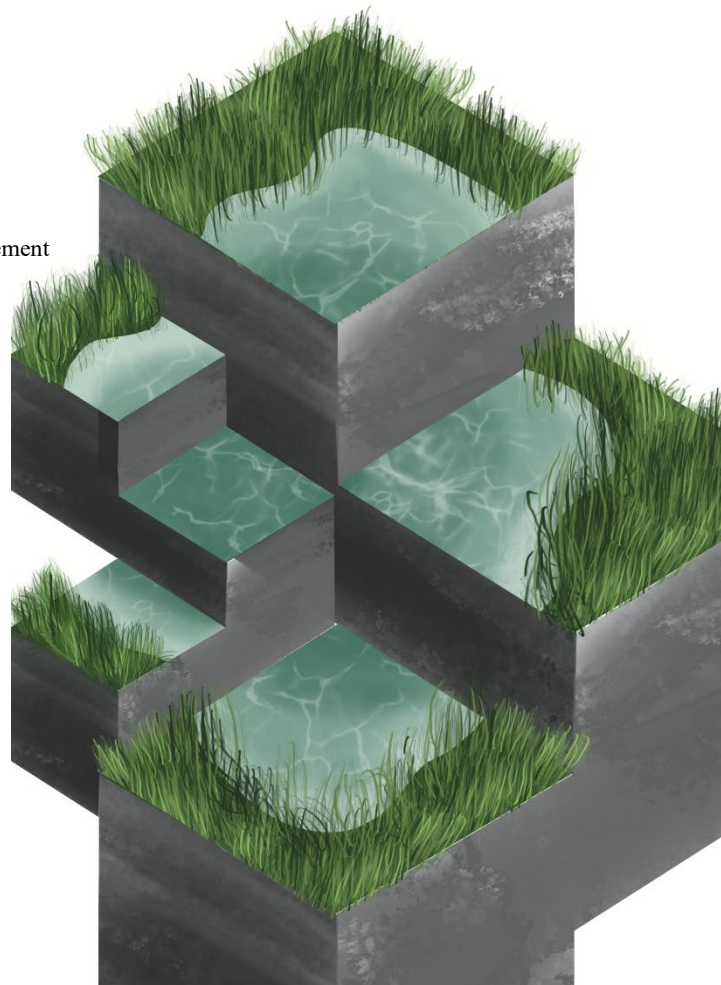




Pattern Book for Public Natural Swimming Pools: Spatial, Ecological, and Experiential Patterns for Recreational Success

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Abstract:

Public Natural Swimming Pools (PNSPs) are chemical-free bathing facilities that rely on biological filtration to maintain safe water quality. The sector's primary design standard, the FLL guidebook, comprehensively addresses the technical and ecological requirements for constructing and operating these facilities, yet contains no guidance on recreational design. Across Europe, all existing guidelines focus on health and safety parameters, leaving the spatial and experiential qualities that determine how visitors actually use these places entirely unaddressed. Knowledge of how to design recreationally successful PNSPs exists among practitioners but remains fragmented and individually held. This study set out to identify the spatial, ecological, and experiential attributes that shape recreational success in PNSPs, and to consolidate them into a communicative decision-support tool. The research employed a qualitative approach triangulated with a literature review, six semi-structured expert interviews with practitioners, researchers, and constructors, and spatial analysis of two European case studies: Bylderup Naturbad in Denmark and King's Cross Pond Club in London. Interview data were analysed through Thematic Analysis, and candidate themes were subjected to a promotion rule requiring evidence from all three data sources before recognition as a pattern. Eight patterns emerged: typological choice between pool and pond, catchment and bather load, zone differentiation by user typology, edges and sightlines, sensory perception, threshold and entry sequence, ecological storytelling, and seasonality. These patterns organise into four groups that reflect the sequence of design decisions practitioners described, from the foundational typological choice through spatial organisation and visitor experience to seasonal adaptation. The patterns were compiled into an illustrated pattern book intended to function alongside the FLL as a complement, not a replacement, ensuring that recreational questions are raised alongside biological and safety parameters during the design process. The study captures the supply side of PNSP design – designers, operators, and researchers – not the demand side. How visitors actually perceive the qualities described remains an open question. The pattern book has not been tested in practice, and whether the eight patterns function generatively when combined requires further investigation.

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Preface

This thesis continues a research trajectory that began during my bachelor's studies, where I conducted a sustainability analysis comparing private Natural Swimming Pools (NSPs) in Sweden and Hungary. That project examined the economic, environmental, and social dimensions of NSPs across two national contexts and revealed how differently the same technology is understood and implemented depending on regulatory, climatic, and cultural conditions. During that time, I became fascinated by the social aspect of NSPs.

As my understanding of landscape architecture expanded, I became fascinated by facilities designed not for private use but for communities, and I encountered the concept of Public Natural Swimming Pools. During early exploration of this topic, I encountered a recurring observation: while the technical and ecological aspects of PNSPs are well documented through guidelines, the recreational and spatial qualities that make these facilities valuable to their users are largely undiscussed in the professional literature. This gap became the starting point for the present study.

At the same time, I was drawn to the concept of design patterns as a way of structuring and communicating knowledge. The idea that recurring design problems can be named, described, and shared in a format that other practitioners can use resonated with what I saw missing in the PNSP sector.

After diving more deeply into the topic, PNSP practitioners mentioned that the key narrative and discourse missing is on recreation and its communication towards stakeholders. I saw that combining the knowledge acquired from practitioners on recreation into a pattern book could hold great potential for opening the door for discourse on this topic.

This influenced the decision to develop this thesis.

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(Biotop Landschaftsgestaltung GmbH, 2023a, p. 18); modifications were made by the author

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(Biotop Landschaftsgestaltung GmbH, 2023a, p. 18); modifications made by the author

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Word definitions:

Bather-capacity: is the total number of visitors a bathing facility can receive over a defined period — typically per day or per season — accounting for turnover of users rather than simultaneous occupancy alone.

Bather-load: is the maximum number of users permitted to occupy a bathing facility simultaneously, calculated based on the biological filtration system's capacity to maintain safe water quality under use.

FLL: is the German Landscape Research, Development and Construction Society, whose guideline for the planning, construction, and maintenance of public natural swimming pools serves as the sector's primary international design standard.

Nominal-bather rate: the expected or assumed number of bathers (swimmers/users) that a swimming pool (typically expressed as bathers per hour or per day).

NSP: Natural Swimming Pool

PNSP: Public Natural Swimming Pool

Secchi depth: a specific measurement used to gauge water clarity and turbidity

1. Introduction

“Some would proffer that standards already do this, but basically, standards are a minimum level of conformance only, designed to preserve the health and welfare of users and not necessarily fulfil them or enrich their experience.” - Lau et al. (2021) on what do swimmers care about when using a swimming pool.

Public Natural Swimming Pools (PNSPs) are public open bathing facilities that operate without the use of chemicals. This is achieved by plants and microbes that function as a filter in the system, removing harmful bacteria and phosphorus from the water, resulting in safe, clean and odourless water, safe to swim in (Littlewood 2005; Dold 2008).

Spatial structures are the fundamental elements through which landscape architecture organises human experience in outdoor environments (Liu & Nijhuis 2020). Edges mediate between different zones and activities. Thresholds mark transitions from one spatial condition to another. Sequences guide movement through a landscape. Zones separate different uses and user groups. Sightlines establish visual orientation and perceived safety. Together, these elements constitute the spatial language through which a designed landscape communicates its logic to the people who use it (Sjöman et al. 2025).

Research in landscape typology suggests that understanding these underlying patterns while respecting their change as a whole over time leads to success (Sjöman et al. 2025).

In the context of PNSPs, these structures are what enable a facility to function recreationally. They determine where visitors sit, how they move from arrival to water, how different user groups are distributed, and how the ecological system is perceived and understood. They are, in short, the elements that hold the recreational experience together while the living system around them changes.

Multiple guidelines determine how a PNSP is constructed; however, the sector's primary design standard is the FLL Guidebook (FLL 2011). This guidebook, which originates from Germany, comprehensively addresses the technical requirements for PNSP systems and gives specifications on how to design, construct, and maintain a PNSP to ensure safe and ecologically functional water for people to use recreationally. However, the FLL contains no guidance on how to organise these spatial structures for recreational quality. Across a European context, all guidelines focus on health and safety when it comes to design, with recreational and spatial considerations left absent from any formal standard (Giampaoli et al. 2014).

This gap means that while the biological performance of PNSPs is supported by a precise shared vocabulary, their spatial and recreational qualities are not. Knowledge of how to design recreationally successful PNSPs exists among practitioners but remains rather silent and individual. Research in other landscape typologies has demonstrated that when a design discipline lacks an articulated vocabulary for the structural elements of a specific typology, the diversity and experiential richness are reduced (Sjöman et al. 2025).

Structuring design knowledge as named, reusable principles that solve a problem is what pattern languages and pattern books were developed to do. Christopher Alexander, a British-American architect and design theorist, proposed that recurring design problems can be captured as patterns. Named description of a problem, the core of its solution, and its connections to neighbouring patterns, forming a generative system, produce diverse design outcomes rather than a single standardised solution (Alexander 1977). While Alexander's approach was criticised for deriving patterns from observations rather than systematic evidence, the principle that design knowledge can be named, structured, and communicated still stands (Dawes & Ostwald 2017). Leaning on Alexander's work and taking the concept of transcribing patterns that provide a communicative vocabulary for practitioners was the initiative of the study.

The goal of the study is to explore PNSPs, aiming to identify the spatial, ecological, and experiential attributes that determine what makes these dynamic typologies recreationally successful. In addition, to consolidate the findings into a tangible communicative pattern book that stakeholders can utilise.

The research questions guiding the study are as follows:

1. What spatial, ecological, and experiential attributes determine the recreational success of public natural swimming pools?
2. How can these attributes be synthesised into a decision-support framework, like a pattern book, for stakeholders?

2. Background

2.1. Natural Swimming Pools

Outdoor recreation refers to an activity which is spent outside in a green area away from the user's regular daily or weekly facility (Komossa et al. 2019). These activities in ecosystems have been recognised with a positive correlation to human health and wellbeing (Komossa et al. 2019). Recreation has several meanings and has been used in several different activities, including swimming facilities. The success of recreation generally refers to the achievement of desired outcomes or goals within a leisure or physical activity (Sevin & Özil 2016). User satisfaction in recreational environments increases when spaces are designed to accommodate diverse motivations like exercise, nature experience, and socialisation, rather than a single activity (Komossa et al. 2019). Beyond designed recreational environments, swimming in outdoor water creates a sense of belonging to nature and even improves mental health (Olive 2023; Overbury et al. 2023).

This study views recreational success in PNSPs as the spatial, sensory, and observed qualities that enable diverse recreational activities, fostering user satisfaction. Therefore, it adopts a working definition of recreational success as the sustained capacity of a bathing facility to support diverse voluntary recreational behaviours. These include, but are not limited to, swimming across different user groups, spatial zones, sensory conditions, and seasons.

Historically, Natural Swimming Pools are a technology developed as a reaction to increased concerns over wetland habitat loss and health concerns regarding chemicals used in traditional pools (Dold 2008). The concept was developed in Austria by D.I. Werner Gamerith, Professor Roldinger, and Richard Weixler in the 1970s (Littlewood 2005). The first NSP was built in 1983, when D.I. Werner Gamerith separated the swimming zone from the regeneration zone with a submerged retention wall. This concept was further developed commercially by Peter Petrich, an Austrian ecologist, who founded the company BIOTOP in 1985. Since then, it has become one of the leading companies in the sector (Littlewood 2005).

Private NSPs are an alternative to their conventional chlorinated counterparts, where high water quality is achieved using mechanical and biological filtration systems rather than chemicals. These pools do not use chemicals for cleaning but rely on plants, microbes, biofilters, and pumps to purify the water, effectively creating a self-contained ecosystem (Littlewood 2005; Dold 2008). Natural Swimming Pools are often confused with natural bathing waters like lakes and ponds. However, there is a significant difference between the two. To facilitate safe swimming conditions, these complex ecosystems are designed to remove nutrients from the water and filter out harmful bacteria (Hoffman 2013). In addition, they are a closed system where water is not discharged to the nearby environment, whereas natural bathing waters are open systems in direct contact with groundwater and

the surrounding ecology (Hoffman 2013). The latter are subject to bathing water directives and standards rather than swimming pool regulations, and are not designed with filtration systems either.

NSPs consist of two parts: the regeneration zone and the swimming zone, which are connected in a closed-loop system. The regeneration – or filtration – zone is a mineral-and/or plant-based filter that serves the purpose of removing nutrients and harmful bacteria. The swimming zone is designed for the sole purpose of recreation (Gün and Ak 2022). (Fig. 1)

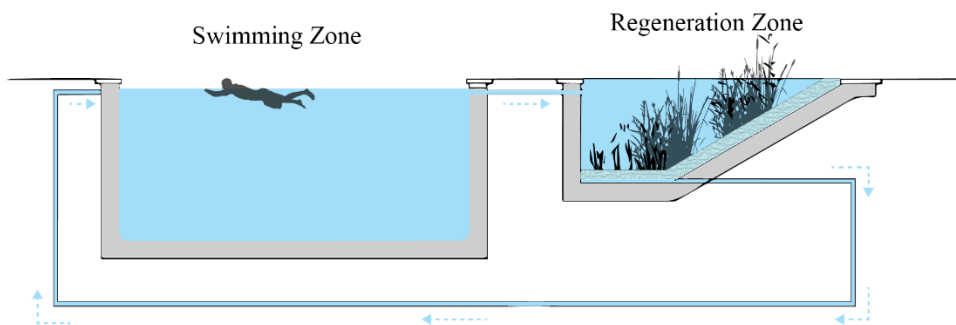


Figure 1. Two parts of a NSP: the swimming zone and the regeneration zone. The illustration further shows that these systems are connected with a closed-loop system. Illustration made by author.

Following the success of private NSPs in the 1980s, Public Natural Swimming Pools (PNSPs) began to emerge as a distinct and recognised category in pool construction. The first public pond operating under the same methods opened in Northern Italy in 1996 (Giampaoli et al. 2014). This shift was driven largely by the health benefits of avoiding chlorine, which has been linked to various respiratory and skin problems, and eye irritations (Bernard et al. 2009; Couto et al. 2021). PNSPs are built upon the same concept but on a larger scale, while giving access to the public. However, it is critical to distinguish the differences between private and public NSPs further. The latter operates under much stricter regulatory systems and have significantly more bathing capacity (Giampaoli et al. 2014). Furthermore, gaining formal approval for a PNSP is much more complicated than for a private one due to public health regulations.

As the concept of PNSPs has spread exponentially over the last decade, other initiatives have started to gain attention as well. One such example is the European Commission's Swimmable Cities programme (Directorate-General for Environment 2025), which by 2025 had gathered over 100 signatory organisations across 22 countries. Another example is “Pool is cool”, a Brussels-based non-profit organisation founded in 2016 that advocates for the return of outdoor swimming through research, public debate, and community-led projects (POOL IS COOL 2016).

Despite their benefits, these pools have limitations, including a restricted number of swimmers per day and more rigid design requirements essential for maintaining ecological balance (Poloprutská et al. 2021). In addition, the types of pools open to the public can be

put into two categories. First, semi-public PNSPs are bathing facilities that are owned by a private company, like a hotel or sports facility. The second are fully public ones that are owned by municipalities. The difference lies in ownership and responsibility to the customers.

Looking from the design and function perspective, NSPs can be categorised into two different designs. One is a more formal, symmetrically shaped pool imitating a traditional swimming pool. These pools use a compact biofilter system that is hidden underground. This filter is a spongy material which increases surface area, allowing the growth of microbial populations, thus removing phosphorus and dangerous bacteria in a confined space (Dold 2008; Gün & Ak 2022). (Fig. 2)

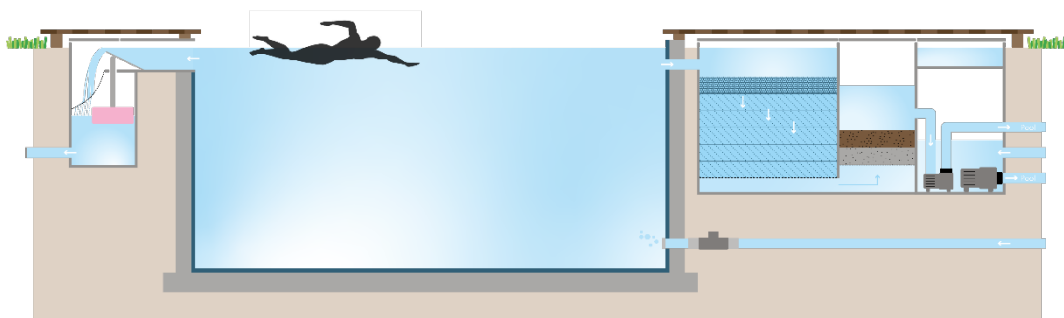


Figure 2. NSP filter and design technique which utilises a hidden underground filtration system called Biofilter. In the illustration, a surface skimmer can be seen on the left side removing floating debris in the water. On the right side, the Biofilter can be seen illustrating how the system works underground by the water passing through the spongy mineral substrate, then pumped back to the system. (Biotop Landschaftsgestaltung GmbH, 2023a, p. 18); modifications were made by the author

The other design is a pond design system. These pools are designed in a more naturalistic manner, with organic shapes and visible recreation zones, and feature a significant number of aquatic plants integrated into the pool. These in turn oxygenate the water, remove excess nutrients, and their roots provide habitat for further microbes that help clean the water. Removing nutrients is crucial for clear water, since excess nutrients promote algae growth, resulting in poor water quality (Gün & Ak 2022). (Fig. 3)

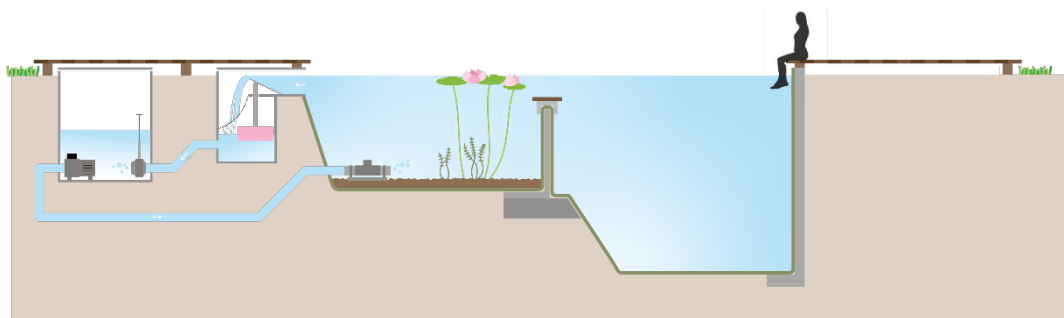


Figure 3. NSP filter and design technique, which is used in a pond type. In the middle of the picture, we see a botanical filter system with plants, which is separated from the main water body. Water flows through the plants into the skimmer system, which removes floating debris in the water. After this, the water is pumped back into the system. (Biotop Landschaftsgestaltung GmbH, 2023a, p. 18); modifications made by the author

It must be mentioned that these two system types can be employed at the same time within one facility, creating a hybrid system (Dold 2008). This is occasionally what happens, since the consumers and operators would benefit from both. For example, a PNSP could have a natural design to show visitors how the pool works and to add natural elements to the landscape, but still utilise a hidden, more efficient biofilter underground to have a higher bathing capacity, resulting in more swimmers per day and more profits for the operators.

