LAND RECLAMATION AND REDEVELOPMENT THROUGH LANDSCAPE APPROACH; A CASE OF BHANPUR, BHOPAL

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MASTER OF ARCHITECTURE (LANDSCAPE)

By
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Declaration

I **Anurag Aman Kaushal**, Scholar No.:2017MLA020 hereby declare that the thesis entitled Land reclamation and redevelopment through Landscape approach; a case of Bhanpur, Bhopal submitted by me in partial fulfilment for the award of Master of Architecture (Landscape), in School of Planning and Architecture, Bhopal, India, is a record of bona fide work carried out by me. The matter embodied in this thesis has not been submitted to any other University or Institute for the award of any degree or diploma.

07th April 2019 Anurag Aman Kaushal

Certificate

This is to certify that the declaration of Anurag Aman Kaushal is true to the best of my knowledge and that the student has worked under the guidance of the following panel.

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Abstract

Waste, “the seemingly mundane and oft-neglected residue of human activity came into the public consciousness in a major way during the late 19th century and raised several uncomfortable questions about health, aesthetics, affluence, technology, and quality of urban life”(Melosi 1981, p. 21). It isn't hard to find that individuals' state of mind towards junk is constantly antagonistic and individuals carry on to maintain a strategic distance from coordinate contact with waste related sites. Due to site negligence and improper maintenance the Landfills became a tumor to the environment of the city. How to alter people’s subjective opinion on waste landscape and how to transform these sites into human friendly places, at the same time; re-infuse certain functions to the dumps in eco-/socio- system. The objective of this thesis is to figure out the possible combinations of the existed landfill landscape design approaches, by reviewing the former waste related designs and transforming projects. The main objective of this thesis is to explore the theoretical possibilities and practical applicability to transfer the landfill into a multifunctional ecological site which might include but not limit to air quality, soil quality, waste management, biodiversity, water treatment and leisure landscape design by incorporating utilizing various landscape designing tools (e.g. ecology diversity) Beside that, the educative meaning will be emphasized as an incorporative objective of the site. The design is about creating a healthy, integrated human-nature ecosystem where ecological, leisure and cultural functions co-exist and in which all parts of the system are equally visible, it should satisfy the community needs and desires. Beyond cleaning contaminated land and creating a new self-sufficient system, desirable community green spaces and educative elements are created.

सार

अपशिष्ट, "मानव गतिविधि के प्रतीत होता है सांसारिक और उपेक्षित अवशेष 19 वीं शताब्दी के अंत में एक प्रमुख तरीके से सार्वजनिक चेतना में आए और स्वास्थ्य, सौंदर्यशास्त्र, संपन्नता, प्रौद्योगिकी और शहरी जीवन की गुणवत्ता के बारे में कई असहज प्रश्न उठाए" (मेलोसी) 1981, पृष्ठ 21)। यह पता लगाना मुश्किल नहीं है कि कबाड़ के प्रति व्यक्तियों की मन: स्थिति लगातार विरोधी है और व्यक्ति अपशिष्ट संबंधित साइटों के साथ समन्वय संपर्क से एक रणनीतिक दूरी बनाए रखने के लिए आगे बढ़ते हैं। साइट की लापरवाही और अनुचित रखरखाव के कारण लैंडफिल शहर के पर्यावरण के लिए एक ट्यूमर बन गया। अपशिष्ट परिदृश्य पर लोगों की व्यक्तिपरक राय को कैसे बदलना है और इन साइटों को मानव अनुकूल स्थानों में कैसे बदलना है, एक ही समय में; इको / सामाजिक-प्रणाली में डंप के लिए कुछ कार्यों को फिर से संक्रमित करें। इस थीसिस का उद्देश्य पूर्व के कचरे से संबंधित डिजाइनों की समीक्षा करके और परियोजनाओं को बदलकर, अस्तित्व में आने वाले लैंडफिल लैंडस्केप डिजाइन दृष्टिकोण के संभावित संयोजनों का पता लगाना है। इस थीसिस का मुख्य उद्देश्य लैंडफिल को मल्टीफंक्शनल इकोलॉजिकल साइट में स्थानांतरित करने के लिए सैद्धांतिक संभावनाओं और व्यावहारिक प्रयोज्यता का पता लगाना है जिसमें शामिल नहीं किया जा सकता है, लेकिन हवा की गुणवत्ता, मिट्टी की गुणवत्ता, अपशिष्ट प्रबंधन, जैव विविधता, जल उपचार और अवकाश परिदृश्य डिजाइन तक सीमित नहीं है। विभिन्न परिदृश्य डिजाइनिंग टूल्स (जैसे पारिस्थितिकी विविधता) का उपयोग करते हुए, इसके अलावा, साइट के एक निगमित उद्देश्य के रूप में शिक्षाप्रद अर्थ पर जोर दिया जाएगा। डिजाइन एक स्वस्थ, एकीकृत मानव-प्रकृति पारिस्थितिकी तंत्र बनाने के बारे में है जहां पारिस्थितिक, अवकाश और सांस्कृतिक कार्य सह-अस्तित्व में हैं और जिसमें सिस्टम के सभी हिस्से समान रूप से दिखाई देते हैं, इसे समुदाय की जरूरतों और इच्छाओं को पूरा करना चाहिए। दूषित भूमि की सफाई से परे और एक नई आत्मनिर्भर प्रणाली बनाने के लिए, वांछनीय समुदाय के हरे स्थान और शिक्षाप्रद तत्व बनाए गए हैं।

“What we do to our Landscape, we ultimately do it to ourselves.”

\- Anonymous

Contents

1. Introduction

1.1 Background

Bhanpur is a town in the Bhopal region of Madhya Pradesh, India. It is situated in the Huzur tehsil and the Phanda square. Strong waste administration is maybe the most significant administration required by urban inhabitants to keep up their personal satisfaction. Immense measure of strong waste is produced in India, in Urban, city and mechanical divisions which are at last arranged to the strong waste transfer locales. Bhopal isn't a special case. The Bhopal city has 57 acres of land for waste dump. The waste created in the city is dumped at this landfill site which is located in Bhanpura at a distance of 16 km from the city. No logical technique for waste transfer is used. Bhanpura transfer site is situated as far as possible and is spread over a territory of 57.80 hectares. This site is being used for most recent 25 years. The offices given by BMC at this site are electronic gauge connect cum record room (limit 30 tons) and washing zones for vehicles. All waste is arranged off at the landfill. This present arrangement of transfer by open dumping of waste makes a ton of ecological issues and general wellbeing perils. Madhya Pradesh state Agro Businesses Improvement Partnership restricted has set up a Natural compost plant dependent on solid waste which produces natural fertilizer from the waste which is being sold to the ranchers of M.P. The landfill is creating numerous medical issues and changing the monetary variables of Bhanpur. Change in the environmental qualities have influenced the general comprehension of a town, making it a high time to redevelop the zone. We have made this issue and now we should address its effects. Barely any individuals need to live by a landfill, particularly while it is effectively accepting hazardous dump. However when the landfill in the long run closes, there is incredible potential to see that scene not as just a gigantic heap of disposed of things that are contrarily affecting nature, but instead as a period container which mirrors our social and cultural attitude.

1.2 Aim

The aim of this thesis is to explore the possibilities and practical applications to develop a landfill into a multifunctional ecological site. The design is about creating a healthy, integrated human-nature ecosystem where ecological, leisure and cultural functions coexist and in which all parts of the system are equally visible, it should satisfy the community needs and desires.

1.3 Objective

To transfer the landfill into a multifunctional ecological site which might include but not limit to air quality, soil quality, waste management, biodiversity, water treatment and leisure landscape design by incorporating utilizing various landscape designing tools (e.g. ecology diversity).

2. Literature Study

2.1 Definition and Misunderstanding of waste

The label ‘waste’ does not necessarily mean that the thing is an ultimate waste; rather, it means that it will be treated as waste. In other words, the waste we usually regard could still have values and is not useless/ non-valuable. It is off use from the perspective of its consumers, whereas might be still of great value for other purposes/uses. Thus, it is not sustainable to define ‘waste’ as a character of the to-be-perished objects that might not be ultimately consumed, or defining it as a character of the final status of production.

EU	Waste shall mean any substance or object in the categories set out in Annex I which the holder discards or is required to discard (European Council, 1991)
OECD	Wastes are materials other than radioactive materials intended for disposal(OECD, 1994)
UNEP	Wastes are substances or objects, which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law (European Council, 1993)

The tag 'landfill' does not really imply that the thing is an extreme waste; rather, it implies that it will be treated as waste. As it were, the waste we more often than not respect could at present have values and isn't worthless/non-profitable. It is off use from the point of view of its consumers, though may be still of incredible incentive for different purposes/employments. In this way, it isn't feasible to characterize 'landfill' as a character of the to-be-perished objects that probably won't be at last devoured, or characterizing it as a character of the last status of generation.

Despite the fact that the classification of garbage is continually changing, the method for managing it has remained moderately unaltered all through centuries. For a large number of years, the most common strategy was to just dispose of remnant materials by hurling them on the ground wherever one happened to be. A portion of these remnants were being discovered these days. This strategy functioned admirably for seeker gatherer social orders who moved often. These social orders were little enough to not create gigantic measures of waste. Whatever squander that they did dispose of most likely deteriorated or was searched moderately rapidly. In any case, as civic establishments developed and as individuals turned out to be less migrant, they could never again just fled from their disposes of. Human advancements started to create different approaches to manage their junk. These procedures for the most part comprised of source decrease, reusing, consuming and dumping. These techniques are as yet the most widely recognized methods for taking care of waste transfer today.

