Recovery of residual public spaces to improve the quality of life of the inhabitants of San Borja, Lima.

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Abstract. The present research aims to propose a model for the recovery of residual public spaces to improve the quality of life of the district of San Borja’s inhabitants. San Borja is in the process of densification and requires a more significant number of public spaces that offer, in addition to vegetation, public places for active and passive recreation, such as spaces for sports and games, walking pets, and relaxation. These needs have increased due to the confinement caused by the COVID-19 pandemic. Also, it was noted that the median strip, or central reservation of the avenue, can be recovered for people to use. Therefore, a four-phase study was carried out that included reviewing the literature and observing two cases. In conclusion, a model was proposed to recover the public space of the median strips of San Borja Norte Avenue and San Borja Sur Avenue to improve the quality of life of the inhabitants of San Borja, which can be replicated in other avenues with residual spaces with similar characteristics.

Index Terms—Residual Public Space, quality of life, Social Integration, Urban Design, Sustainable Public Space

1. Introduction

Residual or empty spaces are of great value in an urban environment because of their potential to correct the deficit of open spaces in congested cities. [1]. In many cities of the world, these spaces are ignored or underused; they are useless, abandoned spaces, intermediate areas between the public and the private [2], being able to join the network of public recreation spaces to make them pleasant for people, associated with the life of the inhabitants and thus achieve the improvement of the quality of life. Residuals or voids are of great value in an urban environment because of their potential to correct the deficit of open spaces in congested cities. Residual spaces also appear as a result of the planning process [3]. They are located at street crossings, between buildings, under bridges, or elevated highways. They are also sometimes called in-between spaces and lost spaces. The residual spaces seem to drag on the city; they are abandoned and host informal activities [4]. On the other hand, they can represent a source of income and allow community participation, which could be part of the sustainable development of cities since they can be exploited and oriented to community service and offer jobs. These spaces have a potential that can be harnessed through reuse [5], becoming critical strategic locations for “green urban development”. In cities, people’s social life requires open public spaces, so it is essential to examine the quality and design of these spaces and, through critical projects, transform them into welcoming places where general activities are scheduled, significantly to
reduce the impact of COVID-19 pandemic and meet the needs of social interaction through usable residual spaces [6]. The district has the particularity of having two ample avenues with wide central separators, abundant trees, and many green areas, which cross the section from West to East, which are used for landscaping. These unused spaces are residual spaces. The problem is that, given the densification, with housings that are expected to be of high quality, it is necessary to increase the public spaces conditioned [7] for the active and passive recreation of the growing population, identifying the residual areas—from San Borja Norte and San Borja Sur avenues, creating spaces that respond to the needs of users, generating quality of life and integration of residents and visitors. These residual spaces do not offer places to develop recreational activities or the urban furniture necessary to provide comfort and safety to the neighbors. For these reasons, a model for the recovery of residual public spaces is proposed, which, well designed, promotes outdoor activity, social communication, social coexistence in the community, and improved quality of life of the inhabitants of San Borja, In Lima city. [8]

2. Literature review

2.1 Residual public spaces
Residual public spaces are publicly owned land with the potential to be exploited. However, they must be equipped and implemented to provide a function that provides a better quality of life for people. These spaces are also known as lost spaces [9], which are underused, without a specific function, or empty or abandoned [10]. These spaces are an opportunity to develop a public space with a sustainable urban design or in many cities in the United States. Residents and business owners along a road with residual spaces have adapted them for various transit activities [11].

![Figure 1. Application of design criteria on the road.](image)

2.2 Calidad de vida e integración de usuarios
In public spaces, people interact, interact with family and friends, and make it easier for the community to get to know each other, incorporating people of any age and culture, without restriction, sharing recreational and rest activities [12], so improves the quality of life of users who live around and outside [16]. A recreational area with vegetation can reduce air pollution and relieve stress for people, improving the quality of life by offering a healthy place to users [13]. A public space can provide quality of life when it offers health and sociability, favoring community cohesion. The sedentary life and the confinement generated by the COVID-19 pandemic [14] have caused the impoverishment of the quality of life in health and social integration. Still, a public recreational space that observes the recommended health protocols can recover them.
3. Methodology

3.1. Study phases
The study was conducted by reviewing the bibliography and gathering information from the study area.

- Review of bibliography: conceptual, theoretical and methodological contents. Arrays of variables
- Survey of information of the public space and environment: matrices and thematic plans. Tools: AutoCAD, Excel.
- Proposal of recovery mode, of residual public spaces for the improvement of the quality of life
- Analysis and evaluation of public space considering the matrices of activities and characteristics.

