

## **DESIGNING AREA ALONG-SIDE URBAN DRAINAGE INTO GREEN OPEN-SPACE AND WATER FOR LEISURE (CASE STUDY: ALONG SIDE URBAN DRAINAGE AT RAYA JEMURSARI STREET-SURABAYA)**

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### **Abstract**

*This paper follows the first paper, which has been discussed in Seminar Lanskap Perkotaan – Green City at UPN “Veteran” Jatim on May 2006. The first paper aimed to explore an idea of improving green area by designing area alongside urban drainage into green open-space. By developing this area as a green open-space will contribute to urban landscape aesthetic, improve the human comfort, reduce air pollution from vehicles disposal gases and also improve the drainage into water for leisure. The case study, in the first paper what we proposed was the area alongside urban drainage at Raya Jemursari Street in Kelurahan Wonokromo, East-Surabaya. It has advantage as a place of street-traders who are greenery sellers, and are well-developed but at undeveloped site-planning. According of these potential, as an open green space and a place of greenery sellers, we are trying to plan it also as water for leisure to the community to get more benefit for the city and the citizens. So, in this paper we aimed to design the green open-space more detail, beside contribute to urban landscape aesthetic, improve the human comfort, and reduce vehicles disposal gases pollution, this green open-space also aimed to bring more leisure to the citizens.*

Keywords: along side the urban drainage, open green space, water bodies for leisure

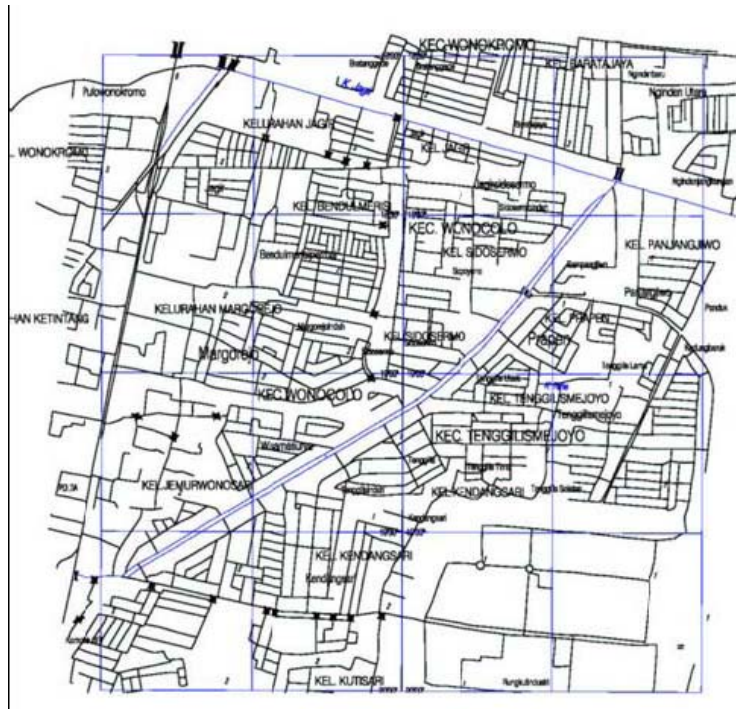
### **Introduction**

Surabaya as a big city in warm-humid climate, most of the citizen socializes in outdoor area (Lewis et al, 1971, Plumley, 1977) and need good, healthy and open green-space. The open green-space in warm-humid climate should be comfort to the human health and thermal, because in warm-humid climate usually has a strong sun radiation, high air temperature and relative humidity, and slow air movement.

The high density of population and housing demand in Surabaya lead to the impact of diminishing the green open-space from urban areas. According to the data from its local government, Surabaya lacks more than 27 million meter square green openspace (Kompas, 14 Juni 2003) whereas the coefficient is 10.03 m<sup>2</sup> per citizen, dictated in Masterplan Surabaya in the year of 2000. This condition bring an idea, redevelopment area alongside urban drainage into green open-space to contribute the urban landscape aesthetic, improve the human comfort, reduce air pollution from vehicles disposal gases and to bring more leisure to the citizens. The land use development in a big city also impact to the urban air quality and air temperature. The open green space improvement have a positive impact to the urban air quality, because less of open green area and ground absorption capacity increase heat emission and the air temperature in the urban area. Planning open green spaces with vegetation, potential to increase the air quality and keeps the air temperature not to become hotter. Whilst to improve open green spaces with vegetation and clean water for leisure, could contribute to urban landscape aesthetic.