Through the majority of the previous century's quantifiable changes in the genuine substance of strong waste, there is a less effectively quantifiable change in the cutting edge society's frame of mind toward waste. These unpredictable dispositions are an outcome of the expanded waste generation coming about because of industrialization and the natural familiarity with our activities, which have prompted reusing and recovery endeavours.

Landfill is currently a relevant theme for some, various fields: designing, financial matters, environment, history, engineering, and even workmanship. Each control has its own frames of mind towards waste. For instance, an architect may concentrate on the best way to cover rubbish effectively with the goal that it presents little risk to the overall population. A biologist would focus on the potential natural impacts of covering the dump in the way in which the architect proposes. The craftsman should seriously think about that equivalent heap of dump and how to utilize its components to make a provocative explanation about the general public. Every point of view gives a legitimate viewpoint in regards to squander, and each speaks to the present beat of social mentalities. As scene engineers, we don't possess enough explicit information to imagine progressively productive reusing framework or get the total picture of different callings. Yet, we can utilize scene as an apparatus to redevelop landfills, re-establish its biological system and decent variety, all the more critically, we can 'reclassify' the conventional meanings of waste that is in individuals' brain for decades.

Additionally, what I should remember is the learning I increase about waste administration and landfill treatment advancements, which are important to finish my plan. By joining these between disciplinary information with our scholarly foundation of scene, an ecological and economical vision of the landfill changing procedure gets clear.

Through the majority of the previous century's quantifiable changes in the genuine substance of strong waste, there is a less effectively quantifiable change in the advanced society's disposition toward waste. These unpredictable frames of mind are an outcome of the expanded waste creation coming about because of industrialization and the biological familiarity with our activities, which have prompted reusing and recovery endeavours.

2.2 Landfill

2.2.2 General Description:

The term 'sanitary landfill' began in the late 1930's. It portrays a methods for disposing waste in a sterile way, covering each layer of dump with a layer of earth every day to keep vermin from getting into the trash and to take out bad odor from drifting into the air.

Landfill as the last advance of waste reusing process, normally considered as a standout among the most unwelcome spot in urban condition. Landfills can oblige different kinds of waste and shift in size from a couple of square meters to many hectares. They can be in activity for an exceptionally brief period to a very long while. They additionally have an extraordinary impact to its encompassing region - negative impacts as a rule.

2.2.3 Landfill Structure:

Landfill structure has changed significantly in the course of recent years. The EPA record, A Leaders Manual for Solid Waste Management, provides significant data respecting landfill development, use, and post-use. This document characterizes the accompanying key terms in regards to landfills, leachate, landfill gas, liner, and spread. Waste management limits are basically the limit zones involved by the landfill management and are estimated in sections of land. Leachate is fluid that rises up out of solid waste and for the most part contains solvable, suspended, or miscible materials that began from the solid waste. This liquid must be dealt with cautiously since it might contain dangerous materials and could contaminate ground water and slaughter vegetation. Landfill gas is a blend of methane and carbon dioxide produced by the anaerobic deterioration of natural waste. A liner is an arrangement of mud or a geo-engineered layer on the base of the landfill which is utilized to gather leachate and avert defilement of the groundwater. A cover comprises of soil and geo-manufactured materials and has two functions: first as a day by day spread over the loss at the end of every day's activities, and second as a last top when the landfill basically an independent unit with substituting layers of waste and soil. Suitable systems must be set up to cover ground water and methane gas emission just as to collect leachate.

Prior to development of a landfill, engineers decide the size for the landfill. The landfill engineers build up the topographic lines which show the size and state of the dump hills to be constructed. The most extreme slant for the hills is three to one; hence the last stature of the hill relies upon the underlying impression. At the point when a landfill is dynamic, dump trucks store the solid waste into the landfill, smaller it down, and after that cover it with a layer of soil, hence making cells of garbage inside the whole landfill. Compacting the loss hence lessens the measure of settling that happens after some time. With appropriate compaction, the surface will settle to 80 to 85 percent of the first height inside five years.

3. Municipal Solid Waste

Landfills are huge mounds of trash, but it is important to get a better understanding of the details of this trash to begin to explain the values inherent in the landfill contents. Most modern landfills are classified according to the type of waste material contained in them:

a. **Hazardous waste landfill** – Waste disposal units are constructed to specific design criteria. These landfills are generally constructed to be secure repositories for material that presents a serious hazard to human health, such as chemical waste. They are restricted, by permit or law, to the types of waste they may handle. These landfill must have a double liner system.

b. **Municipal solid waste landfill** – this type is also called modern, engineered or a secure landfill. This type of landfill usually has physical barriers such as liners and leachate collection systems (leachate is waste water created when water percolates through the waste) and procedures to protect the public from exposure to the disposed wastes. Waste has to be covered daily.

3.1 Solid Waste scenario in India

The solid waste age is expanding step by step because of quick urbanization and industrialization, and subsequently its administration is turning into an highliting issue. Land filling is a standout among the most efficient transfer techniques that is utilized around the world. Landfills can be delegated open dumps, controlled dumps, and sterile landfills (UNEP-IETC 1999). The greater part of the strong waste administration practice which is being used in creating nations lies somewhere close to open dumps and control dumps as there is no need of explicit hardware and skill for dumping waste in open dumpsite (Daskalopoulos et al. 1998). These destinations represent an incredible hazard to condition and the human well being. Open dump locales have grabbed extraordinary eye of scientists who portrayed its potential impacts which prompted the conclusion of such locations in a considerable lot of the creating nations. The produced waste is arranged off in the landfills whether they are remaining materials from materials recuperation offices, private waste, buildup of the burning of strong waste, modern waste, or emergency clinic squander. The inappropriate isolation, or complete non appearance of office at the waste age site, causes the massing of dangerous waste blend in landfills. Harmful waste blend contains PCBs, PAHs, pesticides, bug sprays, and so on. The transfer of these dangerous synthetic concoctions not just prompts the introduction of cloth pickers to these synthetics yet in addition purposes soil and groundwater contamination.

The landfills are intended for lessening the introduction of people and condition from lethal waste (Narayana 2009). In any case, because of their non built nature, Indian landfill locales are representing a danger to condition. The rough landfill destinations win in Indian situation that need baselines, gas ventilation framework, and leachate treatment plants. This outcomes in natural risks and environmental lopsided characteristics because of dumping of unsegregated waste from ventures, medical clinics, and houses on open land (Narayana 2009). The over the top downpour water permeation through the various layers of landfill produces a contaminant loaded fluid called leachate. The leachate is the essential driver of preparation of waste from landfill site to the encompassing condition (Christensen and Kjeldsen 1989). Nonetheless, an advanced sterile landfill office of waste transfer that contains baseliners, leachate, and gas accumulation framework is naturally sheltered.

3.2 Types of Landfill

a. **Sanitary Landfill**
   Sights where waste is isolated from the environment until it is safe. It is considered safe when it has completely degraded biologically, chemically, and physically. Sanitary landfills use technology to contain the waste and prevent the leaching out of potentially hazardous substances. There are two main methods used in sanitary landfills, the trench method and the area method.

b. **Municipal Solid Waste Landfills (MSW)**
   This type of landfill collects household garbage and are regulated by state and local governments. The Environmental Protection Agency (EPA) has established minimum criteria that these landfills must meet. Some materials may be banned from disposal in municipal solid waste landfills. Items such as paints, cleaners,

chemicals, motor oil, batteries, and pesticides are some of the common items that are banned from MSW's. However, some household appliances can be turned into MSW's for disposal.

c. **Construction and Demolition Waste Landfills**
These types of landfills used for debris generated during construction, renovations, demolitions of buildings and bridges. The types of debris include: concrete, wood, asphalt, gypsum (the main component of drywall), metals, bricks, glass, plastics, trees, stumps, earth, rock, and building components (doors, windows, plumbing fixtures).

d. **Industrial Waste Landfills**
Industrial hazardous waste is a separate form of waste consisting of non-hazardous waste associated with manufacturing and other industrial activities.

3.3 Lifespan of a Landfill

Regardless of how advanced landfill innovation is, every landfill will sooner or later achieve limit and should be shut. The 1995 EPA production, A Chiefs Manual for Strong Waste Administration, expresses that, "the essential destinations of landfill conclusion are to build up low-support spread frameworks and to structure a last spread that limits the invasion of precipitation into the waste". Anticipating the conclusion of the landfill should start a long time before the landfill quits accepting waste. These measures help guarantee that the landfill will present least risks. Post-conclusion care can keep going for more than 30 years amid which time the landfill proprietor is in charge of the general upkeep of the site just as the checking of the site's natural highlights.

The cover that is put over the landfill is a significant hindrance which diminishes potential tainting from the site; along these lines it is essential to limit conceivable harm to this spread. The EPA necessitates that the last spread framework be made out of an invasive layer at least 18 inches thick which is then overlain by a disintegration layer at least 6 inches thick (EPA Leaders Guide 1995, p. 9-49). Manufactured liners and soil more often than not include this top. Settlement of the trash proceeds as deterioration happens. Despite the fact that this settlement moderates after the initial couple of long periods of conclusion, this could possibly cause breaks in the landfill cover. It is additionally imperative to anticipate disintegration of the spread. This is frequently tended to by planting vegetation over the landfill (EPA Chiefs Guide 1995, p. 9-63).

