

# Exploring Biophilic Design Principles in the Landscape Transformation of Rigasa Train Station, Kaduna

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**Abstract:** This study explores the use of biophilia to enhance the Rigasa Train Station's environment. Biophilia, which taps into our innate connection with nature, is known for its role in improving well-being. Integrating biophilic design principles in urban areas can boost people's quality of life and create sustainable environments. A qualitative method was used. The study examined how biophilic elements can be incorporated into the train station's landscape. A comprehensive literature review on biophilia, landscape architecture, and train station design was conducted, and the research data was collected through on-site visits and interviews and supported with photographs and aerial images. The results suggest that incorporating nature-inspired elements and materials can create a more inviting atmosphere, improving passenger and personnel satisfaction and reducing stress. In conclusion, this research highlights the practical use of biophilic design in train station landscapes and emphasizes its importance for future urban projects.

**Keywords:** Biophilic Design, Landscape Infrastructure, Landscape Transformation, Railway Aesthetics, Railway Landscape, Rigasa Train Station

## 1. Introduction

In the early 20th century, prevailing architectural practices gave rise to environments characterized by inadequacy and detrimental health implications. Addressing these concerns necessitates the formulation of a novel design paradigm centred on sustainability and the harmonious integration of natural elements (Roos, 2016). Termed biophilic design, this conceptual framework endeavours to infuse human-constructed spaces with elements from the natural world, thereby fostering well-being, interconnectivity, and ecological sustainability (Kellert et al., 2008).

The fundamental premise of biophilic design is rooted in the translation of the inherent human affinity for nature, commonly referred to as 'Biophilia,' into the structural and aesthetic aspects of the built environment. The overarching objective is the cultivation of salubrious habitats conducive to human thriving. This objective necessitates a design approach that delves deeply into the intricacies of nature, encompassing the emulation of geometric configurations and patterns intrinsic to living systems, thereby inducing what has been termed the 'biophilic effect' (Salingaros, 2015). Notably, railway stations bear the potential to wield substantial influence in shaping dynamic and socially interactive urban

locales (Roos et al., 2016). Through the assimilation of sustainable and biophilic design tenets, these transportation hubs possess the capacity to transcend their utilitarian roles and evolve into vibrant urban nuclei that bolster the well-being of metropolitan inhabitants.

Taking into consideration the Nigerian railway transport system, a conspicuous absence of landscape-infused infrastructure and contextual socio-cultural considerations has resulted in railway stations that exhibit a discordant coexistence with their surroundings. The dearth of engagement with Nigerian architects and engineers in the design process may have contributed to the alienated architectural expression of these railway stations, consequently engendering a deficiency in 'place identity' and insufficient adaptability to accommodate escalating patronage and security imperatives. The modernization initiative undertaken by the Nigerian railway system, particularly exemplified in the Abuja-Kaduna rail line, sought to augment economic standards and forge connections between major urban centres. Regrettably, this transformation predominantly revolved around the implementation of standard gauge systems and high-speed train operations, neglecting the pivotal role of landscape-infused infrastructure

design. A salient illustration of this potential is found in the Rigasa Train Station in Kaduna, which provides compelling reasons for the application of biophilic design principles, thereby elevating its visual aesthetics, operational functionality, and enduring sustainability. By seamlessly intertwining natural elements within the station's landscape, a conducive and secure environment can be fashioned, catering to the comfort and satisfaction of both passengers and visitors.

## 1.1 Aim and Objectives

This research aimed to explore the application of biophilic design principles in the landscape transformation of the Rigasa Train Station in Kaduna for an improved visual and aesthetic perception of the railway system in Nigeria. The above aim translates into the following objectives:

1. To transform the conventional transit stations into the model for vibrant public places of social gathering and gateways for cities in Nigeria.
2. To provide the landscape design of aesthetic and functional station spaces that put the surrounding context of the people and the environment into consideration
3. To provide healthier railway station environments by connecting human semblance with the natural system.