### Overview Alongside Raya Jemursari street Urban Drainage, at Surabaya

In Surabaya, there is much urban drainage cross the city; some of it goes along the street as in Raya Jemursari Street, which connecting Nginden Bridge and Raya Jemur Andayani Street. This urban drainage is in the middle and alongside Raya Jemursari, a two-way road. This two-way road connected by bridges upon the drainage in several places, used by the vehicles to turn around and provided by pedestrian bridges across the drainage. The urban drainage itself is around 2.50 meters depth and approximately 2.50 meters width from the drainage edge to edge. It seems less-maintained and seldom cleaned up. In dry season the water is shallow, and it becomes grassy areas. In wet season, especially after rainfall, it is fulfil with drainage water from the road surroundings. The drainage riparian now is used by street-traders who are greenery, pottery, and nature-stone sellers. They seem well-developed but at undeveloped siteplanning. The seller lots are about 5.00 to 10.00 meter long and they have to rent their lot to the Kelurahan (local government). There are no parking areas for the greenery buyer, so that they park the vehicles and buy the greenery on side of the Raya Jemursari road which has very high intensity in vehicles since morning until midnight. In several parts of that urban drainage used for domestic waste dumping (TPA) and at the South end side of Raya Jemursari road used by food traders from evening until night.



Urban Drainage at Raya Jemursari Street, Surabaya



**Existing Condition of the Urban Drainage in Raya Jemursari Street, Surabaya**



**One of the greenery seller's lot**



**The turn over bridge a cross the urban drainage**



**One of the greenery seller's lot**



**One of the greenery (pottery) sellers lot**



**the domestic waste dumping (TPA) at Raya Jemursari**

Looking forward to this area along side urban drainage Raya Jemursari Street condition, it has a potent to improve the street- greenery seller's location as a green open-space by designing this area with a better site plan. The new design site plan, purpose to develop the street-greenery traders and the greenery buyer comfort in their trading activity, contribute to urban landscape aesthetic, reduce air pollution from vehicles disposal gases and. to get more benefit for the city and the citizen.

## Theoretical Approach

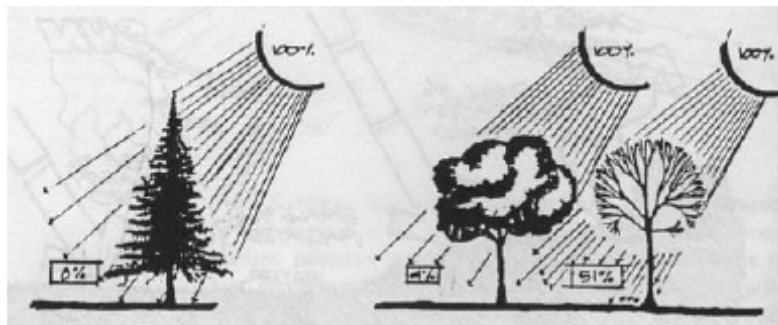
### *Air Pollution*

In many literacy, we learned that in most of tropical big cities, usually has high air pollution (Schell et al, 1993), and most of this air pollution come from vehicles disposal gases and industries. This air pollution in a city produces by every citizen and brings impact to every citizen (Mage et all, 1966). The air pollution which comes from vehicles disposal gases will affect to the citizen health crisis and it also will be an environmental problem. Reducing the vehicles disposal gases in urban area could be effective with vegetation in open green space, because vegetation catch any particulate, absorb the air pollutant and keep the carbon atmospheric (Mc Person, 1992). The vegetation on open green space reduces the amount of CO<sub>2</sub> in the air (Nowak and Mc Bride, 1993) and absorbs efficiently the other pollutant gases (Mc Pherson et al, 1998).