Controlled water waste and leachate and gas observing are likewise basic perspectives to guaranteeing the wellbeing of shut landfills. Seepage examples may change as the landfill settles. Therefore, seepage channels must be assessed occasionally. Furthermore the surface spill over must be appropriately overseen so as not to cause flooding or disintegration. Indeed, even after the landfill top is introduced, the landfill will keep on producing leachate. This leachate should be collected and treated either on location or at an off-site office. The leachate accumulation framework must be checked routinely to guarantee that no pollution of the groundwater is happening. At long last, gas radiating from the landfill must be controlled and observed. Gas checking tests ought to be introduced to help recognize landfill gas. The gas is made for the most part out of methane, a hazardous ozone depleting substance. It can either be disposed of by flaring it on location or it tends to be gathered and utilized as a fuel added substance (EPA Chiefs Guide 1995, p. 9-64).

4. Site selection and analysis

4.1 Study Area

Waste disposal in Bhopal is practiced by dumping in low-lying areas in majority of the urban centres. Currently the solid waste is disposed unscientifically by open dumping at Bhanpur village disposal site. Bhanpura disposal site is located within the BMC limits which are spread over an area of 57.80 acres. This site is in use for last 25 years. The site has facilities such as electronic weighbridge cum record room (capacity 30 tonnes) and washing area for vehicle. Day to day records of waste brought to the site is being maintained. Transportation vehicles entering the landfill site are generally found to be under loaded. Slaughtering of dead animals is also carried out at the site. Plastics, cloths and papers are scattered all around the site thereby spoiling the aesthetic appearance of the Bhanpur site has a bio-fertilizer plant of capacity 100 MT/day. This plant was set-up around 10 years ago by M/s. MP Agro Fertilizer Corporation Ltd. However this plant is not in operation due to some technical reasons.

Figure 1 Bhanpur Landfill

Presently, the generated solid wastes are dumped at Bhanpur site without treatment and compaction. The inefficient operation has resulted in underutilization of the dumping site besides creating other environmental problems. The development of infrastructure facilities at the new landfill sites will take about one and half years after which they would come into operation. During this transition period, solid waste generated from the city will continue to be dumped at Bhanpur site.

4.2 Observation and Deficiency in the present system

- At present, open dumping of waste is taking place.
- Weekly cover material is not spread on dumped waste. As the waste remains open to atmosphere emitting hazardous obnoxious gases.
- No compaction of waste and trash is done to improve life of dumping site.
- Existing disposal site is not fenced to prevent unauthorized entry of persons/habitations and stray animals.

- Internal roads do not exist at existing site for easy movement of transportation vehicles.
- There is no control over the dumping of inert, organic waste, electronic and ash of biomedical waste at the site.
- Basic facilities as per the requirement of MSW (Management & Handling) Rules, 2000 are not available at existing dumping site.
- Apparently no studies have been carries out to determine the effect of the landfill operations on the environment and ground water. No environment impact assessment (EIA) study reports are available.
- Dumping of waste by private contractors are noticed in low-lying areas at Bhanpur.
- Industrial, Medicinal waste and construction debris are being dumped unauthorized at the disposal site.
- The region has not identified site or facilities for the disposal of industrial waste.
- The safety and environmental aspects as per the MSW Rules (M&H) 2000 are neglected at the site.
- Open trucks are used to transport waste to the landfill site. This causes dropping of garbage, contamination of soil, odour and nuisance problems along the transport route.

4.3 Waste Generation in Bhopal City

Expanding population, changing utilization designs, financial improvement, evolving salary, way of life and in general urbanization and industrialization results in expanded age of solid waste. So as to know the amount of solid waste age and transfer in Bhopal city, study for evaluation and portrayal of MSW was completed as of late by Bhopal Civil Organization. The examples were gathered from various areas, for example, local locations (HIG, MIG, LIG and EWS), business zone, leafy foods markets, week by week advertise, and butcher house, fish and meat shops, lodgings, eateries, nursery, clinics and nursing homes, mechanical and MSW transfer at Bhanpur dumping ground. The samples were gathered for 4 days straight from a few sources in every class. For each source tests were gathered from three waste generating focuses. Spring adjusts at each waste gathering point were utilized for account the heaviness of waste. Tests gathered ordinary was gathered in poly sacks and were sent to a research facility for investigation. In the wake of gauging each example precisely in the research centre, composite examples of every classification were set up for physical and chemical analysis.

4.4 Status of Solid Waste Management in Bhopal City

Today, most of the urban centres in India are struggling to come to the terms of acute problems of solid waste management. Due to lack of sincere efforts by municipal bodies, solid waste management has become a tenacious problem and this notwithstanding the fact that the large part of municipal expenditure is allotted to it. Solid waste management is still considered an inferior services and most of the times should overlooked by municipal bodies and The Bhopal Municipal Corporation is no exception. MSW generation in Bhopal city is about 600 to 650 TPD, out of which only 60-70 % are collected on daily basis, and rest is left on roads, streets, colony dust bins and drains etc. Urban solid waste generally contain up to 20% of recyclables material, 40-50% waste is compostable material and the rest is mostly inert materials such as sand, debris, dust etc.

4.4.1 Ground Water Quality

Twelve ground water samples and one surface water from Patra River were collected. The pH of ground water samples of the area 7.15 to 8.13, that is from neutral to slightly alkaline. The total hardness of the water was in a narrow range of 420 to 776 mg/L, indicating that the water is slight to moderately hard as per United States Ground Water Surveys (USGS) norms. In the present area the chloride content of the water samples varied from 160 to 310 mg/L, exceeding the limits prescribed in MSW Rule-2000. The recommended content of sulphates in drinking water is in the range of 200 to 400 mg/L and in the study area it was within the safe limit of 7 to 14mg/L. According to IS-10500, the acceptable limit for Bacteriological contamination indicator (MPN - Most Probable Number) in drinking water is 10 per 100ml of sample. Perusal of the MPN data indicated that all the exceed limits, except control point i.e. Bhopal Memorial Hospital and Research Centre (BMHRC) tube well. MSW leachate may contain heavy metals finds its way into the underground water, rendering it unfit for drinking. In view of this the Heavy Metals like Nickel (Ni), Iron (Fe), Manganese (Mn), Copper (Cu), Cadmium (Cd), Lead (Pb), Zinc (Zn), Mercury (Hg) and Cobalt (Co) were analysed in all the ground water samples. Except Fe, Mn, Zn and Cu, other metals were not detected during the study period.

Figure 2. Ground water and Leachate condition

location	Source	turbidity	ph	conductivity	chloride	nitrates	Total hardness	TDS	Fe	F	Fecal coliform
Mohali1	TW	1.3	7.8	1020	21	19	572	725	0.20	0.35	-
Mohali2	TW	3.2	7.9	1123	12.5	12.5	-	665	0.71	0.31	-
Mohali3	HP	1.9	7.4	1192	16.5	13.2	612	812	0.23	0.30	-
Damkheda	TW	78	7.6	1312	27	25	325	830	0.52	0.25	520
Bhanpur1	TW	2.4	7.5	1010	5.9	7.2	-	650	0.25	0.38	1000
Bhanpur2	HP	2.1	7.8	985	18.2	18.3	-	690	0.19	0.29	1150
Bhanpur3	TW	2.5	7.6	1132	1.5	2.1	-	695	0.26	0.39	-
Bhanpur4	TW	1.3	7.4	960	1.2	1.2	562	725	0.20	0.28	-
Bhanpur5	Tap water	2.9	7.9	820	3.3	3.9	281	475	0.21	0.26	-
Bhanpur6	TW	2.5	7.6	1135	25.9	25.3	501	-	0.20	0.20	45

TW= Tube well HP= Hand pump

Table 1. Ground water quality index

4.4.2 Soil & Waste Quantification

a. **Geology and Soil**

The top portions of the hillocks generally consist of hard red soil, mixed with basaltic boulders. Black cotton soil is seen at various depths from 1 to 3m. The soil in and around is alluvial land. The soil is conductive for agriculture & is appropriate for Rabi &Kharif crop harvesting. The geological formations underlying the Bhopal area – at the eastern edge of the Malwa Plateau – are largely red sandstone strata, with the depth of the rock varying according to the slopes.

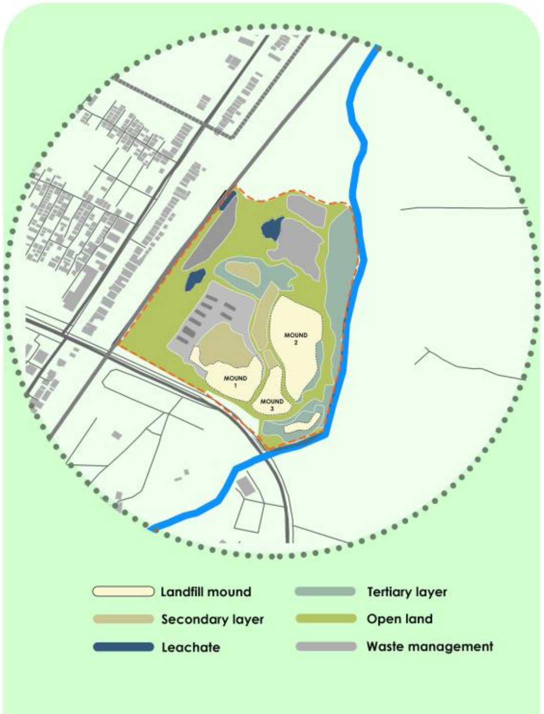


Figure 4 Landfill condition

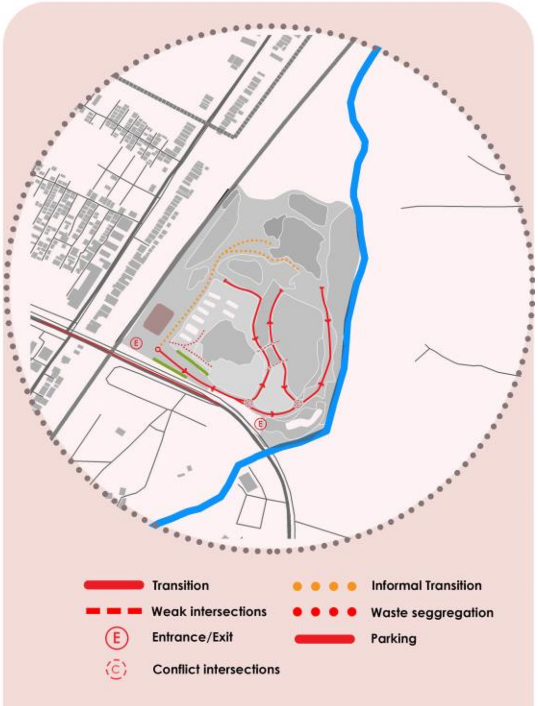


Figure 3 Transport and transitional map

b. Waste Quantification

- Biodegradable: Organic materials, which can be degraded by biological agents, e.g., microbes are known as biodegradable. Examples are food material, fruit and vegetable waste, garden waste (plant waste) etc.