## 1.2 Research Questions

1. How can the conventional transit stations be transformed into a model for vibrant public places of social gathering in Nigeria using landscape?
2. What type of landscape design elements that are people and environmental context can be used for rail station transformation?
3. Which biophilic design principles are most suitable for the solution for the transformation?

## 2. Overview of Biophilic Design Principles and Landscape Design

### 2.1 The Biophilic Design Principles

The concept of biophilic design is characterized by the intentional infusion of an awareness of humanity's innate proclivity for connecting with natural systems and processes (termed Biophilia) into the architectural configuration of built environments (Kellert and Wilson, 1993; Springer Science and Business Media LLC, 2020). This framework finds its origins in the pioneering work of Edward O. Wilson, a distinguished biologist, who introduced the Biophilia Hypothesis in 1986. This hypothesis

postulates that the well-being and longevity of human beings are positively influenced by regular engagement with the natural world. Wilson's contention rests on the notion that humans have co-evolved with the environment, consequently fostering an intrinsic emotional affinity with other living entities. This inherent rapport with nature assumes a paramount role in contemporary discourse on human health and well-being, garnering recognition within the domain of health sciences (Kellert, 1997; 2012). A plethora of investigations in the sphere of human health and well-being have corroborated the affirmative consequences of exposure to natural surroundings across a spectrum of contexts, encompassing workplaces, domiciles, recreational spaces, communal domains, and the urban landscape in which individuals reside and labour (Browning et al., 2014; Kellert, 2012). Notwithstanding the inherent predilection for nature that humans harbour, the benefits derived from such interactions necessitate repetitive experiences. This innate biological proclivity demands nurturing and cultivation to optimally function amidst the contours of contemporary living conditions (Kellert, 2012; Wilson, 1986). Kellert and Calabrese (2015) advocate for the cultivation of this innate connection with nature by devising built environments that facilitate and encourage recurrent encounters and affiliations with genuine as well as surrogate natural elements in the daily lives of individuals. They invoke the viewpoint of Rene Dubos, underscoring the urgency of reinstating a respectful and affectionate rapport between humanity and the natural world. Dubos posits that this reciprocal adaptation between humans and nature can yield outcomes that are not only gratifying but also sustainable. By effecting modest adjustments in human behaviour and the environment, and through a conscientious process of design, novel environments can be fashioned that resonate ecologically, aesthetically, and economically (Rene Dubos: The Wooing of the Earth). However, it is acknowledged that exposure to biophilic elements is beneficial to the health & well-being of humans and, and a lesser degree the health and well-being of terrestrial and aquatic ecology. Consequently, fundamental considerations need to be considered to have an effective outcome as have been identified as follows by Kellert and Calabrese (2015) and cited in (Roos et al, 2016; [webapps.unsworks.library.unsw.edu.au](http://webapps.unsworks.library.unsw.edu.au))