2.2. Pattern Book

In emerging design sectors where practice is fragmented and few built examples exist, individual practitioners and communities often follow a bottom-up approach. This results in limited opportunity to share and learn from one another, resulting in separated practitioners, which Jarvis et al. (2016) described as "reinventing the wheel." This challenge points toward a need for formats that can capture commonly used solutions and communicate them in an accessible way (Felstead & Thwaites 2024).

Pattern languages were introduced as one such format. Christopher Alexander, a British-American architect and design theorist, was among the most vocal critics of the modernist movement in the twentieth century and had a considerable impact on landscape architecture. In *A Pattern Language* (Alexander 1977), he proposed that recurring design problems can be addressed through a network of named patterns, each containing an illustration, a problem statement, a principle, and connections to neighbouring patterns. A single pattern captures a frequently occurring solution in a standardised template. A structured collection of interrelated patterns forms a pattern language, which can be selected and combined in infinite ways to produce unique design outcomes rather than a single standardised solution (Alexander et al. 1977). The physical medium that compiles these patterns is commonly referred to as a pattern book (Dawes & Ostwald 2017). This contrasts with design codes, which are rigid geometric rules offering a fixed, repeatable solution to a problem more associated with hardscape in architecture (Alexander 1977; Zavoleas 2021).

Regarding biological systems – like PNSP –, Zavoleas (2021) points out that nature cannot be replicated with an identical outcome, since living systems grow, adapt, and respond to their environment through time. This signals a flexible, generative logic of pattern languages particularly suited to nature-based design.

Furthermore, as Felstead & Thwaites (2024) mention, pattern languages present a practical design and research tool for practice that includes capturing spatial forms and social events that communicate and translate knowledge between professionals and other stakeholders.

The main guidebook used by the industry is the FLL, short for Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau e.V., which was published in 2011 and made

available in English later in 2013 (FLL 2011). The guidebook was published after a severe outbreak related to natural water bodies in 2001 (Giampaoli et al. 2014). The FLL guideline specifies the principles and requirements for planning, construction, servicing, and operation of PNSPs. These include specific system dimensioning, water quality parameters, bather load calculations, microbiological safety thresholds, and future management practices. These are systematically summarised, illustrated in sections, plans, and tables.

3. Methods

This paper employs a qualitative research approach combining three data sources:

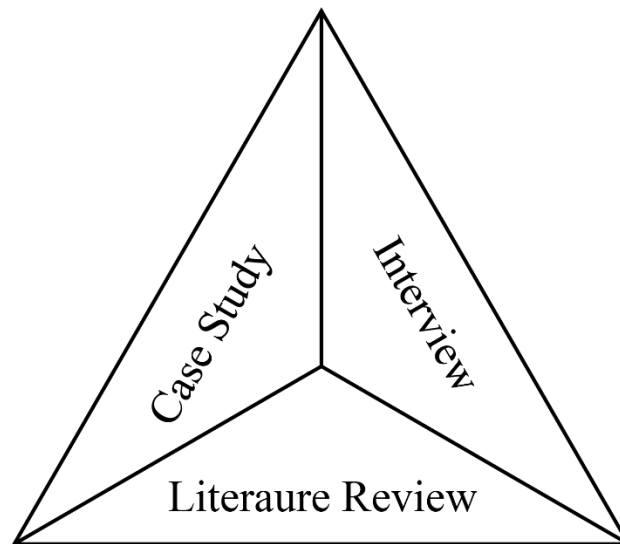
- Literature and document review
- Semi-structured expert interviews
- Spatial case study analysis

This triangulation increases the validity and credibility of the findings (Bans-Akutey & Tiimub 2021) (Fig. 4).

Research took place over five months, divided into two separate but interconnected phases:

- Phase 1: November 3 – December 19, 2025,
- Phase 2: March 24 – May 18, 2026.

These time intervals also excluded the time spent reaching out to companies and stakeholders, which took place between these two periods. The reason for splitting the research into two intervals was that the author participated in an internship in Hungary.



*Figure 4. Triangulation methodology illustration.
Illustration made by the author*

3.1. Working process

The research process followed a sequential, iterative procedure comprising five phases:

Firstly, an exploratory literature review of NSPs was conducted, in which knowledge of Public Natural Swimming Pools was identified as a niche and under-researched typology. In addition, it revealed the absence of recreational discourse and design guidance, which initially motivated the direction of the study.

Secondly, multiple potential case study candidates were identified through the literature and publicly available project documentation.

In the third phase, six expert interviews were conducted in a semi-structured manner with practitioners, researchers, and constructors. These provided data on the spatial, ecological, and experiential qualities that practitioners associate with recreational success. Furthermore, they supplied project-specific documentation, including design drawings, permit documents, and operational data, that informed the final selection of two case studies from the initial pool of candidates.

In the fourth phase, the interview transcripts were coded. The resulting themes were cross-referenced with the literature review and case study data using a promotion rule, where eight patterns passed this threshold.

In the fifth phase, these eight patterns were translated into a pattern book.

Figure 5 shows the timeline of the working process, where additional connections are shown, like the interviews feeding back into case study selection and all the data sources feeding into Phase 4, representing the triangulation of methods.

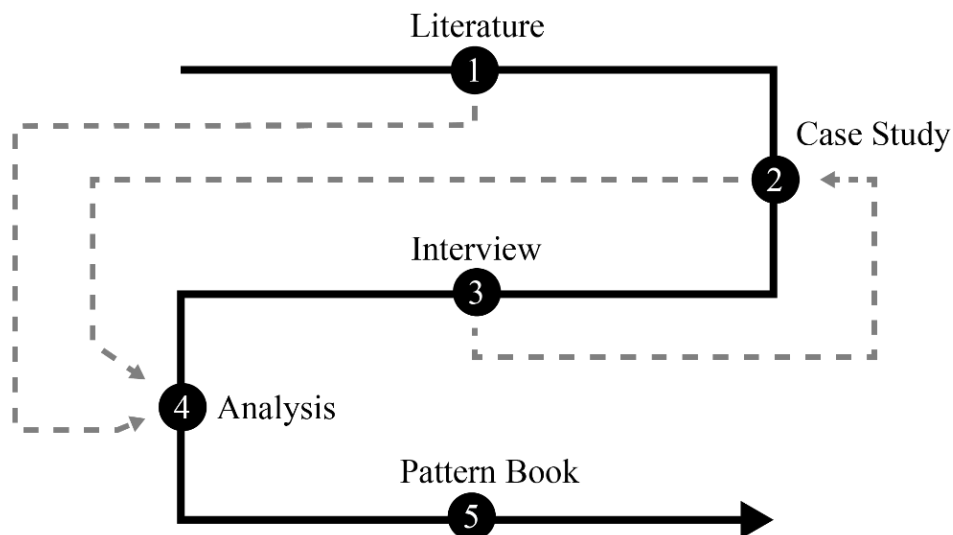


Figure 5. Overview of the sequential research process, illustrating the five phases from literature review to pattern book development and the feedback loop between expert interviews and case study selection. The first three phrases feed simultaneously into the analysis. Then, from the analysis to the pattern book. Illustration made by the author

3.2. Data collection

Literature and document reviews

Access to literature about Natural Swimming Pools and recreation was achieved using research databases, including:

- Google Scholar
- SLU Primo
- ResearchGate
- Web of Science

These were used in combination with Boolean operations and specific keywords listed in Table 1. AI-assisted research tools were used for source discovery, such as Consensus and Scispace. In all cases of using AI, all synthesis and interpretation of sources were conducted by the author. Furthermore, a snowball method was used with newer documents, where the reference list was read to find additional references on the topic (Badampudi et al. 2015). No date range was applied to the documents collected, and the main language was English. The literature was gathered in Zotero to ensure an organised library and correct citations. For literature collected outside these techniques, permission was asked from the interviewee candidates.

The FLL worked as the primary source for the content analysis (FLL 2011). The publication used was in English. A keyword-based screening was conducted to assess the presence or absence of recreational design guidelines within the document. The following terms were used for the searches: “recreation”, “recreational quality”, “recreational success”, “storytelling”, “aesthetic”, “landscape integration”, “social value”, “user experience”, and “ecosystem services”.

Table 1. Keywords used in research databases

Databases	Search terms
Google Scholar SLU Primo Web of Science ResearchGate	"natural swimming pool" AND recreation; "public bathing" AND "water quality"; "biological water purification" AND swimming
	“case study” AND “natural swimming pool”; “Pattern book” OR “pattern language” AND “landscape architecture”
	"environmental psychology" OR "spatial*" OR "space*" AND "landscape"; "temperature" AND "water" OR "pool" AND "perception"; "color" OR "colour" AND "water" AND "pool*" AND "nature*"; "edge*" AND "swimming pool*", "zone*" AND "pool*" AND "public",

Expert interviews

Expert interviews were chosen as one of the key methods in this study since they provided in-depth, experience-based, and scientific knowledge on how PNSPs are designed, used, and maintained. In addition, engaging with experts rather than PNSP users with a larger sample gave the study more tangible, multidisciplinary, and broader results to compile.

In-depth interviews were carried out with six professionals between 14 January and 11 April 2026. Time constraints and participant availability significantly limited the sample size. However, the objectives were still reached, meaning adequate saturation was achieved with six participants (Wutich et al. 2024). This was because the interviewees are to be considered leading figures with high levels of expertise, and by the last interview, most of the patterns repeated themselves. Furthermore, the duration of the discussions was sufficient to ensure the complete extraction of the data needed (Wutich et al. 2024).

The outreach was mainly by email, where a formal letter was constructed with a specific orientation to the recipient. After agreement was reached, a Teams, WhatsApp, or Zoom meeting was organised by either the interviewee or the interviewer, except for OOZE Architects, who responded to written correspondence rather than a live interview. This exchange is treated as expert testimony but is noted as methodologically distinct from the semi-structured interviews conducted with the other five participants.

Each session lasted between 60 and 90 minutes, with English being the main language chosen. Before the initiation of the interviews, consent was obtained from each participant, documented via audio recording and pen-and-paper. The interviews were semi-structured: the questions remained the same throughout; however, when necessary, the conversation was guided. Before initiation, the participants were informed of the thesis topic on recreation, and the questions ranged from regulatory and approval context to ecological performance, recreation and user experience, trade-offs, and future potential. Information regarding interview participants can be seen in Table 2, and the questions in Appendix 1.

Upon the conclusion of the initial interview, the participant was asked to name possible additional candidates and specify the preferred method of contact. This created a snowball effect for getting in contact with the other candidates.

Table 2. Information on the interviews conducted during the study.

Participant	Date	Duration	Title	Organization	Medium	Contribution
<i>OOZE Architects</i>	2026. 01. 12.	Written	Landscape Architect	OOZE Architects	Email	Design, concept development, temporary installations
<i>Stefan Franz Meier</i>	2026. 01. 14.	1,5 hour	President	International Organisation for Natural Bathing Waters	WhatsApp	Advocacy, international PNSP policy, sector coordination
<i>Lars Juncker</i>	2026. 02. 02.	1 hour	COE	Junckerhaven	WhatsApp	Construction, landscape contracting, project delivery
<i>Dr. Jakob Schelker</i>	2026. 02. 27.	1,5 hours	Research and development	BIOTOP	Teams	Hydrology, water chemistry, biological systems
<i>Stefan Bruns</i>	2026. 03.20.	1 hour	Managing director	Polypplan	Teams	FLL development, PNSP engineering, design process
<i>Dr. Holger Kihnhold</i>	2026. 04. 10.	1 hour	Research and development	Polypplan	Teams	Marine biology, water quality monitoring, ecological performance

Case study

Two PNSPs were chosen in Europe, selected for their similarity in size but differences in context, regulatory frameworks, and spatial configuration. The European context was chosen because the FLL originates from Germany and is primarily applied within European regulatory contexts. In addition, the majority of PNSPs are concentrated within Europe, thus professional expertise is located there as well.

Purposive sampling was chosen for the study to maximise variation in setting, permanence, regulatory framework, and design intent (Stake 1995; Yin 2007). In addition, the case selection was limited by data availability: only cases with sufficient evidential attributes (photographs, measurements, information regarding design choices) and direct contact were included, as seen in Table 3.

Multiple potential cases were examined as well before the data collection; however, available data on the topic were scarce, so they were not selected for this study. These were: Midgårdsbadet (Sweden), Mountain Beach (Austria), BIOTOP hotel projects, and Polyplan projects (Appendix 2).

Table 3. Two main cases chosen and their available data attributes.

Attribute	Bylderup Naturbad	King's Cross Pond Cub
Key actors	Junckerhaven, Polyplan, SWECO	OOZE Architects, BIOTOP/Kingcombe (Partner of BIOTOP)
Data source	FLL calculations, SWECO plans, municipal permit, 2 interviews	Published descriptions, OOZE interview/correspondence

The main driving case of the paper is the Bylderup Naturbad in Denmark. The documents used for the analysis were obtained from Lars Juncker following the interview conducted on 2 February 2026. These were the FLL nominal-bather calculation by Polyplan (Polyplan 2020), detailed site plans and sections from SWECO (SWECO 2023), and the Aabenraa Kommune permit and ministry decision (Aabenraa Municipality 2025). These documents were in Danish but were later translated into English with the use of Google Translate. The documents were triangulated with interviews with Lars Juncker and Stefan Bruns, who were directly involved with the project.

The second case was King's Cross Pond Club, an art installation which operated as a PNSP between 2015 and 2016. Published project descriptions were obtained online and were combined with OOZE Architects' correspondence. This made the case saturated with data after triangulation (Kucharek 2015; OOZE 2024).

3.3. Analytical Framework

Interview data were analysed with a Thematic Analysis (TA) methodology (Braun & Clarke 2012). Each interview was primarily documented as notes, and the recording of the whole interview was transcribed by a transcription tool integrated within a Pixel 7A phone, which was consolidated into a separate document. The consolidated document was evaluated before proceeding, checking for grammatical mistakes and misspellings. The author re-listened to each recording while simultaneously further summarising it into another document. With the information from three documents – full transcription, primary summaries, and later summaries – codes recording concepts, spatial observations, and professional judgement were identified in relation to recreation. These codes were compiled and analysed by similarity and overlap, which created clusters of codes. These clusters became the patterns after naming them by code information.

Examples of recurring codes included references to water colour and clarity, edge use and positioning, arrival experience, seasonal variation in use, and the visibility of ecological processes.

Promotion rule together with the TA

The final patterns were recognised during the study by a so-called promotion rule. It was important not to include every recreation-influencing pattern, to ensure only those with relevance or strength of evidence were selected. A technique was therefore created to distil the most important ones.

Only those themes were promoted to a final pattern if they satisfied the following conditions: first, the theme had to address a spatial, ecological, or experiential attribute in alignment with the research question. Second, the pattern had to be supported by evidence from all three triangulation methods. This ensured that no pattern rested on a single source type alone. Of the ten themes recognised by the TA, following this promotion rule, eight patterns emerged, which were then later illustrated.

The number of patterns is not a theoretical choice; eight was the number of candidate patterns that satisfied the promotion rule. Weaker or isolated statements were not considered in the final pattern book.

To illustrate the analytical process: during familiarisation, recurring concepts were identified across multiple interviews independently. For example, four participants raised the importance of making ecological processes visible and understandable to visitors. These individual statements were coded separately, then grouped under the candidate theme 'ecological storytelling.' Codes were descriptive labels assigned to individual

statements and observations, documenting the subject each one addressed in relation to recreational design.

For example, the codes from the interviews were subsequently cross-examined against the case study documentation, where both Bylderup and King's Cross demonstrated design decisions to make filtration and regeneration zones visible. This was further analysed against the FLL, which contains no guidance on communicating ecological processes to users. Having satisfied the promotion rule through literature, documentary support, and multiple interview confirmations, the theme was promoted to Pattern 7.

3.4. Development of Pattern Book

The format of the pattern book is an A5 booklet that is printed once on an A4 sheet of paper, then cut in half and folded accordingly. The illustrations were produced by Szonja Somogyvári and the author, with close collaboration to ensure cohesiveness between images, text, and content. Each illustration serves the purpose of communication, with text embedded or attached to it for further explanation of the recreational aspect described. The pattern book is constructed so that the reader encounters ideas that should be considered in order when deciding on a PNSP design concerning recreation. In relation to the thesis, the pattern book is the illustrated findings section, which should be viewed in addition to the thesis as a whole.

3.5. Pre-study limitations

The author's research position was built on prior research on Natural Swimming Pools, contributing existing knowledge and understanding of the processes by which these pools function. However, this could have introduced interpretive bias toward confirming the recreational gap.

Having only two case studies examined can limit the generalisability of the patterns recognised. However, strategic case selection based on maximum variation can produce context-dependent knowledge that is analytically generalisable, even from a small number of cases (Flyvbjerg 2006). In addition, as King's Cross was an art installation which operated for a short time, this could have influenced certain patterns. This is acknowledged by the thesis.

Additionally, conducting six interviews with stakeholders only from the designer, operator, and researcher perspectives – not the demand side, namely swimmers and visitors – is the study's principal limitation, which the thesis acknowledges. Furthermore, the interview sample size is considered small; however, the information was sufficient (Wutich et al. 2024). Having no native English speakers on either side and translating documentation from Danish and German to English could have resulted in losing nuances during the data collection period.

All cases and most literature are European. This reflects the FLL's origin and the sector's concentration in central Europe, but limits applicability to other regulatory and climatic contexts. No site visits were conducted for the case studies, since Bylderup Naturbad PNSP was under renovation during the time of the thesis.

There are other guidelines which have been examined and mentioned by professionals, such as the Austrian guideline (Austrian Standards International 2015). This was not examined further because, according to interviewees, the guidebook is stricter on technical parameters, so professionals opted for other alternatives like the FLL¹.

¹ Lars Juncker, interview conducted by the author, 2026

4. Case study

The two case studies – Bylderup Naturbad and King's Cross Natural Swimming Pond – were selected based on direct access to their designers and operators through the expert interviews. Lars Juncker acted as a "door opener" and provided unpublished municipal permit documents, engineering calculations, and operational data for Bylderup Naturbad. In addition, having the chance to interview Stefan Bruns, who did FLL calculations for the project, gave further insight into the planning phase. OOZE Architects provided insight into the design rationale and spatial strategy behind King's Cross. This direct access to practitioners and their project documentation enabled a depth of analysis not achievable through published sources alone. The primary criterion for selecting only two cases stayed consistent with purposive sampling in qualitative case study research (Stake 1995; Flyvbjerg 2006; Yin 2007).

4.1. Bylderup Naturbad

Bylderup Naturbad is part of Bylderup Sports Centre, which was supposed to open in 2023, but due to unforeseen circumstances in the project, it opened two years later in 2025. The precise address of the pool is Slogsherredsvej 41, 6372 Bylderup-Bov in Denmark (Fig. 6). The rural town has an estimated population of 1,300 people (Thomas 2025).

Bylderup Naturbad operates under a two-year dispensation granted by Aabenraa Kommune on 28 May 2025, valid until 28 May 2027. The dispensation was issued under the Danish Swimming Bath Order (Svømmebadsbekendtgørelsen), with the consent of Miljøstyrelsen (the Danish Environmental Protection Agency) attached as a condition (Aabenraa Municipality 2025).

