11. Nieuw Roffa 2100 Beyond Defence: Reimagining Adaptation in Rotterdam Through the Palimpsest Lens

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Abstract

The paper examines how the lens of palimpsest urbanism reshapes design practice in the context of climate adaptation. Set in Rotterdam's Oud-Mathenesse, a post-war neighborhood below sea level, the research integrates urban design, hydraulic engineering, building technology, and social science to address the vulnerabilities of existing urban fabrics. Through archival study, ethnographic fieldwork, participatory methods, and speculative drawing, the palimpsest approach reveals the layered spatial, temporal, and social relations that constitute the neighborhood. It transforms design from a solution-oriented discipline into a mode of inquiry that negotiates between technical precision and lived experience. Using backcasting, the study develops future scenarios toward 2100, tracing how adaptation can unfold gradually through maintenance, modification, and care. The paper argues that the palimpsest lens enables a deeper understanding of adaptation as an ongoing, collective process rooted in the capacity to inhabit change rather than to control it.

Keywords

Palimpsest, Interdisciplinary Design, Climate Adaptation, Delta Urbanism

Introduction

In the coming decades, climate change will reshape the spatial, ecological, and social conditions of heavily urbanized deltas, where exposure to sea-level rise is particularly high. In the Netherlands, much of the territory lies below sea level and depends on an intricate system of dikes, pumping stations, canals, gates, and dams. Projections indicate a sea-level rise between 0.63 and 1.01 meters by 2100 (IPCC, 2023), while changing rainfall patterns are expected to intensify fluvial flooding and local waterlogging. These projections underline the vulnerability of the Dutch delta, where densely built environments coincide with subsiding polders.

Rotterdam epitomizes these conditions. As Europe's largest port and a city historically shaped by water, much of its territory lies several meters below mean sea level. Its safety depends on large-scale infrastructures that have long embodied the paradigm of control: the belief that water can be mastered through engineering. This paradigm enabled urban growth and industrial expansion but also produced governance challenges. The heavy reliance on engineered protection exposes not only the physical limits of dikes and pumps, which require constant upgrading, but also the fragility of governance models built on predictability and control rather than on the uncertainty and non-linearity of climate risks (Beck, 1992; Pahl-Wostl, 2007, Meyer et al., 2017).

This reliance creates a paradox. The Netherlands is celebrated as a model of hydraulic expertise, yet the very infrastructures that sustain this reputation are increasingly questioned under accelerating climatic pressures. In recent decades, national programmes such as the Delta Programme and Room for the River have signaled a gradual shift: rather than raising dikes alone, they reintroduce space for water within the landscape, acknowledging that hydrological processes cannot be entirely controlled (Rijke et al., 2012; OECD, 2014). At the city scale, Rotterdam has implemented a range of climate-adaptive projects that integrate water management with urban design. The Benthemplein Water Square combines public space with temporary stormwater storage, acting simultaneously as civic infrastructure and flood-mitigation device; it has been often used as a model for neighbourhood-scale adaptive design in Rotterdam (De Urbanisten, n.d.; Water Environment Federation, 2014). The Floating Pavilion in Rijnhaven, together with pilot projects for floating housing, tests adaptive construction typologies for rising water levels. The Dakpark in Delfshaven merges a flood defence with a linear park and commercial spaces, exemplifying the multifunctional use of dike structures. Along the port's waterfront, experimental soft-defence interventions such as artificial dunes and temporary sand beaches have been developed to explore sediment-based and ecological approaches to protection (Gemeente Rotterdam, 2019).

Yet these efforts remain uneven. Most programmes operate at the scale of the nation-state or major redevelopment zones, while adaptation in existing neighborhoods is limited. Interventions in high-profile areas often reinforce urban inequality, contributing to gentrification and displacement, especially under housing pressures that drive large-scale new construction in the Netherlands. Recent research by Janssen et