**Table 1: Biophilic Design Patterns, Narrative and General Principles**

Biophilic Design Pattern	Biophilic Design General Principles
1. Visual Connection with Nature A view of elements of nature, living systems and natural processes	Ensure visual access to real presentations of nature throughout the station complexes in preference to simulated nature and non-nature representations
2. Non-Visual Connection with Nature Auditory, haptic, olfactory, or gustatory stimuli that engender a deliberate and positive reference to nature, living systems or natural processes	Enhance opportunities for sensory connections (audible, smell, texture, temperature) to nature throughout the station complexes, in preference to urban simulated or constructed representations
3. Non-Rhythmic Sensory Stimuli Stochastic and ephemeral connections with nature may be analysed statistically but may not be predicted precisely	Instill patterns of nature's movements and seasonality throughout the station complexes, using real or artistic representations where necessary
4. Thermal & Airflow Variability Subtle changes in air temperature, relative humidity, airflow across the skin, and surface temperatures that mimic natural environments	Consider sequential changes in thermal and airflow variability to refresh spaces and enable comfortability throughout the station complexes
5. Presence of Water A condition that enhances the experience of a place through the seeing, hearing or touching of water	Use water as a static, dynamic and or variable design element to achieve multi-sensory experiences throughout the station complexes
6. Dynamic & Diffuse Light Leveraging varying intensities of light and shadow that change over time to create conditions that occur in nature	Use mixtures of dynamic, diffuse and changeable lighting arrangements and patterns (including illuminance and colour) to evoke movement, time, and seasonality, while maximizing solar access throughout the station complexes
7. Connection with Natural Systems Awareness of natural processes, especially seasonal and temporal changes characteristic of a healthy ecosystem.	Use natural systems (weather, hydrology, geology, terrestrial and aquatic wildlife, diurnal and seasonal patterns) as design inspirations throughout the station complexes
8. Biomorphic Forms & Patterns Symbolic references to contoured, patterned, textured or numerical arrangements that persist in nature.	Ensure biomorphic patterns legibility and interest in floor/ceiling/roof/wall places and furniture detail throughout the station complexes
9. Material Connection with Nature Material and elements from nature that, through minimal processing, reflect the local ecology or geology to create a distinct sense of place.	Consider the richness of material colour, warmth, authenticity and tactility throughout the station complex
10. Complexity & Order Rich sensory information adheres to a spatial hierarchy similar to those encountered in nature.	Prioritise pattern compositional and order use enabling stimulation, interest and legibility, including artwork throughout the station complexes
11. Prospect An unimpeded view over a distance for surveillance and planning.	Provide a sense of arrival, and prospect, for each portal 'gate', concourse level and platform level for the station complexes
12. Refuge A place for withdrawal, from environmental conditions or the main flow of activity, in which the individual is protected from behind and overhead.	Provide opportunities for retreat, contemplation, waiting, meeting, and refuge, for each portal 'gate', concourse level and platform level of the station complexes
13. Mystery The promise of more information is achieved through partially obscured views or other sensory devices that entice the individual to travel deeper into the environment.	Provide a sense of journey in pedestrian environments that ensures sightlines, permeability, and variability in edges and planes
14. Risk/Peril An identifiable threat coupled with a reliable safeguard	Lessen personal risk in preference to safety but do not let safety considerations override Biophilic Design opportunities and principle execution

Source: Springer Science and Business Media LLC (2020)

## 2.1 The Concept of Railways Landscape Design

In the past, design was related to architecture, structure, product, landscape, and urban design. These new concepts can now be seen in train stations as examples include the Shinagawa Station on JR East's Tokaido mainline, the Paddington Station in London and other railway stations in Europe (Kido, 2006). Landscape generally refers to the aesthetic and refined elegance of a specific object. The quality of a landscape is evaluated based on its design and overall impression. The concept of landscape embraces many different elements. These elements include size, form, feel, colour, etc., evaluated in terms of visible qualities by stereotyped analysis. They also include subjective factors, such as utility, designer's intention, visual and psychological impressions, surrounding conditions (background), uniqueness of the structure, atmosphere, etc (Kido, 2006).

The development of railway transport systems is perceived as one of the most effective ways of shaping sustainable urban transportation (Polom et al., 2018). Due to the current unprecedented growth in urbanization, cities and their governance entities are now investing in more sustainable public transport systems to aid the reduction in greenhouse gas emissions, aid economic efficiencies in goods and people movements in and out and across and within the cities, provide better forms of transport, as well as in assisting in creating better sustainable and healthy urban environments. Core to these investments is the upgrades and construction of railway stations (Roos et al, 2016), making railway stations, transit centres and transport interchanges evolve rapidly from purely functional transit spaces to new urban centres and destinations, resulting in activity hubs and gathering places. These stations generate high footfall creating life and vitality and are the centre of daily routines for many urban dwellers (Roos & Juvara, 2012). The Flinders Street Railway Station in Melbourne, Australia, is a case study on how biophilic design principles can be applied to existing structures and in the application of designs to a new railway station.