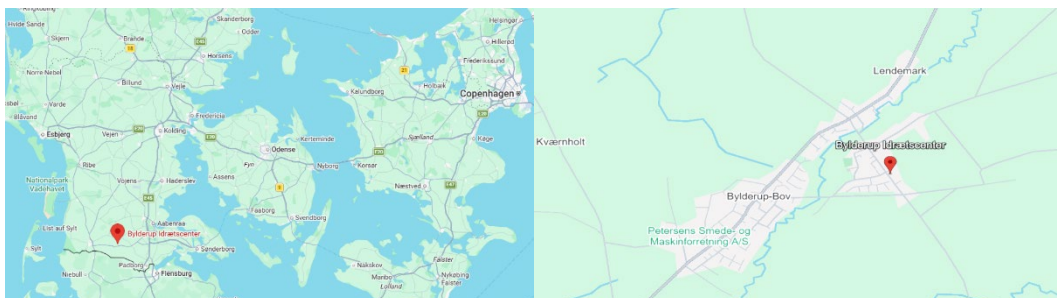


Figure 6. Location of Bylderup Naturbad. (Google Earth, 2026a)

The Sports Centre wanted to renovate the public bathing facility to incorporate a natural bath as well, so it could be an asset for the local area for many years (Aabenraa Municipality 2025). The main driving motive for the renovation was to create a sustainable, chemical-free pool that operates with fewer resources (Aabenraa Municipality 2025). (Fig. 7)



Figure 7. Before and after pictures from the renovation of the Bylderup Sport Centre from 2021 to 2025 (Google Earth, 2021; 2025).

The project was driven by the German principles and guidelines of the FLL, in collaboration with SWECO, Aabenraa Municipality, Bylderup Sports Centre, and Junckerhaven (Aabenraa Municipality 2025). Junckerhaven is Lars Juncker's company, and he was a contractor during the facility's development (Aabenraa Municipality 2025). (Tab. 4)

Table 4. The key actors of the project Bylderup Naturbad

Role	Actors
Client	Bylderup Sports Centre (chair: Christian Iwersen; hall inspector: Stefan Sangild Paulsen)
Landscape contractor	Junckerhaven (Lars Juncker)
Natural pool designer / FLL calculators	Polyplan (editor: Stefan Bruns)
Engineering	Sweco Danmark (project manager: Morten Asp Hansen)
Design basis	FLL (German guideline)
Regulators	Aabenraa Kommune

Bylderup-Bov Naturbad consists of four distinct water basins: the regeneration zone (Fig. 9), a children's pool for younger visitors (Fig. 10), a shallow water area providing gradual entry for casual water contact (Fig. 11), and a main swimming pool for active recreation (Fig. 12). The shallow water is separated by loges placed inside the water (Fig. 13). This is all surrounded by recreation zones of sunbathing lawns, wooden decks, and seating areas, and other utilities like showers and toilets inside the sports facility (Aabenraa Municipality

2025). Furthermore, the facility is enclosed by a perimeter fence and accessed through a single entrance point. The reference map for sightlines is Figure 8.

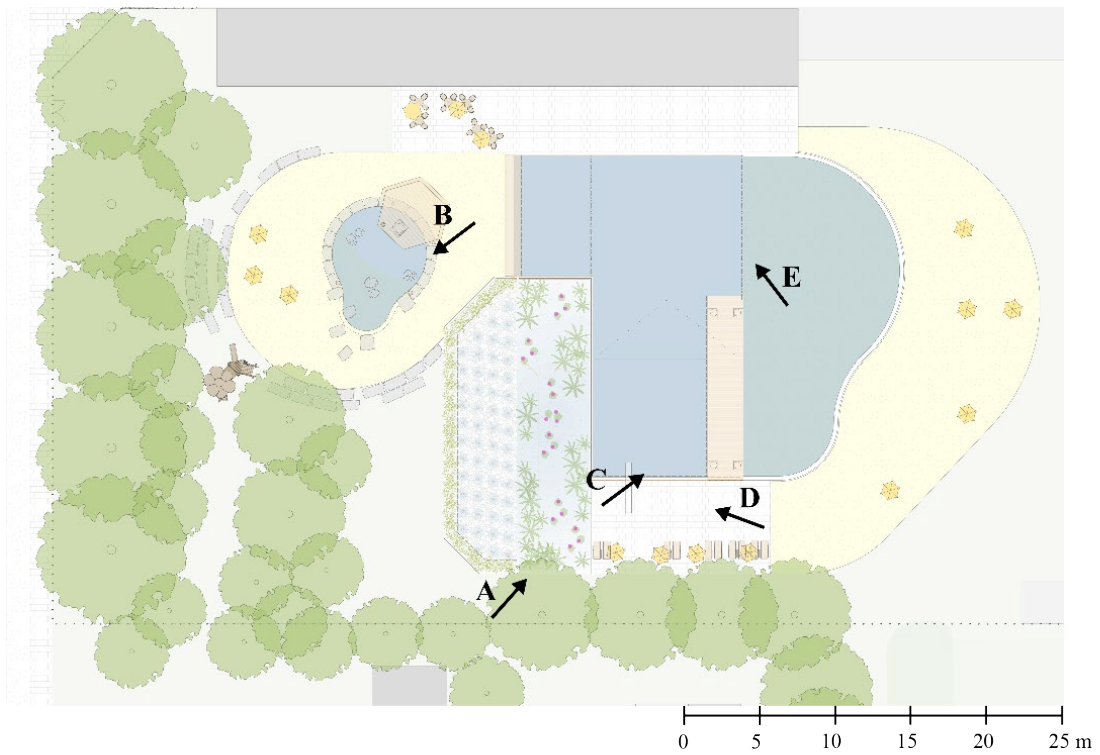


Figure 8. Overall map of Bylderup Naturbad and referring to sightlines A, B, C, D and E for figures 9, 10, 11, 12, and 13. (SWECO, 2023); modifications made by the author. 1:500 (A4)



Figure 9. "A" sightline showing the recreation zone (Junckerhaven, 2025)



Figure 10. "B" sightline showing the children's pool (Junckerhaven, 2025)



Figure 11. "C" sightline showing the shallow water area (Bylderup Idrætscenter, no date)



Figure 12. “D” sightline showing the main pool (Junckerhaven, 2025)



Figure 13. “E” sightline showing logs placed inside the water for separation (Junckerhaven, 2025)

The total swimmable volume of water is 839 m³, and the pool's surface area is 560 m², divided into three distinct parts, excluding the area for the regeneration zone:

- 1) a large pool with the swimming area,
- 2) a pool with shallow water
- 3) the children's pool (Fig. 10 and 11).

The FLL bather-load calculation was based on preliminary design parameters of 290 m² and 700 m³ (Polyplan 2020); the final execution dimensions differ, as shown in Table 5 (SWECO 2023).

Table 5. Summary of Bylderup's pool volumes in relation to the surface

Pool sections	Volume (m ³)	Surface area (m ²)
Swimming Pool	504	157
Pool with shallow water	323	350
Children's pool	12	52

The design capacity is approved by the FLL calculations: 234 bathers per day for optimal *E. coli* binding. The engineering application describes a filter system dimensioned for up to 493 bathers per day (SWECO 2023), while the municipal permit caps daily attendance at 400, with a weekly average of 300 (Aabenraa Municipality 2025). The facility is restricted to children under three years old, and the facility must remain fenced (Aabenraa Municipality 2025).

The filtration system utilises hybrid techniques for demonstration purposes and maximum filtration capacity. It has a hydro-botanic array of 80 m², a submerged substrate filter of 130 m², and an irrigated substrate filter of 130 m². How the filters function in combination can be seen in Figure 14.

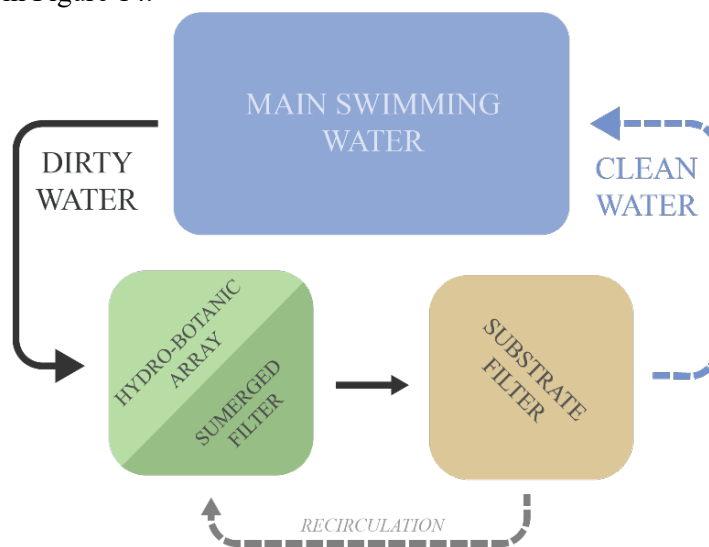


Figure 14. Illustration of the hybrid filter system used in Bylderup Naturbad
Illustration made by the author

In Figure 15, the hydro-botanic array with a combination of the submerged filter can be seen. On the left side is the mineral filtration with integrated sprinklers; on the right side, the hydroponic array and the submerged filter can be seen.

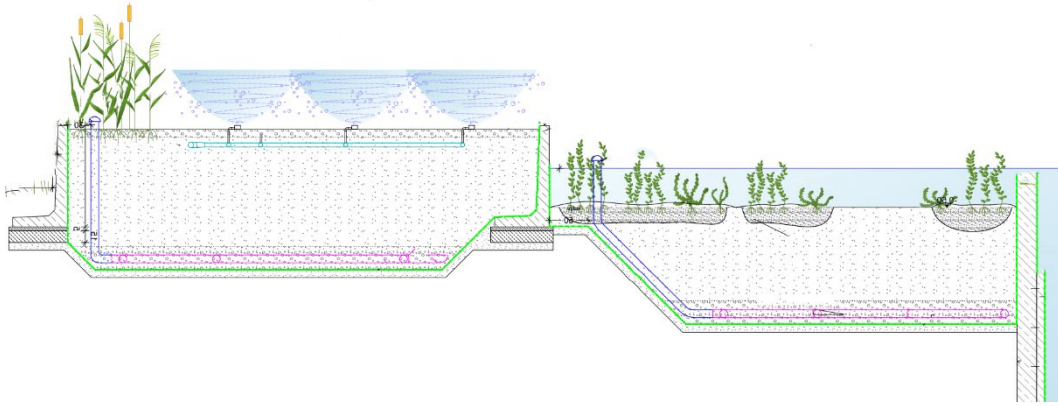


Figure 15. In detail section of the hybrid filtration system of Bylderup Naturbad (SWECO,2023); edited by the author.

Furthermore, the prominent structures were made as wooden decks next to the shallow and deep-water areas in a formal rectangular shape. This wooden bridge is 3 metres wide and 15 metres long, occupying half of the major swimming area's edge (Fig. 16).

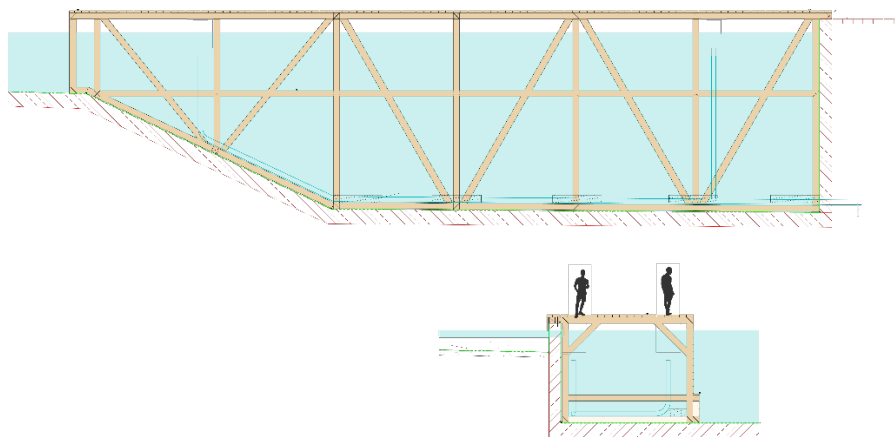


Figure 16. Wooden deck next to the deep and shallow swimming zone at Bylderup Naturbad. The structure is large and prominent, acting as a main feature within the facility. (SWECO, 2023), edited by the author

A similar design continued, but on a smaller scale in the children's pool as well. The pool itself uses an organic shape and has one deep zone, while the other has an incline towards the shore, reaching almost 8 metres along its long diagonal. It has a similar formal hexagonal wooden deck, which is 3 metres wide (Fig. 17).

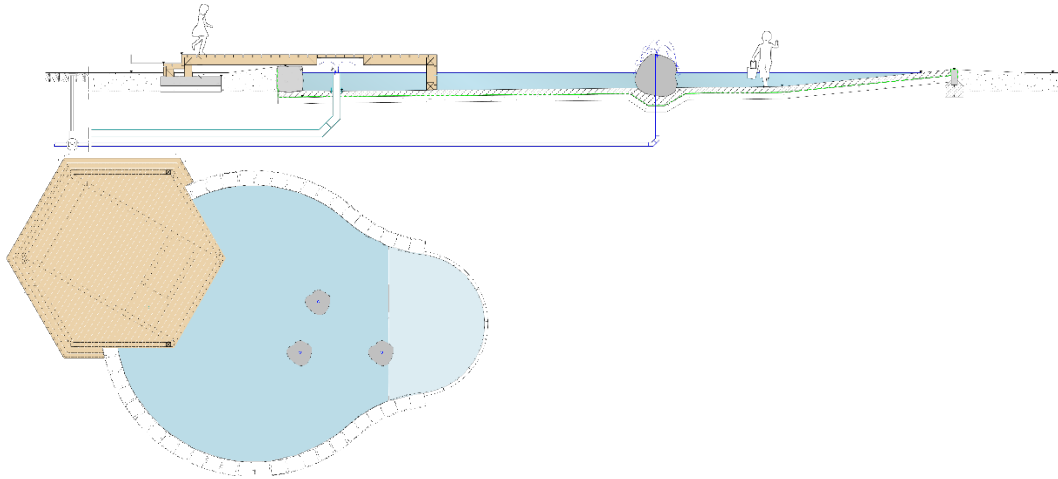


Figure 17. Section and a top view map of the children's pool in Bylderup Naturbad showcasing design and size. (SWECO, 2023), edited by the author

4.2. King's Cross

King's Cross Public Natural Swimming Pool was a temporary art and concept project within the heart of London, in Lewis Cubitt Park (Kucharek 2015; OOZE 2024). (Fig. 18)



Figure 18. Location of the Kings Cross PNSP (Google Earth, 2026b)

At that time, the project was the first in the UK to design a PNSP. The concept was an experiential art installation by OOZE Architects, led by Eva Pfannes and Sylvain Hartenberg, in collaboration with artist Marjetica Potrč² (Kucharek 2015).

The natural pool system was built and designed by BIOTOP through its UK representative, Kingcombe Aquacare. The pool was operated by Fusion Lifestyle, a sport and leisure charity². In contrast, Global Generation, an education charity, maintained the surrounding landscape, providing nature-reconnection tours for visiting children².

Planning permission was negotiated with Camden Council by the developer's project team as part of a broader art programme accompanying the King's Cross construction². The regulatory basis followed EU bathing water standards, applied before Brexit. Critically, the project was granted permission partly because it was a temporary installation; a permanent infrastructure would have been more challenging to approve.² The pond opened on 22 May 2015 and operated for two seasons, closing in 2016 (OOZE 2024). (Fig. 19)

² OOZE Architects, Interview conducted by the author, 2026

2013



2015



2026

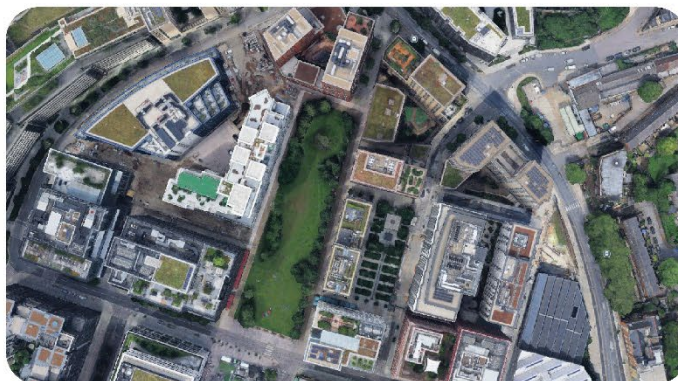


Figure 19. Timeline showing the circumstances under which King's Cross PNSP was operating. Last picture shows a picture of today, where the pool does not exist (Google Earth, 2013;2015; 2026c)

The pond measured 10 metres wide by 40 metres long, with a total water volume of 600 m³ and a maximum depth of nearly 3 metres (Kucharek 2015; OOZE 2024). It was built two metres above ground level because the site's existing surface infrastructure and deeper transport systems made excavation impossible, meaning the form was constrained by the footprint rather than freely designed ³. (Fig. 20)



Figure 20. Picture of Kings Cross PNSP and its zones and its topography during the construction phase (BD Landscape Architects, 2022)

³ OOZE Architects, Interview conducted by the author, 2026

The water was purified through a closed-loop system that combined mineral filtration, a filter zone, and a regeneration zone⁴ (Fig. 21). The filter zone had a large aquatic plant with high filtration capacity⁴. The regeneration zone had mostly water lilies with the same purpose, but without blocking sightlines (Fig. 22). The mineral filtration had the highest capacity for cleaning and was done underground (Fig. 23). The system was calibrated for 163 bathers per day, distributed across four time slots. (Jan-Carlos Kucharek 2015).

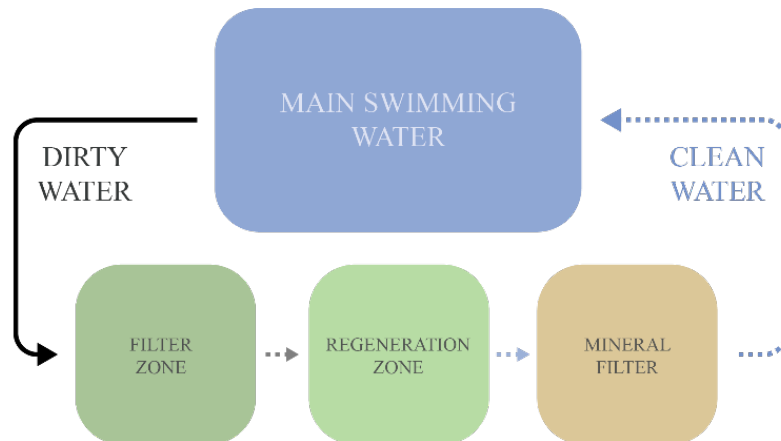


Figure 21. Illustration of the King's Cross PNSP filtration system. Illustration made by the author



Figure 22. Picture of King's Cross's filter and regeneration zone highlighting the two zone's high in the landscape (BD Landscape Architects, 2022); modified by author.



Figure 23. Aerial photo of King's Cross's layout and filtration systems (BD Landscape Architects, 2022); modified by author

Furthermore, the edges of the pool were planted with more than 30 species of flowers (OOZE 2024). (Fig 24)



Figure 24. Picture collage showcasing the plants within King's Cross PNSP (BD Architects, 2022; Sturrock, 2015)

The design also included showers and changing rooms, toilets, and designated sunbathing areas. The whole PNSP had a colour scheme of red and white, which was used throughout the design. This included facilities with printed illustrations on the ground so that visitors could locate themselves and understand the different water zones⁴ (Fig. 25).



Figure 25. Pictures of the red and white design for separating zones and red guiding illustrations on the ground for guiding people within the facility (Sturrock, 2015; OOZE, 2015).