### *Vegetation*

Vegetation in open green space also creates thermal comfort to the human (Heisler, 1974, Stark and Miller, 1977). According to a research in Miami ground covered with vegetation could decrease the ground surface temperature until 15 degree Celsius in hot season (Parker, 1983) and in sub-tropic climate at Mexico City decrease the city air temperature until 5.5 degree Celsius in two miles radius (Jauregui, 1973). Another positive influence of vegetation in open green spaces in the cities, if the air temperature decreases 1-2 degree Celsius, it will decrease the buildings heat (Oke, 1989, Shasua-Bar and Hoofman, 2003).

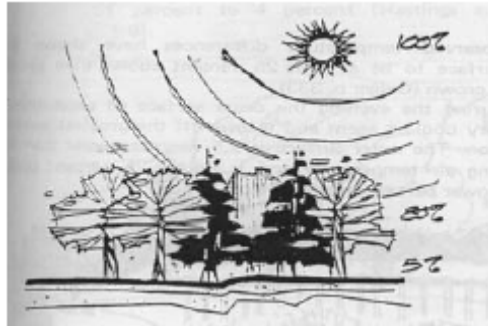
Vegetation in the cities microclimate not only creates a thermal comfort to the citizen, it also affect to the efficient usage of the building energy to keep the indoor air in comfort (Miller, 1988). Vegetation influences radiation by blocking direct solar radiation and reducing heat loads on exposed surfaces. Vegetation shades because plants absorb rather than reflect sunshine. Vegetation can also improve hot micro-climate by filtering and cooling the air (Davis and Schubert, 1977). Shading from trees can prevent as much as 70 % of the sun's heat from being absorbed by the ground, and this combined with tree transpiration process will have a measurable effect on air temperature. (Kerner)



Vegetation blocking and shade direct radiation

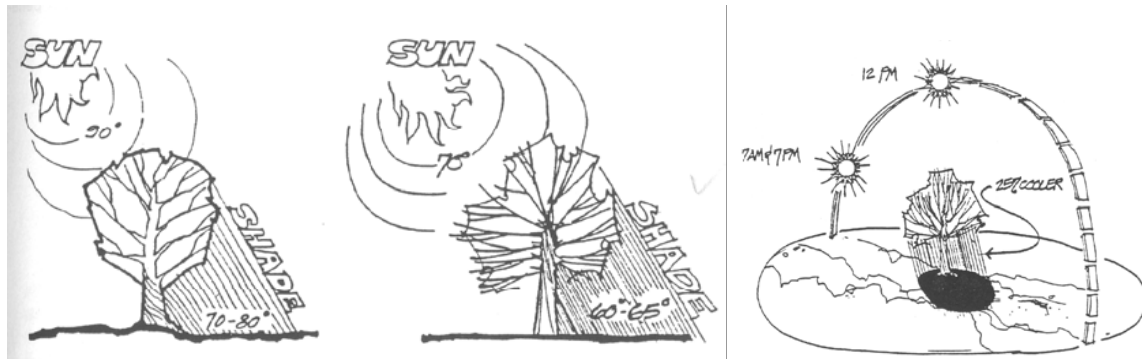
Vegetation is effective in controlling and shading the solar radiation because of the vegetation crown (Heisler, 1974). A mount of sun radiation which struck on vegetation use for it growing, and about 10-25 % for heating the air temperature surround it. Otherwise hard ground cover, for example open parking area in town absorbs 85 % sun radiation which struck on it and less of it heats the air temperature. The solar radiation which absorbs by the parking area surface also heats the air above it, so the air temperature above the open parking area surface is cumulative of the direct solar radiation heat and the solar radiation heat which reflected by the open parking area surface.

In a dense group of trees, up to 80 % of the incident solar radiation is caught in leaves, needles, twigs and branches of vegetation, so that less then 5 % reaches the ground during the day (Geiger, 1957).