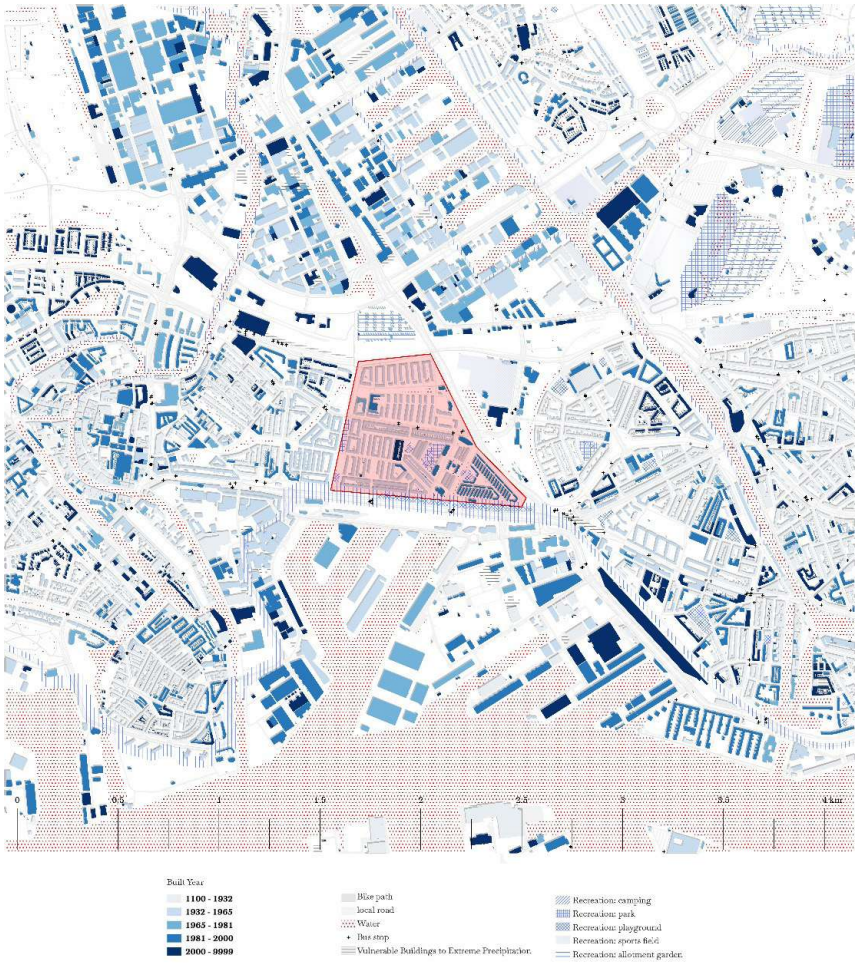
al. (2023) on state-led gentrification in Rotterdam illustrates how strategic redevelopment zones attract higher-income residents and restructure housing stock, leading to indirect displacement and socio-spatial polarization. At the level of neighborhoods, districts, and buildings, particularly in post-war areas, the gap in adaptation remains striking. Climate strategies in Rotterdam continue to focus on new developments, while older neighborhoods and their vulnerable building stock receive limited attention. We position the research and design study Nieuw Roffa 2100 within this critical zone by focusing on Oud-Mathenesse, a post-war neighborhood at -2.45 m NAP characterized by subsidence, aging housing, and a socially diverse population. The case demonstrates how the vulnerabilities of a delta city materialize locally, where the limits of national or municipal strategies become tangible. Through speculative and interdisciplinary design, the project explores how adaptation can be enacted without demolition, how resilience can be cultivated within existing urban fabrics, and how everyday practices can support living with water in the future. In doing so, the research reframes adaptation as a multi-scalar and interdisciplinary challenge that must integrate technical, spatial, and social dimensions to address the uncertainties of climate change.

The interdisciplinary approach, bringing together expertise from urban design, building technology, hydraulic engineering, and social science, focuses on design as a mediating practice. It establishes a future scenario for 2100 and traces a series of 20-year intervals to explore how incremental interventions at both neighborhood and building scales can guide a gradual transformation.

To support this, the research is grounded in the theory of palimpsest urbanism (Macera, De Meulder, & Shannon, 2020). This framework enables a deeper understanding of the neighborhood and its relationship with water through diverse methodologies, tools and outputs informing the design decision making. Drawing from multiple fields spanning from archival research, ethnographic mapping, fieldwork, photovoice, interviews, to speculative spatial representation, the palimpsest approach that we applied reveals the overlapping spatial, social, and temporal layers that constitute the places. These insights informed the development of a cooperative interdisciplinary methodology in the design phase.

This paper focuses on the palimpsest lens and examines how it contributed to understanding the neighborhood and shaping the interdisciplinary design process. Central to this process are the acts of drawing, visualization, and representation, which serve not only as communicative tools but also as instruments of research and experimentation. The selected figures and captions included throughout the paper are therefore integral to understanding how methods and design outcomes were developed in parallel. Rather than presenting the full results of the Nieuw Roffa 2100 project, the paper aims to articulate how these outcomes emerged through collaboration among disciplines, and how the combined use of the palimpsest and design scenario approaches, mediated through drawing, framed the collective exploration of adaptation and design in Oud-Mathenesse. The paper develops this approach through fours sections, on method, time, space and design, and concludes with a reflection on their

ethical and political implications.