⁴ OOZE Architects, Interview conducted by the author, 2026

5. Findings

5.1. General findings

During the research, it was identified that the PNSP sector is considered a niche one. Few research papers focus solely on this typology, and publicly available data on similar infrastructures are insufficient. However, multiple interview candidates mentioned that the sector seems to be growing in the market^{5 6 7}. Stefan Bruns mentions that Germany alone now operates around 300 PNSPs, while traditional chlorinated facilities see a declining trend⁵.

A keyword-based screening of the FLL guidebook was conducted to assess the presence or absence of recreational design guidance. None of the terms relating to recreation appeared as substantive design guidance within the FLL (FLL 2011). The guidebook comprehensively addresses filtration systems, water quality parameters, bather load calculations, depth specifications, and maintenance protocols, but contains no guidance on how to organise spatial structures for recreational quality.

This finding is supported by Giampaoli et al. (2014), whose peer-reviewed analysis of European NSP regulations concluded that existing regulatory frameworks focus on water quality, management, and health parameters, with recreational considerations absent. That statement is further supported by the case study, where regulatory arrangements reflect the fact that no permanent approval pathway currently exists for PNSPs in Denmark; instead, each project must negotiate a case-by-case dispensation.

Interview data independently confirmed this gap. Stefan Bruns, managing director of Polyplan and an active FLL committee member, stated that storytelling and recreation are missing from the guidebook and are left entirely to the designer⁵. When asked directly what is missing from PNSP design guidelines, he responded that "only the social aspects are missing"⁵. Stefan Meier, president of the International Organisation of Natural Bathing Waters (IOB), stated that recreational aspects are not discussed within the FLL at all and should be represented equally alongside ecology in decision-making⁶.

All six interviewees confirmed that health agencies and authorities treat the FLL as a binding regulation, despite it being a set of recommendations. Dr Holger Kühnhold stated that health agencies interpret the FLL as equivalent to a law⁷. He acknowledged that the

⁵ Stefan Bruns, Interview conducted by the author, 2026

⁶ Stefan Meier, Interview conducted by the author, 2026

⁷ Dr Holger Kühnhold, Interview conducted by the author, 2026

FLL's precision, while necessary for public health, constrains designers' capacity to address recreational quality⁸.

Interview candidates mentioned that when it comes to recreational success, one of the major contributors is the pool managers and operators – the people who are physically there and monitor the pool. They are the ones who are responsible if something goes wrong inside the facility^{9 10}.

5.2. Patterns That Did Not Get Promoted

Ten candidates for a pattern were identified during the process presented in this study. However, due to the promotion rule, two were excluded (see Section 2.2). These are reported below with the evidence that was identified and the specific reason for exclusion.

5.2.1. Accessibility

In this scenario, accessibility is understood as the physical and functional capacity of a PNSP to accommodate users with different mobility levels or physical needs.

The FLL addresses entry and exit points as technical parameters, specifying stairs, ladders, and ramps as means of water access (FLL 2011). It mentions in one sentence that the usage area should be accessible for disabled users (FLL 2011). It does not go into further detail compared to other parameters.

Literature suggests that better access leads to increased participation in physical activity (Herbison et al. 2023). However, no relevant research was found on swimming facilities. According to the Bylderup case study, public access to the facility is available for people aged three years and older; however, accessibility for other groups is not addressed (Aabenraa Municipality 2025).

King's Cross had no documentation available regarding accessibility.

The theme failed the promotion rule due to insufficient data on multiple accounts.

5.2.2. Minor Utilities

Minor utilities refer to built elements within a PNSP facility, such as changing rooms, toilets, and showers. These elements appeared in both case study documentation. At King's

⁸ Dr Holger Kühnhold, Interview conducted by the author, 2026

⁹ Stefan Bruns, Interview conducted by the author, 2026

¹⁰ Stefan Meier, Interview conducted by the author, 2026

Cross, the design included showers, changing rooms, and toilets integrated into the facility's colour scheme (OOZE 2024). At Bylderup, the SWECO plans reference changing rooms and a sales area as part of the entry sequence (SWECO 2023). The FLL references coordination group guidelines for entrance areas, ticket offices, and locker rooms (FLL 2011).

Literature mentions that swimming facilities that have utilities have a significantly positive effect on visitor satisfaction (Basri & Rosita 2023).

In interviews, these elements were mentioned incidentally within discussions of other topics rather than as standalone design problems. Stefan Bruns mentioned this in relation to the bather load calculation of a PNSP. He noted that the volume of the water is determined by the number of bathers the facility will have per year, and from that calculation come the utilities within¹¹.

Since no coherent interview statement was given regarding minor utilities, the pattern was excluded due to the promotion rule.

¹¹ Stefan Bruns, Interview conducted by the author, 2026

5.3. The Eight Patterns

The eight patterns that satisfied the promotion rule are organised into four thematic groups that reflect the sequence of design decisions practitioners described: Main decision (Pattern 1), Shaping the Space (Patterns 2–4), The Visitor Experience (Patterns 5–7), and Seasonality (Pattern 8). The following presents each pattern in this sequence. All patterns recognised can be seen in Table 6.

Table 6. Patterns recognised in the study.

Group	No.	Pattern name	Promotion rule	Status
I. Main decision	1	Pool or Pond?	Documentary support (FLL, literature, both case studies) + 4 interviews	Promoted
II. Shaping the Space	2	Catchment and Bather Load	Documentary support (FLL, Polyplan, SWECO, municipal permit) + 3 interviews	Promoted
II. Shaping the Space	3	Zone Differentiation by User Typology	Documentary support (FLL, both case studies) + 2 interviews	Promoted
II. Shaping the Space	4	Edges and Sightlines	Documentary support (literature, both case studies) + 2 interviews	Promoted
III. Visitor Experience	5	Sensory Perception	Documentary support (FLL, literature, Bylderup permit) + 4 interviews	Promoted
III. Visitor Experience	6	Threshold and Entry Sequence	Documentary support (SWECO plans, Bylderup permit) + 2 interviews	Promoted
III. Visitor Experience	7	Ecological Storytelling	Documentary support (both case studies) + 4 interviews	Promoted
IV. Designing Across Time	8	Seasonality	Documentary support (FLL, Bylderup permit, SWECO) + 3 interviews	Promoted
-	-	Accessibility	1 interview, no PNSP-specific literature	Not promoted
-	-	Minor Utilities	Mentioned incidentally, no recurring problem-and-solution structure identified	Not promoted

Pattern 1: Pool or Pond?

PNSPs take two fundamentally different spatial forms: a formal, geometrically shaped pool with hidden underground filtration, or a naturalistic, organically shaped pond with visible regeneration zones (Gün & Ak 2022; Poloprutská et al. 2021). This decision determines the entire spatial language of the facility – the geometry of zones, the character of edges, the visibility of ecological processes, and the sequence through which visitors encounter water¹²¹³. Liu & Nijhuis (2020) argue that spatial structures are the fundamental elements through which landscape architecture organises human experience.

The FLL applies identical techniques and requirements to all PNSPs, regardless of whether they are presented as a formal or organic pond, without distinguishing between the two typologies (FLL 2011).

Comparing the two cases together reveals this pattern. At Bylderup, the pool typology uses a compact, geometrically strict layout where the deep swimming zone, shallow water, and children's pool are distinct rectangular or semi-rectangular shapes. The edges are formal wooden or concrete decks. The regeneration zone occupies a small footprint within the facility (80 m² hydro-botanic array plus 260 m² of substrate filters) (Fig. 26 and see Section 4.1). These were context-aware design choices made by the developers, as the facility was within a sports centre and the project was a renovation of a previous chlorinated pool (Aabenraa Municipality 2025). Literature, Dr Jakob Schelker, and Dr Holger Kühnhold confirmed that pool types support higher capacity¹⁴ and more active recreation in a smaller footprint within a landscape¹⁵ (Poloprutská et al. 2021; Walczak et al. 2025).

At King's Cross, the pond typology produces an entirely different spatial condition. A large amount of the water surface is occupied by visible plants, edges are softer and planted, and the regeneration zone is not separated but integrated into the visitor's visual field. (See section 4.2) OOZE Architects explain the difference between the two typologies and why they opted for a pond design. They mention, “more nature and plants means fewer swimmers per day... a basin-like design (pool type) with high recirculation produces a different, more active experience.”¹⁶ In King's Cross PNSP, they chose the pond type to create "a representation of a system that would explain the principles of NPSs"¹⁶ (Fig. 27 and see Chapter 4.2). King's Cross employed a pond-type design in an urban park, prioritising ecological visibility and educational programming over maximising bather numbers.

¹² Stefan Meier, Interview conducted by the author, 2026

¹³ Stefan Bruns, Interview conducted by the author, 2026

¹⁴ Dr Jakob Schelker, Interview conducted by that author, 2026

¹⁵ Dr Holger Kühnhold, Interview conducted by that author, 2026

¹⁶ OOZE Architects, Interview conducted by the author, 2026

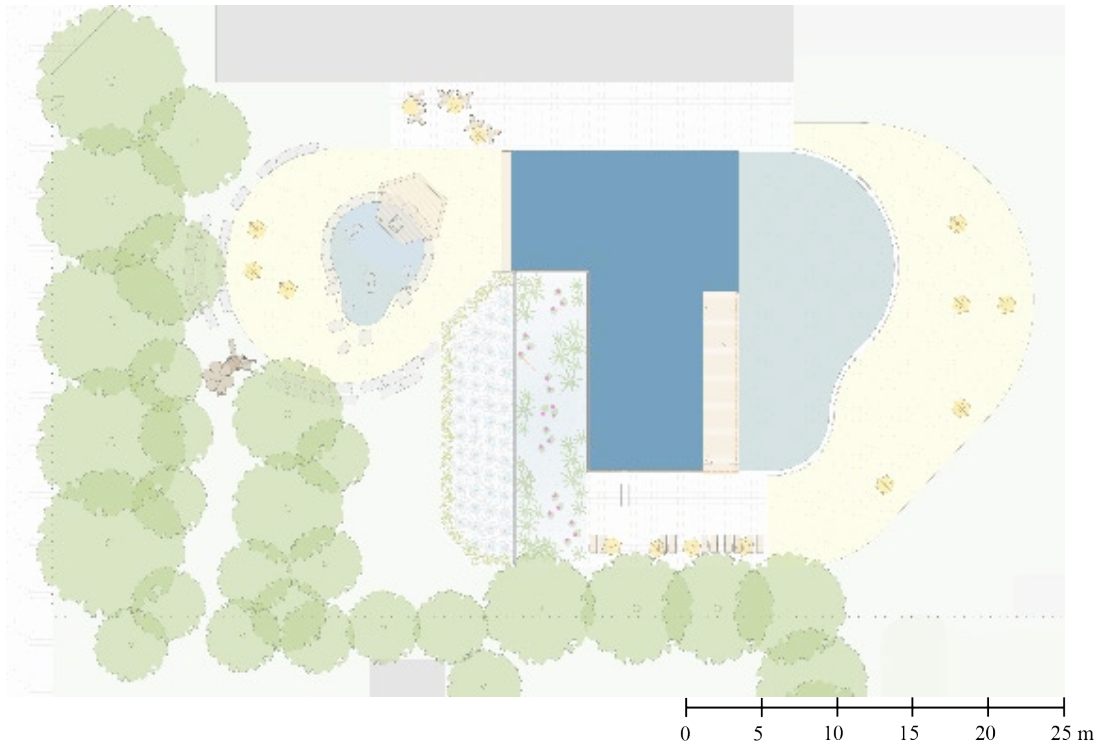


Figure 26. Map of Bylderup Naturbad highlighting the main formal typological choice (SWECO, 2023) modification made by the author. 1:500 (A4)



Figure 27. Map of King's Cross PNSP highlighting the main organic typological choice (BD Landscape Architects, 2022) modification made by the author. 1:500 (A4)

The spatial relationship between the PNSP and its surrounding context differs fundamentally between the two cases. (Fig. 28) At King's Cross (Fig. 29, top), the pond-type design occupied a significant portion of Lewis Cubitt Park. Placed in London's most actively developed urban sites, the naturalistic typology produced a deliberate contrast with its surroundings. At Bylderup (Fig. 29, bottom), the pool-type design sits within an existing sports centre in a rural village of approximately 1,300 inhabitants (Thomas 2025). The formal, rectangular geometry of the pool mirrors the sports facility it was integrated into, rather than the surrounding agricultural landscape.

The typological choice in each case responded to its institutional and spatial context: King's Cross used the pond typology to create ecological contrast within an urban setting; Bylderup used the pool typology to maintain continuity with an existing recreational facility.

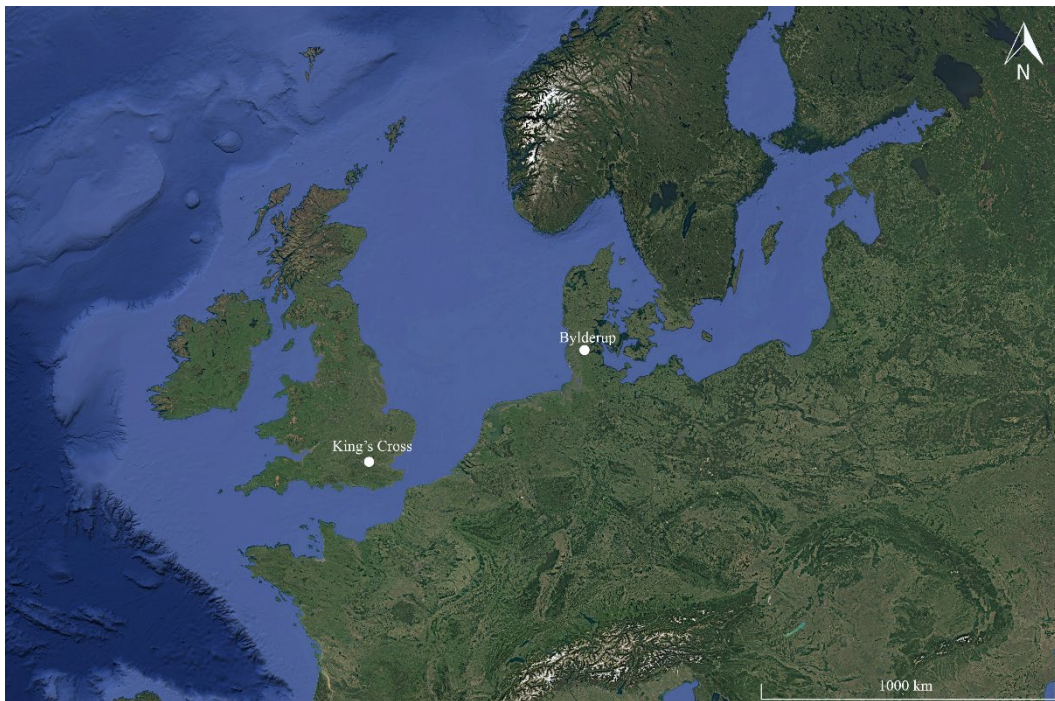


Figure 28. Spatial location of the two case studies in Northern Europe (Google Earth, 2025)



Figure 29. Aerial comparison of the two case study contexts. Top: King's Cross Pond Club situated within the King's Cross redevelopment area in central London, surrounded by rail infrastructure and urban development. Bottom: Bylderup Naturbad situated within Bylderup Sports Centre in a rural village in southern Denmark, surrounded by residential areas and agricultural land. (Google Earth, 2015; Google Earth, 2025); compiled by the author.

The pool-or-pond decision is the foundational typological choice for any PNSP. It determines space requirements, filtration strategy, bather capacity, and place of recreation. All subsequent patterns are shaped by this initial decision. This confirms what Sjöman et al. (2025) identify in other landscape typologies, where the underlying pattern must be understood before its variations can be designed successfully. In PNSPs, the pool-or-pond decision is the underlying pattern.

Pattern 2: Catchment and Bathers load

The number of visitors a PNSP can safely accommodate is constrained by the biological filtration system's capacity to maintain water quality (Poloprutská et al. 2021; Acuña et al. 2024). Exceeding this capacity allows harmful bacteria and *E. coli* to flourish, creating a harmful environment to swim in. Catchment area and projected visitor numbers, therefore, drive the dimensioning of the entire facility and its recreational success¹⁸.

The FLL calculates the nominal bather rate from water volume and filter performance, disregarding recreational use outside the water (FLL 2011).

Stefan Bruns stated that the design process begins with the discussion on the catchment area and how many bathers per year there will be, which determines the volume and the filtration of the pool. He specifically ranked the factors that shape the design of a PNSP as follows: 1) the catchment area and the projected number of visitors, 2) the demands of the visitors, 3) the demand of the owner, and 4) specific programme demand. He adds that the latter means what the facility is intended for: sport, recreation, biodiversity, or cultural programming¹⁷.

Stefan Bruns further stated that there has been no complete bather limit in Germany since 2011 and cited a pool of 100–120 m³ that can handle even 500 bathers per day.¹⁷

Dr Jakob Schelker stated that the calculations are being redesigned for more realistic figures within the FLL regarding bather capacity.¹⁸

The two cases demonstrate different catchment contexts. In the case of Bylderup Naturbad, the capacity of the design approved by the FLL calculations is 234 bathers per day for optimal phosphorus and *E. coli* binding for safe swimming conditions (Polyplan 2020). The engineering application describes a filter system dimensioned for up to 493 bathers per day (SWECO 2023), while the municipal permit caps daily attendance at 400, with a weekly average of 300 (Aabenraa Municipality 2025) (Tab. 7). Lars Juncker stated the 400/day limit at Bylderup "is not at all close to the limit."¹⁹ This reveals that bather capacity is not a single number but a negotiated outcome between biological performance, engineering ambition, and regulatory caution.

Table 7. Bather capacity figures for Bylderup Naturbad from three authorities.

Authorities' calculations	No. Bathers / Day	Date
Polyplan (FLL)	234	2020-11-24
SWECO (engineering)	493	2023-06-08
Aabenraa Municipality	<400	2025-05-28

¹⁷ Stefan Bruns, Interview conducted by the author, 2026

¹⁸ Dr. Jakob Schelker, Interview conducted by the author, 2026

¹⁹ Lars Juncker, Interview conducted by the author, 2026

At King's Cross, capacity was limited to 163 bathers per day across four time slots, constrained by a temporary permit, site footprint, and 600 m³ water volume ²⁰. (see Section 4.2) The four time slots, which were mostly determined by the capacity of the water, led to tension among visitors ²⁰.

²⁰ OOZE Architects, Interview conducted by author, 2026

Pattern 3: Zone Differentiation by User Typology

Users visit PNSPs with different motivations: exercise, relaxation, nature experience, socialising, or supervising children. Designing zones aligned with these different motivations improves satisfaction (Komossa et al. 2019), while overdesigning a specific zone can create hierarchical imbalance and overcrowding (Collins & Pajak 2019).

The FLL specifies depth zones for safety but does not address zoning by user group or motivation (FLL 2011). (Tab. 8)

Table 8. Zone differentiation table borrowed from the FLL Guidebook

Area	Water depth
Area for small children	< 0.6 m
Non-swimmer area	< 1.35 m
Swimmer area	> 1.35 m
Diving area	> 3.4 m

Meier described different client groups and needs, which translated into separate zones. “Some people prefer to do active recreation inside the water, and other people want to enjoy a relaxed environment next to the water.”²¹

Bylderup Naturbad has multiple distinct zones. The water areas can be separated into four parts: the regeneration zones, the deep main swimming pool, the shallow beach area, and the children's pool, all designed according to the FLL's depth parameters seen in Table 7 (Fig. 30). Each is designed in a way that serves different user groups with different motivations. Surrounding the water, wooden decks, grassland, sunbathing areas, and sand shores provide additional non-swimming recreational zones (Fig. 31). The majority of the zones follow a strict formal design that ties the place together, making it cohesive. For example, the two wooden decks use the same material and formal shapes, as presented in Section 4.1.

