - 8 | |

- Old commertial area of Majorna has most access to greenery
- The large greenery is not a park so the access for recreational purposes is lower than the small parks
- small greeneries but more public ones give more accessibility
- urban public areas consist of high quality greenery with multiple access points

5.7.6. Distance to Greenery



Figure 18, Distance to Greenery QGIS

- | | |
|--|--------------------|
| Walking Distance to Public Greenery | BASE LAYERS |
| ■ -1 - 299 | ■ Water |
| ■ 299 - 599 | |
| ■ 599 - 900 | |
| ■ 900 - 1200 | |
| ■ 1200 - 1500 | |

- Access from stena line to greenery is weaker
- The neighbouring waterfront areas have more access to greenery
- Karl Johansgatan has good walking-distance access to greenery for residents.
- Green access is stronger inland than along the selected waterfront.

5.7.7. Age of buildings



Figure 19, Age of Building QGIS

- | | |
|------------------------|--------------------|
| Age of Building | BASE LAYERS |
| ■ 1 - 1 | ■ Water |
| ■ 1 - 5 | |
| ■ 5 - 9 | |
| ■ 9 - 13 | |
| ■ 13 - 15 | |

- Historical Area value
- Connectivity of Old buildings to new ones in waterfront.
- Visible discontinuation of historical axis
- Linear older buildings around main inland streets
- Disconnection of old area axis to the waterfront

5.7.8. Angular Integration 1.5KM



Figure 20, Angular Integration 1.5k QGIS

- Most integrated routes are located around existing commercial and residential streets
- Highly integrated inland routes can become entry points
- The waterfront has weaker angular integration and continuous horizontal waterfront route can improve movement along the river edge.
- Existing historic street axis do not clearly continue toward the waterfront.
- The site needs stronger vertical connections from Majorna/Klippan to Göta älv.

5.7.9. Roads and Public Transport



Figure 21, Roads and Public Transport QGIS

- Highway is the barrier from main commercial center
- Public transport is limited to the Karl Johansgatan
- one vertical and one horizontal axis for public transport can be noticed
- The public transport in waterfront is limited to ferry stop
- Road and transport structures currently support inland movement more than waterfront access.

5.7.10. Distance to public transport



Figure 22, Distance to Public Transport QGIS

- Waterfront has lower accessibility to public transport
- The hill and topography increase walking distance on the eastern side of the study area.
- The access to public transport is stronger in residential and commercial areas
- Public transport access does not currently support strong activation

5.7.11. Opportunities and Challenges

The QGIS analysis shows that the Stena Line waterfront is strategically located but currently disconnected. It has strong potential to become a green-blue connector, but is currently weakened by limited access, fragmented greenery, flood exposure, and infrastructural barriers. The accessibility and movement maps identify the need for stronger links between Majorna/Klippan, Karl Johansgatan, public transport stops, and Göta älv. These findings guide the placement of new entrances, pedestrian and cycling routes, and active public nodes.

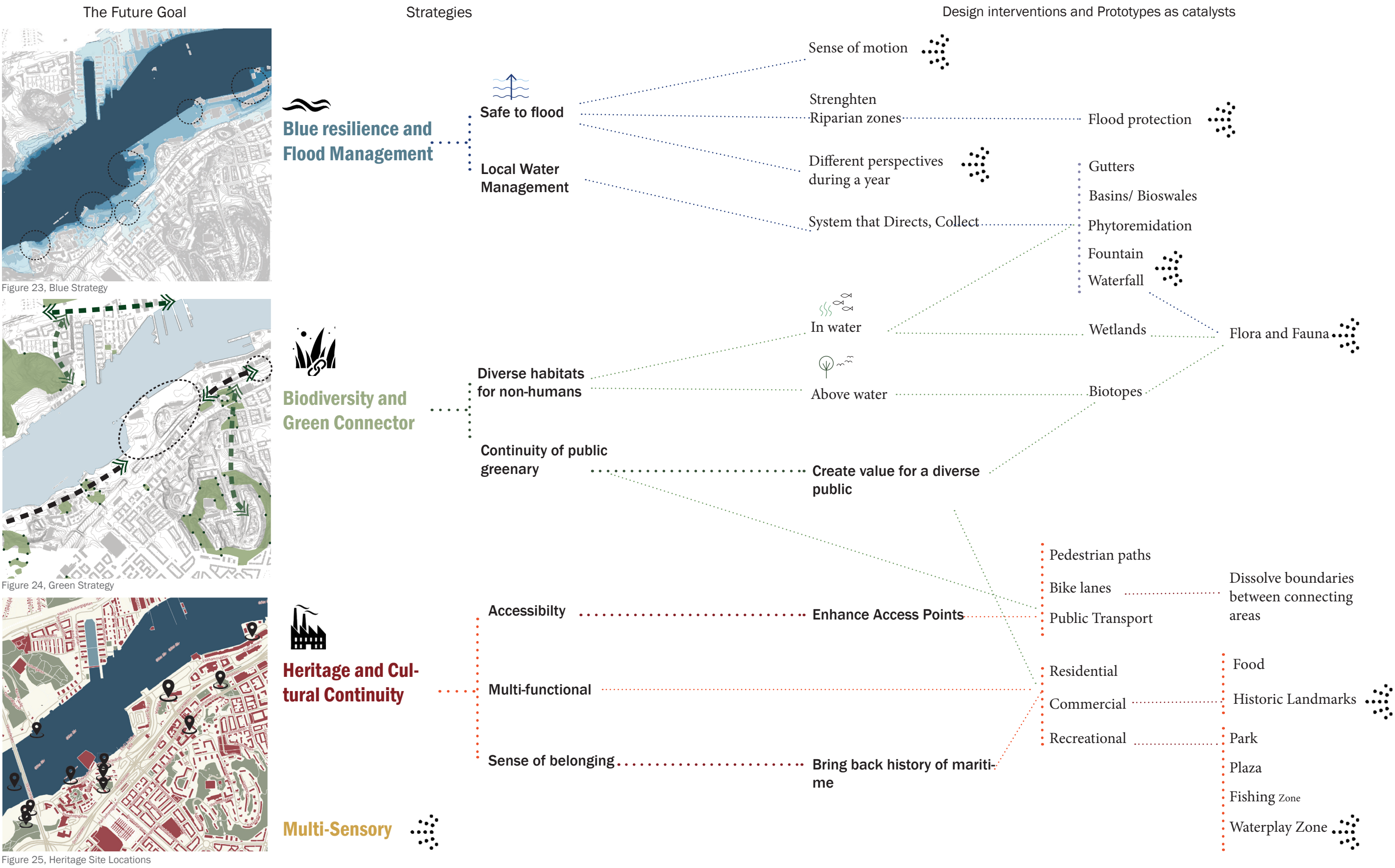
The greenery maps show where ecological continuity is missing. This supports the design of new planting areas, shoreline habitats, and green corridors that can connect the waterfront to surrounding green spaces.