(Fig.01 - Oud-Mathenesse, Rotterdam - Source: Hasan Hashas 2025)

Palimpsest & Scenarios

The research employed an interdisciplinary approach integrating architecture, urbanism, structural and hydraulic engineering, and social sciences to address climate adaptation from technical, spatial, and social perspectives. Fieldwork in the Rotterdam neighborhood of Oud-Mathenesse combined on-site observations, walking tours, interviews, and experiential mapping to document everyday interactions between residents, water, and space. Ethnographic and archival research traced local dynamics and historical transformations, while critical spatial analysis examined the built form, infrastructure, and flood vulnerability. Community-based participatory research engaged residents through interviews, workshops, and the Photovoice method to co-develop and visualize current adaptation actions. These participatory and analytical

approaches were complemented by research-by-design experiments, analysis of the structural aspects of the buildings and hydraulic simulations and modeling, linking social engagement with spatial and structural assessments to test and refine future adaptation scenarios.

The guiding theme across all methods was the palimpsest lens, which framed how the neighborhood was read, reinterpreted, and reimagined through design. As Corboz (1983) described, territory can be understood as an accumulation of layers rather than a blank slate. In the context of Oud-Mathenesse, this perspective enabled an understanding of both the material and social strata of the neighborhood: its physical infrastructures and housing typologies, as well as the ways residents have customized and maintained their environment over time. Technological shifts and the increasing abstraction of landscape perception, from satellite imagery to remote sensing, have progressively distanced people from direct, lived engagement with their surroundings (Corboz, 1983). The palimpsest lens was thus used to reconnect design with this experiential dimension, making visible the layered traces that define the neighborhood's identity. In design pedagogy, this approach is considered foundational, as it reveals the site's inherent capacities for inclusive transformation by integrating perception, process, and scale (Bobbink & de Wit, 2021).

This interpretive framework directly informed the design phase, where four iterative scenarios were developed to explore how the neighborhood could evolve with water over time. Moving from strategies of protecting against to living with water, each scenario unfolded in 20-year intervals (2025, 2045, 2065, 2085, and 2100), illustrating how incremental interventions could collectively enable long-term adaptation to changing hydrological conditions. The scenarios tested interdisciplinary synergies, combining design experimentation, hydrological simulation, structural assessment, and social-scientific insights on residents' perceptions and willingness to adapt. The final vision, set in 2100, envisions a condition where living with water becomes a normalized spatial and cultural practice.

To operationalize this process, the design phase began from the future horizon of 2100. Hydraulic engineers modeled not only the projected sea-level rise but also compound conditions that more accurately represent flood risk in Oud-Mathenesse, including potential overtopping of the main dike protecting the neighborhood from the River Maas, as well as increased precipitation and groundwater rise. Hydraulic simulations were conducted for each temporal horizon to estimate corresponding water levels and degrees of inundation across the neighborhood. These results provided the technical basis for the adaptation framework and guided the sequence of spatial scenarios developed through the interdisciplinary design process.

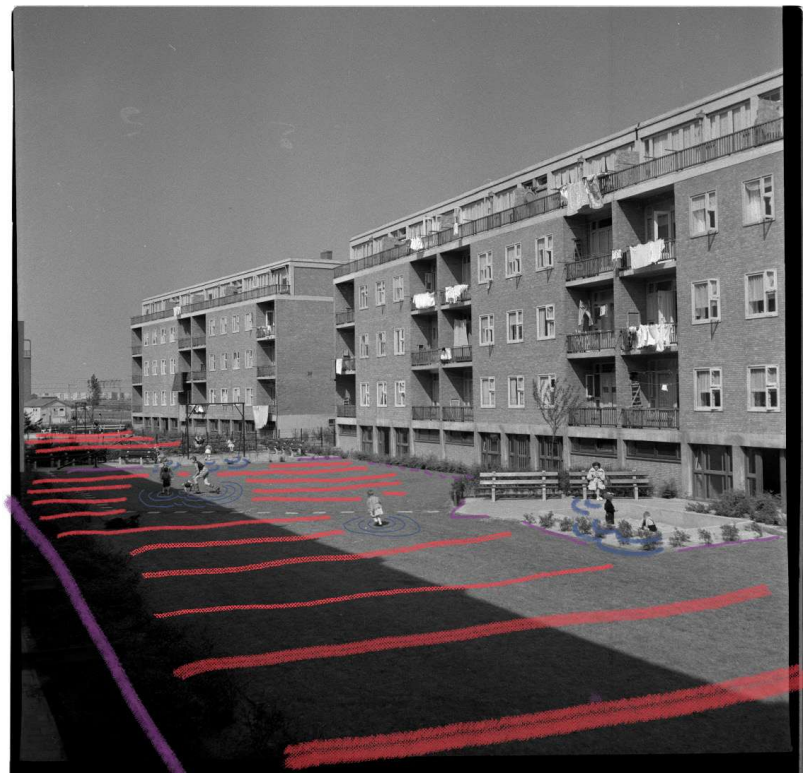
Working backward from these modelled conditions, each stage translated long-term adaptation goals into concrete, near-term measures: elevating plinths, retrofitting courtyards as water buffers, and reconfiguring streets into multi-functional channels for storage and flow. This iterative approach addressed uncertainty while producing plausible and actionable pathways, each grounded in site-specific hydrological data,