²¹ Stefan Meier, Interview conducted by the author, 2026



Figure 30. The four water areas in Bylderup Naturbad which provide different recreational values. The regeneration zone which is not accessible, shallow water, deep water, and the children's pool. (SWECO, 2023); modification made by the author. 1:500 (A4)

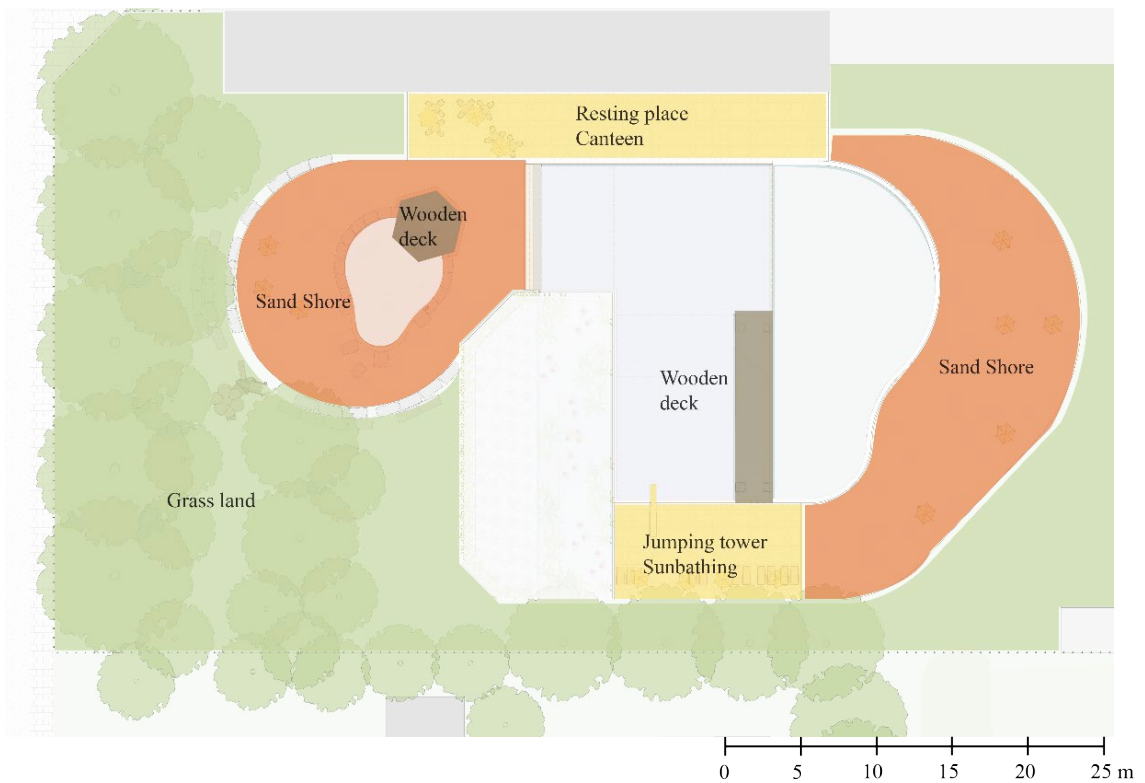


Figure 31. Illustration outside the water at Bylderup Naturbad. Sand shores, grassland, wooden decks, a resting area and sunbathing locations. (SWECO, 2023); modification made by the author. 1:500 (A4)

At King's Cross, zone differentiation was achieved through colour-coded surface markings. OOZE Architects mentions that zone differentiation was important for the design: “Providing a clear plan printed on the site was key to enable people to understand and experience the different zones and project themselves into it”²². It was important for them to highlight the zones with bright colours so that people understood where they could swim and where they could relax outside of the water²². The red-and-white design scheme separated changing rooms, toilets, and bathing areas within a compact footprint while maintaining visual cohesion across the facility (see Section 4.2). From a broader perspective, by being elevated two metres from ground level, the pool itself became a separate zone from the city, which was intentional²² (Fig. 32) The pool was separated into four different water zones, which were discussed in the case study section (see Section 4.2). A wooden deck was placed next to the shallow pond area for a gradual entrance into the water. Furthermore, outside zones can be observed, such as resting areas, changing rooms, toilets, showers, and sunbathing places (Fig. 33).

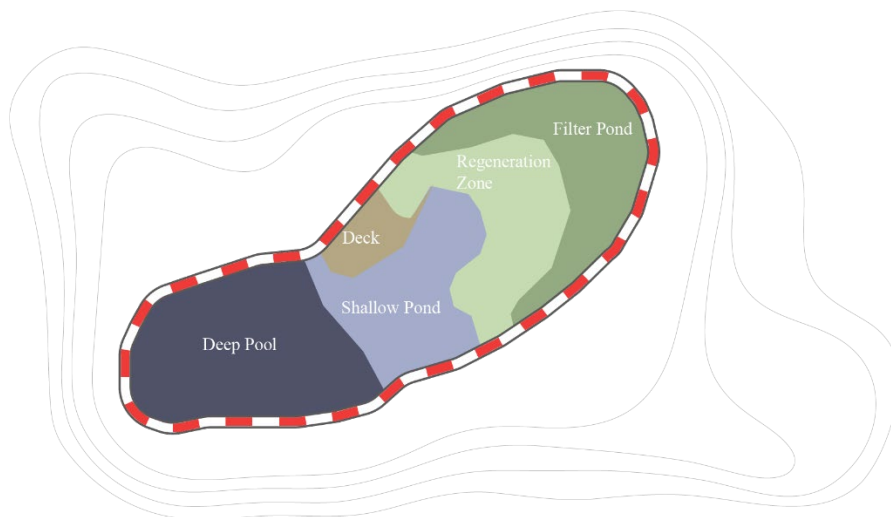


Figure 32. Zones within the pool and the topography show separation from the outside. Illustration made by the author

²² OOZE Architects, Interview conducted by the author, 2026



Figure 33. Zones outside the pool at King's Cross PNSP. (BD Landscape Architects, 2022); modified by the author. 1:500 (A4)

Pattern 4: Edges and Sightlines

Edges are where most recreation occurs in swimming facilities. An observational study found that more than 70% of time is spent in the water or at the water's edge (Gould 2010). Open sightlines within a facility create a greater perception of safety, increasing satisfaction and thus recreation (Ouyang et al. 2026).

The FLL addresses edges on a technical level only, mentioning that edges should be designed in a way that the liner cannot be damaged by the user, and the height should be above 10 cm so that water is not lost (FLL 2011). The liner's main purpose is to separate the water within the pool from the outside, creating a watertight barrier.

Stefan Bruns mentions that the edges of a PNSP are used the most, and people may enter the water one or twice a day²³.

At Bylderup, multiple edge types serve different user groups: wooden decks along the children's pool and main basin, wooden logs placed between the shallow and deep water, and a shallow sand beach entry (see Section 4.1). Lars Juncker stated that edges should separate and protect the regeneration zone from the bathing zone²⁴. In addition, Lars mentioned that wooden decks serve as a critical recreational area within a facility²⁴. This is confirmed by a photograph obtained from him, which shows that the wooden logs positioned between the shallow water and the deep water seem to attract bathers' attention (Fig. 34).



Figure 34. Visitors at the edge of Bylderup Naturbad's main pool and shallow pool. (Junckerhaven, 2025)

²³ Stefan Bruns, Interview conducted by author, 2026

²⁴ Lars Junckern, Interview conducted by author, 2026

At King's Cross, edges were defined through the red-and-white colour scheme, with the stripe pattern separating water from deck and continuing into utility areas. Photographs of the facility consistently show visitors positioning themselves at edges rather than in the water (Fig. 35)



Figure 35. Edge use at King's Cross. (Left): Visitors occupy the perimeter of the water, and only a few people are inside the water. (Right): People are sitting at the edge of the swimming zone. (BD Landscape Architects, 2022)

Pattern 5: Sensory Perception

In chlorinated pools, sensory conditions are controlled through chemical disinfection. Water colour is determined by tiles or liner, temperature is mechanically regulated, and smell is that of chlorine²⁵. In PNSPs, these conditions are produced by living biological processes and change daily with weather, season, and nutrient load. Designers set initial conditions but cannot fully control sensory outcomes²⁵.

The FLL specifies a 1.80-metre Secchi depth as the safety threshold for water transparency and a recommended water temperature of $\leq 25^{\circ}\text{C}$, with elevated temperatures not exceeding 28°C for more than five consecutive days (FLL 2011). It does not address the perceptual experience of colour, temperature, or smell further.

Colour:

Water colour is a primary visual cue for judging water quality and recreational value (Angradi et al. 2018). Water appearing yellow or yellow-green is perceived as less appealing than green-blue or blue (Angradi et al. 2018). Research found that in certain water settings, colour can become more important as an indicator of aesthetic appeal than water clarity (Lee 2017).

Stefan Meier stated that liner colour determines perception. Dark grey liners produce a water colour that integrates with natural landscapes, while light blue liners make biofilm prominent and trigger chlorinated-pool expectations²⁵. It is further confirmed that biofilm causes a greenish colour and that some visitors reject non-blue water, while others prefer a natural appearance²⁶.

What this means is that the decision on the colour of the liner affects visitor expectations, perceived water quality, and recreational satisfaction.

The Bylderup permit requires water to be transparent to the point where visitors can see the bottom, following the FLL guideline (Aabenraa Municipality 2025). The water colour fluctuates within the facility over time from bright blue, grey, brown, and green (Fig. 36).

²⁵ Stefan Meier, Interview conducted by the author, 2026

²⁶ Dr Holger Kühnhold, Interview conducted by the author, 2026



Figure 36. Bylderup Naturbad's watercolour fluctuates from green to grey. (Junckerhaven, 2025)

Temperature:

Temperature in PNSPs influences biological activity within the water, resulting in algae growth and biomaterial (Coffey et al. 2019). Stefan Bruns stated that the design language of a PNSP affects temperature perception²⁷. In formal, symmetrically designed pool-type PNSPs, users perceive the water as cooler. In naturalistic, organically shaped pond-type PNSPs, users perceive the same water temperature as approximately 2°C warmer. He adds that this is a perception difference, not an actual temperature difference²⁷. Similarly to water colour, the design decisions determine visitor experience.

Bruns, Kühnhold, and Schelker all confirmed that solar-powered heating and cooling pumps are now installed in PNSPs to regulate water temperature^{27 28 29}. They add that these technologies do exist but will be deployed consistently in the future, not as of today.

Bylderup requires automated temperature monitoring during operational hours, referencing FLL standards (Aabenraa Municipality 2025).

King's Cross operated without a documented heating system; OOZE described "the fresh waters of the pool," suggesting unheated, cool water³⁰.

Smell and Texture:

Interviewees stated that if users smell decomposition or taste sulphur or earthiness, they tend to leave the facility earlier^{28 29} (Coffey et al. 2019). Furthermore, debris floating inside the water has the same effect^{28 29}.

²⁷ Stefan Bruns, Interview conducted by the author, 2026

²⁸ Dr Holger Kühnhold, Interview conducted by the author, 2026

²⁹ Dr. Jakob Schelker, Interview conducted by the author, 2026

³⁰ OOZE Architects, Interview conducted by the author, 2026

Pattern 6: Threshold and Entry sequence

This pattern is similar to "Zone Differentiation by User Typology". Zone differentiation (Pattern 3) organises the facility on the plan: which areas exist and which user groups they serve. The entry sequence addresses a different problem: how visitors move through time from arrival to water. One distributes users across space; the other structures their passage through it.

The transition from arrival to the water involves a spatial sequence: approach, first view, orientation, changing, reaching the edge, and entering the water. Environmental psychology research demonstrates that environments with clear signage reduce user confusion and stress (Wener & Kaminoff 1983).

The FLL treats entries and exits as technical parameters, such as stairs, ladders, and ramps (FLL 2011). It also references coordination group guidelines for entrance areas, ticket offices, and locker rooms (FLL 2011).

Both case studies show that entering the facility requires crossing a border. In both cases, the facilities were fenced (Aabenraa Municipality 2025; OOZE, 2024).

OOZE Architects used printed red-and-white markings at the entrance as a threshold device, noting that providing a clear plan printed on the site was key to enabling people to understand and experience the different zones and project themselves into them³¹. In addition, there were signs in the facility for the purpose of guiding visitors in the right direction³¹. Visitors approached through an elevated landscape before reaching the pool, which was built two metres above street level. The physical climb separated the urban context from the water, both physically and psychologically³¹. Mentioned by the interviewee, this evokes a sense of surprise and curiosity in the visitor, drawing them to explore further³¹. This can be observed in an illustrative section in Figure 37, showing the sightlines which King's Cross PNPS had.

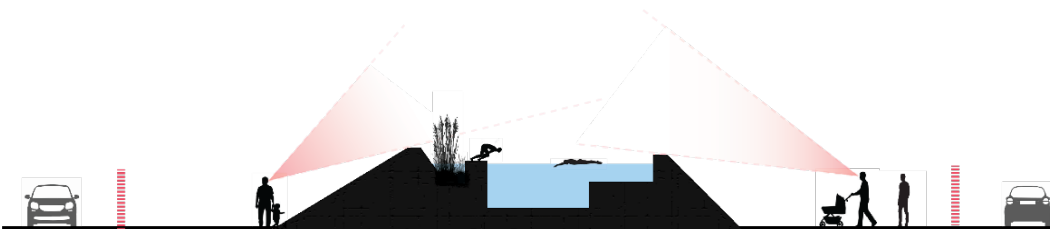


Figure 37. Section illustration of King's Cross PNPS and its elevated design compared to the surrounding landscape and the user's sightline. Indicating, the entering the place came with a sense of surprise. Illustration made by author.

Four daily time slots structured arrival, controlling flow and creating deliberate transition rather than continuous access³¹.

³¹ OOZE Architects, Interview conducted by the author, 2026

In Bylderup, SWECO designed a three-stage information system integrated into the entry sequence: information walls at the entrance to changing rooms, at the door from changing rooms to the pool area, and information tables near the pool describing the layout of the facility (SWECO 2023).

Pattern 7: Ecological storytelling

Ecological filtration is the reason PNSP can function without chemicals (Poloprutská et al. 2021). Whether and how this process is made visible and comprehensible to visitors affects their understanding of the facility and their recreational engagement with it.

The FLL purely addresses the technical elements of the regeneration zone, filters, water flows, and bubblers that create functioning biological ecosystems, and not the communication of the ecological processes to users (FLL 2011).

Lars Juncker stated, when asked about recreational success, that communication with bathers and the ability to showcase the cleaning process of PNSPs is important³².

Stefan Meier mentions that integration into the surroundings is the most important factor when it comes to recreation³³.

Stefan Bruns believes that storytelling of the process and the willingness to showcase it is the main determining factor when it comes to the success of recreation in PNSPs. Furthermore, he says, landscape integration is as important to a design as a successful ecological system³⁴.

OOZE Architects stated the pool was designed as "a representation of a system that would explain the principles of the different zones related to different qualities of the water." The main design choice was driven by the intention to showcase and educate visitors on how these systems work³⁵. They described the goal as bringing visitors to an awareness of the processes at play and immersing themselves in nature³⁵. This design choice is confirmed after looking at the plans and observing that almost 50% of the pool's surface was occupied by plants like water lilies and reeds. Furthermore, more than 30 species of flowers were planted at the edge of the pool for this purpose³⁶ (Fig. 37) Whether and how this process is made visible and comprehensible to visitors affects their understanding of the facility and their recreational engagement with it (Poloprutská et al. 2021).

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³² Lars Juncker, Interview conducted by author, 2026

³³ Stefan Meier, Interview conducted by author, 2026

³⁴ Stefan Bruns, Interview conducted by author, 2026

³⁵ OOZE Architects, Interview conducted by author, 2026

what the processes were at play and immersing themselves in nature"³⁶. This design choice is confirmed after looking at the plans and observing that almost 50% of the pool's surface was occupied by plants like water lilies and reeds. Furthermore, more than 30 species of flowers were planted at the edge of the pool for this purpose³⁶ (Fig. 24 and Fig. 38)

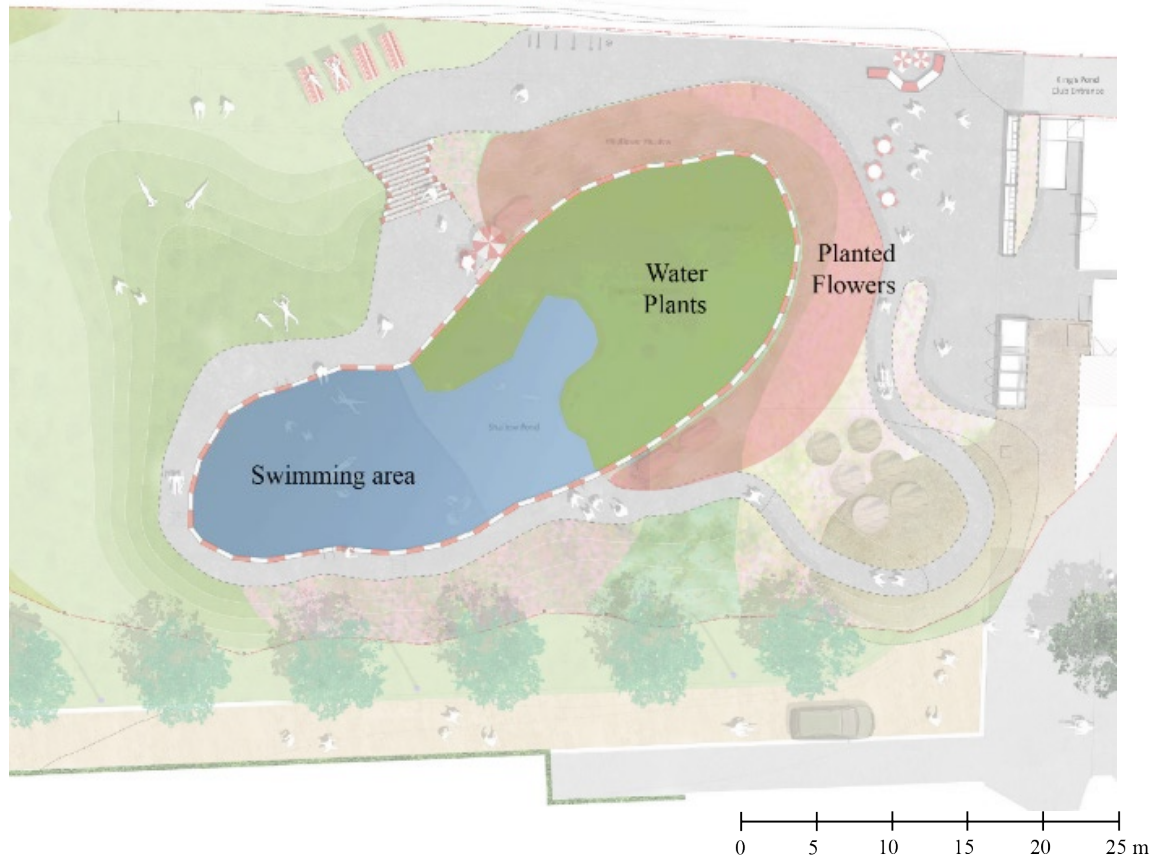


Figure 38. Map of King's Cross PNSP showing plants to water ratio exuding grass and trees. (BD Landscape Architects, 2022); modified by author. 1:500 (A4)

At Bylderup, the hydro-botanic array (80 m², 11 species of plants) and the visible sprinkler system provide a partial ecological narrative, but the majority of filtration occurs underground in substrate filters (260 m²). The pool typology conceals most of the biological system that makes chemical-free swimming possible.