The landscape is a dynamic system that is constantly changing over time. The present landscape structure, consisting of land use and land cover, is the result of gradual variation in the original natural landscape caused by

humans (Feranec & Otahel, 2001). The rail transport infrastructure, especially railway stations, significantly contributes to the quality of life, sustainability and economy of urban centres (Roos et al, 2016). The landscape structure takes into account biotic and abiotic processes and phenomena in the landscape and expresses the spatial arrangement of landscape properties. The landscape structure elements as proposed by Petrovi et al (2009), comprise six basic groups/categories: trees and shrubs; grass and herbaceous vegetation; crops; exposed bedrock and subsoil; water bodies and wetlands; residential and built-up areas. According to Clark et al (2003), the landscape is the cultural perception of the physical environment created by our minds and emotions with the environment as a physical place and the landscape as a culturally determined perception and representation of the physical place, and therefore, form a complex unity (Purcar, 2019).

Landscape depends on its relationships with form, function and aesthetics. With changing times, these relationships have changed according to contemporary architectural styles. For engineers, function is always the most important and the structures they design and build always have defined functions. Railway stations are constructed as the major facility for railway passengers and have various purposes. In the past, railway stations in Europe and the USA influenced the quality of contemporary architectural styles and remained standard structures until the station buildings were revolutionized in terms of structure, form and function. The landscape character of a specific object is influenced by design. The word 'design' has two meanings: 'to hammer out an idea' and 'to express an idea as a specific form.' Therefore, design not only means ornamentation but also incorporates the creative process of expressing a designer's intention by a specific form (Kido, 2006).

## 2.2 Railway Landscape

Transportation infrastructure holds significant influence over both urban and natural landscapes. In cities, railways constitute part of the "planned landscape," shaped by cultural patterns and planning efforts (Rackham, 1986). This Railway Landscape (RL) encompasses a three-dimensional network of railways, subways, and LRT (light rail transit), comprising railroads, stations, and train cars (Railway Stations, 2016). Throughout history, town and

city layouts, guided by transportation facilities as communication corridors, have changed, affecting ecosystems, human patterns, and landscape processes. While human planning has sometimes disturbed the natural beauty of landscapes, adjustments in design, layout, and alignment can mitigate negative impacts, such as those seen with elevated railroads (Kido, 2005).

Railway stations, as essential public buildings, serve multiple functions beyond providing train access. They act as meeting places, shopping centres, and urban landmarks, with their impact on the landscape dependent on their functional type (Edwards, 1997). Contemporary stations have grown more complex, combining buildings with train sheds or canopies, concourses, and outdoor environments (Tsuchihashi, 2003). In Japan, station spaces designed for passenger transit have evolved into multifunctional spaces, serving various purposes, a tradition observed in European stations as well. These stations not only facilitate transportation but also act as commercial centres and provide links to other modes of transport (Takeyama, 1997).

### 2.3 Landscape Infrastructure

The process of creating a socio-oriented and comfortable urban environment involves modern landscape planning, design approaches, and innovative technologies that imbue public areas with identity and unique character. This process encompasses various aspects, from establishing transport areas, public gardens, squares, and pedestrian zones to designing residential complexes and architectural structures based on "green architecture" principles. Creating a continuous system of pedestrian-friendly green pathways throughout the city, connecting urban areas with suburban landscapes, is a priority in effective landscape infrastructure development. This approach enhances the city's sanitation, accessibility, and openness (Krasilnikova et al., 2013). Railway stations are integral components of the Railway Landscape (RL), considered in terms of both visual aesthetics and functional efficiency (Kido, 2005). Over time, railway infrastructure has become intricately linked with urban spatial differentiation, movement of people, and accessibility. The railway station building, as a node point in this network, has undergone significant functional transformations within the urban structure (Ye-Kyeong, Shin, and Jung

Hye-Jin, 2015). These stations have evolved from mere traffic facilities to multi-functional mega-building complexes, serving purposes such as shopping, conferences, lodging, and entertainment, providing new spaces for modern city dwellers. The landscape-architectural transformation of the urban spatial structure involves elaborating on a landscape architecting scenario. This includes regulations for the architectural planning organization of public spaces like parks, gardens, squares, and embankments, as well as guidelines for main highways and architectural spatial organization of local environmental zones (Krasilnikova et al., 2013).