structural analysis, and socio-economic potentials.

Time & Backcasting

The research approached time as a layered condition, using the palimpsest lens to trace how different historical, social, and technical moments have shaped Oud-Mathenesse and its relationship with water. Historical analysis showed that the neighborhood has undergone successive transformations since its construction in the 1940s: first as a workers' housing estate for shipyard employees, then as a social housing area affected by post-industrial decline, and more recently as a mixed-tenure district exposed to subsidence and aging infrastructure. These transitions established the temporal rhythm of the neighborhood, where cycles of construction, neglect, and repair mark both the physical environment and community life. This rhythm informed the 20-year intervals adopted in the design scenarios, reflecting the observed pace at which maintenance policies, housing renovation, and demographic shifts occur in the area.

Archival research provided detailed documentation of the neighborhood's early years. Original plans from the 1950s revealed generous inner courtyards designed for collective use with shared drying racks, benches, and play areas intended to encourage interaction and mutual care (Fig.02)



(Fig.02 Children Playing on Brigantijnstraat (duplicate). Children playing in front of the flats on Brigantijnstraat, reflecting the early post-war residential atmosphere, 1953. - Source: Stadsarchief Rotterdam. Edited by Hasan Hashas, highlighting the spatial transformations and socio-urban processes unfolding over time 2025)

Over time, as ownership structures changed and individualization increased, these communal courtyards were gradually fenced, privatized, or converted into parking lots. This spatial privatization corresponded to broader societal changes: the retreat of public management, the introduction of individual leases, and shifting attitudes toward collective maintenance.

Archival research also revealed the cultural dimension of the neighborhood's evolving relationship with risk and adaptation. Among the collected materials, two photographs captured the atmosphere of post-war Oud-Mathenesse: one depicting a girl, Netty van Aalst, standing with a plastic bag over her head to protect herself from blowing sand during roadworks in 1956 (Fig.03)), and another image captures a car crash caused by slippery conditions in 1955 (Fig.04). These pictures supported the claim about the existing attitude toward hazards, especially those related to water. Beyond their documentary value, these images expose a pragmatic defensive attitude. When read alongside the contemporary observations from photovoice and interviews, they illuminate a persistent mindset that views environmental disturbance as something to be resisted or avoided.

This historical continuity informed the design logic. The stepwise sequence of scenarios, progressing through 20-year intervals, was conceived not only as a technical response to climate projections but as a cultural transition. The gradual shift from protection to adaptation mirrors the neighborhood's temporal rhythm and social memory, allowing change not by abrupt transformations but through familiar gestures that still today characterise the neighborhood.

(Fig .03 - Netty van Aalst During Roadworks on Schiedamseweg. Netty van Aalst stands with a plastic bag over her head to protect herself from blowing sand during roadworks, 1956 - Source: Stadsarchief Rotterdam 2025)

(Fig.04 - Police Officer by Car Crash on Schiedamseweg. A police officer stands by a car that crashed into a lamppost on Schiedamseweg due to slippery conditions, near the Witte Dorp, 1955 - Source: Stadsarchief Rotterdam 2025)

During fieldwork, researchers conducted repeated site walks and mapping sessions to record how residents currently inhabit and modify these same spaces. The observations captured a series of small but meaningful acts: planters placed outside windows, rain barrels installed near entrances, temporary wooden decks built above low points that frequently flood, and birdhouses fixed to traffic signs (Fig.05). These gestures, though informal, demonstrated an ongoing engagement with water and a form of bottom-up maintenance that keeps the shared environment alive.