³⁶ OOZE Architects, Interview conducted by author, 2026

Pattern 8: Seasonality

The final pattern addresses the temporal dimension of PNSP design: how the facility's recreational capacity changes across seasons.

PNSPs are living systems that change across seasons. Plant growth cycles, water temperature fluctuations, biological activity levels, daylight, and visitor numbers all vary throughout the year. Unlike chlorinated facilities that maintain constant conditions, PNSPs operate within ecological rhythms that affect both system performance and recreational use.

The FLL addresses seasonal change as a maintenance concern: planting occurs from late April through July, submerged plants are cut back during summer, and rigid stems are retained through winter to promote gas exchange (FLL 2011). It does not treat seasonal variation as a design consideration.

Dr Holger Kühnhold stated that temperature is the driving factor of activity. He observed that visitors at a pond-type PNSP he visited used the facility recreationally during the off-season as well, where the landscape was used not only for swimming extensively³⁷.

Stefan Bruns stated that the nominal bather rate is designed for summer demand, and that on peak summer days, comfort decreases and visitors self-regulate. He described PNSPs as "daily vacation" facilities, implying summer leisure as the primary programme³⁸.

At Bylderup, the permit explicitly structures seasonal operation: summer attendance of 100–300 bathers per day, with a ceiling of 400; off-season capped at 100 per day. Condition 52 requires winter bather-load planning because biological processes are less effective at lower temperatures (Aabenraa Municipality 2025). The system operates year-round with reduced but continuous circulation even in winter (Fig. 39).

³⁷ Dr. Holger Kühnhold, Interview conducted by author, 2026

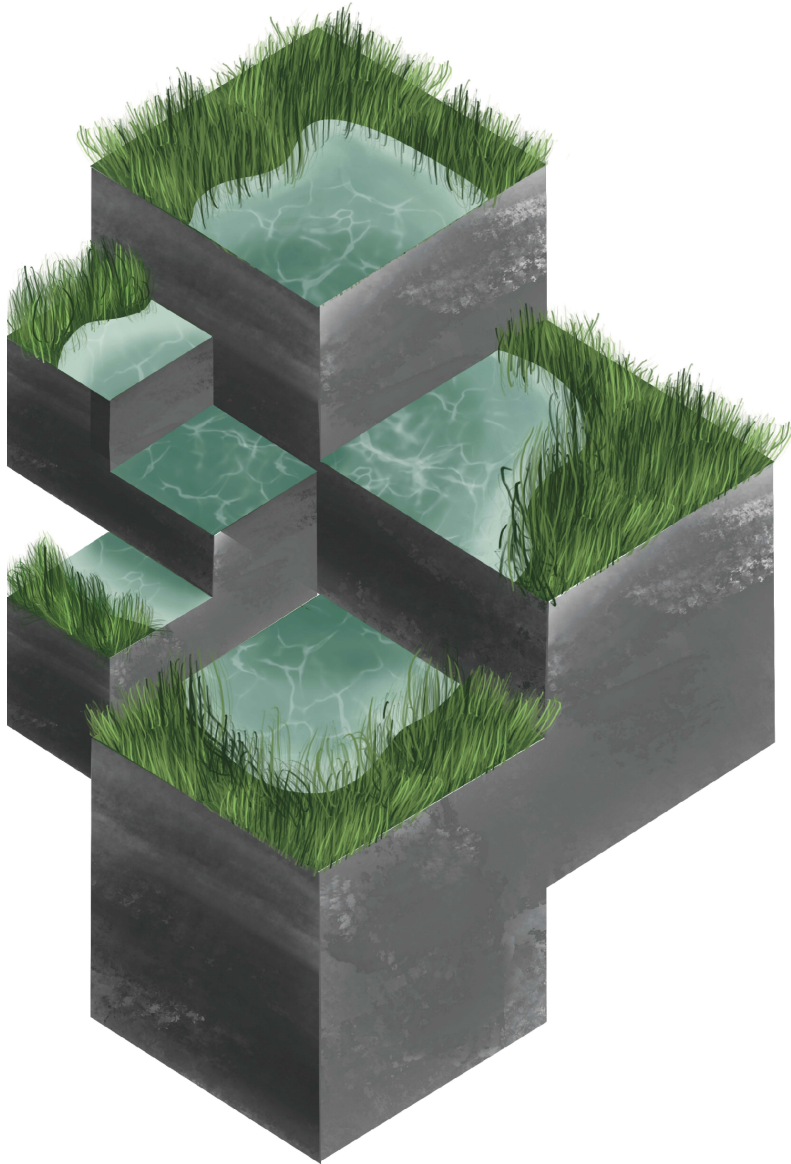
³⁸ Stefan Bruns, Interview conducted by author, 2026



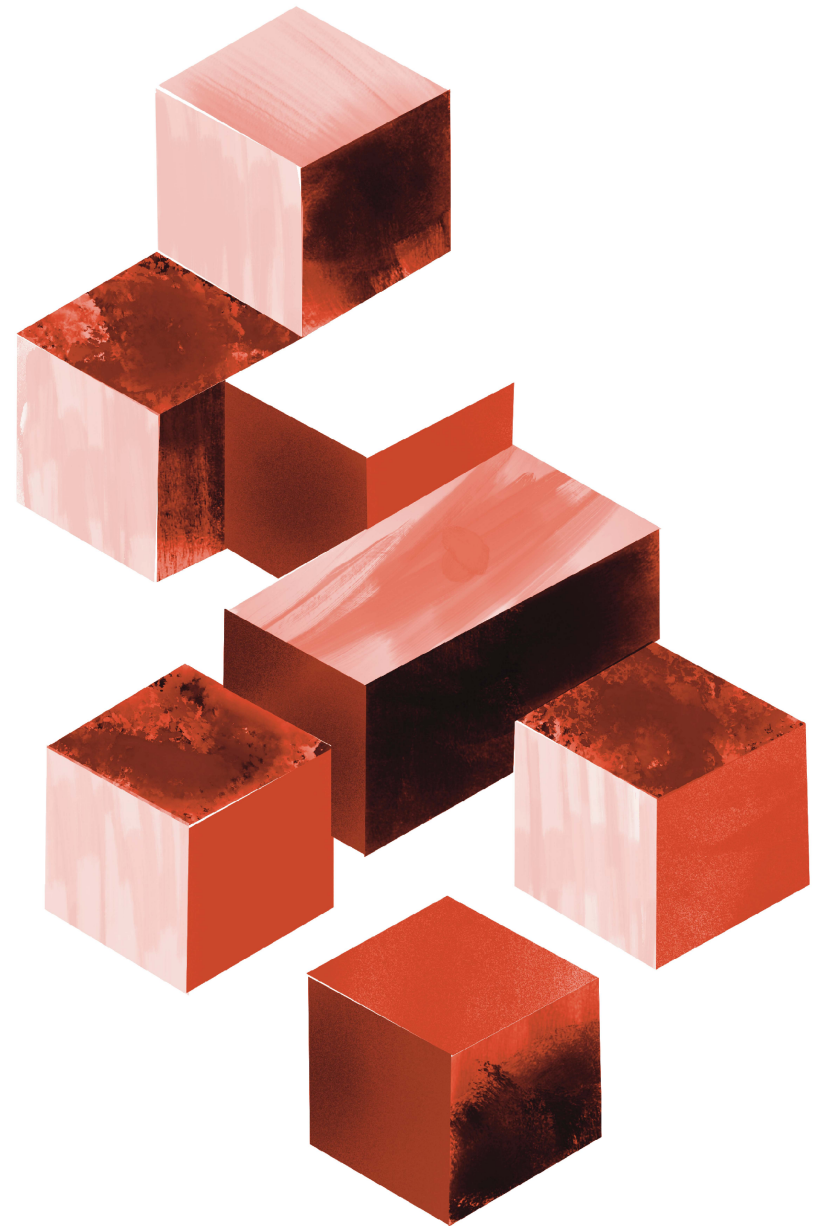
Figure 39. Picture showing the Bylderup Naturbad Functions in the winter time as well. (Bylderup Idrætscenter, no date)

King's Cross operated for two seasons (2015–2016) and was then removed. No winter operation or off-season programming was documented (see Section 4.2).

PATTERN BOOK



*Written by Ernő-Tóth Pál
Illustrated by Szonja Somogyvari*

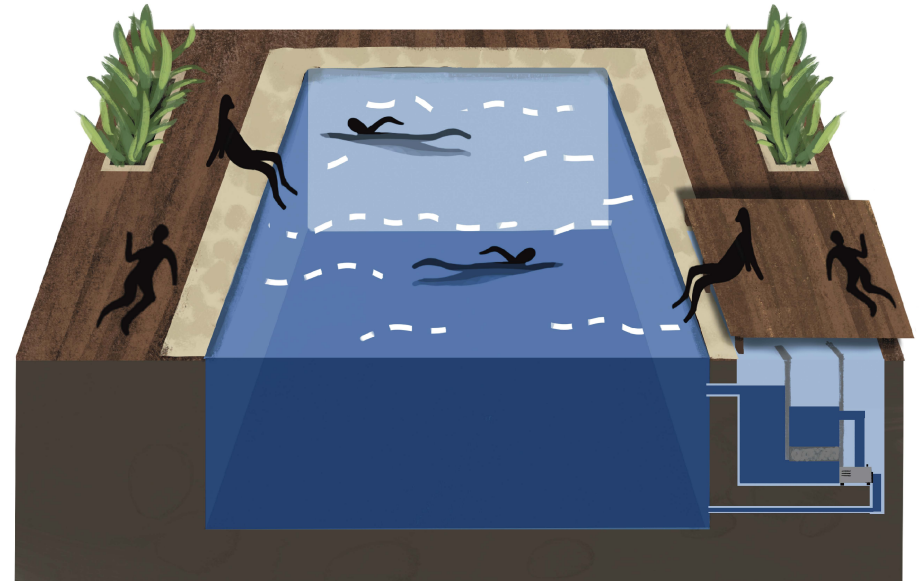
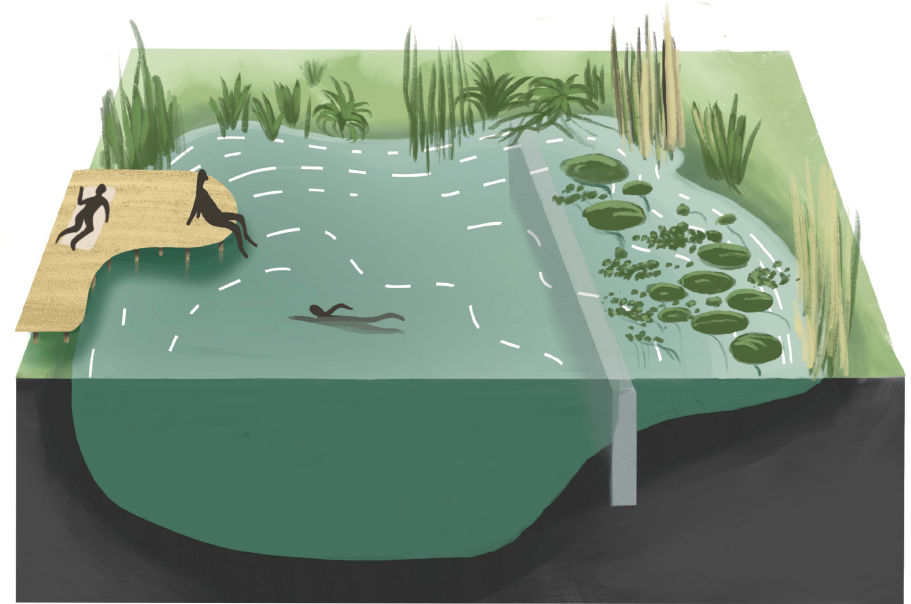


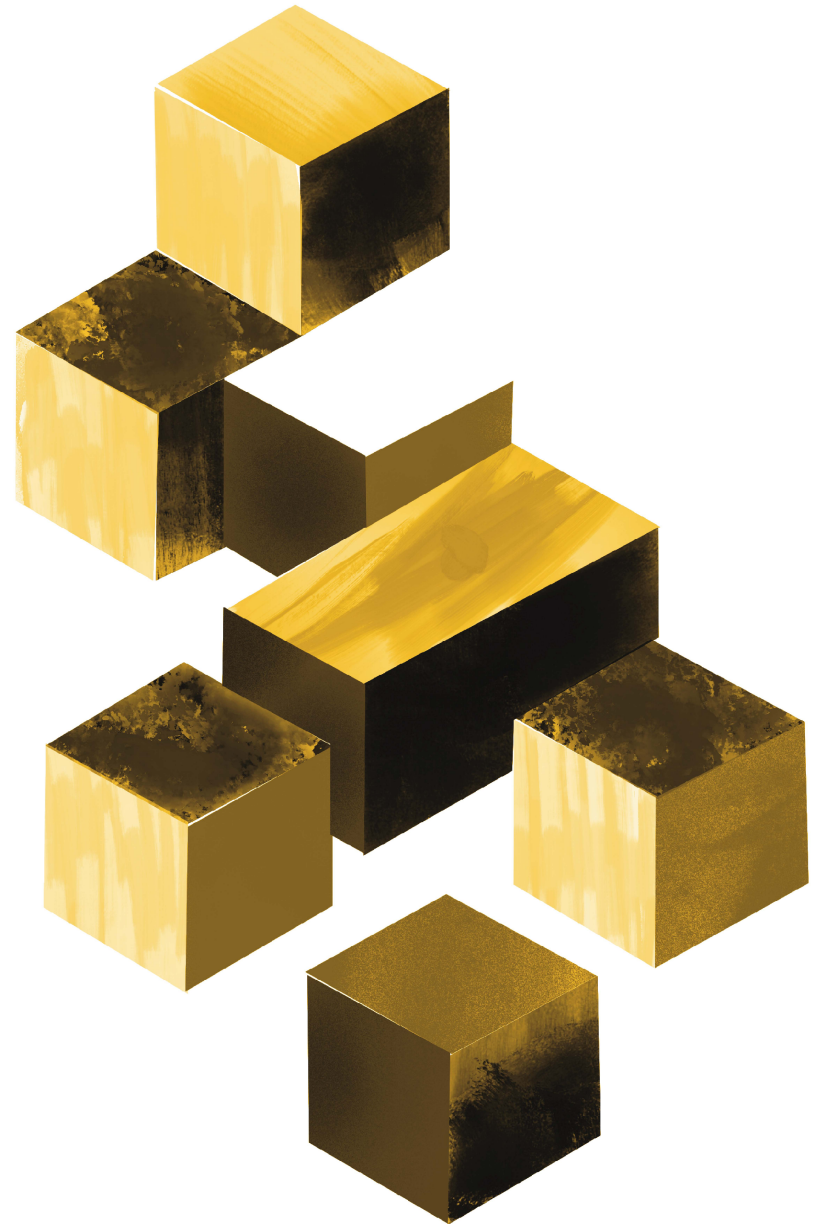
Pattern 1

Pool or Pond?

A geometric basin with clean lines and hidden filtration, or an organic shape with visible plants and regeneration zones? This is the first decision, and it is not only about engineering. It sets the visitor's expectations and perception before they touch the water. A pool shape invites expectations of control and predictability. A pond shape invites expectations of ecological life and seasonal change. The same green water reads as neglect in one and as vitality in the other. Everything that follows: How the space is organised, what the edges feel like, what story the water tells begins here.

Connects to all patterns. Particularly shapes how visitors interpret sensory conditions (5), ecological visibility (7) and how seasonality use is affected (8)





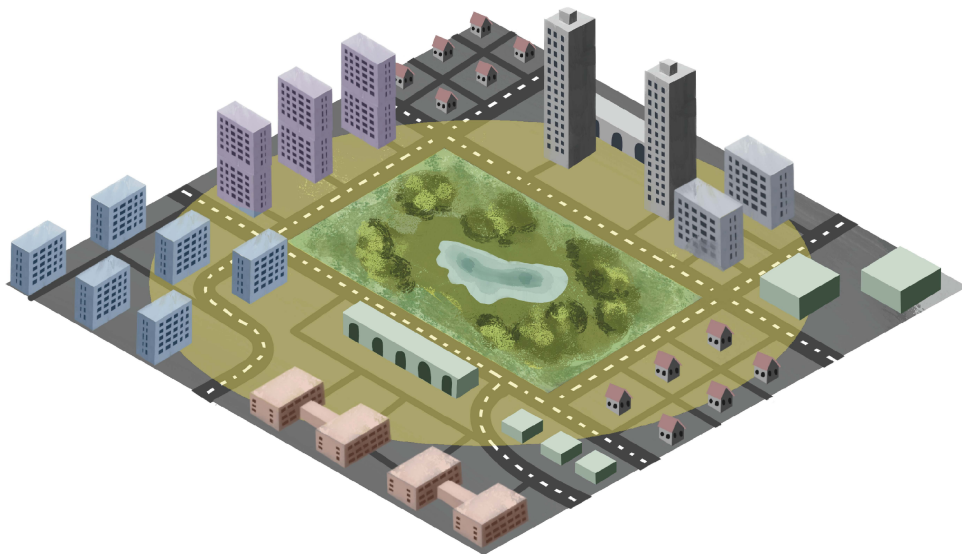
Pattern 2

Catchment and Bather Load

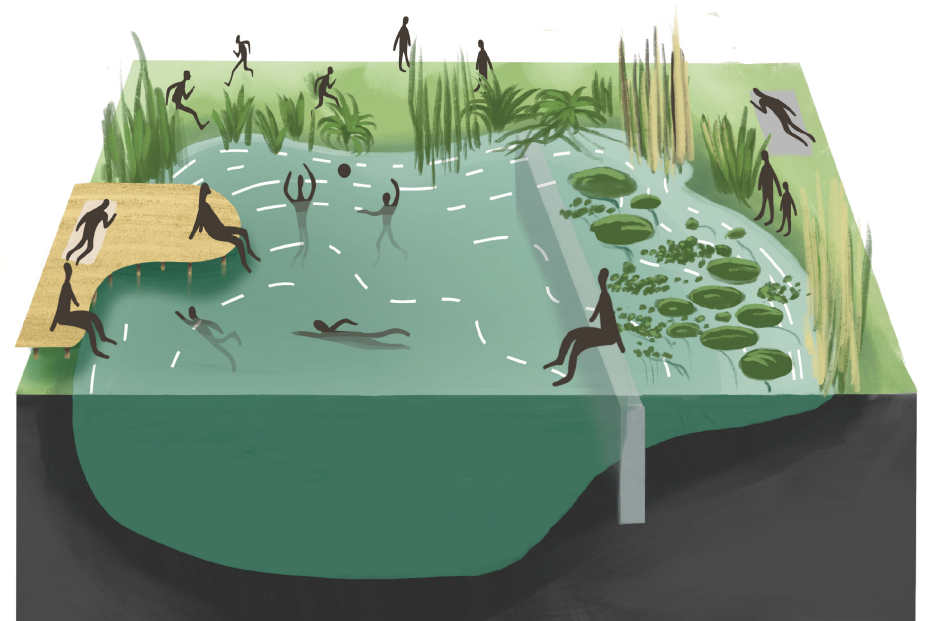
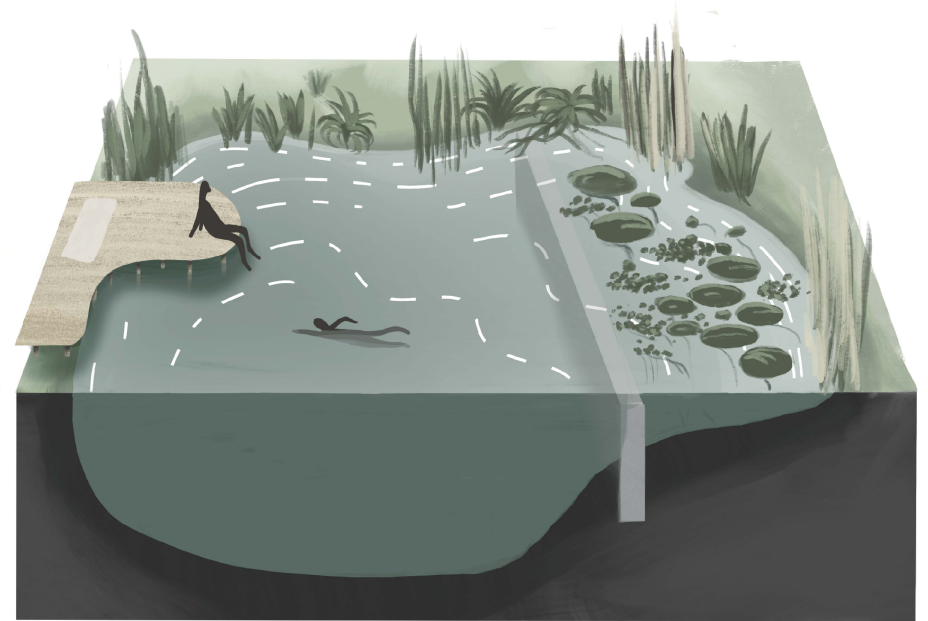
How many people is this place for?