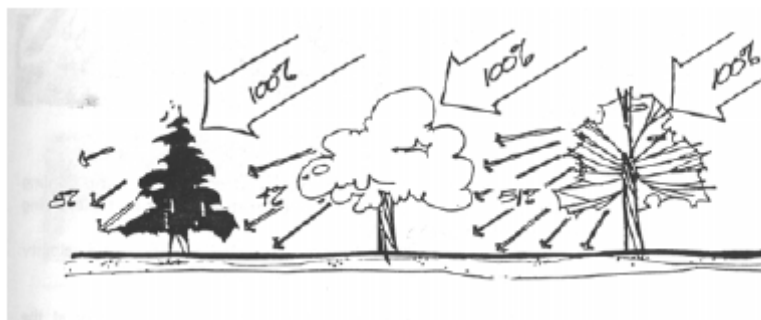
Incident of solar radiation less than 5 % reaches the ground

When the general temperature is 90 degrees F, the air temperature can be cooled 10 to 20 degrees due to shading the tree and it can be cooled by 5 to 10 degrees, when the general temperature is 70 degrees F. At sunrise, it is coolest in the tree crown with a cool air layer maintained on the ground surface under it. For three hours, until the sun reaches noon level, the ground remains cooler and it is not heated until radiation penetrates the entire canopy. Temperature differences has been observed shown that the ground surface to be at least 25 % cooler than the air above the crown.



Vegetation filter the sun radiation

The type of vegetation actually will affect the type and degree of radiation control, for example deciduous reduces light penetration in range from 51 to 4 % (Hasting and Crenshaw). Shrubs and ground cover reduce temperature due to absorption and evaporation. At hot day cooling effect has been measured and shown 10 to 14 degrees cooler for grass as opposed to exposed soil (Olgyay, 1963).

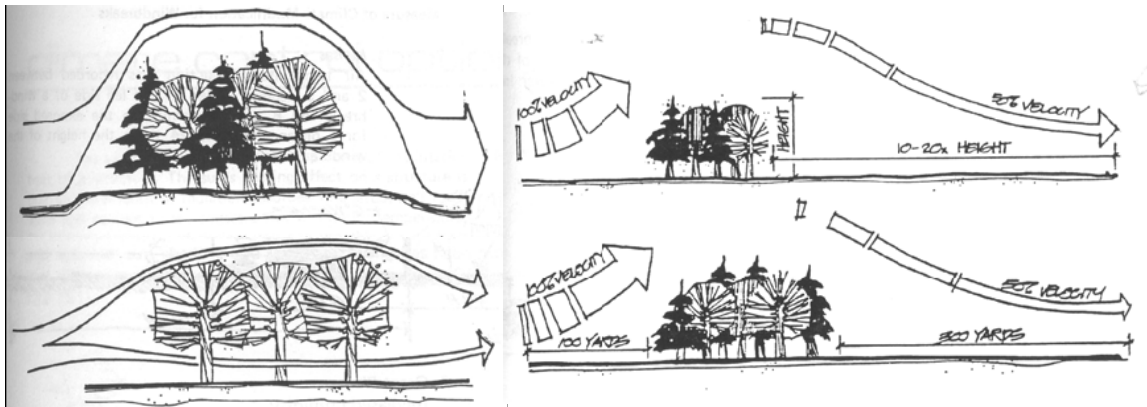


The type of vegetation affect the type and degree of the sun radiation control

The direct impact of open green space with vegetation in the cities on decreasing the air temperature, is not too significant if it comparing with the decreasing of the solar radiation impact (Robinette, 1973). In tropical climate, the air above the city become hotter after it heated by the hot surfaces, it can not carried by the low speed air flow, and it become urban heat island. This condition could be minimizing with green open areas which cover with vegetation (Yoshikado

and Tsuchida, 1966). The lower air temperature in a city, control the urban heat island, and it keeps the city more comfortable to the citizen, especially in tropical climate cities.