- Recyclables: Plastic, Paper, metal

- Combustibles: Relatively dry material having a high calorific value, such as paper, plastic, rags, cardboard, etc. are known as combustibles.

- Hazardous; certain items which are hazardous for human or animal health and detrimental for the environmental either due to their chemical or pathogenic nature are classified as hazardous waste e.g., hospital waste, certain industrial etc.

- Inert; Dust, cinder, grit and other debris are known as inserts.

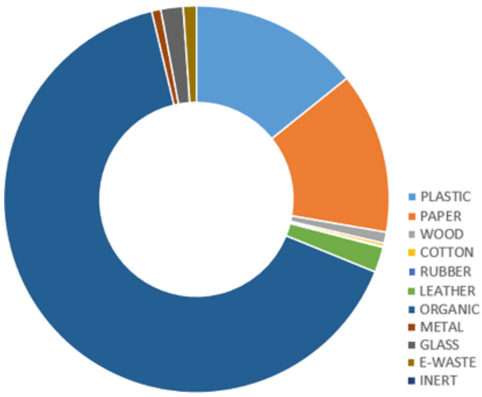


Figure 5 Waste quantification

4.5 Slope & Hydrology

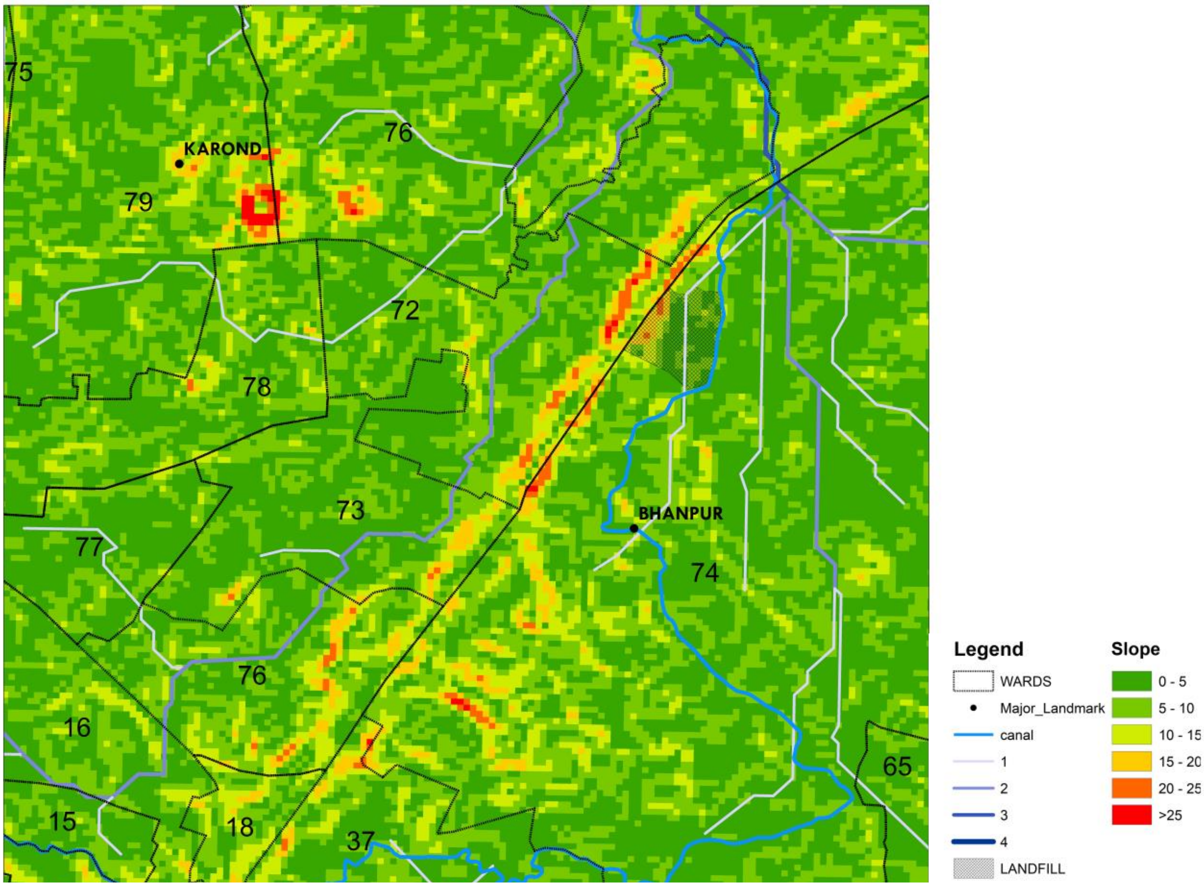


Figure 6. Slope analysis

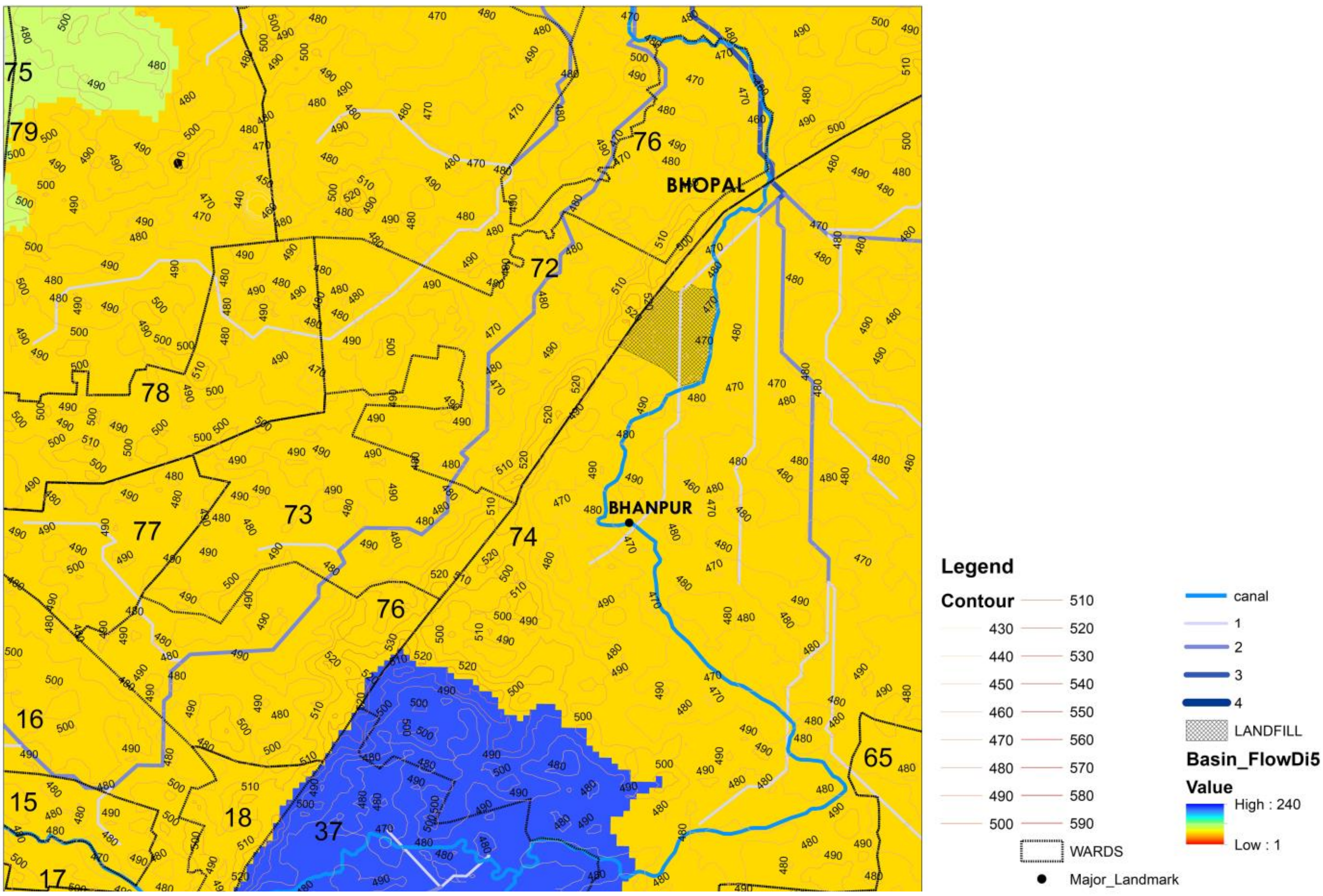


Figure 7 Hydrology map

4.6 Activity mapping

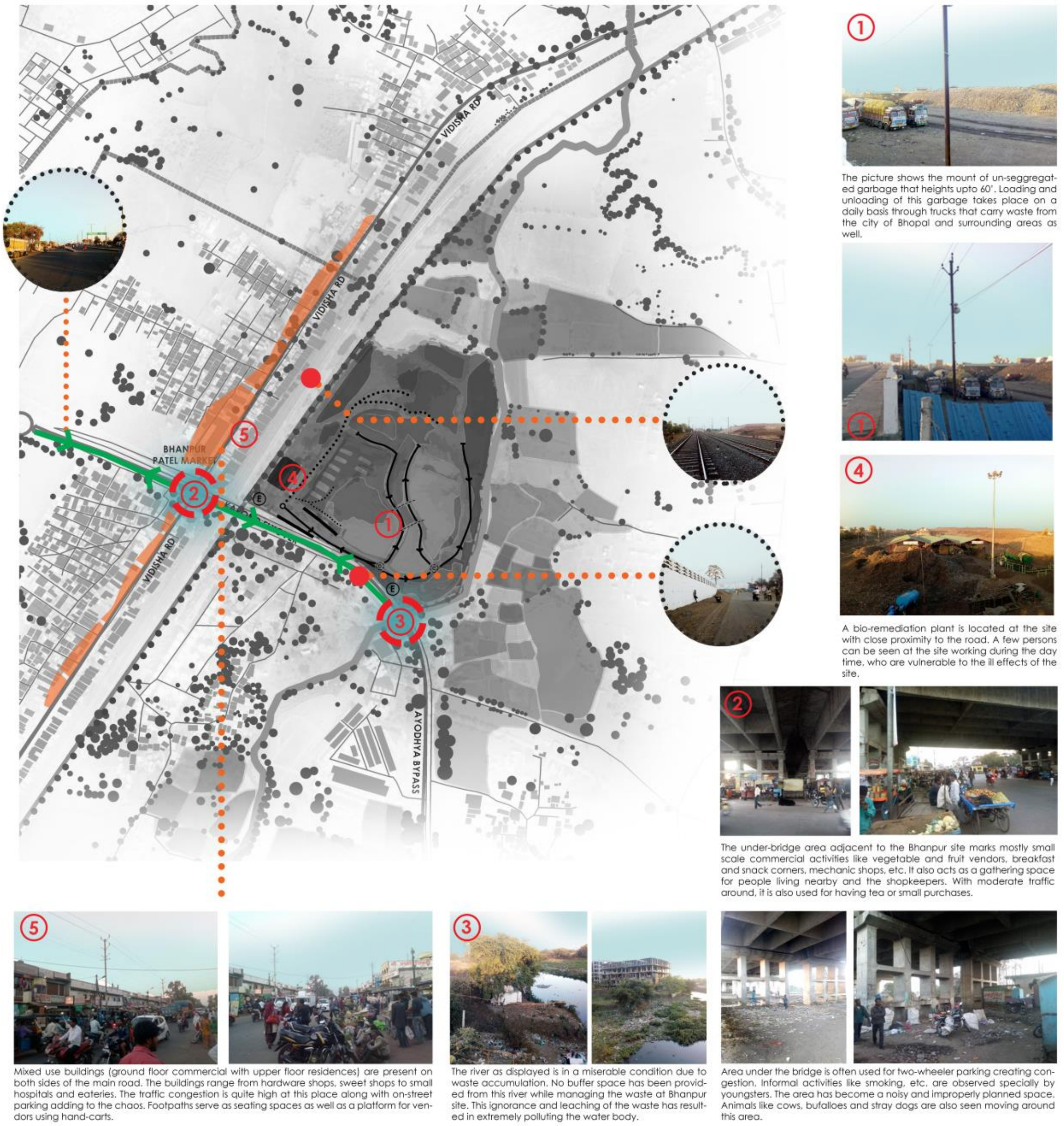


Figure 8 Activity Mapping

Three statuses of animal species used the dumpsites, namely resident local migrants and wanderers. Resident species refer to animal species that remain within a definable home range throughout the year, local migrants move short distances between breeding and non-breeding places and wanderers status make unpredictable movements in response to rain or high temperatures, hence inhabit drier or wet areas respectively.

Common Name	Status	J	F	M	A	M	J	J	A	S	O	N	D	Total
Mosquito	R		x	x			x	x	x	x	x	x	x	9
Cockroach	R	x	x	x	x	x	x	x	x	x	x	x	x	12
Dragonfly	R	x	x	x			x	x	x	x	x	x	x	10
Honey Bee	M	x	x	x	x	x	x	x	x	x	x	x	x	12
Black Ant	R	x	x	x	x	x	x	x	x	x	x	x	x	12
Doa	M	x	x	x	x	x	x	x	x	x	x	x	x	12
Pigeon	M	x	x	x	x	x	x	x	x	x	x	x	x	12
Lizard	W	x	x	x	x	x	x	x	x	x	x	x	x	12
Beetle	R				x	x	x	x	x	x				6
Vulture	M	x	x	x	x	x	x	x	x	x	x	x	x	12
Giant Rat	R	x		x		x			x					4
Cat	M	x	x	x	x	x	x	x	x	x	x	x	x	12
Domestic Hen	M	x	x	x	x	x	x	x	x	x	x	x	x	12
Blue- breasted kingfisher	M					x	x	x	x	x	x	x		7
Earthworm	R	x	x	x	x	x	x	x	x	x	x	x	x	12
Centipede	R						x	x	x	x	x	x	x	7
Housefly	R	x	x	x	x	x	x	x	x	x	x	x	x	12

Table 2. Bio-diversity in Bhanpur landfill

4.8 Origin of waste