The answer determines the size of the water, the power of the filtration, and the scale of the surrounding landscape. But as technology allows more swimmers per day, the question shifts. The challenge is no longer whether the water can handle the visitors, but whether the space can welcome them comfortably. A number on paper becomes a spatial problem on the ground.

Connects to 1 (typology affects capacity), 3 (more visitors need clearer spatial separation), and 4 (clear sight-lines are necessary for recreational success).



8



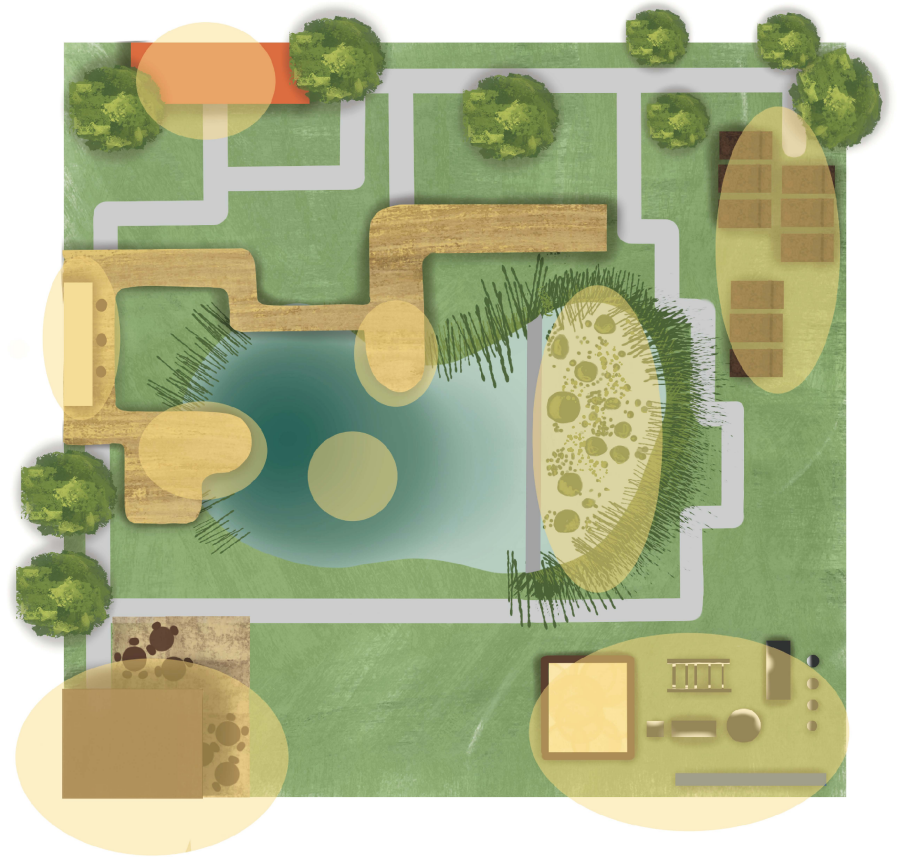
9

Pattern 3

Zone Differentiation by User Typology

A lap swimmer, a toddler with a parent, a group of teenagers sunbathing, a couple reading by the water. They all came to the same facility, but they came for different reasons. When these activities share undivided space, they compete. When they are given their own zones — a children's area, a swimming lane, a social edge, a quiet corner — they coexist. Designing for different visitors means designing different places within one place.

Connects to 6 (zone layout shapes how arrival moves through the facility).



Pattern 4

Edges and Sightlines

Most of the time spent at a swimming facility is not spent swimming. It is spent sitting at the edge, watching, talking, dangling feet in the water, deciding whether to get in. The edge is where recreation actually happens. A wooden deck invites lingering. A log between shallow and deep water becomes a gathering point. A sand beach entry slows the transition. The variety and character of edges determine whether a facility feels generous or cramped. Open sight-lines across the space give visitors the feeling of safety and orientation.

Connects to 5 (different edge materials create different sensory experiences)



12



13

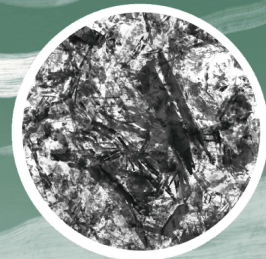
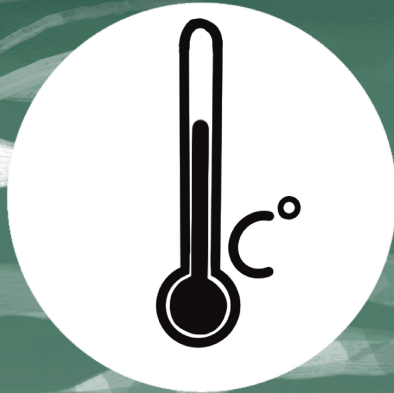


Pattern 5

Sensory Perception

The water in a PNSP is alive. Its colour shifts with algae and light. Its temperature follows the weather, not a thermostat. Its smell changes with biological activity. Even the liner colour beneath the surface shapes what visitors feel: a dark grey liner makes the water look natural and warm; a light blue liner makes every biofilm deposit visible and triggers expectations of chlorine. What the water looks, smells, and feels like is not decoration, but it is the main experience.

Connects to 7 (understanding the ecology reframes how visitors interpret what they sense), 4 (edge materials shape touch and texture at the water boundary).

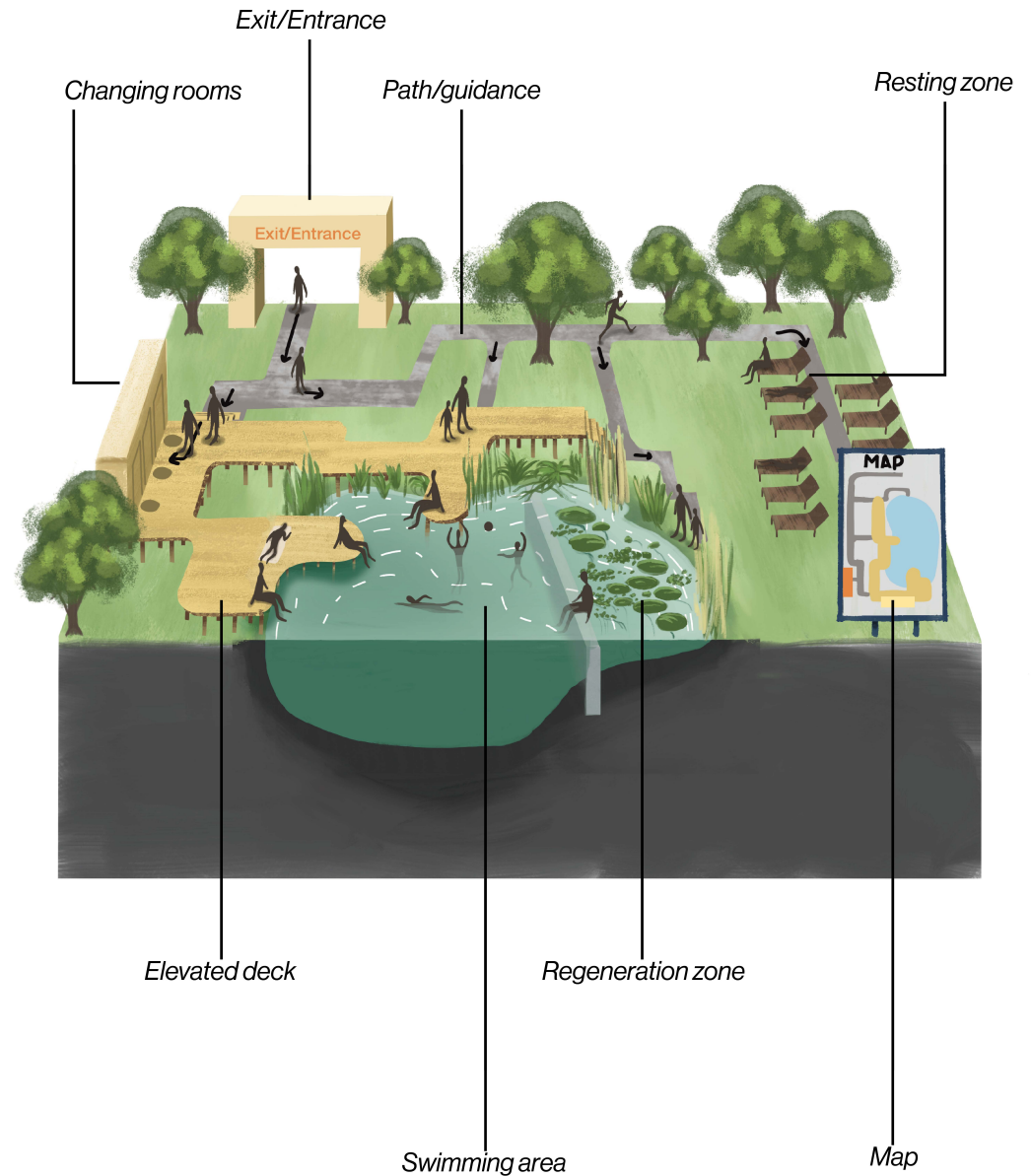


Pattern 6

Threshold and Entry Sequence

The experience does not begin at the water. It begins at the gate. The walk from arrival to the pool edge is a sequence of moments: the first glimpse of the water, the shift from street clothes to swimwear, the orientation towards the zones, the decision of where to sit. How a facility choreographs the transition from public space to bathing environment and how visitors orient themselves in the facility shapes whether visitors are curious or disoriented.

Connects to 3 (the zone layout determines what the sequence passes through)



Pattern 7

Ecological Storytelling

A PNSP cleans its water through plants, microbes, and biological processes, not chemicals. This is remarkable, but only if visitors can see it and understand it. Visible planting, water flowing through regeneration zones, sprinklers showcasing filtration in action are not technical details. They are the story the facility tells. When visitors understand that green water means the biology is working, they read the same water differently. When they cannot see the process, they have no story, and what they sense may feel wrong rather than alive. Storytelling turns ecology from a hidden system into a shared experience, even influencing visitor perception as well.

Connects to 5 (sensory cues are the material for the story; the story reframes how senses are interpreted) these two feed back from each other



IV.

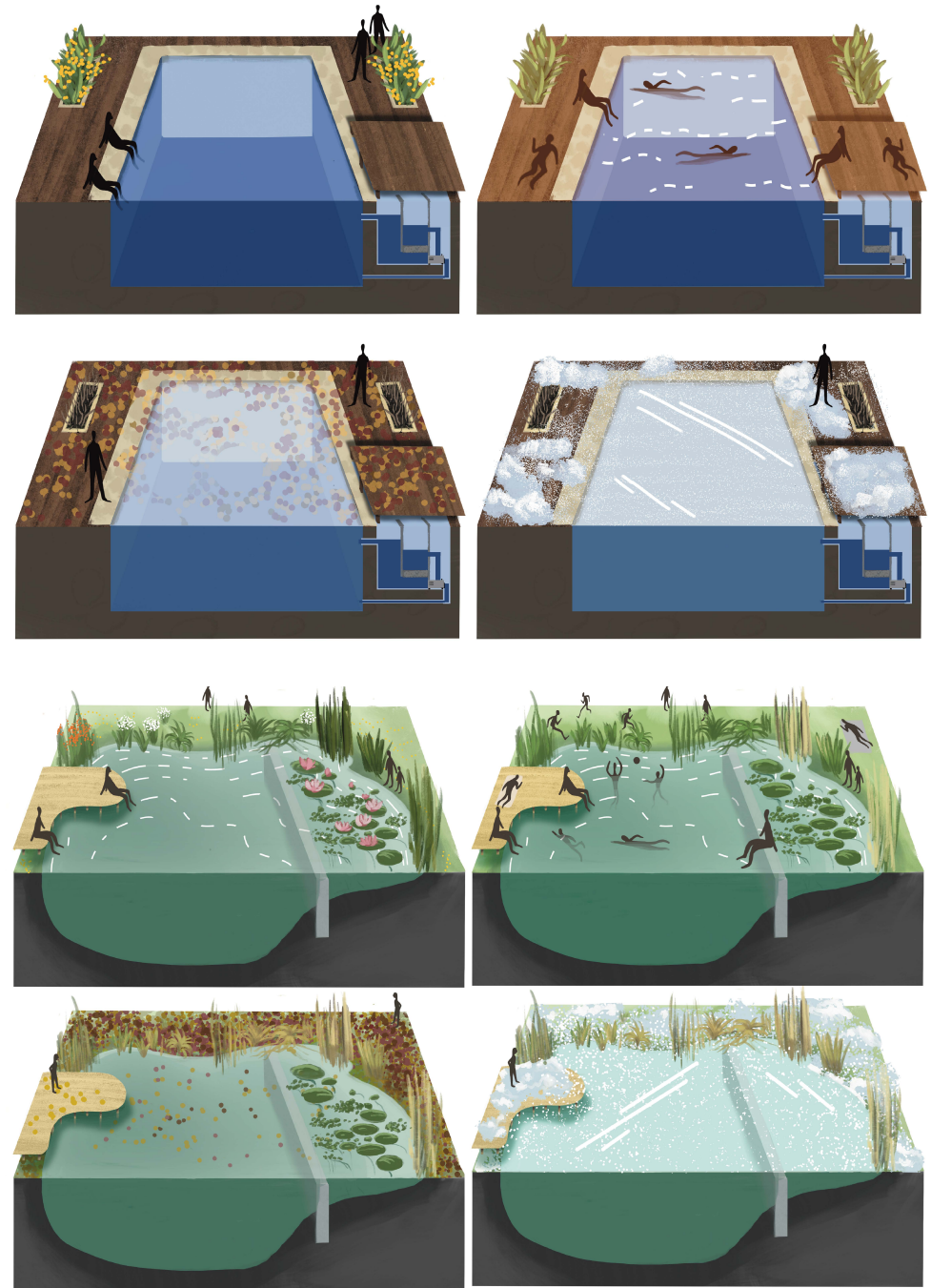


Pattern 8

Seasonality

A PNSP is not the same place throughout the year. Summer brings warm, green water, crowded edges, and visible biological abundance. Winter brings cold, clear water, quiet spaces, and dormant ecology. The light changes. The plants change. The smell changes. The same facility tells a different story in every season. A design that only works in summer abandons the rest of the year. A design that embraces seasonal change offers a facility that shifts with its ecology. This offers a different kind of recreation for every time of year, rather than restricting users from it.

Connects to 5, 6, and 7 (seasonality transforms every experiential pattern), and 2 (biological performance shifts with temperature, requiring seasonal attendance planning).



About the Pattern book

Public Natural Swimming Pools are bathing facilities that clean their water through plants and biological processes instead of chemicals. While their technical design is well documented through industry guidelines, the recreational and spatial qualities that make these places work for visitors remain largely undiscussed.

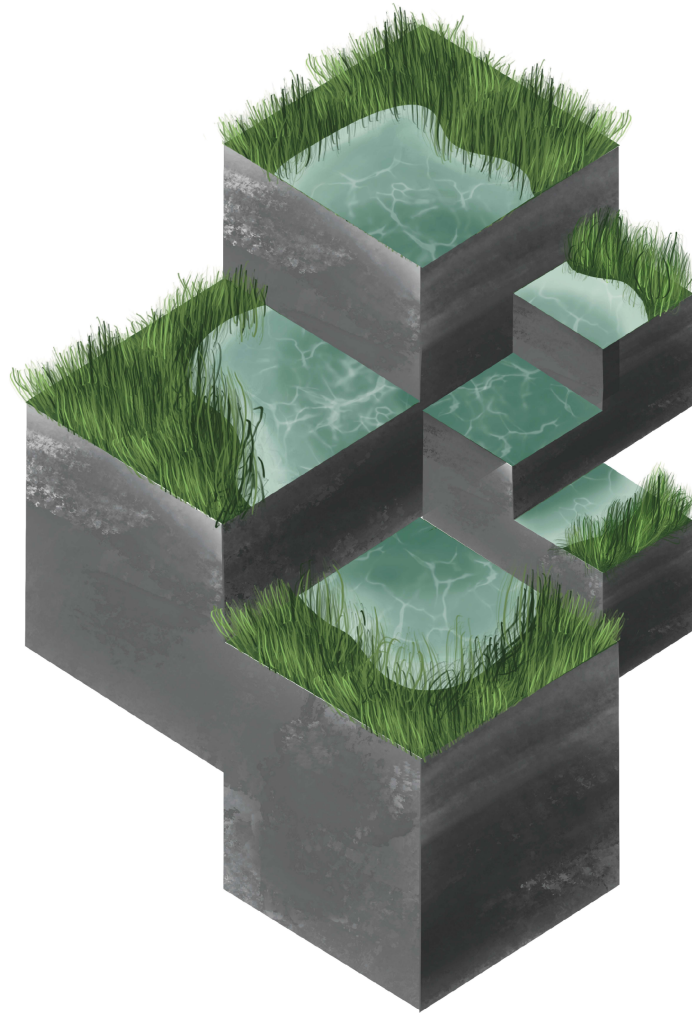
This pattern book names eight recurring design problems that shape the recreational experience of public natural swimming pools. The patterns were identified through expert interviews with designers, operators, and researchers, and cross-examined against two case studies and existing literature. They are organised in four groups — from the foundational typological decision, through spatial organisation and visitor experience, to seasonal adaptation — following the sequence in which practitioners encounter these decisions.

The patterns are not instructions. They are prompts for thinking: questions a designer or municipality should ask before and during the design of a public natural swimming pool. Each pattern connects to others, because no single decision exists in isolation.