The flood-risk and flash-flooding maps define where water-sensitive interventions are needed. These areas can guide floodable landscapes, wetlands, basins, bioswales, raised paths, and adaptive shoreline design based on the zone functions.

The historical layer shows where maritime and industrial memory can be reconnected to the waterfront. This can inform visual axis, landmarks placing, and public programs.

Together, the maps define main design priorities of strengthening green-blue connectivity, adapting to flood risk, and making the site's maritime-industrial identity visible in the future. Making it landscape urbanism is possible by improving waterfront access.

5.8. Design Strategies and Solutions



5.9. Application of Strategies

Based on the QGIS analysis and the site-specific framework, the following diagrams show how design interventions are applied within the Majorna/Klippan waterfront. Each diagram focuses on a specific layer of the proposal in order to reach the adaptive urban landscape. The diagrams translate the framework into spatial decisions.

The general zoning defines how the site can support both local residents and wider city visitors by balancing everyday recreation, active public areas, calm ecological zones, and waterfront experiences. This helps the future park function both as a neighbourhood landscape and as part of Gothenburg’s larger riverfront within the whole city’s waterfront vision that needs to be continuous.

The access and multifunctionality diagrams show how the waterfront can become more inviting and usable. Since the site is currently disconnected from the surrounding urban fabric, new entrances, pedestrian routes, cycling paths, and public nodes are needed to strengthen movement toward and along the river. As the access to the site gets stronger, more visitors will pass the urban landscape and be involved with the design. Multifunctional spaces also support different users, activities, and seasonal conditions to attract different age groups with different hobbies.

The multi-sensory strategy highlights the biophilic role of the landscape. Water, vegetation, sound, texture, smell, shade, wind, and seasonal change are used to create restorative experiences that can support well-being through everyday contact with nature. By focusing on neighborhood-scale and as apart of local residents every day pass zone, the waterfront becomes more than a visual landscape, it becomes an environment experienced through the body and senses that contributes to them.

Water is treated as both a sensory element and a technical system. It creates reflection, sound, movement, and tactile contact, while also supporting flood adaptation and local water management. The water strategy shows how basins, bioswales, wetlands, floodable areas, and adaptive edges can be distributed across different zones of the site.

The biodiversity and habitat strategies connect planting design with ecological function. Different levels of disturbance, accessibility, and vegetation density guide where habitat zones, nesting areas, shoreline biotopes, and planting palettes should be placed. To start with that, the diagram needs to mention where targeted fauna can be placed so the habitat for them can be created. Also, the diagram support human–nature co-existence by linking public use with the needs of targeted fauna and ecological systems.

5.9.1. Functional Zones

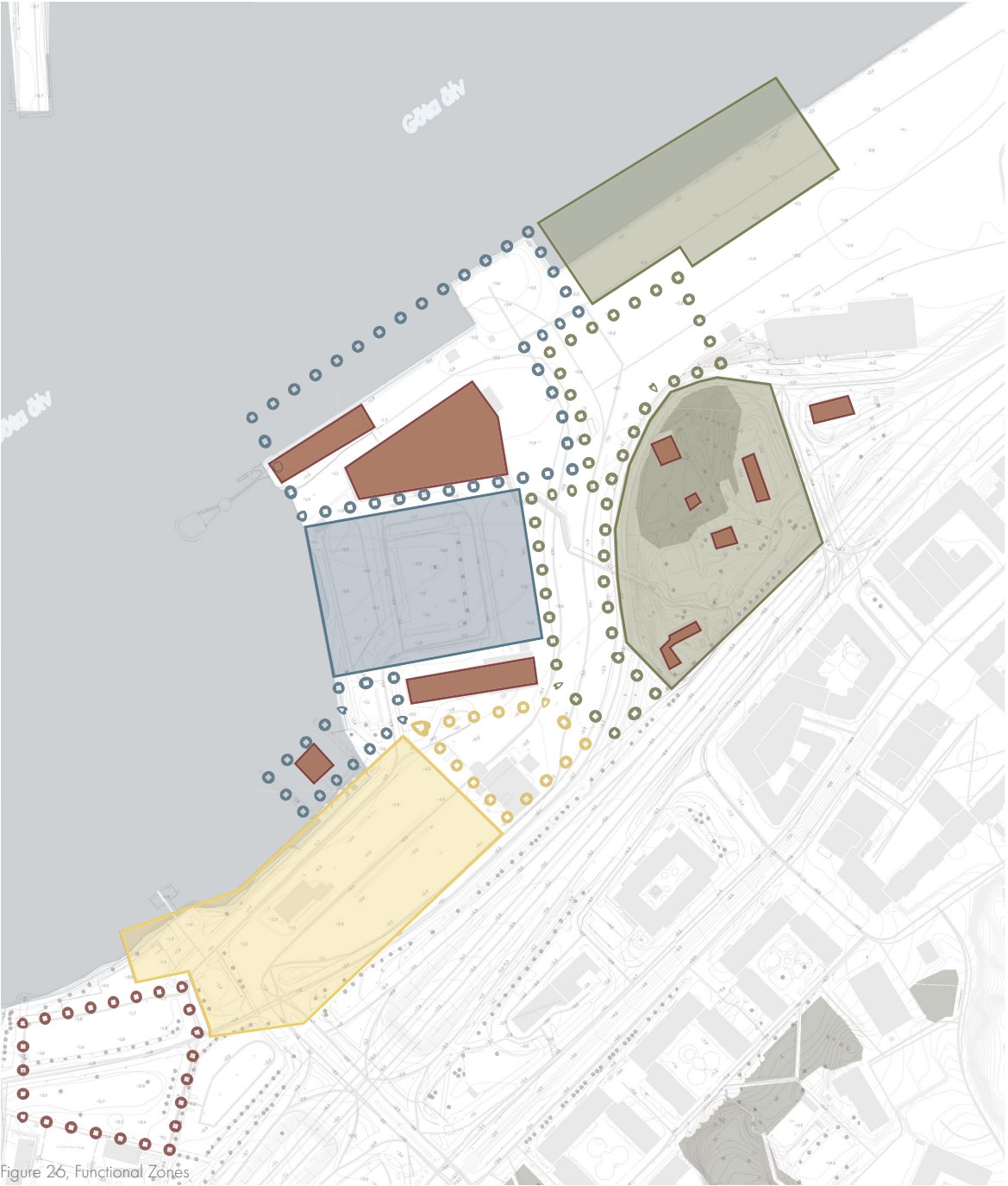


Figure 26, Functional Zones

The diagram organizes the site into natural, recreational, residential, and transitional areas. It shows how the waterfront can serve both local residents and wider city visitors by combining everyday neighbourhood use with larger public and ecological functions. The zoning also separates more active areas from calmer natural zones, helping the design balance recreation, natural, and existing historical structures.