Vegetation also reduces wind velocity due to frictional drag. Vegetation is an effective wind break because it permits jet air movement through it (Olgyay, 1963). According to classic climate studies (C.G. Bates) while various forms provides grater percentage of wind reduction over limited distance, vegetation provided the greatest extended wind reduction when compared to other forms which were impenetrable (Olgyay, 1963). Vegetation can reduce wind velocity by 50 % over a distance from 10 to 20 times the height of the wind-break. (ASLA, 1977) Studies on vegetative wind breaks indicate that vegetation affects air flow. Vegetation could divert air current upward on the windward side, while the wind flow does not turn back and sweeps the ground; an area of calm is created near the ground on the lee side. The most protected part of the “sheltered area” is close to the windbreak on the leeward side with small protected zone on the windward side- especially if the windbreak is dense. If it open the wind can sweep under the trees, the windward side has little protection.

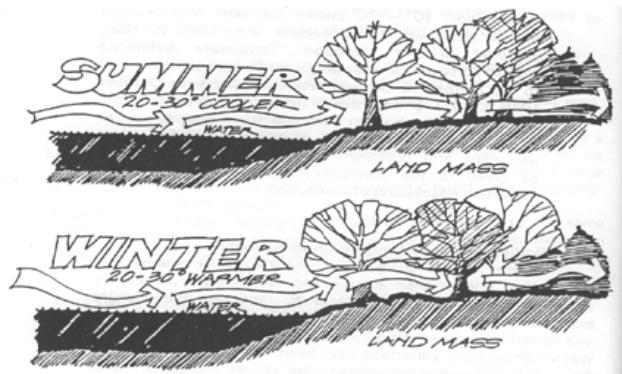


Vegetation divert air current and as wind break

Another impact of open green spaces in a city, are increase psychological comfort to the citizen (Ames, 1980, Ulrich, 1984, Wileke, 1989), because the aesthetical and the color of the vegetation and it enrich the bio-diversity in a city (Hough, 1984). Open green-space also increases the quality and the sum of rain water flow (Rutter, 1972, Shuttleworth, 1989), because the ground surface absorbs more rain water. In big cities, the land use development will impact to the air quality and the air temperature in those cities. The less open green area and the absorbing capacity of the ground surface, increase the heat emission and the air temperature in the city.

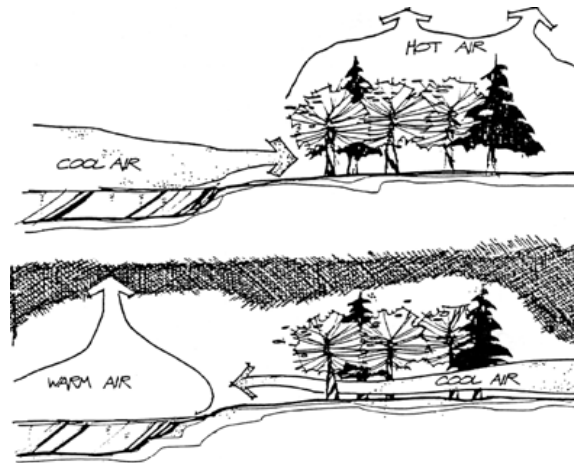
*Water Bodies*

Water bodies store more insolated solar energy and radiate less energy than surrounding land mass. Proximity to water bodies has been found to moderate temperature extremes of adjacent land forms by raising cold temperature and lowering hot temperature (Olgyay, 1963, ASLA, 1977).



Water bodies decreasing the air temperature and increasing the humidity in hot season

Water bodies also affect the temperature and humidity of adjacent land mass on daily basis due to the process of air flow. During the afternoon, when land is warmer than water, low cool air flows over the land and cools it. During the evening the ground surface begins to radiate heat and cool off. At the same time, warm air above the water rises due to convection and it replaced by cool air flowing in a low pattern along the land's surface. The degree to which this air flow is effective is dependent upon the size of water body, and location on the lee side. In general, the effect of cooling is proportionate to the size of the water body (Olgay, 1963).