Modern transit systems, particularly light rail transit, require aesthetically pleasing and convenient stations that occur frequently along transit lines. Integrating rail stations with attractive public open spaces and pedestrian-friendly areas helps attract users and maintains passenger transit (Ilie, 1982). In Europe, new railway projects prioritize customer expectations, emphasizing both functional and aesthetic aspects of station spaces (Kido, 2005). The railway stations are designed to be pleasant environments for those working inside, offering a complex shopping centre, a 24/7 active environment for retailers, and efficient transit options between different modes of transport (Ilie, 1982).

### 2.4 Perception of Landscape

Modernization, including the development of railways, has altered the perception of the landscape. In the Western world, there has been a greater emphasis on form and context, valuing unchanged natural landscapes and long-lasting structures (Kido, 2005; Traganou, 2004). The perception of the railway landscape can be categorized as static or transitional. Static elements, such as railroads, railway stations, and trains, are appreciated by standing or walking individuals (Carpenter, 1994). In scenic landscapes, according to Kido (2006), the lack of visual intrusion is crucial. On the other hand, transitional landscapes are observed from moving trains, and high speed can distort the perception of details. For conventional trains, passengers focus on the outside scenery, while high-speed trains create a flowing movie-like experience, leading passengers to focus more on the train's interior. To mitigate the negative impact of railways on the landscape and enhance the visual experience, designers should avoid visual obstructions, preserve pleasing views, and use

techniques like transparent barriers, appropriate design, vegetation, and landscaping (Moloch, 2001). The goal is to strike a balance between the modern functionality of railways and their harmonious integration with the natural and built environment.

### 2.3 Aesthetics of Railways

Aesthetics in architecture involves the appreciation of beautiful and refined built forms, assessed through human perception. It encompasses visual attributes like size, shape, texture, and colour, as well as subjective elements such as utility, designer intentions, contextual considerations, and the sense of place (Holgate, 1992). The relationship between form, function, and beauty in architecture has evolved, with an increasing emphasis on aesthetics in railway station design. Historically, train depots in Europe and America reflected prevailing architectural styles but became more standardized over time. However, there is now a renewed interest in station buildings, focusing on innovation in their structural, formal, and functional aspects. The aesthetics of railway stations balance exterior and interior design, considering planning, layout, details, and contextual factors to create accessible and inviting spaces (Ilie, 1982).

Aesthetic elements in station design include spatial considerations for security and well-being, strategic use of light to enhance architectural features, and careful scaling with human-scale elements. Details, image-based elements like local landmarks railway symbolism, and the station's identity play essential roles in the overall aesthetic appeal (Kido, 2006). Railway companies are actively incorporating aesthetics into station design through improvement programs, corporate design concepts, and collaboration with renowned architects (Kido, 2006). Transit station architecture extends beyond functionality and significantly shapes the urban landscape of cities. These stations contribute to the overall urban fabric, enriching urban life and community experiences by providing aesthetically pleasing spaces for waiting and gathering (Ilie, 1982). They have the potential to enhance the quality of urban life and create places that add value to the city's built environment.

## 3.0 Research Methodology

### 3.1 Research Design

A research methodology is a philosophical stance or a worldview that underlies and informs the style of research (Sapsford and Jupp, 2006) and it is considered the overall approach to the design process of researching all phases from the theoretical underpinning to the collection and analysis of data (Collis and Hussey, 2003; Creswell, 2009). Therefore, the method for this research involved a qualitative review of related literature. Studying the Rigasa train station is a prerequisite to engaging in the processes of analysis, synthesis and evaluation of this research.