5.9.2. Accessibility Enhancement

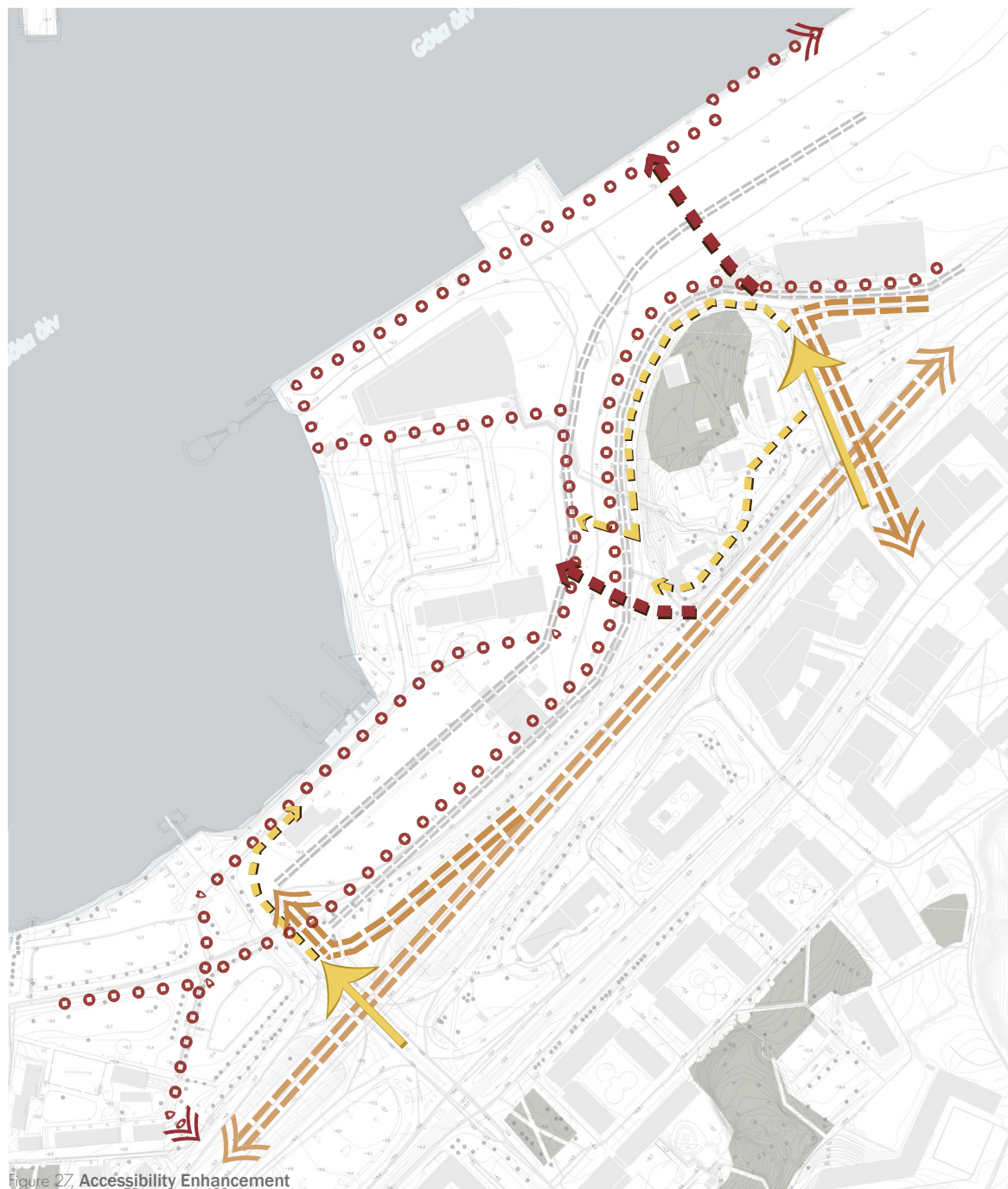


Figure 27. Accessibility Enhancement

-  Main Existing Entrances
-  Additional Access Point to Waterfront
-  Existing Pedestrian Access
-  Additional Pedestrian and Biking Route
-  Remaining Mobility Access
-  Removed Mobility Access

The site can become more connected to Majorna/Klippan and Göta älv. New pedestrian and cycling routes strengthen movement along the waterfront, while additional access points connect the neighbourhood to the river edge from elevated area. The diagram also clarifies which mobility routes should remain, which should be removed, and where entrances should be emphasized to make the future park more inviting and accessible.

5.9.3. Multi-Sensory Involvement



Figure 28, Multi-Sensory Involvement

- | | |
|---|-------------------|
|  | Framed View |
|  | Zones |
|  | Visual |
|  | Tactile |
|  | Olfactory (smell) |
|  | Movement |
|  | Acoustic |

The illustration identifies where visual, tactile, olfactory, acoustic, and movement-based experiences can be introduced. Framed views help create orientation and curiosity. By combining accessible water, vegetation, materials, sound, smell, and movement, this layer supports the biophilic aim of creating a restorative landscape that affects well-being through everyday sensory experience. It also indicates that less senses are involved in residential only zone.

5.9.4. Water management



Figure 29, Water Management

- Breaking Points
- Hidden canals
- Waterflow (Acoustic with stones)
- Hidden Waterflow with visible canals
- Bio-Swales
- Basins
- Built water feature (waterplay, artificial waterfall)
- Water Touch and Floodable area

The water management diagram shows how flood adaptation and sensory water experience are integrated. The selected interventions help collect, direct, slow, and reveal water across the site, while also creating acoustic, tactile, and visual experiences. Water therefore becomes both a technical system for flood resilience and a main biophilic element within the design. In residential section the water gathering is more neat and in natural is following nature.