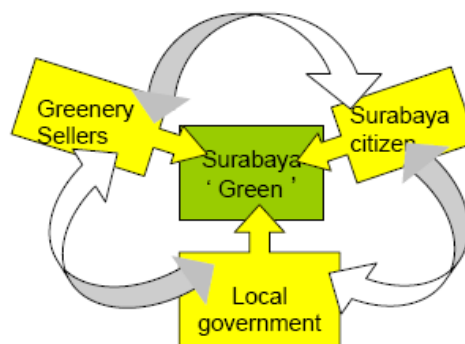
The cooling effect in during the day and night

Another benefit from a clean water body of urban drainage is it can be visual water leisure to the citizen. It's water could be use to wet the vegetation surround it and to increase the humidity in hot season, so generally the air temperature feels cooler than the reality.

### Description of Sustainable System in this Case

Sustainability in a city can be describe as a relationship of whole system in the city, include how the better quality of the environment, that will be ensure to the better quality of human life in that city.

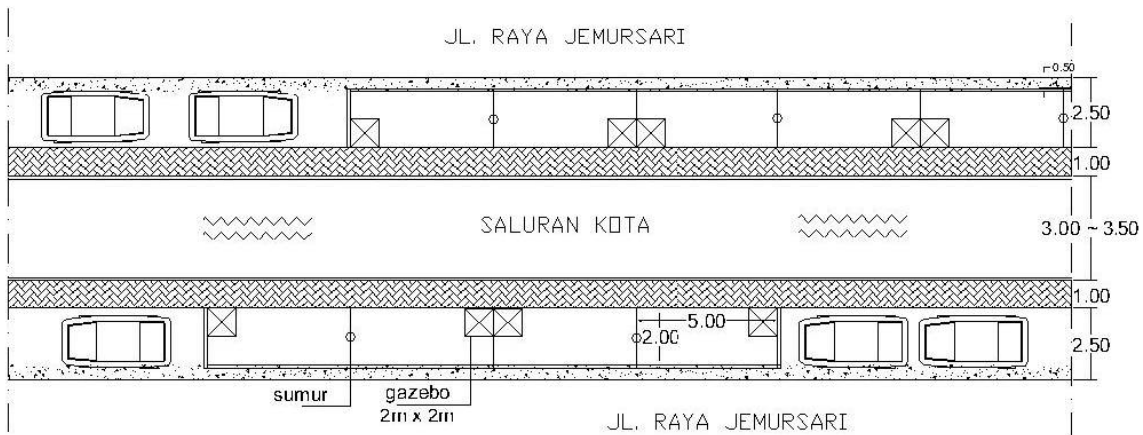
The diagram below describes the process how the system can sustain in improving the lung of the city. The participating group consists of greenery sellers, the Surabaya citizen, and the local government. Every group has to take part in this process. Greenery sellers who cultivates the greenery alongside Raya Jemursari road, has an important role in this process, since from their greenery implementation can bring about the CO2 reducing, lower the solar radiation and air temperature and also decrease the amount of vehicle disposal gases. Besides, also bring an urban aesthetics and improve the healthy microclimate along the street for Surabaya citizen's activities, such as trade in greenery and food while enjoy the green scenery. Where as local government who plays the role in creating the regulation and services especially in providing the sanitary and disposal facilities, will get benefit from the economic value of these area.



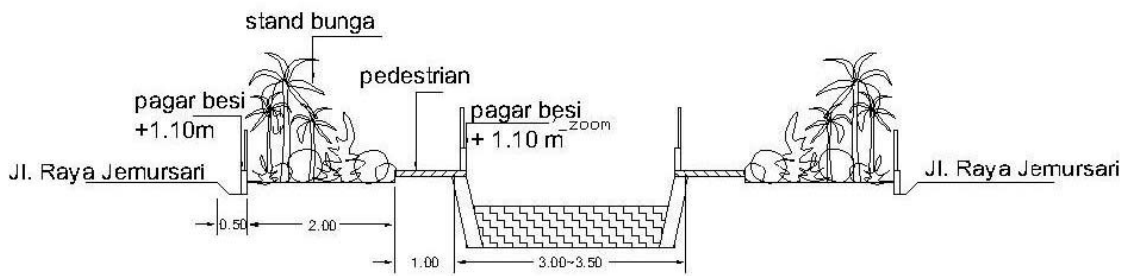
Sustainability Diagram in Improving the Lung of the City