(Fig.05 - Fieldwork observations. Amber Coppens, Emily Lenarduzzi, Ahmed Alsalhi, Hasan Hashas, Vera Safronova, Natalin Tosun - Source: Hasan Hashas, final outcome 2024–2025)

The photovoice method added a more personal temporal layer. Photovoice is a participatory method that has been widely used in community-based research to empower individuals and to document and reflect on their experiences through photography (Wang & Burris, 1997). Residents were invited to photograph two themes: “Life in Oud-Mathenesse through your lens” and “Water shaping life in Oud-Mathenesse” with disposable cameras. The collected images showed puddles transforming streets into temporary play areas, reflections of façades in flooded courtyards, and self-made drainage channels dug by residents to redirect rainwater (Fig.06). These photographs and accompanying interviews revealed how people perceive water not only as a threat but also as an ordinary, recurrent part of everyday life. They confirmed the persistence of local knowledge and sensitivity toward environmental change, even when formal infrastructure fails to accommodate it.

(Fig.06 - Oud-Mathenesse photovoice (participant image) - Source: Participant 2, 2025)

While examining the layers of time, the future layer was also important to study, particularly the visions that had a significant impact on the discourse of urbanism, such as Constant Nieuwenhuys's New Babylon (Wigley, 1998). The future city was conceived as a visionary urban model that challenges capitalist norms, imagining a post-capitalist, liberated society designed to support creativity and human freedom (Wigley, 1998). The city promotes a lifestyle where play, creation, and exploration replace traditional labor and work routines (Huizinga, 1949; Nieuwenhuys, 1974). Its spatial design rejects permanence; instead, it features dynamic, ever-changing structures that adapt to users' needs and movements (Heynen, 1999; Sadler, 1999). Studying these ideas left traces that guided the research in later stages, particularly when developing the 2100 scenario. This phase involved examining scientifically grounded speculations on how the future might look and integrating those insights with the collected findings to articulate the final vision.

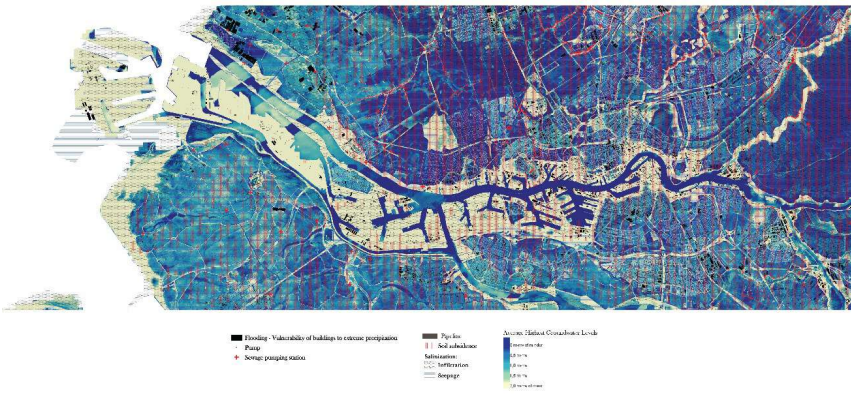
The synthesis of these temporal observations informed the first design horizon of the backcasting sequence, starting from explicit desirable future scenarios and tracing backwards to identify policy and design pathways and intermediate steps (Dreborg, 1996).

The documentation of privatized courtyards and their spontaneous reactivation inspired strategies for re-collectivizing these inner spaces: incrementally transforming them into shared water gardens, retention courtyards, or play areas that double as micro-basins during heavy rain. In this way, the study of time – through archival reconstruction, observation, and participatory imagery – became an operative component of design, translating the accumulated experience of living with water into phased, future-oriented spatial strategies.