5.9.5. Fauna Placement

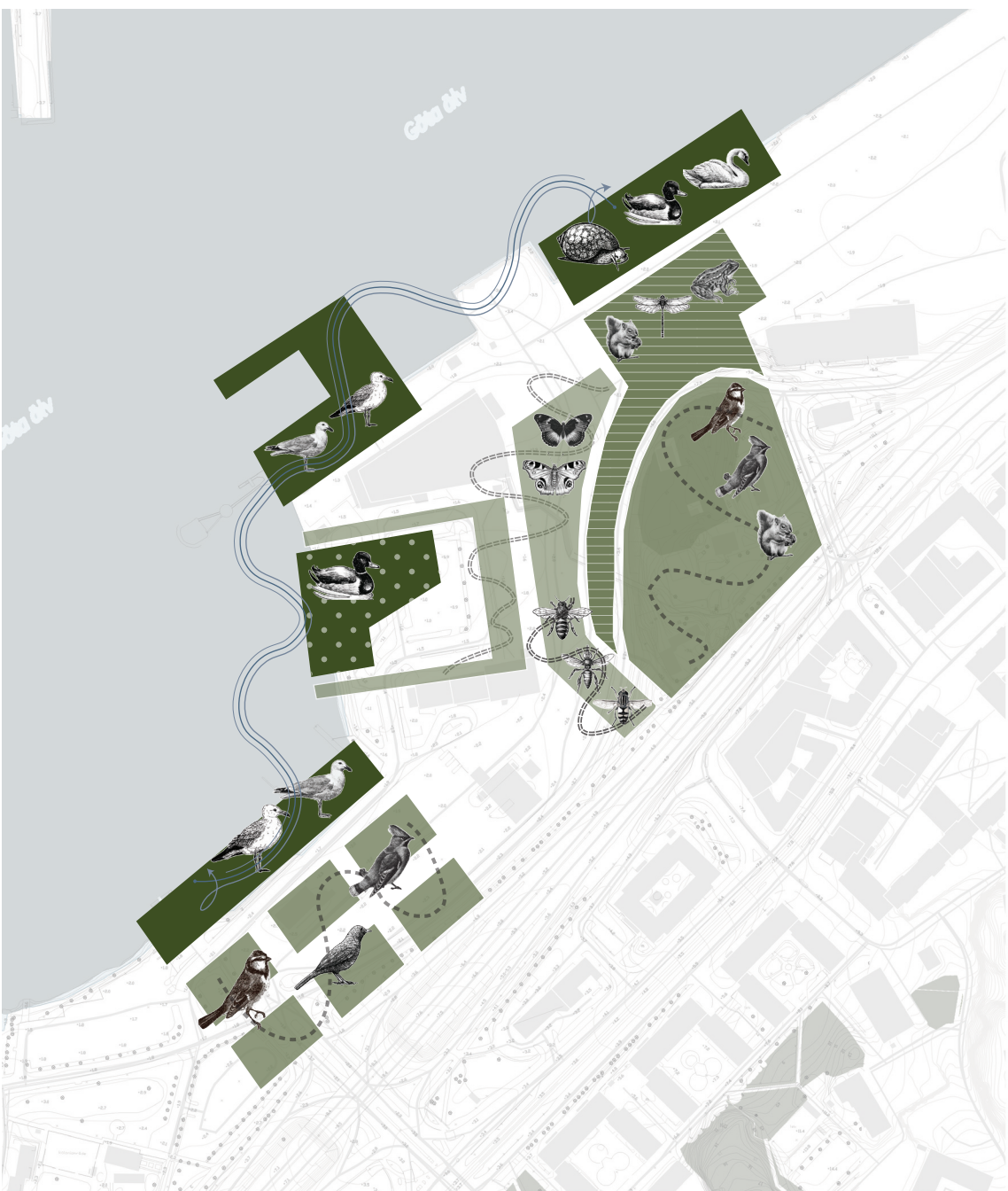


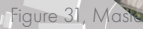
Figure 30, Fauna Placement

- Shrubs and Tree canopy
- Open water and shallow water
- vegetated bank
- Pollinator meadow
- Rain garden

Different species can be supported across the site through varied habitat conditions. Ducks are placed along both recreational and natural water edges, while calmer shoreline areas support swans and birds. The natural transition zones provide habitat for butterflies, squirrels, and smaller urban species, creating a soft buffer between public activity and protected nature. The hill mainly supports bees, butterflies, and other pollinators through flowering vegetation.

The master plan brings the strategy diagrams together and translates them into a more detailed spatial proposal for the Majorna/Klippan waterfront. By merging the layers, the design defines different recreational areas and gives each space a clearer role within the future park. Heritage elements and landmarks are placed according to sensory qualities, visibility, historical meaning, and their potential to strengthen the identity of the waterfront. The elevated areas, framed viewpoints, floodable zones, and water-based interventions are also developed through the combination of the diagrams, allowing the proposal to balance public use, flood adaptation, and sense of place.

- Existing Buildings
- New Buildings



5.11. Blue resilience and Multi-sensory

5.11.1. Formation

The large flat green area is designed as a floodable landscape. Its terraced levels allow people to move gradually toward the waterfront while creating habitat conditions for ducks along the edge. This makes the floodable zone both recreational and ecological.

Along the edge of the floodable area, waterflow is used to create both visual and acoustic effects. The slope of the path and the use of small stones help break the water movement, producing a natural sound similar to a stream or small waterfall. This water element also works as a spatial divider between the flat public area and adjacent zones, while contributing to future flood protection through level changes and raised edges.

The waterplay area is located near the landmark to activate the waterfront and attract both local residents and visitors. It creates a playful public space, especially for children, while strengthening the relationship with water.

In the residential area, water is directed through visible and hidden canal systems. In some parts, the water is not fully visible, but the sound and movement can still be experienced. This creates a subtle sensory layer within the everyday landscape. Near the water edge, existing stone edges are strengthened with larger stones that can function as seating and stepping elements. These edges create a more relaxed relationship with the water, allowing people to move closer to the river while maintaining a small protective barrier between buildings and the waterfront. Bioswales placed before this edge help collect and filter rainwater before it reaches the river.

The stepped pond near the Stena Line area can support cooling during summer and small-scale ice-skating during colder periods, while also collecting and storing water. Other basins in the natural zone have a more ecological role, focusing on water collection, filtration, habitat creation, and controlled water movement.

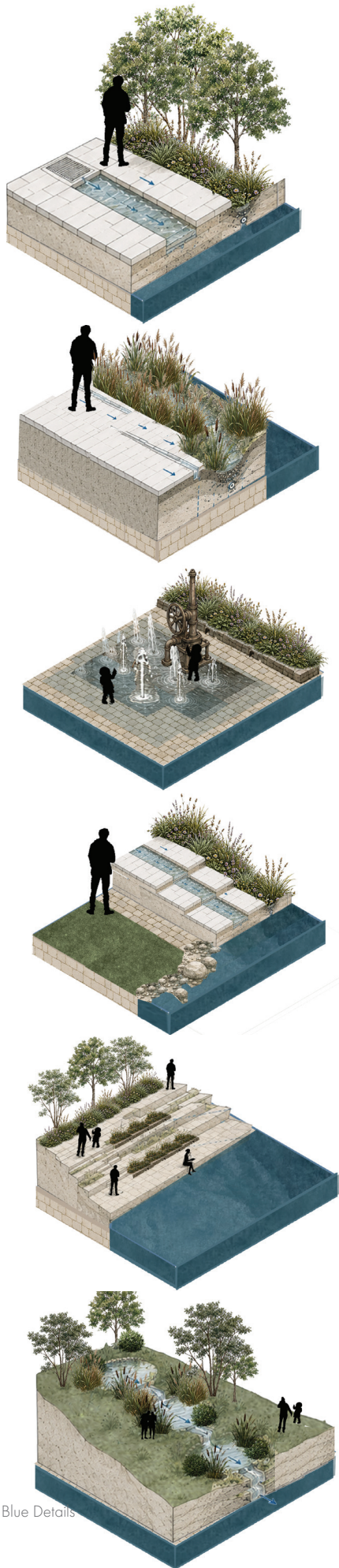


Figure 32, Blue Details

5.11.2. Flooding and Future Scenarios

The floodable flat area is expected to become smaller over time as sea levels rise. With an estimated future sea-level increase, lower parts of the landscape may gradually become more exposed to water. This means that the design must allow for long-term adaptation rather than a fixed shoreline condition.

The stone-based shoreline can also be expanded gradually toward the river in the future. This would help reduce wave impact, protect the edge from splash water, and create a more adaptive transition between land and water.