The methodology employed in this research encompassed the acquisition of data from both primary and secondary sources, which were subsequently subjected to meticulous analysis of pictorial presentation and tabular frameworks. The data procurement process was multifaceted, entailing an exhaustive review of pertinent literature, a systematic transect walk, and a comprehensive evaluation of the Rigasa train station. This evaluation primarily focused on discerning the architectural and landscape attributes. Subsequently, the acquired information underwent a twofold refinement process. Firstly, it was evaluated and enhanced through the application of Geographic Information System (GIS) tools. These tools facilitated a comprehensive amalgamation of photographic imagery, and precise and spatial analyses conducted along the railway corridor. Secondly, these findings were juxtaposed with the geographical context and topographical layout of the stations, substantiated through meticulous documentation on field forms specially devised for this purpose.

### 4.0 Analysis of the Case Study – Rigasa Train Station

The Rigasa Train Station is situated within the Rigasa ward, which is a suburban region encompassing approximately 14 by 8 square kilometres close to the city of Kaduna, Nigeria. This area stands out as one of the most populous and densely settled regions in Nigeria, estimated to be inhabited by approximately three million residents. Within this ward, various villages are located, including but not limited to Danmani, Nariya, Makera, Mashi, Hayin Malam Bello, Sabon-garin Rigasa, Makarfi Road, Kwate, Mai-giginya, among others. The landscape configuration of the train station is analysed as follows based on its location and design as shown in plate 1 with

the elements needed in the landscape reconfiguration of Rigasa train station.



**Plate 1: Google Map of Rigasa Train Station, Rigasa, Kaduna State.**

Source: Google Earth (2023)

1. Entrance Plaza and Accessibility: The Rigasa Train Station is a contemporary infrastructure situated on an elevated terrain. It features a principal entrance forecourt serving as the central focal point for passenger services. This forecourt includes a ticketing counter and a passenger lounge. Notably, the station's design incorporates modern aesthetics,

utilizing alucoboards to embellish its exteriors. Furthermore, the station includes ramps to facilitate the movement of rolling trolleys; however, it is important to note that these ramps are too steep to accommodate individuals with disabilities. Regrettably, the station's immediate vicinity lacks a comprehensive railroad network that would enable efficient mobility utilization.



**Plate 2: Rigasa Train Station Plaza, Rigasa, Kaduna State**

Source: Author's Fieldwork (2023)

Additionally, there is a deficiency in essential landscape elements and outdoor amenities, such as trees, flowerbeds, roof overhangs, and canopies. These elements, if integrated, could offer much-needed shade and greenery, thereby

enhancing the entrance area's visual appeal and overall inviting ambience. It is observed that passengers, as depicted in plate 2, tend to congregate in front of this complex, often resorting to makeshift

seating arrangements atop their luggage while awaiting their turn for ticketing.

1. **Drop-off and Pick-up Areas & Motor Parking Facilities:** The train station incorporates designated zones for the drop-off and pick-up of passengers, accommodating both private vehicles and public taxis as illustrated in plate 3. Furthermore, parking facilities are available

to cater to commuters who arrive at the station by car. Nevertheless, these areas lack effective design elements aimed at ensuring the seamless flow of traffic. Specifically, there is a notable absence of proper delineation between vehicular and pedestrian pathways, encompassing essential features like curb cuts, signage, and road markings.



**Plate 3: Google Map of Rigasa Train Station, Rigasa, Kaduna State.**

Source: Author's Fieldwork, 2023)

To address these shortcomings, the train station must prioritize pedestrian accessibility. This can be achieved through the establishment of clearly defined pedestrian walkways leading from the entrance plaza to the station building and adjacent platforms. Furthermore, the existing parking areas exhibit suboptimal conditions, lacking concrete surfacing and landscape elements, such as trees and other ornamental plantings, essential for enhancing both visual aesthetics and the provision of shade. These walkways may be surfaced with pavement or concrete materials, often featuring ramps or staircases to facilitate convenient and safe pedestrian movement.