Space and layers

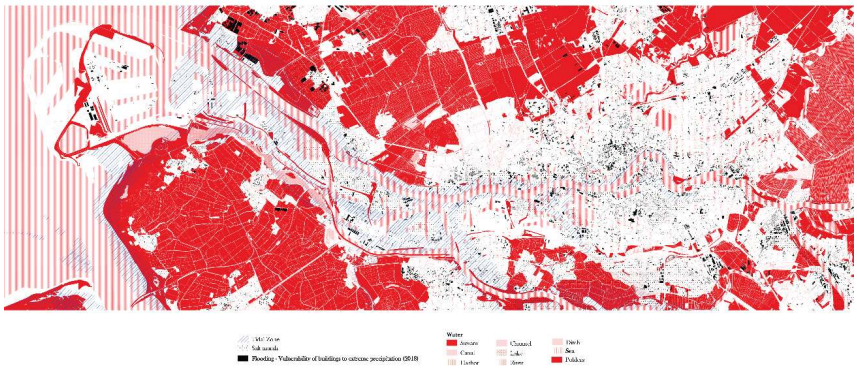
Complementing the temporal exploration developed through backcasting, the spatial reading of Oud-Mathenesse examined how water and built form interact across different layers of the neighborhood. Through the palimpsest lens, the area was understood not as a static composition but as a living stratification of ground, structure, and atmosphere, each carrying traces of use, modification, and environmental transformation. The aim was to articulate how technical systems, spatial organization, and human practices overlap and interfere with one another, and how these relationships could later inform the design of adaptive measures. The analysis was structured along two complementary dimensions. Horizontally, the research identified three hydrological strata that define the neighborhood's interaction with water: infra-aqua, ad-aqua, and supra-aqua.

The infra-aqua layer (Fig.07) focuses on what lies beneath the surface, basically foundations, soil composition, and drainage infrastructure that regulate the invisible flows of groundwater. Archival construction documents and structural calculations were cross-checked with engineering data to assess the vulnerabilities of post-war foundation systems and to understand how subsidence and rising groundwater might affect them in future flood scenarios.



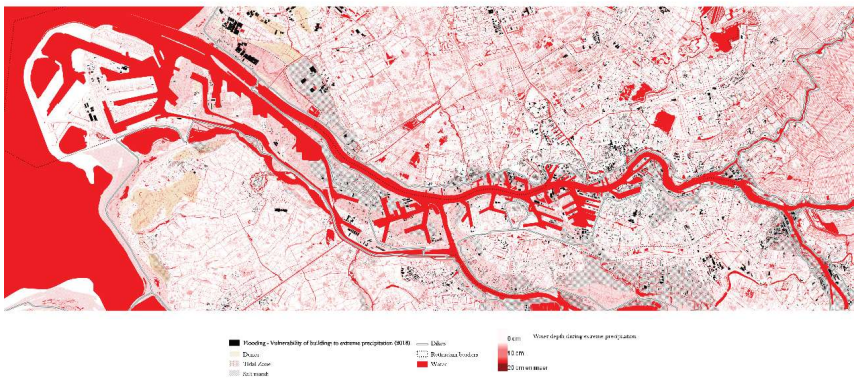
(Fig.07 - Infra-aqua: subsoil and foundation mapping - Source: Hasan Hashas, 2025)

The ad-aqua layer (Fig.08) corresponds to the ground plane: the interface where water meets everyday life. Here, fieldwork, interviews, and photovoice also helped tracing how residents experience and negotiate flooding, from temporarily inundated courtyards to improvised drainage at doorsteps or the use of rain barrels along façades.



(Fig.08 - Ad-aqua: ground-plane mapping and everyday water interactions - Source: Hasan Hashas, 2025)

The supra-aqua layer (Fig.09) extends the observation upward, capturing façades, balconies, and roofs as climatic mediators that host both ecological and social adaptations: shading devices, green walls, and open galleries that support outdoor living even under shifting conditions of heat and humidity. Mapping these three layers provided a comprehensive horizontal reading of water as a structuring force operating across and through the built environment.



(Fig.09 - Supra-aqua: façades, balconies and roof adaptations - Source: Hasan Hashas, 2025)

Vertically, the study focused on the façade as the point where the physical, social, and hydrological layers converge. The façade embodies the neighborhood's relationship to water: it registers levels of exposure, thresholds of defense, and forms of daily adaptation. Archival plans and original structural drawings revealed differences in foundation depth and material composition; field observations added a layer of lived interpretation showing how residents modify the façade through informal actions such as sealing thresholds, adding shading elements, or reclaiming exterior surfaces with plants. These insights informed the conception of the *space-containing façade* (Kousidi, 2025), a mediating architectural element that transforms the boundary be-

tween inside and outside into a space of negotiation. The façade becomes not a sealed envelope but a responsive interface, accommodating climatic functions (sun, wind, rain) while also supporting social and aesthetic expression (Fig.10).