Some basins may become permanently filled with water over time. Instead of treating this as a problem, the design uses this change as an opportunity for new seasonal activities and ecological functions that helps with cooling heat waves during summer.

In natural zone, some lower paths and biotopes may be partially or permanently affected by future water levels. Therefore, the planting strategy should be flexible and also changable, using species that can tolerate moisture conditions and support both land-based and water-related fauna.



Figure 33, Floodable areas

5.12. Biodiversity and Green Connector

5.12.1. Diversity of Green Connector

Trees, shrubs, and groundcover plants are used to create different levels of greenery across the site. The natural waterfront zone has the highest planting density, with a wider variety of species to support biodiversity and habitat creation. The transition zones use selected flowering plants, shrubs, and some species from the natural zone to maintain green continuity while allowing public access.

In biotopes and floodable wetland areas, the planting palette focuses on species that support water filtration. In flatter residential and recreational areas, planting density is reduced to keep views open, maintain safety, and create smaller calm spaces for residents. Together, these planting strategies reconnect the waterfront linear park to the existing green areas near Röda Sten.

5.12.2. Habitats Creation

Targeted fauna has vegetation needs and secured placemaking. Habitat creation is based on the density, combination, and placement of vegetation in each zone of fauna. More protected and natural areas support nesting, feeding, and shelter for targeted fauna, while active public areas use clearer edges and more durable planting. The strategy balances visibility and ecological function, allowing people to experience biodiversity without disturbing sensitive habitats.

Trees and Shrub layers	
	Silver birch
	Scots pine
	Bird Cherry
	Rowan
	Hawthorn
	Dog Rose

Pollinator Meadow	
	Goat willow
	Salvia nemorosa
	Thymus serpyllum
	Achillea millefolium
	Lotus cornicalatus
	Trifolium pratense
	Urtica dioica

Wet Meadow and Waterside	
	Filipendula ulmaria
	Lythrum salicaria
	Iris pseudacorus
	Phragmites australis
	Carex acuta
	Potamogeton spp.

Table 7, Flora Palette

5.12.2. Flora and Fauna

The flora and fauna table identifies targeted species that are commonly found in Gothenburg and can be supported within the site. The food, shelter, and nesting needs of each species guide the selection of plant palettes and habitat conditions. Some species are more active during specific seasons, which also supports seasonal variation in the design.

	Common Blackbird (<i>Turdus merula</i>) Jan – Dec (Resident) Spring: Singing/Nesting Winter: Foraging Shelter: Nests in dense Shrub Thickets (<i>Ligustrum vulgare</i>) Food: Eats Sorbus berries in Winter
	Blue Tit (<i>Cyanistes caeruleus</i>) Jan – Dec (Resident) Spring: Feeding Chicks Winter: Roosting Shelter: Roosts in Canopy Trees (<i>Acer platanoides</i>) Food: Hunts caterpillars in Willow/Birch canopies.
	Common Gull (<i>Larus canus</i>) Jan – Dec (Resident) Spring: Breeding Winter: Roosting Nesting: Nests near "Swamp" edges or on grassy banks.
	Bohemian Waxwing (<i>Bombus garrulus</i>) Nov – March (Winter Visitor) Winter: Berry Feasts Food: Relies on berries from Sorbus intermedia and Cornus mas.
	Herring Gull (<i>Larus argentatus</i>) Jan – Dec (Resident) Spring: Nesting Year-Round: Scavenging Nesting: Nests on flat roofs, rocky shores small islands, or sheltered coastal ledges Shelter: Open waterfront edges, quays
	Common Blue Butterfly (<i>Polyommatus icarus</i>) May – Sept Summer: Mating/Feeding Food: Adults feed on Thymus serpyllum and Echinops ritro
	Peacock Butterfly (<i>Aglais io</i>) April – Sept (Adults) Spring: Basking Summer: Nectaring Shelter: Overwinters in hollow trees. Food: Nectar from Salvia nemorosa ("Highly attractive")

	Bumblebee Queens (<i>Bombus</i> spp.) March – Oct March: Emerging (Hungry!) Summer: Colony building Food: "Highly valuable early season flowers" of Prunus padus & Cornus mas Nesting: "Soil cavities" or old mouse holes
	Solitary Bees (<i>Osmia</i> spp.) April – June Spring: Nesting Nesting: "Bee Hotels" or "Soil cavities" in dry banks. Food: Pollen from Prunus padus
	Hoverflies (<i>Syrphidae</i>) May – Sept Summer: Pollinating Food: Needs flat flowers like Achillea millefolium (Yarrow)
	Aquatic Snails (<i>Gastropoda</i>) April – Oct Summer: Grazing Algae Food: Grazes algae on "aquatic vegetation" stems. Function: Cleans the "Phytoremediation" basins
	Common Frog (<i>Rana temporaria</i>) March – Oct Spring: Spawning Winter: Hibernating Nesting: Spawns in "shallow, calm freshwater" (Water Basin). Shelter: "Dense vegetation" (<i>Carex</i>) or "logs" on land
	Dragonflies (<i>Aeshna</i> spp.) June – Sept Summer: Aerial Hunting Nesting: Larvae develop in "vegetated water" (Pond Sedge roots). Shelter: Adults perch on Iris pseudacorus.
	Mute Swan (<i>Cygnus olor</i>) Jan – Dec (Resident) Spring: Nest Building Nesting: Nests in "vegetated riverbanks". Needs Carex acuta root mats to support nest weight
	Mallard (<i>Anas platyrhynchos</i>) Jan – Dec (Resident) Summer: Aerial Hunting Nesting: Nests in sheltered ground vegetation near water, reeds, or shrubs Shelter: Calm shallow water, vegetated banks
	Red Squirrel (<i>Sciurus vulgaris</i>) Jan – Dec (Resident) Autumn: Caching Nuts Spring: Breeding Shelter: Travels via "Biodiverse Corridor" canopy (<i>Pinus/Acer</i>). Food: Feeds on Pinus cones and nuts.

Table 8, Fauna Palette

5.12.3. Relationscape

The relationscape focuses on how people encounter the living systems of the site. Habitat zones are placed so that birds, ducks, insects, and pollinators can be observed without being disturbed. Paths, edges, seating areas, and viewpoints create controlled moments of contact between humans and non-human life. In this way, biodiversity becomes part of the public experience while protected zones remain functional for fauna.

5.12.4. seasonal Change

The seasonal change uses selected flora to create ecological and sensory variation throughout the year. Planting is added based on blooming periods, and colour change to the flora needed for targeted fauna. By combining evergreen species with seasonal flowering and changing vegetation, the green connector can remain active, diverse, and visually engaging all year round.