### Preliminary Design Recommendation

It is possible to improve along side drainage in big city as Surabaya as a part of open green space, it improve the quality of the city environment and the citizen quality of life will be better. The increasing of the citizen quality of life is because it has green open spaces with vegetation as the lung of the city. The more green open space with dense vegetation would generate the air in the city into better air quality to the citizen, reduce the radiation and heat impact of solar radiation. Green open spaces and vegetation in the city, makes the city more aesthetic, shady because of the vegetation shade and get lower air temperature. In this case, the site planning of this along-side urban drainage at Raya Jemursari Street have another benefit, there are as a place of the greenery seller in the city, to make the greenery buyer comfortable and also the water body of the drainage could be as a visual water leisure to the citizen. At the Surabaya ‘ Green ’ Surabaya citizen Greenery Sellers Local government other hand, its negative impact such as the safety matters in parking, social aspects in maintaining the waste disposal, land-use regulation and more other social aspects still need some further discussion. In this recommendation we tried to design one of the site plan solution. This site plan is only a preliminary design and to get an optimum solution, this design has to be discussed more detail.

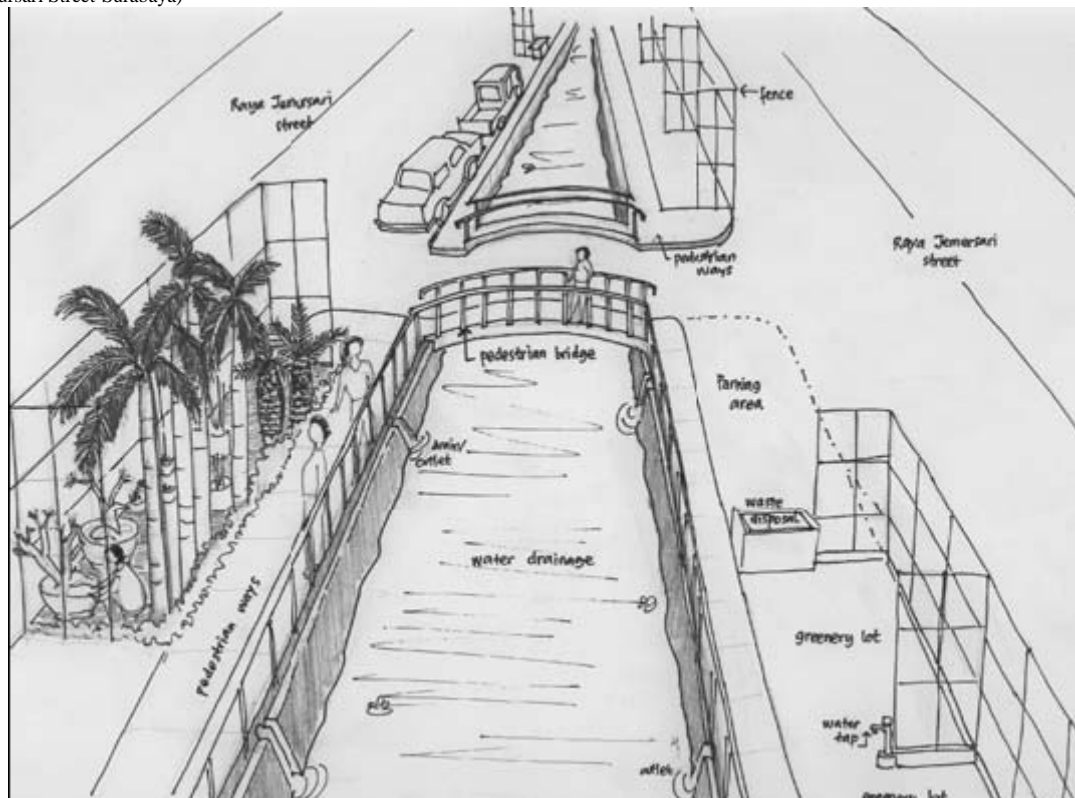


The site plan alternative



The Site Plan Section





Perspective

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