(Fig.10 - The palimpsest in Oud-Mathenesse (composite diagram) - Source: Hasan Hashas, 2025)

The interplay between horizontal mappings and vertical readings was crucial in translating research into design. The infra-, ad-, and supra-aqua maps provided a plan-based understanding of spatial conditions: where water accumulates, how it flows through streets and courtyards, and how it interacts with underground drainage and foundations; while the façade studies revealed how adaptation could occur through architectural detail and lived modification. To connect these two dimensions, a series of axonometric drawings were developed as synthetic representations of the design scenario where hydrological, structural, and social data were intertwined. These drawings visualized the simultaneity of processes normally examined in isolation, showing how subsurface drainage, street-level occupation, and façade transformations align or conflict across the same section of the neighborhood. The axonometrics combined the precision of engineering data with the interpretive richness of ethnographic and design observation, functioning as collective instruments through which disciplines could work on the same plane of reference.

Equally important were the technical sections, which operated both interpretively and projectively. Extending from the subsoil to the roofline, they demonstrated the material continuity between infrastructural, architectural, and human scales. Within these sections, adaptation strategies (subsurface storage basins, permeable courtyards, raised thresholds, and adaptive balconies) were positioned along a continuous vertical logic that linked technical feasibility to spatial experience.

Each section and axonometric view corresponded to a temporal horizon (2045, 2065, 2085, and 2100) making visible how interventions accumulate over time and how the

built fabric thickens through successive layers of adaptation.

The axonometric and sectional drawings therefore functioned not as illustrations but as speculative tools. They condensed the interdisciplinary design work of engineers, designers, and social scientists into a shared and understandable visual grammar, allowing the project to oscillate between empirical grounding and spatial imagination. In this way, the spatial analysis evolved beyond documentation into an operative method. The palimpsest lens structured a dialogue between the measurable and the lived, the technical and the cultural, revealing how adaptation unfolds not only across time but through the very thickness of the built environment – from under- to the above-ground – to ensure that proposals for living with water in Oud-Mathenesse remained both technically rigorous and deeply rooted in the existing material and social fabric.

From layers to scenarios

The design phase translated the layered analytical readings of Oud-Mathenesse into the sequence of speculative drawings (Fig.11,12,13 and Fig.14) – technical sections and axonometric – that explore how adaptation could unfold across time.

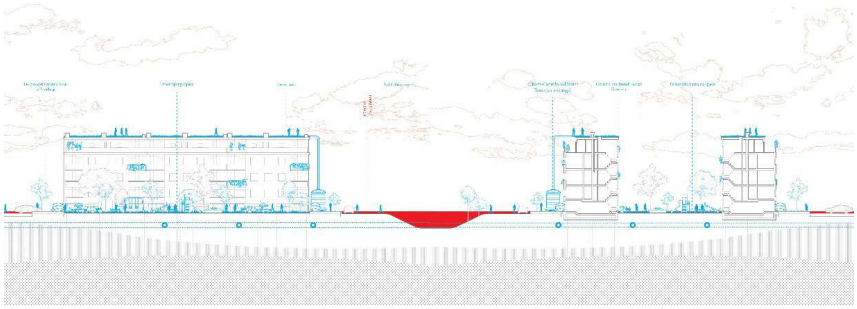
In 2045, the Maeslantkering, the movable barrier protecting Rotterdam, is assumed to have reached the end of its operational lifespan. Although the dikes continue to contain the river's two-meter rise, heavy rainfall becomes the dominant risk. Hydraulic simulations indicate that water would accumulate in Oud-Mathenesse to depths of 20–40 centimeters, stagnating for nearly a week. Residents, extending familiar coping practices, install rain tanks, use planters as barriers, and adapt façades with shading and drainage elements. Pocket gardens are reclaimed as collective retention spaces connected by new infiltration sewers, while municipal interventions expand green corridors and increase local storage capacity. Through these small but coordinated actions, the duration of flooding is reduced from a week to two days.

By 2065, these measures mature into an adaptive urban fabric. Architectural retrofits and public-space redesigns interlace hydraulic logic with social infrastructure: permeable courtyards, raised thresholds, vegetated façades, and multifunctional water streets reorganize the neighborhood's surface while the post-war grid remains recognizable.