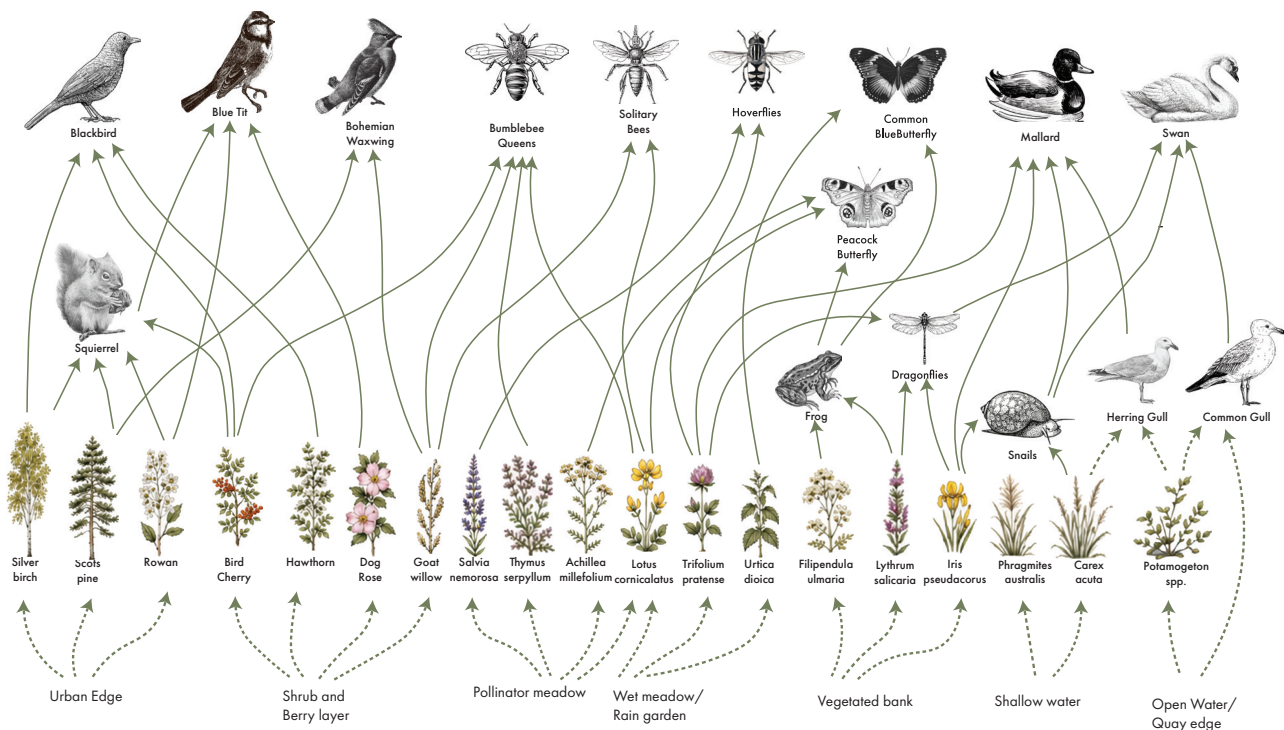


Figure 34, Flora and Fauna Relationscape

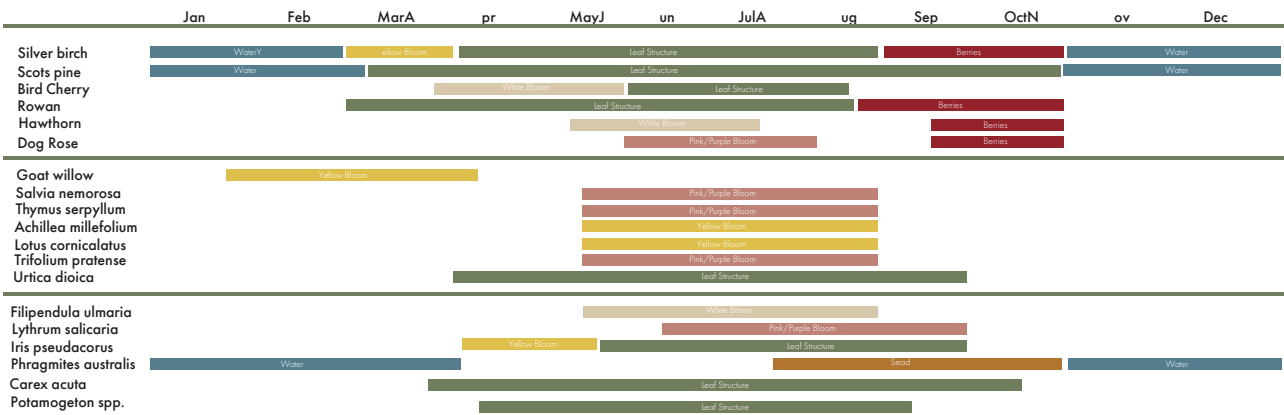


Figure 35, Seasonal change

5.13. Heritage and Cultural Continuity

5.13.1. Historical elements

The old harbour and boating area is preserved and transformed into a public waterfront space. Today, parts of this area are connected to Stena Line's shipping function as gaurding, but in the proposal they can become paths, seating areas, and places to approach the water. By adding a maritime landmark or sculpture, this edge can become more visible and act as a point of attraction along the waterfront.

Industrial materials such as steel, thick timber, pipes, and concrete are reused in furniture, railings, lighting elements, water features, and play structures. Steel from demolished or remaining Stena Line structures can help maintain the industrial character of the site, while timber and concrete can create seating, platforms, and plaza elements.

Pipes can be reinterpreted as short lighting elements near the shoreline or playful water features for children. Former harbour can also be relocated to where the ship is usually placed and create a close loop so it can act as canoeing center. In this way, the design will have active water-based functions that are in central location and the need for thses activities at the edge of city in the lakes will be reduced.

Together, these interventions create cultural continuity by connecting the future landscape to the site's maritime past.

5.13.2. Visuals

The visulas are showing how different historical elements are reused and reimagined in the design proposal. There are illustrations of residential shoreline, preserved bridge with improvments, stair-down platforms to reach the sea level and placement of factory landmark in the current boat harbor. Also, transition of spaces from bridge are visible with enhancing the current stena line building as main preserved building in the area.