Domestic Origin: Kitchen waste (left over/rejected food materials), human waste, paper, plastic, rags, metal, rubber, glass, cardboard, expired medicine, containers of medicine/disinfectants, etc.

Street/Kerb side Waste: Street/ sweepings comprising dust, grit, dry leaves, papers, plastic, rubber, glass, cardboard, metal containers, carcass of animals and so on.

Market Origin: Paper, plastics, cardboard, packaging materials, etc.

Industrial Solid waste: Scrap metals, alloys, ores, glass, paper, plastic, chemicals and other industry specific items.

Hospitals/Medical solid waste: Hospital wastes include used bandages, infected linen, Plaster of Paris, injection vials, medicine bottles and containers disinfectants, diseased organs etc. apart from common solid waste items (Paper, plastic and food materials etc.)

Commercial Institutional Origin: Paper, plastic, cardboard, packaging materials, etc. from shops and offices, leftover food from hotel and miscellaneous items.

Agricultural and Animal Waste; these also find their way into the urban area through the agricultural marketing complexes, dairy & poultry
Zoological & botanical gardens, etc.

4.9 Treatment and disposal of waste

The waste generated from all the wards of Bhopal city is dumped at the site Bhanpura which is located approx. 12 km from the city having an acre of 57.8 acres. This site is operating since 35 years. The existing waste disposal site where crude open dumping is practiced with no leachate collection and treatment system and does not meet the current requirements of MSW 2000 – 2016 rules. Open burning of waste, indiscriminate disposal, presence of stray animals & rag pickers at the disposal site and leachate migration into the subsurface are common occurrences. Every day the Bhopal Municipal Corporation (BMC) dumps over 909 MT of solid waste at the Bhanpura village disposal site. The site has an electronic weighing bridge cum recorded room (capacity 30 MT) & a washing area for vehicles. Day to day record of waste entering the premises is maintained.