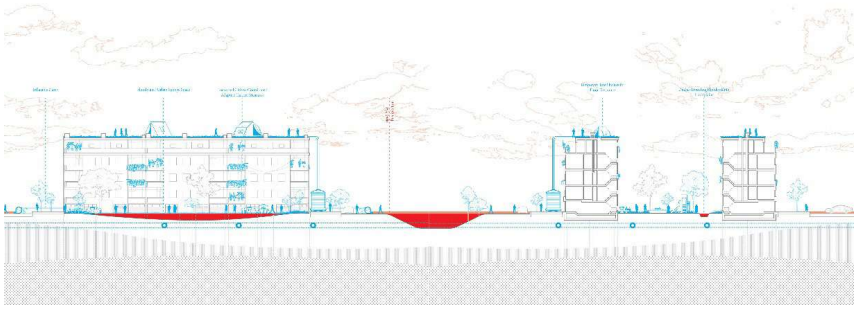
In 2085, the accumulated transformations reach a threshold. Continuous subsidence and sea-level rise generate a semi-amphibious environment where ground and water intermix. Adjustable foundations, elevated walkways, and floating public structures sustain daily life amid fluctuating conditions. Collective courtyards evolve into social-ecological commons that absorb, filter, and reuse water while maintaining communal life.

The axonometric view of 2100 synthesizes these progressive transformations into a long-term vision of coexistence. The neighborhood operates as an inhabited hydro-

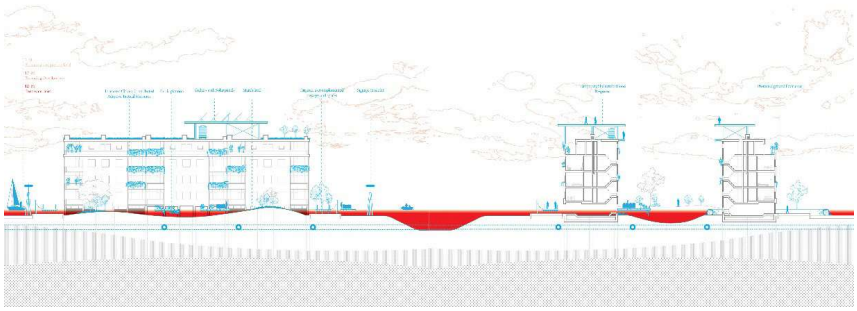
logical system: water channels, green infrastructures, and adaptive dwellings form a continuous urban-ecological network. The drawings visualize a deltaic urbanism where adaptation is no longer an emergency response but an embedded condition of everyday life. Within this operative palimpsest, design functions as both analytical and projective tool, rewriting the relationship between ground, water, and habitation through time.



(Fig.11 - 2045 section - Source: Hasan Hashas 2025)



(Fig.12 - 2065 section - Source: Hasan Hashas 2025)



(Fig.13 - 2085 section - Source: Hasan Hashas 2025)

(Fig.14 - Axonometric view 2100 - Source: Hasan Hashas, 2025)

Conclusion

In this research, the palimpsest has served not merely as a metaphor or as a required theoretical framing, but more as an epistemic stance, a way of engaging with the material and temporal depth of the urban landscape. To read and design through its layers is to recognize that knowledge emerges from within the traces of the 'already--there': from infrastructures sedimented over decades, from collective gestures of maintenance and repair, from the rhythms of everyday inhabitation that persist beneath the scale of policy or masterplan. In this sense, the palimpsest reframes adaptation as an act of careful interpretation before it becomes a project of transformation. It demands attentiveness to the coexistence of temporalities, the slow subsidence of ground, the cyclical return of floods, the daily adjustments of residents and positions design as a mediator capable of articulating their interplay.

Seen through this lens, interdisciplinary design for adaptation reveals its political and ethical dimensions. Design is never a neutral or purely technical enterprise: it is a continuous negotiation over what, and whom, a society chooses to preserve. In the Dutch delta, as in many other highly urbanized coastal areas threatened by climate change, the inherited paradigm of hydraulic control and spatial optimization tends to privilege large-scale interventions and zones of economic visibility. Yet this research and design study in Oud-Mathenesse exposes another territory of possible adaptation: one constituted by ordinary actions and modest infrastructures that quietly could sustain life below sea level, even in the long term. The palimpsest brings these overlooked practices into focus, affirming that adaptation can also take the form of maintenance, incremental modification, and shared care. To design within the palimpsest

is therefore to work ethically, acknowledging that adaptation to the changing climate is not built through replacement but through the capacity to inhabit change.

To conclude, the palimpsest reminds us that adaptation, like the city itself, is never complete. Each intervention adds another layer, another trace of negotiation between water, ground, and habitation. What endures is not a fixed solution but the capacity to keep rewriting, to engage the unfinished and the uncertain as constitutive elements of our urban life. In this ongoing process, spatial design finds its ethical ground: not in controlling the delta, but in learning to dwell within its shifting depth.

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