2. **Platform Landscaping and Outdoor Seating:** The absence of landscaping elements such as trees, shrubs, flower beds, potted plants, and seating arrangements, whether concrete or alternative materials, is notably conspicuous within and around the train station's platforms. These green spaces, if integrated, hold the potential to provide essential benefits. These benefits encompass the provision of shade,

improvement of air quality, creation of a more pleasing environment conducive to the comfort and relaxation of waiting passengers, and enhancement of the overall aesthetic appeal of the train station.

3. **Drainage Pattern:** In the context of landscape design for train stations, the establishment of effective drainage systems and irrigation infrastructure holds paramount importance. However, the Rigasa train station has encountered challenges in the proper integration of these essential components. Notably, the access road exhibits a slope leading toward the plaza drop-off area, which lacks both concrete surfacing and asphalt overlay. This configuration results in suboptimal management of rainwater runoff and inadequate maintenance, ultimately contributing to a less attractive appearance, particularly during the rainy season, when the station area tends to become muddy and untidy.

## 6.0 Conclusion

In conclusion, biophilic design seeks to translate humans' connection with nature into built environments, creating healthier habitats. Railway stations like Rigasa in Nigeria have



often overlooked landscape design, leading to incongruous and impersonal station designs. Rigasa presents an opportunity to integrate biophilic design principles, enhancing aesthetics, functionality, and sustainability. The biophilic design recognizes the human-nature connection, known to positively impact well-being. To realize these benefits, ongoing engagement with nature and thoughtful design adjustments are crucial. Integrating biophilic design in urban landscapes, exemplified by Rigasa Train Station, offers numerous advantages, including improved well-being, sustainability, and vibrant public spaces. As urban design evolves, embracing biophilic principles is imperative. Recognizing humanity's inherent bond with nature and integrating it into architecture can create spaces that promote health, connectivity, and ecological balance. This necessitates a collective commitment to prioritize these principles in future landscape design initiatives, ultimately enhancing both human lives and the environment.

## 7.0 Recommendations

To facilitate more sustainable landscape practices and incorporate eco-friendly design elements at the Rigasa Train Station, the following biophilic design principles are proposed:

1. **Incorporating Natural Elements:** Integration of natural components like plants, water features, and natural materials is recommended. Incorporating plants and trees can offer benefits such as shading, pollution reduction, and aesthetic enhancement. The inclusion of water features, such as fountains or small streams, can create a tranquil ambience and mitigate noise pollution.
2. **Maximizing Natural Light:** Maximizing the utilization of natural light sources should be prioritized. Implementing

skylights and expansive windows can introduce ample natural light into the environment, thereby enhancing users' moods and reducing energy consumption.

3. **Creating Connections with Nature:** Establishing a profound connection between users and the natural environment is essential. The use of natural materials like wood and stone can foster a sense of harmony with nature. Additionally, the incorporation of outdoor spaces, such as gardens and green roofs, can cultivate a stronger connection between users and the natural world.
4. **Incorporating Natural Shapes and Forms:** Embracing natural shapes and forms, particularly those culturally relevant to the Kaduna region, is encouraged. The incorporation of curves and organic shapes can evoke feelings of relaxation and serenity. The integration of natural textures, such as wood and stone, can further contribute to a sense of comfort and warmth.
5. **Providing Opportunities for Interaction with Nature:** Encouraging users to engage with nature should be a priority. This can be achieved by including outdoor spaces like parks, gardens, and green roofs that offer opportunities for interaction. Additionally, incorporating seating areas, walking paths, and other amenities can incentivize users to spend more time in natural settings. By implementing these biophilic design principles, the Rigasa Train Station can undergo a transformation that not only enhances its sustainability but also fosters a more eco-friendly and user-friendly environment in alignment with the local culture and natural surroundings.

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