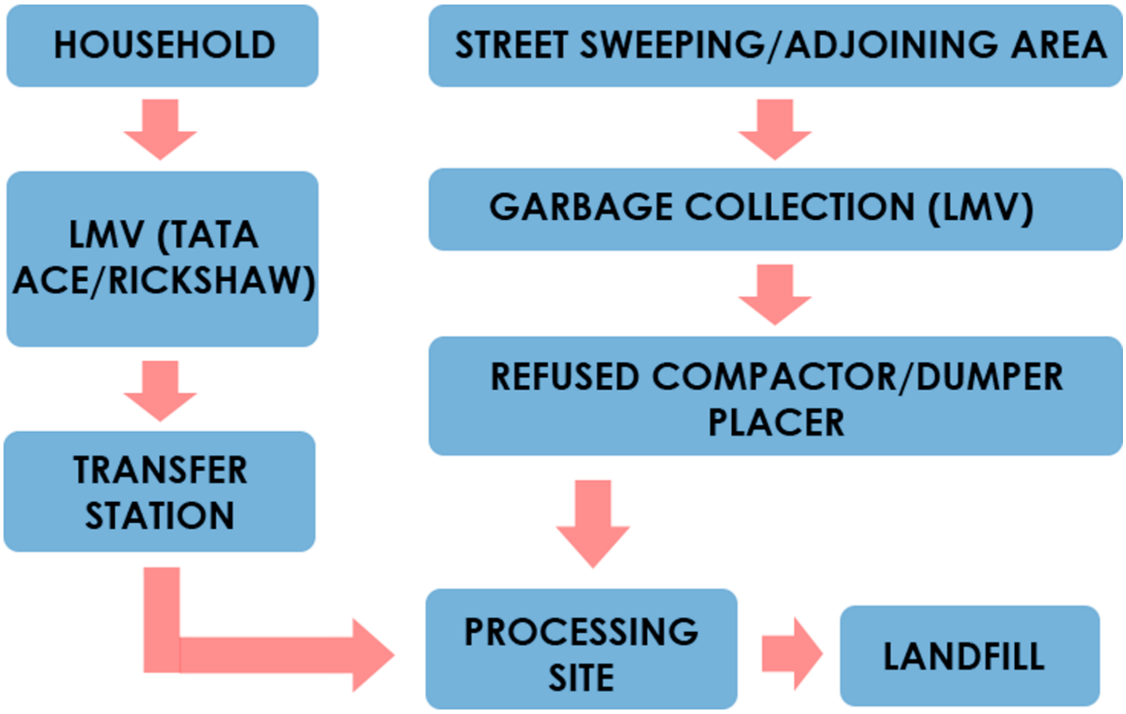


Figure 9 Garbage collection system

4.10 Observation and deficiency in present system

- There is no segregation takes place. All types of waste is in mixed form.
- The waste is dumped on site is without processing & unscientifically.
- At present, crude dumping of waste is taking place.
- Daily cover material is not spread on dumped waste. As such waste remains open to atmosphere.
- Internal roads do not exist at existing site for easy movement of
- There is no control over the dumping of inert, organic waste, electronic and ash of biomedical waste at the site.
- Apparently no studies have been carries out to determine the effect of the landfill operations on the environment and ground water. No environment impact assessment (EIA) study reports are available.
- Industrial waste and construction debris are being dumped unauthorized at the disposal site.
- Open trucks are used to transport waste to the landfill site. This causes dropping of garbage, contamination of soil, odour and nuisance problems along the transport route.
- The safety and environmental aspects as per the MSW Rules (M&H) 2000-2016 are neglected at the site.

5. Case Study, Indore Trenching Ground

Figure 11. Indore trenching ground

Indore has converted its garbage landfill site into a garden with a composite plan of waste management through which, the garbage is used to generate both fuel and manure.

The city strives to become a zero landfill and garbage-free city, with eco-friendly disposal of garbage, through the use of technology that includes a plant for conversion of plastic waste into fuel.

The Municipal Commissioner of Indore, Ashish Singh said that it all starts with segregating waste into wet and dry garbage at the source (household) itself. Thereafter, the garbage collected from all over the city is first taken to 10 nodal points from where it is sent to the trenching ground. Further segregation of dry waste takes place at this ground.

The IMC has planned to press additional staff and machines dispose of heaps of garbage from the landfill. As of now, two machines are treating waste at the landfill site. We will increase the number of machines to 10. IMC is going to do remediation of garbage, which is a scientific method of treating waste. As garbage is lying at the dumping site for past many years it has decomposed. Bacterial spray will be used on it so it gets loosed further and segregated easily. When scientifically segregated, soil from the waste will be removed which will be used for developing garden at Devguradia and nearby places. Residues such as plastic, clothes and other material will be recycled.

Figure 10. Indore trenching ground site pictures

Bio-remediation or bio-mining is an environmentally friendly technique to separate soil and recyclables like plastic, metal, paper, cloth and other solid materials from legacy waste. The work was taken up on war footing, and bio-remediation of legacy waste of approximately 13 lakh metric ton of garbage was completed on 5th December 2018. Initially 2 machines were used for the treatment until realising it is taking more time than usual, 16 other machines were introduced which helped in segregating waste in 27 different categories later useful for recycle, reuse.

Indore has strived to become a ‘zero landfill’ and ‘garbage-free’ city, with the eco-friendly disposal of trash, through the use of technology that includes a plant that changes plastic waste into fuel. The city has also given contract for the establishment of a 20MW waste to energy plan and there is a different plan for processing demolition and construction waste.

ADAPTIVE REUSE

The garbage - both dry and wet - are used for making different products to generate revenue. The Indore Municipal Corporation, with the help of an environmental consultancy agency helps generate manure, interlocking tiles, diesel, petrol and gas from the garbage. Both recyclable and non-recyclable plastic is used in this plant for making the fuel that is used in generators, the diesel plant operator. 50 per cent of the non-recyclable plastic is converted into burning fuel, which, after further filtration, gives diesel, petrol,

- **C & D WASTE –100TPD**
- **COMPOST FROM FLOWER WASTE**
- **COMPOST FROM GARDEN WASTE**
- **SCIENTIFIC LANDFILL AT TRENCHING GROUND**
- **RECYCLING OF DRY WASTE**
- **REUSE OF PLASTIC WASTE**
- **SLUDGE HYGINATIONWASTE -100TPD (COLLABO-**
- **RATION WITH BARC)**

Figure 12. Before and after reclamation

Indore Municipal Corporation has taken waste management initiative for Indore trenching ground which has accumulated waste since 40-50 yrs. i.e. 13, 00,000 MT of waste. Indore is becoming a zero landfill city where Indore trenching ground was a challenge to clean 100 acre site with minimal human intervention and make a fully mechanised control system which went successful and Indore got its first land reclamation in 6 month of duration.

The plastic would be sent to material recover plant at the trenching ground and clothes will be given to cement or other facilities. Landfill will be a thing of past once garbage is removed from there, as today solid waste in the city is segregated at the source. Instead of moving piles of trash to a dumpsite, the wet waste is composted in local plants and a significant amount is processed into biogas for cooking, while the dry waste is channelled to recyclers

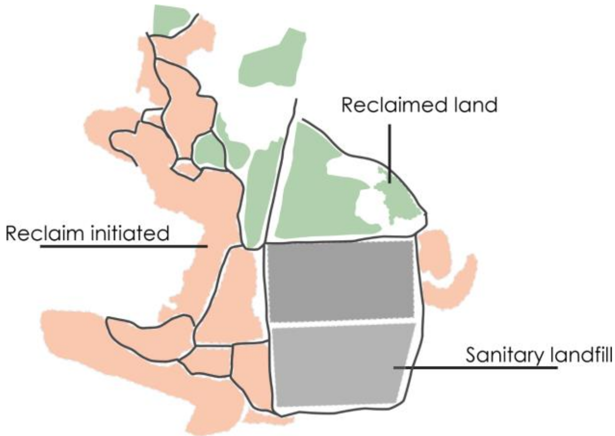


Figure 13. Zoning

6. General results and conclusions

a. There is no system of door-to-door collection of waste and adequate community bin facilities are also not provided to collect the waste. In the absence of doorstep collection and improper and insufficient community bins, people throw the waste on the street, which is collected through street sweeping. Street sweeping is the only method of primary collection of waste.
b. There are 88 hotels and 210 registered restaurants in Bhopal city. No proper arrangements of primary & secondary collection of trash from hotel and restaurants are made. Hotels and restaurants, therefore dispose off their waste on the street or into the municipal bins.
c. There are 7 main vegetable and fruit market namely Navbahar subzi mandi, Jahangirabad market, New market, Kotra market, Bittan market, Kasturba haat, New market haat and many small and local market, where about 50-60 tonnes of garbage generated per week with primary collection. Inadequate storage facility in the market area, which results scattering of market waste in open space causing unhygienic and unhealthy conditions in that area.
d. There is no system of primary collection of construction waste. Generally the people disposed off construction waste on the streets or near their building.
e. Segregation of recyclable waste is commonly not rehearsed. The vast majority of the recyclable material is arranged off alongside local and exchange squander. Thusly, recyclable waste is for the most part discovered blended with rubbish in the city, in district canisters and at dumpsite from where some portion of this waste is picked by the cloth pickers.
f. It was observed that the solid waste was transported from the community bins to the disposal sites by vehicles, which are not designed for the purpose. Furthermore, the disposal of the waste is unplanned and uncontrolled and open dumping is done at landfill sites. Open burning of MSW is a common feature at Bhopal and Indore.
g. Disposal is the last Stage of the waste management cycle. The situation here is as grim as in collection and transportation. About 60-70% of the municipal waste collected by the civic authorities is dumped in Iow- lying areas outside the city limits which have no provision of leachate collection, treatment, landfill gas collection and use. Even dumpsite area is not properly fenced. Rag pickers and animals freely roam under the site surroundings.
h. During the study period, it was observed that, the dense smoke coming-out from the dump yard throughout the time (especially in night-time). In rainy season bad odour and flies create problem in nearby habitations. Open burning of MSW also creates visibility problems for the movement of railway traffic on the trunk route connecting

Delhi and road traffic on the busy state highway located next to the site.

i. In rainy season the runoff of MSW dumpsite flows towards Patra River, which subsequently joins Halali Dam (used for irrigation and fish farming).

j. The Madhya Pradesh State Agro Industries Development Corporation Ltd. is running an organic manure plant based on solid waste at MSW Dumpsite, Bhopal with the total capacity to process 100 MT of solid waste per day. This plant is running successfully and the manure produced is sold to the farmers of MP with the help of its district offices as well as with the help of private dealers. The present retail price of the manure sold to the end-users is Rs.2100/- per MT, while the ex-factory price to the dealers is Rs.1250/- per MT.

7. Model strategy of landfill redevelopment

The Model System can assist me with formulating my examination structure and developed my very own procedures and plan rule. More importantly, I can discover the deficiency and neglected focuses in Indian open dumps and landfill redevelopment through looking into the Model Technique and contextual analysis. With the goal that I can give these missing parts in my exploration and plan.

7.1 Maine objectives of the model strategy

• To diminish dangers presented by previous landfills to the earth and public health.

• To stimulate the re-utilization of previous landfills through trade and spread of strategies, activities and instruments.

• To get the issue of former landfills on to the Asian plan and thus to stimulate nearby specialists and other open bodies at national, territorial and neighbourhood levels to begin managing previous landfills;

• To include partners from the waste administration, venture improvement, consultancy and open segments in early periods of basic leadership concerning the administration of previous landfills.