3.2. Place of Study
The place of study was developed in the department of Lima, province of Lima, in the district of San Borja. It is located in the geographical coordinates 12°06’28” South latitude y 76°59’56” West longitude, with an altitude of 143 meters above sea level [18].

Figure 2. Application of design criteria on the road.

Figure 3. Study phases.
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Figure 4. Location of Av. San Borja Norte and Av. San Borja Sur, District of San Borja, City of Lima, Peru.

Figure 4 explicitly shows where the investigation took place, San Borja Norte Avenue, from block 10, intersection with Av. San Luis, up to block 14, meeting with Av. Boulevard de Surco, also San Borja Sur Avenue from block 9, intersection with Av. San Luis, to block 14, intersection with Av. Boulevard de Surco. [15]

3.2.1 Climatología

The climate of San Borja is temperate-warm and without abrupt variations [19]; this is because it is located in Lima, which has an arid and temperate climate, with a deficiency of rains in all seasons of the year [16].

Figure 5. Average temperature and precipitations (a), Cloudy sky, sun, and precipitation days (b)

Figure 5(a) shows that the average temperature varies between 23 °C and 18 °C. Precipitation is scarce; there are drizzles in the winter months, especially. The maximum temperature, in March, exceeds 25 °C, also in (b), we can see that most of the year is partially cloudy, it is shown that in June and July they have the least number of cloudy days, in addition to January and February are the months that have the most overcast days. The average annual humidity is above 95% [20].
Figure 6. wind speeds (a), compass rose (b)

Figure 6 (a) shows that in July, there are more days with winds with speeds below 38 km / h, in September and October, there are fewer winds with speeds below 5 km / h, also in (b) shows that the prevailing winds are from the southwest with a maximum speed of 38 km / h.

3.2.2 Flora
San Borja has 1,345,503.2 m² of green areas, of which 64,130.07 m² are under the administration of Metropolitan Lima, and 29,973.62 m² are under the Autonomous Authority of the Electric Train; the rest is in charge of the local administration. San Borja has 55 parks with a total of 575,063 m² and avenues with green central divisions, observing a harmonious landscape throughout the district. Public parks represent 43.4% of total green areas. The district has an average of 11.95 m² of green area per inhabitant exceeding what is recommended by the World Health Organization (WHO) of between 9 and 12 m² of green areas per inhabitant; this indicator highlights the level of quality of life in a district or a city and 25 species of trees native to Peru were distinguished.

Figure 7. Distribution of tree species of the district of San Borja.

Figure 7 shows the different tree species from the forest inventory provided by the San Borja district. In San Borja, 88 tree species were identified, predominantly Delonix Regia, commonly called Ponciana Real with 23%, and Ficus Nitida with 13%, commonly called Ficus Verde.
Table 1: Data of the two most common tree species on Av. San Borja Norte, Av. San Borja Sur.

| Scientific name | Common name     | High     | Type of cup | Diameter |
|-----------------|-----------------|----------|-------------|----------|
| Delonix Regia   | Ponciana real   | 6 – 8 m  | Parasolada  | 5 – 6 m  |
| Ficus Nitida    | Ficus verde     | 30 m     | Round       | 50 m     |

3.2.3 Irrigation system
San Borja has an Ecological and Biophysical Plant for the treatment of contaminated waters from the Surco River, as shown in figure 8, to be used only for the irrigation of green areas, minimizing the environmental impact, and performing adequate health management.

Figure 8. MINAM irrigation system (a), water treatment plant of the Surco River, Municipality of San Borja (b).

Figure 8 (a) shows that the Surco river passes through the district of San Borja, which is a channel that comes from the Rimac river, also in (b) shows that its waters are used by the treatment plant located in the La Felicidad park, where the contaminated water is treated and stored in a cistern, then pumped into the sprinkler irrigation system.