Acknowledgments

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Pattern Book for Public Natural Swimming Pools
Written by Ernő Tóth-Pál
Illustrated by Szonja Somogyvári
SLU Alnarp, 2026
Independent Project in Landscape Architecture, 30 hp



6. Discussion

The findings of this study confirm that PNSP are growing exponentially in popularity³⁹. Beyond individual markets, initiatives like Swimmable Cities and POOL IS COOL demonstrate institutional and civic demand for public natural bathing facilities (*POOL IS COOL* 2016; Directorate-General for Environment 2025). However, the PNSP sector is still considered a niche one that relies on the FLL for construction and maintenance. The FLL, which is the driving guidebook for designing PNSPs across Europe, at the moment of writing this paper, is completely silent on recreational aspects (Giampaoli et al. 2014). Due to this, and the sector being fragmented and niche, recreational success and its discourse usually follow a bottom-up approach within companies, where opportunities are not shared within the sector (Jarvis et al. 2016).

The eight patterns identified in Section 5.3 respond directly to this gap by naming and structuring the recreational design problems that the FLL leaves unaddressed. For communicative purposes, an attempt was made to compile the findings into a pattern book that addresses the need for formats that can capture commonly used solutions in an accessible and communicative way (Felstead & Thwaites 2024). The pattern book recognised in this paper is not a replacement for the FLL by any means, but functions as a set of decision-making prompts in combination with the FLL. Furthermore, the design of it was art-driven for the purpose of evoking questions rather than answering them. In addition, the small layout ensures ease of use, but to evoke specifically the right questions and understand what they convey, it should be read together with the thesis.

Grouping of the Patterns:

Beyond their individual contributions, the eight patterns organise into four thematic groups that mirror the chronological sequence of design decisions described by practitioners³⁹:

I. Main Decision (Pattern 1) stands first: the choice between pool and pond typology precedes and shapes every subsequent decision.

II. Shaping the Space (Patterns 2, 3, and 4) addresses the physical and spatial organisation. This answers how many users, how the facility is divided into zones, and how edges serve different recreational functions.

III. Visitor Experience (Patterns 5, 6, and 7) addresses what users perceive, how they arrive and orient themselves, and what they understand about the ecological system.

IV. Designing Across Time (Pattern 8) addresses how the facility adapts across seasons.

³⁹ Stefan Bruns, Interview conducted by the author, 2026

This sequence is not a rigid hierarchy but an orientation for the designer. If one pattern is altered, it requires reconsidering the others in relation.

Group I – *Main Decision* – Pattern 1

The typological decision between pool and pond is consistently described by practitioners as the first decision in any PNSP project⁴⁰. What the findings reveal is that this decision is not merely technical but also perceptual, altering the visitor's experience and setting the visitor's frame of reference. A pool typology triggers expectations formed by chlorinated swimming pools: controlled environment, predictable appearance, and sterilised water. A pond typology triggers landscape expectations: ecological variation, naturalistic materials, and seasonal change⁴¹. These expectations determine how every design decision is received by the visitor. A visitor who expects a pool and encounters biological variation may perceive the facility as poorly maintained; the same visitor in a pond setting may read identical conditions as natural character⁴¹. However, it is acknowledged that this decision is not as simple as deciding between two types and mechanisms. Many cases operate with hybrid systems that blend both systems, with the result of getting benefits of both (Dold 2008). Regardless of where a project sits on this spectrum, the typological choice remains the single decision that shapes how visitors evaluate the facility and its further decisions.

Group II – *Shaping the Space* – Pattern 2, 3, and 4

Reading the findings across patterns reveals that the nature of the design challenge facing PNSPs is shifting. As Pattern 2 demonstrates, the biological constraints that once defined bather capacity are loosening through technological advancement^{40 42}. This shift means that the remaining design challenge is no longer biological but spatial and experiential. The question becomes not whether the water can handle more visitors, but how the space can accommodate them in ways that tolerate recreational comfort.

This shift reframes what zone differentiation and edge design mean. The FLL specifies depth zones for safety. As Pattern 3 shows, designing zones aligned with different visitor typologies like sport swimmers, families, and social bathers, reduces conflict between user groups, but is absent from any current PNSP guideline (FLL 2011; Komossa et al. 2019).

Similarly, as Pattern 4 demonstrates, the majority of recreational time is spent at edges (Gould 2010). However, current standards address edges only as structural elements for liner protection and containing the water, not as the primary sites of recreational activity. As bather capacity expands, the question of how to distribute visitors comfortably without feeling overcrowded or sightlines being blocked – reducing recreation – across diverse zones and edge conditions remains unanswered (Ouyang et al. 2026).

⁴⁰ Stefan Bruns, Interview conducted by the author, 2026

⁴¹ Stefan Meier, Interview conducted by the author, 2026

⁴² Lars Juncker, Interview conducted by the author, 2026

Group III – Visitor Experience – Pattern 5, 6, 7

The experiential patterns reveal that PNSP design is fundamentally different from conventional pool design. In chlorinated pools, the designer controls appearance through material selection and chemical sterilisation, where the result is predictable and static. In PNSPs, colour, transparency, temperature, smell, and texture are produced by living biological processes that the designer influences but does not fully control (Zavoleas 2021).

This means that recreational satisfaction in a PNSP depends not only on what the visitor perceives (Pattern 5) but on whether the visitor understands what they perceive (Pattern 7).

Research says that the water colour can matter more than clarity for aesthetic recreational purposes (Lee 2017; Angradi et al. 2018). Interviews indicate that water colour is one of the most important factors in users' evaluation of the recreational success of PNSPs^{43 44}. The design also affects users' experience, not just looks. Liner colour is the main determining factor whether visitors perceive the pool as a pool or a pond type⁴³. This ties together with what Stefan Bruns found that users in formal pool-type PNSPs perceive water as approximately 2°C cooler than in pond-type PNSPs at the same actual temperature⁴⁵. This means decisions made on how a PNSP looks directly affect how people perceive the experience on a physical level as well. Similarly to the main decision, but on a smaller, more perceivable level.

The physical temperature of the water affects how fast biological processes work (Coffey et al. 2019). This affects the colour, taste and smell of the water. If algae and bio particles break down faster, they produce sulphur compounds (Coffey et al. 2019). This influences how long visitors stay^{44 46}. Meaning that if the quality of the water is bad regarding smell and taste due to high temperatures, visitors tend to spend less time in the facility.

No existing guideline, including the FLL, addresses water appearance simultaneously as an ecological indicator, a safety parameter, and a recreational signal. The FLL's Secchi depth is a safety metric that determines whether the pool stays open. It says nothing about how the water looks and feels to a visitor. What this means for practice is that PNSP design is closer to designing a park or a wetland than designing a pool. The designer sets initial conditions and stewards a living and evolving system rather than engineering a fixed outcome (Zavoleas 2021). This is a fundamentally different design problem, and it requires guidance that does not yet exist outside this thesis.

⁴³ Stefan Meier, Interview conducted by the author, 2026

⁴⁴ Dr Holger Kühnhold, Interview conducted by that author, 2026

⁴⁵ Stefan Bruns, Interview conducted by the author, 2026

⁴⁶ Dr Jakob Schelker, Interview conducted by the author, 2026

Group IV – Designing Across Time – Pattern 8

The FLL treats seasonal change as a maintenance concern (FLL 2011). The findings suggest it is better understood as a design variable for recreation. If PNSPs are living systems that operate all year-round, then seasonal change offers shifting recreational opportunities. A facility designed only for summer peak use underutilises public infrastructure that could serve its community across the full year. Furthermore, due to the change in temperatures, visitor attendance frequency, and the appearance of the facility changes, influencing other separate recreational factors as well ⁴⁷. It is mentioned by the interviewee that a pond-type PNSP he regularly visited had great off-season recreational use, suggesting that pond-type PNSP could have better recreational use all year round⁴⁷.

What the patterns reveal together:

What the patterns reveal together is that the recreational success in PNSPs is not a single quality but an interconnected network of careful design decisions that influence each other, like what Alexander proposed (Alexander 1977). Each has its own hierarchy and relationship with other patterns in the designing process, but should not be viewed as an individual problem-solving answer. Rather, each pattern and specific relationship should be recognised as an important factor to consider during the design phase or in communication regarding recreational success.

Reading the eight patterns in relation to each other reveals that even though every pattern is connected to the others, they are not connected directly. (Fig 40)

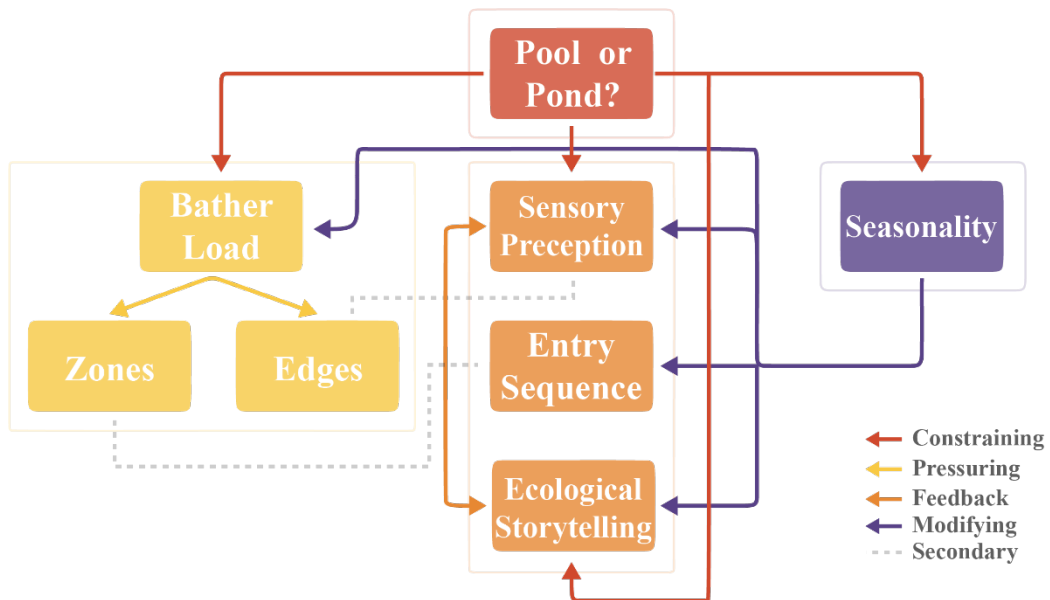


Figure 40. Illustration of how the patterns relate to each other in depth. Illustration made by the author.

⁴⁷ Dr Holger Kühnhold, Interview conducted by that author, 2026

Constraining: This connection type locks in a range of possibilities for every pattern that follows. It determines zone geometry, edge materiality, system visibility, and visitor expectation.

P1→P2 Pool or Pond decision determines how many visitors can enter its facility.

P1→P5 The visitor's sensory expectations are set by the typology. If those expectations are not met (green water in a pool-looking facility), recreational satisfaction drops. If they are met (green water in a pond-looking facility), the same conditions are accepted or even appreciated.

P1→P7 It determines whether visitors arrive expecting a chlorinated pool or a natural environment, whether the ecological system is visible as landscape or hidden as infrastructure.

P1→8 Determines that when choosing a pond type will likely result in seasonal use, and if using a pond type results in use of the facility all year round. This connection is considered weak based on one observation.

Pressuring: This connection tells that as the biological capacity expands, more visitors can enter. Creating pressure on the spatial patterns

P2→P3 As different user groups share the same places, it puts more pressure on the facility to separate them into zones without user conflicts (Collins & Pajak 2019).

P2→P4 As more visitors enter, the edges where people tend to spend most time become a scarce resource that needs more attention. Furthermore, with more people, clear sidelines become more important due to overcrowding.

Feedback: This connection reshapes each other, thus the feedback.

P7→P5 Storytelling changes how a visitor evaluates what they perceive. Green water without explanation reads as contamination; with explanation, the same water reads as a functioning system. The sensory input is identical, but the recreational evaluation is not.

P5→P7 Perception provides the material storytelling needs. If the biological system is hidden, there is nothing to narrate. If planting, water colour, and filtration are visible, every element of it becomes storytelling material.

Modifying: This connection shifts the conditions under which existing patterns operate.

P8→P5 In summer, the water is warm and green, the surfaces are hot, and biology is active. In winter, the water is cold and clear, the surfaces are cool, and biology is quiet. The same facility produces entirely different sensory conditions depending on the season.

P8→P6 In peak season, entry is crowded, where the sequence must manage flow and orientation by signage to avoid confusion (Wener & Kaminoff 1983). In the off-season, entry is isolated; the sequence must embrace quietness without feeling abandoned, and the guiding of people within the facility becomes less important.

P8→P7 In summer, the ecological story is abundant. Lush planting, active regeneration, visible wildlife. In winter, biology slows down and becomes dormant. If storytelling is designed only for summer, the facility has nothing to say off-season.

P8→P2 This modifier goes backwards. Cold temperatures slow biological filtration, reducing how many bathers the system can handle (Coffey et al. 2019).

Secondary connections:

P3→P6 The zone layout determines whether entry feels oriented or confused. If zones are clearly separated, for example by fencing, the visitor knows where to go. If they blur together, the first impression is disorientation (Collins & Pajak 2019).

P4→P5 Edge materiality and sightlines shape what the visitor perceives at the water's edge. Timber gives warmth, stone gives coolness, and sand gives softness. Clear sightlines create safety and openness; obstructed ones create enclosure or anxiety (Ouyang et al. 2026).

Limitations

Whether the eight patterns constitute a design language similar to Alexander's works, this study does not fully elaborate. Alexander insisted that a design language is generative, which, if combined, produces new design configurations (Alexander 1977). In addition, his language contained hundreds of patterns spanning scales from regional to detailed ones. The eight patterns recognised in this paper, which cover one building typology, cannot claim to have the same generative range and effect. Furthermore, the patterns were not tested in practice, meaning they remain purely hypothetical. Another limiting factor of the study is that the six expert interviews represent the supply side of PNSP design, not the user side. How visitors actually perceive the environment they are in and how their experiences are shaped is not answered and remains an open question. Therefore, the thesis cannot claim that the patterns represent recreational success as experienced by visitors.

Further research:

The study suggests testing whether the patterns function generatively when combined – as Alexander's theory would predict – would extend the understanding of how these design principles interact in practice. To expand the patterns and incorporate the user side would address the most significant limitation; therefore, the study suggests further research on this topic. Comparative research across non-European regulatory and climatic contexts would test the transferability of the patterns. The question of whether pond-type PNSPs sustain higher off-season recreational use than pool-type facilities seek investigation, which came up in the interviews ⁴⁸.

⁴⁸ Dr. Holger Kühnhold, Interview conducted by author, 2026

7. Conclusion

This study's aim was to identify what spatial, ecological, and experiential attributes that determine the recreational success of Public Natural Swimming Pools, and how these attributes can be synthesised into a decision-support framework for designers and municipalities.

Through triangulation of six expert interviews, two case studies, and a targeted literature review, eight recurring patterns were identified in recreational to recreational qualities absent from the FLL guidelines.

Typological choice between pool and pond, catchment and bather load, zone differentiation by user typology, sensory perception, edges and sightlines, threshold and entry sequence, ecological storytelling, and seasonality. Each pattern after TA analysis was put through a promotion rule where only those patterns emerged that had evidence from each triangulated methodological process. This approach is not limited to PNSPs; it could be applied to other emerging building typologies.

The findings demonstrate that the recreational challenge facing PNSPs is shifting. As biological constraints on bather capacity loosen. The remaining design problem and need for development is no longer whether the water can safely accommodate visitors, but whether the space can engage them comfortably and meaningfully.

This is a spatial and experiential problem, and the FLL, as the sector's primary international standard, does not address it. The eight patterns identified in this study begin to fill that gap by naming recurring recreational design problems that were previously unaddressed in any formal framework. The pattern book produced as the outcome of this study translates these findings into a practical communication and decision-support tool that the sector is missing. It is not a replacement for the FLL by any means, but a complement to it. It is intended to ensure that recreational questions are raised alongside biological and safety parameters during the design process.

The pattern book created in this study is art-driven, provoking the questions that should be asked, and its use should be read together with the thesis. In practice, the pattern book produced by this thesis is intended to function alongside the FLL as a decision-support tool for municipalities and design firms. Where the FLL asks whether the water is safe, the patterns ask whether the space is recreationally successful, ensuring that both questions are posed during the design process rather than only one. A PNSP sector that shares a vocabulary for discussing spatial, sensory, and experiential quality alongside biological performance is a sector better equipped to produce facilities that serve the public not only safely but well.

This study captures the supply side – designers, operators, and researchers – not the user side. How visitors perceive the recreational qualities described in the patterns remains an open question. The pattern book itself has not been tested in practice, and whether it functions as a decision-support tool in reality seeks further investigation.

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9. Appendix

Appendix 1. Questions for hte interviews.

Question for people who were not directly involved with a PNSP project:

1. Which stakeholders are most influential in decisions about public bathing waters, and how are they engaged during planning, approval, and operation?
2. How do you communicate bathing water quality and health risks to the public, and what works or doesn't?
3. How is responsibility for public bathing waters allocated between your organisation, municipalities, health authorities and private actors?
4. What are the main policy goals for public bathing waters, and how are trade-offs between health, recreation, and ecology handled in practice?
5. Where do you see the biggest governance challenges or opportunities in creating and maintaining safe public bathing sites?
6. How are ecological aspects (biodiversity, natural treatment, surrounding habitats) considered in designating or upgrading bathing waters?
7. What planning or environmental principles does your organisation promote for new or upgraded bathing sites, particularly regarding ecological performance and public safety?
8. What are the biggest day-to-day management problems for bathing waters, and how do you support local operators?
9. Looking ahead, what changes (in law, funding, collaboration) are most needed to improve public bathing waters?

Question for people who were directly involved with a PNSP project:

1. How did national or local regulations influence the design of the public natural swimming pool you worked on?
2. Which authorities were most involved in approving the project, and how did this shape design decisions?
3. What ecological performance requirements (water quality, filtration, biodiversity) were most critical in the project when it came to recreation?
4. How were ecological systems (regeneration zones, planting, substrates) translated into spatial and architectural form?
5. Where did you experience tensions between ecological performance, safety regulations, and user experience?
6. How did regulations or ecological limits influence visitor capacity, access, and programming of the space?
7. From your perspective, where does responsibility for water safety lie—designer, operator, or authority—and how does this affect design?
8. Looking back, which regulatory or ecological constraints most strongly shaped the final design outcome in the perspective of recreation and social attributes?
9. Are there aspects of public natural swimming pool design where you felt regulatory guidance was unclear or insufficient?
10. What changes in regulation or policy would most help architects design better public natural swimming pools in the future?

Appendix 2. All PNSPs that were considered for a case study.

Name	Location (Country, City)	Available efficient data
<i>King's Cross Pond Club</i>	England, London	Yes
<i>Mountain Beach</i>	Austria, Gaschurn	No
<i>Borden Natural Swimming Pool</i>	Canada, Edmonton	No
<i>Webber Park</i>	United States, Minneapolis	No
<i>BioLake of Sasso Pisano</i>	Italy, Buca S. Rocco	No
<i>Natural bathing lake Dobbiaco/Toblach</i>	Italy, Dobbiaco	No
<i>Naturbad Riehen</i>	Switzerland, Riehen	No
<i>Midgårdsbadet</i>	Sweden, Märsta	No
<i>Bylderup Naturbad</i>	Denmark, Bylderup-Bov	Yes