Quality of re-use	Type of re-use
Low-graded	Parking area
	Industrial area
↓	Shopping malls
	Office buildings
	Nature
	Sports and recreation
High-graded	Residential area

Figure 15. Model strategy

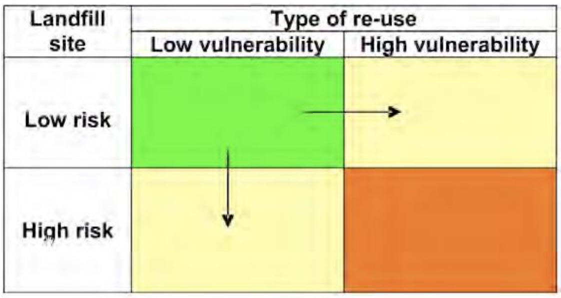


Figure 14. Objectives to reclaim land

7.2 Examination, aftercare and redevelopment

SufalNet's technique on examination utilizes a source– pathway– receptor way to deal with build-up site calculated model. This can assist architects with planning for future activity and decide the degree of measures required to oversee distinguished dangers. Analysis can happen stage wise, ordinarily including a primary stage; elaboration of a site calculated model; meaning of the analysis procedure; and execution of the analysis procedure.

When analysis has occurred, chance evaluation offers a scaffold into aftercare. Execution of aftercare measures is pivotal to take out real dangers and to maintain a strategic distance from future dangers to human well-being and to the earth. SufalNet recognizes six classes of aftercare measures: arrangements and enactment; specialized measures; association; financing; correspondence; what's more, legitimate measures. The usage of these measures can open the potential for redevelopment. Be that as it may, this isn't direct for each situation. The model system looks to decrease the multifaceted nature of the basic leadership process and improve the achievability of redevelopment. A synopsis of the basic leadership process that unites each of the three components in surveying venture possibility is appeared in the figure 1.13.

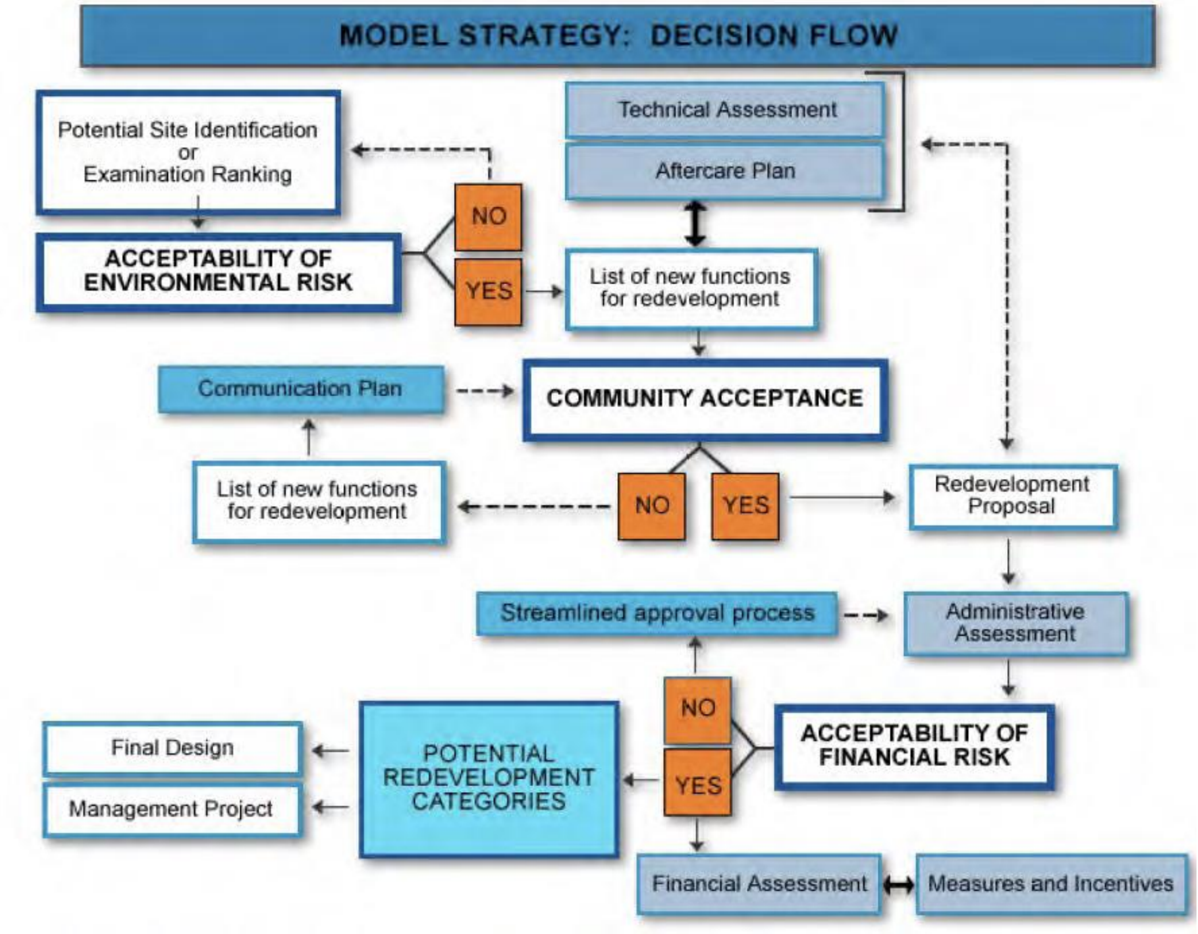


Figure 16. Model strategy : Design flow

8. Research Design

8.1 Goals

The primary target of this theory is to investigate the hypothetical potential outcomes and viable material to change the landfill into a multifunctional environmental site which may incorporate activities, not constrain to air quality, soil quality, remnant the board, biodiversity, water treatment and relaxation structure by consolidating using different structuring instruments . Adjacent to that, the educative significance will be underlined as an incorporative target of the site. The configuration is tied in with making a sound, incorporated human instinct biological system where environmental, relaxation and social capacities coincide also, in which all pieces of the framework are similarly noticeable, it ought to fulfill the network needs and wants. Past cleaning contaminated land and making another independent framework, attractive network green spaces and educative components are made. This could be accomplished in four stages:

1. Theoretically considering the environmental rebuilding and waste scenarios related learning, characterizing the general issues.

2. Picking the reasonable investigation zone to apply the thought. Figuring out the present circumstance and issues of the landfill site, particularly in finishing and biological viewpoints of biodiversity, natural contamination, leisurements, and so on, determining both the best and negative environmental components of this territory.

3. Investigating the neighbourhood's view of the landfill, finding their possibilities to dispense educative behaviour components into the site, to address individuals' misconception of waste. Therefore positioning the most appropriate consolidated choices for the site from a public environmental view. Arranging the site dependent on the best alternatives for the site, joining existing information and innovation into the examination results and site setting.

4. Reviewing the process, summarizing the pregnant effects, and concluding the landscape designing principles for ecological and educative transformation redevelopment.

8.2 Hypothesis

A well-planned landfill ought to have the potential outcomes to have not just nature esteems but also educative implications, encourage individuals to get to know the waste treating process, similar to how dump is being covered, stacked and reused, so as to bring out an acknowledgment of sparing vitality and ensuring condition by diminishing an inefficient mentality and unnecessary waste. Additionally a possible incorporating approach could be connected later on landfill retreatment in different tasks.

8.3 Research questions

The analysis will be led with a few research questions. My principle explore question is:

By what method can my considering region be formed into a sustainable and attractive site, where negative effects from landfill are diminished, and different landscape functions be created also, incorporated in a feasible and educative manner?

At that point, a few sub-investigate questions are characterized:

a) What are the present characteristics, dangers and possibilities of the distinctive landscape type in the landfill study area?

b) What are the spatial manifestations of a landfill site?

c) What are the desires and requests of neighbourhood individuals advances the future landscape enhancement of landfill?

d) In what capacity can the landfill be redeveloped concentrating on environmental and supportable qualities?

e) In what manner can the educative importance be fused with landscape configuration utilizing existing assets in a landfill redevelopment project?

9 Research Methods

9.1 Research flow

System depends on "examine for plan". Research and configuration are two important exercises. A total research for configuration is an iterative procedure, in which, investigate, agreeing to Zeisel (2006), draws on hypothesis, preparing, mass learning, and experience to create provisional thoughts regarding how to take care of issue. The entire approach map is represented in Figure. The procedure begins with setting up theory. Writing audits and contextual investigations assume a huge duty in gathering and inciting valuable hypothetical structure and configuration instruments. As talked about by Forster Ndubisi (1997), substantive hypothesis in scene arranging begins from sciences and humanities, are graphic, and utilized for managing data, while procedural speculations which are prescriptive centre around methodological issues, and elucidate the utilitarian connections that grant the use of the learning. So as to get a complete hypothetical structure, hypothesis of two sorts are both required. The included substantive theories incorporate eight waste-related scene configuration approaches standards with strategy centre around environmental decent variety; the hypothesis comprise of layer approach and a model technique of landfill redevelopment. The analysis procedure is separated to four sections; each part has a few stages and a primary objective. The methodology map depends on my examination procedure, related with the choice progression of Model Technique into stage two and also stage three. Every one of those means have a specific commitment on the procedure and the greater part of them base on a cyclic methodology. So after a time of research I will think back to analyse the plan or on the other hand inquire about what I have done to correct oversights, include more data or clarify headings for following stages.