3.2.4 Fauna
The fauna of the San Borja district is made up of birds such as the white-tailed (Zenaida auriculata). This species has better adapted to the changes produced by urban growth, the common pigeon (Columba Livia) and the sparrow (Passer domesticus), those that inhabit the vegetation of the district. In addition, there are species such as the common snail (Helix aspersa) and rodents such as the mouse (Mus musculus) or the rat (Rattus rattus), which are attracted by the organic waste produced in the district [19].
3.2.5 Población

According to the Census carried out in 2017 in the province of Lima, the district of San Borja has a registered population of 116,906 inhabitants, of which 57,642 are men and 59,264 are women, and its population density is 11,370.18 [18].

![Figure 9](image)

**Figure 9.** The population of the district of San Borja is according to their age and sex.

The population of San Borja has been studied, figure 9, and in the case of 0 - 15 years, the population is around 16,780 inhabitants, age in which they need recreational spaces. Currently, there are none in the sections of Av. San Borja North and Av. San Borja Sur. Almost 30% of the female population is over 60 years old and requires rest furniture such as benches, which, in the Av. San Borja Norte section, we only find five, which are insufficient. [20]

3.3. Land use

**Current situation Av. San Borja Norte and Av. San Borja Sur**

The selected roads are av. San Borja Norte, from block 10, intersection with Av. San Luis, up to block 14, intersection with Av. Boulevard de Surco, and Av. San Borja Sur from block 10, intersection with Av. San Luis, up to block 14, intersection with Av. Boulevard de Surco.

![Figure 10](image)

**Figure 10** Zoning map San Borja - Av. San Borja Norte y Sur
Figure 10 shows that the zoning of Av. San Borja Norte and Av. San Borja Sur is high-density residential (RDA), and the commercial sector is located at the intersection with Av. San Luis. It was observed that the current use of residential land with single-family homes, multi-family homes, commerce with multi-family and single business. This research allows us to understand the current distribution and zoning (See figure 11).

![Figure 11](image1)

**Figure 11** Current use of Av. San Borja Norte (a) y Av. San Borja Sur (b)

It is observed in figure 11 (a) that in Av. San Borja Norte has a predominance of 42 single-family homes, 48 are multifamily, 2 are multifamily plus businesses, and 3 are only businesses, also in (b) shows that in Av. San Borja Sur Norte has a predominance of 42 single-family homes, 48 are multi-family, 2 are multi-family plus businesses, and 3 are just businesses.

3.4 General characteristics

The two selected roads, Av. San Borja Norte and San Borja Sur, currently have a road, a berm, a sidewalk, a central separator, and also a bike lane.

![Figure 12](image2)

**Figure 12** Plan and section of Av. San Borja Sur from block 10 to 14.

Av. San Borja Sur, from blocks 10 to 14, a central arborized separator was observed, with a 34 m section showing landscaped treatment and a 2.10 m wide bike/pedestrian lane. The sidewalk on the wall perimeter has a team that varies from 1.20 m to 1.50 m and a berm 3.30 m wide, see figure 12.
Av. San Borja Norte, from blocks 10 to 14, a central arborized separator, varies between 20 m and 66 m wide section showing landscaped treatment and a 2.10 m wide bike/pedestrian lane. The sidewalk on the perimeter of the separator has a team that varies from 1.20 m to 1.50 m, and a berm 3.30 m wide, see figure 12. [6]

Table 2: Road and citizen security of Av. San Borja Norte and Av. San Borja

| Road and citizen security | Av. San Borja Sur | Av. San Borja Norte |
|---------------------------|------------------|-------------------|
|                           | The road only has two security cameras and four hydrants. | The road only has four security cameras and three hydrants. |
|                           | The road has traffic lights at the junctions with Av. San Luis, Av. Boulevard de Surco, and Ca. Rousseau, and signage with all the streets and shreds. | The road has traffic lights at the junctions with Av. San Luis, Av. Boulevard de Surco, and Ca. Liszt, and signage with all the streets and shreds. |

4. Results

In the proposals given, the principle of intermodality was applied, which consists of the sections having different types of activities and that they can coexist, through rest areas, recreation areas, and bike lanes, and prioritizing mobility sustainability.
Figure 14 Proposal plan of Av. San Borja Norte from block 10 to 14 (a) and Av. San Borja Sur from block 10 to 15 (b)

The proposals cover the variables of environmental sustainability, universal accessibility, road safety, uses, economy, citizen security, comfort, and landscaping, which can be seen in figure 14 of av—San Borja Norte (b).