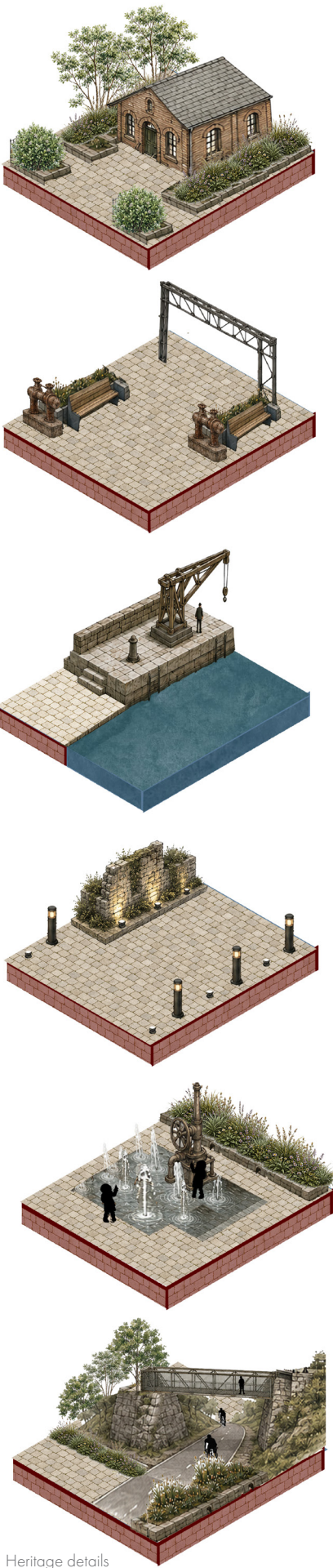


Figure 36, Heritage details



Figure 37, Preserved Stena line and open green space



Figure 38, Landmark placement



Figure 39, bridge preservation and urban furniture

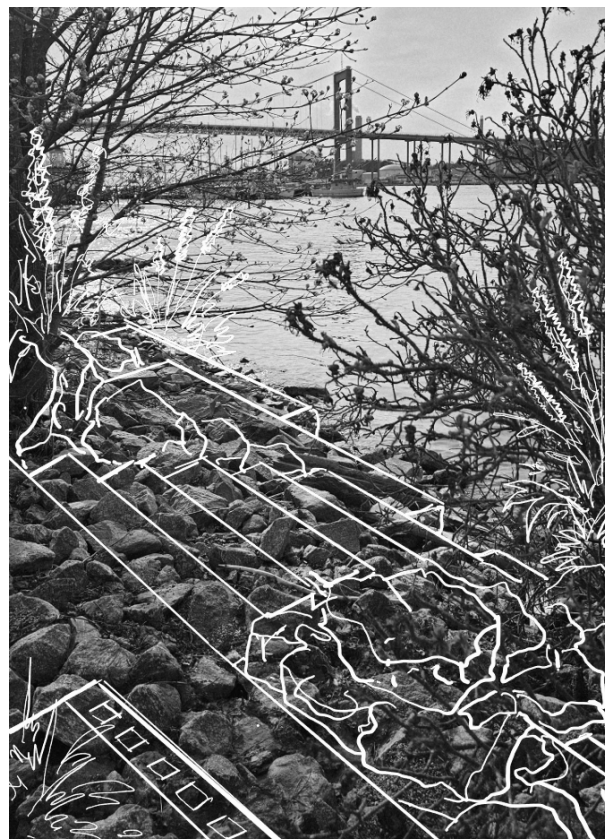


Figure 40, Enhanced staged water edge



Figure 41, Residential water edge with bio-swales and canals

5.14. Additional Documents

5.14.1. Sections

The illustration shows that the old bridge is used as a secured pathway between the two hills, while the existing stone cliff beside the cycling path is mirrored in the proposal to create the feeling of moving along a natural rock edge. This strengthens the human-nature relationship and gives the route a clearer spatial identity.

The sections also show the transition from higher ground to the waterfront. The sequence moves from offices and natural areas into a transition zone where built and natural elements are combined, and then continues toward the river edge. Along the waterfront, hard surfaces are partly maintained but transformed into recreational zones. Water-based strategies are introduced at key transition points, allowing the edge to support public use, flood adaptation, and sensory contact with Göta älv.

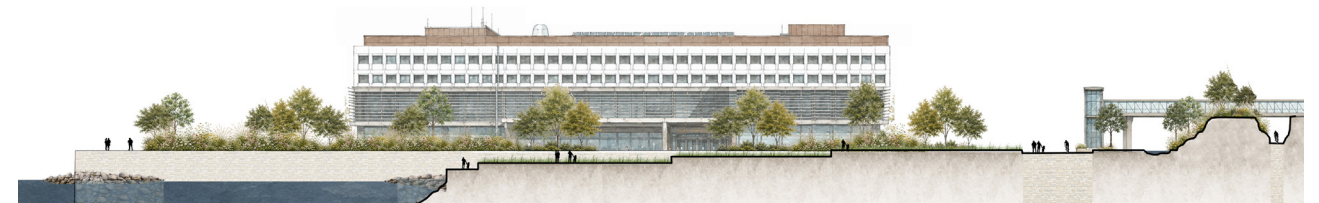


Figure 42, Sections

6. Conclusions

6.1. Addressing the Research Question

Building on the translation of the biophilic regeneration framework into spatial interventions, and the adaptation of best practice strategies to Gothenburg's waterfront context, this chapter evaluates how the framework has been applied to meet the thesis objectives. The discussion reflects on how multi-sensory experience, water-sensitive design, biodiversity, public access, and maritime-industrial heritage have been combined to answer the research question. The Majorna/Klippan waterfront is used as a test site to explore how the framework can transform a former infrastructural and post-industrial edge into an adaptive urban landscape.

This thesis investigated the question: How can a biophilic framework integrate multi-sensory experiences and maritime/industrial heritage to transform waterfront brownfield sites into adaptive urban landscapes? The question was first addressed through the theory and theory-to-practice chapters, where related topics of biophilic design at the urban scale, brownfield regeneration, waterfront transformation, multi-sensory experience, water-sensitive design, and heritage continuity were studied. By focusing specifically on waterfront brownfields, several limitations and site-specific challenges became visible, such as flood exposure, infrastructural barriers, fragmented green systems, and the risk of losing maritime-industrial memory through redevelopment.

As a way to connect these topics into a clearer design guideline, the framework was developed. Its parameters focus on biophilic regeneration, but the factors used to assess them are mostly qualitative. They help identify how ecological restoration, water adaptation, spatial experience, green connectivity, heritage legibility, multi-sensory restoration, and human-nature co-existence can be understood in a brownfield context. In this way, the framework becomes the first response to the main research question: it defines what needs to be considered before design interventions can be proposed.

The best practice analysis addressed sub-question of which indicators can be used to assess the biophilic and heritage potential of waterfront brownfields in Gothenburg. Framework parameters

created a focused lens for studying international and local case studies. Each case was analysed to understand how design elements such as water edges, planting, habitat zones, reused materials, historical traces, movement routes, and public programs respond to the framework. These design elements acted as indicators, showing how biophilic and heritage potentials can be recognized and translated into spatial strategies. This stage also clarified how maritime and industrial heritage can be practically integrated into design through preservation, reuse, material reference, landmarks, and spatial memory.

The design and implementation chapter then tested how the framework could be translated into practical solutions at the neighbourhood scale. In the implementation phase, the framework was applied to the Majorna/Klippan waterfront, where the future relocation of Stena Line creates an opportunity to transform an infrastructural edge into a public green-blue landscape. The design proposal shows that biophilic regeneration is not only about adding greenery to a brownfield. It is about creating a spatial system where flood adaptation, biodiversity, public access, sensory experience, and cultural memory support each other. Water becomes both a technical and experiential element. Planting becomes both ecological structure and sensory atmosphere. Heritage becomes both memory and public function.