4.1. Environmental Sustainability
Sustainability in saving non-renewable resources, through the use of Led lighting and the use of solar panels, technical drip irrigation by laying a network of pipes, and the location of cisterns at specific points. Environmental sustainability through the selection of leafy trees with the capacity to absorb greenhouse gases, which both consume little water and produce shade, and the use of durable materials that do not require much maintenance, use of recycled and recyclable materials, use of containers, that secrete waste to take advantage of it. Sustainability in promoting sustainable transport through bike lanes and bicycles that the municipality provides free to neighbors, and the incentive for people to walk through attractive and safe spaces. [12,17]
4.2. Universal Accessibility
An infrastructure that combines constructive and operational elements was proposed for the comfortable movement of people with disabilities, children, and the elderly. To achieve this, different parts were presented: ramps with international standards, auditory traffic lights, tactile pruning strips, colors, textures, and, in some cases, railings. [5]

4.3. Road Safety
To prevent automobile accidents, measures were proposed for calm traffic, such as signage, bollards, and flat bulls' backs. The places identified for pedestrian cruises can be used even at night.
4.4. Uses
The proposal is that different types of activities can take place in space: rest, recreation, sports, culture, circulation, and that the different types of users can make use of the rooms in harmony. Areas of the interaction of various activities were proposed for the recreation of people. [11]

4.5. Economy
Spaces for social integration and areas for sports and recreational activities have been proposed; these require some food and hydration services, so kiosks were raised, which generate a profit for the municipality, which will invest in the maintenance of public spaces. In addition, by achieving living spaces, where cultural, social, sports, and recreational activities are promoted, with a varied audience,
capital gains are generated since many people want to live in attractive places close to recreation and sports.

![Figure 19](a) ![Figure 19](b) ![Figure 19](a') ![Figure 19](b')

**Figure 19** Current photography Av. San Borja Norte (a) and Av. San Borja Sur(a’). Design proposal Av. San Borja Norte (b) and Av. San Borja Sur(b’)

### 4.6. Public Security

It was proposed to locate a public lighting network with led lighting, which gives greater security to recreation areas and pedestrian paths, to be able to be used even at night.

![Figure 20](a) ![Figure 20](b) ![Figure 20](a’) ![Figure 20](b’)

**Figure 20** Current photography Av. San Borja Norte (a) and Av. San Borja Sur(a’). Design proposal Av. San Borja Norte (b) and Av. San Borja Sur(b’)


4.7. **Comfort**

Furniture was proposed that responds to the needs of the users, such as benches to rest with shade, good lighting, trash cans at distances of 5 m to 6 m in the respective sections, snack kiosks, children's games, mini gyms, spaces for various activities or multipurpose squares, drinking fountains, bike lanes and sidewalks that measure from 1.20 to 1.50, which allow you to walk simultaneously and social distancing in times of pandemic. [3,7]

![Current photography Av. San Borja Norte (a) and Av. San Borja Sur(a'). Design proposal Av. San Borja Norte (b) and Av. San Borja Sur(b’).[Figure 21](#)](Image)

4.8. **Landscaping**

Design with the use of colors, textures, vegetation, and surface materials creates a good image and an attractive space for users. The proposed vegetation is made up of trees selected by family, size, or shape, depending on the climate since some trees turn a lot on the environment where they are planted and shrubs and grasses found in the stretch. The design of the proposed furniture, such as benches, pergolas, lighthouses, sinks, was thought more than all the styles in the environment of the place, plus the landscaping harmonizing nature with the built landscape.

![Current photography Av. San Borja Norte (a) and Av. San Borja Sur(a'). Design proposal Av. San Borja Norte (b) and Av. San Borja Sur(b’).[Figure 22](#)](Image)
5. Conclusions
Residual spaces are existing public areas in the urban context. In the San Borja district, two residual spaces were identified in two of the most important roads in the neighborhood, with great exploitable potential to serve the community. The intervention in these spaces requires a sociocultural, physical, and environmental study that allows generating a model of recovery of public spaces to improve the inhabitants’ quality of life. The district is densified, and public openings for recreation are not projected to meet the population's needs in the future. To revitalize the residual areas in a way that attracts the community and satisfies their recreation and health needs, the sustainability criteria have been considered in the proposal: Universal Accessibility, Road Safety, Public Safety, Comfort, Landscaping, Connectivity, Economy, Uses. The recovery process of urban spaces has a positive impact on the quality of life of the inhabitants.

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