The sub-question of water interventions supporting multi-sensory experiences and create multi-functional spaces, while simultaneously addressing flood adaptation in the local context, was answered by analysing which senses are involved in each framework parameter and by using water as the main design element in the waterfront context. Water guided the necessary QGIS maps by helping identify flood-prone areas, flash-water accumulation, access to the river, and zones where water-based interventions were most needed. Based on this analysis, water management strategies such as floodable zones, basins, bioswales, wetlands, visible waterflows, and adaptive edges were placed in different parts of the site. These interventions support flood adaptation, but they also create vis-

ual, acoustic, tactile, and seasonal experiences. By shaping different water conditions, new habitats can also be created to support biodiversity and human-nature co-existence.

In sum, the thesis demonstrates that the framework can act as a base guideline for biophilic regeneration of waterfront brownfields. It uses heritage as one of the main brownfield values to be preserved, reused, and enhanced through ecological, sensory, and spatial strategies. However, the framework is not a fixed design recipe. It provides a structure for what to look for and what to consider, but each site still requires analysis to identify missing elements, local challenges, and possible design opportunities. In this way, the framework can move beyond one site-specific proposal while still needing contextual analysis to become practical in each location.

6.2. Discussion

The thesis shows that biophilic regeneration of waterfront brownfields is a broad and complex topic. Many additional aspects could have been explored in greater depth, but including all of them would have expanded the thesis beyond the time and scope of a master's project. Topics such as soil remediation, contamination, governance, maintenance, well-being studies, technical hydrology and participatory planning are all highly relevant to brownfield transformation but they require more technical and interdisciplinary investigation.

Selected theories mainly focus on biophilic design, but they were used to extract urban-scale parameters. The discussion of well-being is mainly addressed through multi-sensory and spatial experience. Biophilic indicators such as light, shadow, sound, smell, texture, movement, mystery, prospect, refuge, framed views, seasonal change, and contact with water helped translate well-being into design qualities. These indicators show how the landscape can support restoration not only through greenery, but also through atmosphere, comfort, curiosity, calmness, and repeated everyday contact with nature. Since the thesis is delimited to waterfront brownfields, water became a central focus. Water-sensitive design, flood adaptation, and multi-sensory water experience were studied more closely to understand water as both a technical and experiential design element.

To get into practical solutions, the case studies were selected because they are waterfront brownfields with visible heritage, ecological transformation, and public landscape value. Other projects, such as Domino Park, The Goods Line, and Hunter's Point South Waterfront Park, could also have been studied, but the selected cases were more directly related to the framework focus. An important observation in case studies, is that many sustainable post-industrial projects do not directly mention biophilic design, even though biophilic qualities can be identified through water, planting, habitat creation, sensory experience, heritage reuse, and public access. This shows that biophilic principles can exist in practice even when they are not named.

The main aim of this thesis was not to create a complete citywide brownfield selection tool, but to develop a biophilic regeneration framework. Site selection was kept brief because of the main aim was to develop and test the framework in one location. However, site selection could become a method by itself, comparing several post-industrial voids in Gothenburg to identify which sites have the strongest potential for biophilic regeneration. Therefore, the Majorna/Klippan site functions as a testing ground for the framework and design proposal should be understood as a conceptual application rather than a fully engineered plan.

6.3. Limitations

The main limitation is that the framework and design proposal are conceptual rather than technically verified. The thesis does not include detailed soil testing, contamination mapping, remediation strategy, hydrological modelling, cost estimation, or construction-level detailing. The framework is also mainly qualitative. It helps identify spatial, ecological, sensory, and heritage-related potentials, but it does not yet include quantitative indicators to measure the success or failure of each intervention.

The QGIS analysis was used to guide design decisions, but it does not replace technical surveys or engineering studies. More detailed data would be needed before real implementation. Since brownfield regeneration also involves multiple actors and stakeholders, multidisciplinary surveys, consultations, and meetings would be necessary to further guide and adjust the design proposal.

The case study and site selection processes were also limited by the thesis timeframe. A broader comparison of international post-industrial projects and more brownfield sites in Gothenburg could provide stronger technical and contextual feedback. However, this would require a more time-consuming chapter, especially when comparing international practices with the specific conditions of Nordic urban landscapes.

Finally, the framework was tested on only one site. This shows how it can be translated into design, but further testing in different brownfield contexts is needed to understand how adaptable it can be.

6.4. Future Research

Future research could expand the framework by adding more technical brownfield parameters. Soil type, contamination level, remediation methods, soil depth, water infiltration, plant tolerance, and ground stability could be studied in more detail. This would upgrade the framework by connecting biophilic and spatial qualities with the technical realities of brownfield regeneration.

Well-being could also be developed as a stronger research direction. This thesis discusses multi-sensory experience and human–nature connection conceptually, but future studies could evaluate how users respond to different sensory environments, water features, habitat zones, heritage elements, light and shadow, mystery, refuge, and levels of public access. Surveys, interviews, behavioural mapping, and post-occupancy studies could help measure whether the design supports restoration, comfort, belonging, and everyday use.

To upgrade framework with more practical aspects, it could also be tested through quantitative evaluation. Each parameter could be connected to measurable indicators, such as flood storage capacity, green connectivity, biodiversity value, accessibility improvement, sensory diversity, heritage visibility, user activity, and habitat performance. This would make it possible to compare different proposals and better understand the balance between indicators.

Another future research direction could be a regional or city-scale site selection method. By mapping brownfields and post-industrial voids across Gothenburg or the wider region, future studies could identify which sites are most suitable to become urban landscapes. This method could use framework-related analysis to compare sites based on flood risk, green-blue connectivity, heritage value, public access, ecological potential, and urban need.

6.5. Final Conclusion

This thesis concludes that waterfront brownfields can become adaptive urban landscapes when ecological restoration, flood adaptation, multi-sensory experience, public access, and maritime-industrial heritage are designed together. The proposed framework provides a base guideline for understanding how biophilic regeneration can be applied to post-industrial waterfronts.

The Majorna/Klippan waterfront was used as a test site to explore how the framework can be translated into spatial interventions. The proposal shows how water can function as both flood infrastructure and sensory experience, how planting can support biodiversity and atmosphere, and how heritage can become part of everyday public life through preservation, reuse, landmarks, materials, and spatial memory.

At the same time, the thesis shows that the framework is not a fixed solution. It is fixed lens that needs site-specific analysis to identify missing elements, local challenges, and possible interventions. Further technical and quantitative research would strengthen the framework and make it more applicable to real brownfield implementation. Even so, the study demonstrates that brownfields should not be seen only as contaminated or leftover land, but as potential green-blue urban landscapes that can support climate adaptation and cultural continuity. The framework offers one possible basic method for moving toward that transformation.

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AI Context

AI tools were used during the thesis process as a supporting tool for text refinement, language editing, translation, and creation of table of context. The use of AI was limited to improving readability, coherence, and academic expression. The research direction, theoretical framework, case study and spatial analysis, design decisions, diagrams, and final proposal were developed by the author. All AI-assisted text was reviewed, edited, and adapted by the author to ensure accuracy, relevance, and consistency with the thesis objectives.