9.2 Design process

The exploration will be test by a site-specific plan. The design will follow an inventory, analysis, concept, structure, and elaboration process. In the inventory part, information will be gathered through site overview, writing survey and meeting. The natural conditions, for example, geography, traffic examination, soil structure, land use, and so forth these imperatives are significant for the further plan. The exploration goals and research questions can additionally be altered when I acquire data and information about the site. The assessment will follow the design to check if they are suitable or not. If the designs are not suitable, I will go back to the design part again and repeat this circle.

9.3 Methods

Each sub question has its own methods to come to the desired results. To ensure that the sub questions will be closely related to the objective and goals of this research, they are accompanied by a short description of their desired results.

1 What are the current qualities, threats and potentials of the different landscape type in the landfill study area?

Method	Results
Field excursion, analysis on site	Analysis of qualities, threats and potentials in maps, principle sketches, text and photographs
Maps/GIS research	Insight in historical development of different patterns, settlements and land use in relationship to elevation, soil conditions and geomorphology, to understand the current morphology of the landscape

Table 3. Potential and threat

2 What are the spatial manifestations of a landfill site?

Method	Results
Short field trips to other landfill areas in the Netherlands and research (internet/literature)	Photographs, sketches of spatial principles and description of atmosphere, to give an overview of the spatial manifestations of landfill in the Netherlands, with special attention for general characteristics that can be recognized in the study area
Field excursion to the study area	A graphic presentation of the location and characteristics of risk areas where the effects of landfill can be expected to be most severe
Open interviews with local experts and residents	Summarization of most important problems as experienced by local people

Table 4. Manifestation of landfill

10. General strategies and principles

10.1 Vegetation restoration

In the research, my considerations was to form Bhanpur landfill site into various multi-use zone. To accomplishing those end utilizes, setting up and keeping up a powerful vegetative stand on the last spread soil is a mandatory advance in the primary stage. Vegetation restoration is the way toward fixing harm brought about via landfill exercises to the decent variety and elements of indigenous biological systems. Phytoremediation has the accompanying focal points: ease and support costs, simple procedure, environmental and sustainable, no intrusive, enhanced visualizations, and easy to be acknowledged by the public. The absence of trees and bushes seriously restricts the landfill's potential for untamed life living space/halls, also visual assortment. Another convincing motivation to plant trees is to diminish scene support. Nearby trees will colonize practically any site except if effectively prevented. Preventing trees on landfills involves a blend of cutting and herbicides, both of which convey vitality and contamination costs. Trees additionally have potential for disintegration control. There are heaps of fruitful vegetation rebuilding cases and techniques everywhere throughout the world. Subsequent to looking into the writing and contextual analysis. I joined them and built up the general vegetation rebuilding technique and rules that most reasonable for my site. I will clarify them in detail in the following part.

10.1.1 Trees and environmental qualities

There are four main environmental problems existing in the landfill that will affect people's life. Air pollution, noise, dust and smell. Air pollution is one of the main problems in landfill, which will cause lots of diseases for people.

The impacts of those four problems can be decreased due to correct trees selection and planting principle. A trees has the ability to improve the environmental quality in using different parts of it. However, engineering supports is also required to solve those problems.

"Every landscape design must star t with the germ of a vision for the site in question and an understanding of how the site will be used and what functions the plants will serve in it. There is no one correct vision, of course. Landscape design is an ar t form precisely because of its infinite possibilities."
- Peter J. Trowbridge and Nina Bassuk, 2004

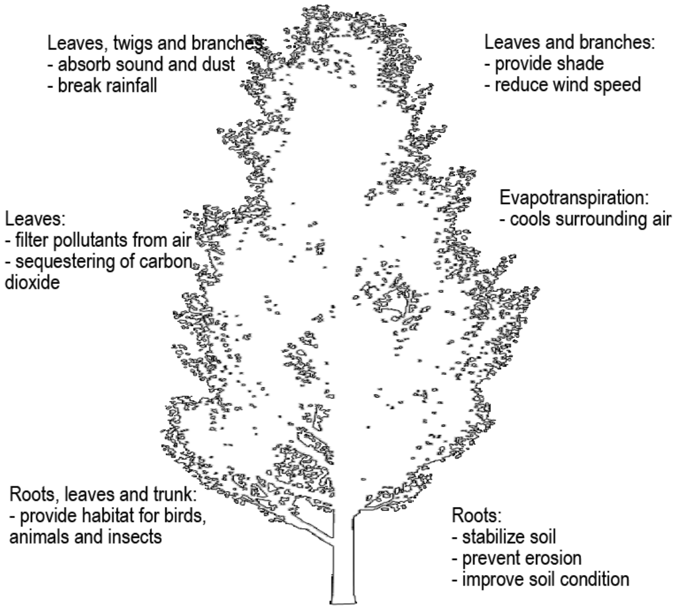


Figure 17 Tree and environmental qualities.

Pollution

Plants play important role in decreasing air contamination, both particulate and gaseous. Trees go about as characteristic channels, evacuating particulate issue as well as gaseous toxins including carbon monoxide and sulfur dioxide by retaining them through leaves and other plant parts. The particulate issue that sticks to trunks, twigs, and leaves is generally washed into the dirt by precipitation. Nonetheless, trees are able to assimilate low dimensions of harmful exhaust without related harm to the tree. More research is required into the viability of specific species in the decrease of airborne toxins.

Noise

A couple of plants alone complete a poor occupation of diminishing noise. Notwithstanding, thick planting, particularly joined with strong obstructions or land frames, can diminish noise fundamentally.

Air contamination, clamor, smell and residue are generally traveling through the wind stream, and wind stream affected by various obstacle:

1. Hard wall: the breeze will be guided over, however will descend following the obstacle

2. Permeable wall: the breeze is guided over and will likewise go through the divider making a region which will divert the wind current further away.

3. A tree: the breeze will enter the crown and crash against leaves and branches. This causes the breeze to circle inside the crown, making other breeze streams to go over the tree and lift them higher so they will descend further then choice 1 or 2. But the breeze has open field under the tree, so some wind streams will enter the zone behind the tree.

4. A tree with undergrowth: the tree is lifted over the tree as depicted at option3. Besides, the bushes will stop the lower wind currents. The shielded area behind the tree is much bigger then with the initial 2 choices.

Also, the air contamination is made out of a few layers. The background contamination has been blended with other wind currents and has been lifted higher. To impact all contaminated air a mix of higher and lower vegetation ought to be utilized. The wind current that has been lifted by a vegetation structure will lose tallness after 10 or multiple times the tallness of the vegetation. At the point when on that area another vegetation structure is put the entire procedure of separating and lifting will be rehashed. Along these lines the air is separated a few times and a bigger region can be protected from contaminated air.

At the point when a tree is 60% permeable the breeze will almost certainly enter the crown and be thought about all the branches, bringing about a nonstop revolving around wind current inside the tree's crown. The contamination will interact with the leaves and be sifted. The wind current coming are being lifted high out of sight. At the point when a tree is increasingly thick, the breeze can't enter the crown and consequently the contamination won't be separated and the tree will work like a divider thinking about the impact on the wind stream.

For the ideal outcome the vegetation ought to be put in a direct structure, along these lines the contaminated wind currents will have the most impact. This implies the crowns of the trees ought to structure a nearly joined deterrent. On the off chance that the plants are put excessively far separated, at that point both the green
Component and the linearity will be lost; then again, if the trees are set excessively close together then it will prompt a too thick obstacle. A straight vegetation structure with bushes or other (climbing) undergrowth has effect on all air levels (low and high). This is better both for the sifting of contamination and for controlling the wind streams over the zone behind the structure.
High fences will hinder the view from a cyclist, which can make a risky inclination andna perilous circumstance. Bringing down the bush tallness probably won't be perfect for the wind current separating, however is essential for a protected structure.
Inside the given rules of linearity and porosity, there is as yet variety conceivable. A solitary line of one sort of tree will give a formal, stately encounter, while variety of species what's more, sizes will give a progressively normal image.

As a landfill re-use as parks, a single species of plants should be avoided. Furthermore, different species also have their different functions and capacities:

- Growing possibilities determine whether a tree can grow on the specific location

- In general; broadleaved trees have a large ability to absorb NO

- In general, coniferous trees have a large ability to catch PM

- A broadleaved tree with featherlike leaves is more porous and is therefore more suitable for catching fine dust and for guiding airflows

- A broadleaved tree with more (accessible) leave surface will catch more pollution than a tree with less foliage

- In winter broadleaved trees lose their leaves, the capacity for filtering the air decreases seasonably (branches and trunk are still active), the capacity to guide flows can still be up to 80%.

10.1.2 Erosion and runoff

Plants have a crucial role to play in reducing soil erosion as well as trapping and slowing the runoff of storm water. It is important in contemporary design to incorporate plants that can significantly reduce our dependence on storm water depletion systems, improve natural water infiltration, and reduce the speed of water moving across a landscape. Plants can provide the ability to reduce runoff on highly erodable soils and steep topography areas. Plants with a highly fibrous root system that with their stems and leaves work best in this regard yield a more complete ground cover.

Plants create spaces
Plants may be used to create physical barriers, directing foot traffic or screening unsightly views. Plants can change the sense of scale to a more human dimension.

Recreation/Habitat
Green space can provide the necessary animal habitat and are the places where most people connect with the natural world and actively seek recreation. These areas represent critical habitat where people in natural settings can interact with animals.
For the landscape designer, the vast aesthetic possibilities plants offer can be overwhelming. However, we can create wonderfully inventive landscapes by embracing this diversity of seasonal interest, shape, colour and texture. The realization of a site design vision and the ultimate success of a built landscape require a thorough understanding of how people will use the site and how it can or cannot support the site.

10.1.3 Preparatory work

When landfill is closed, the soil is usually covered by 60 to 90 cm deep. It is not conducive to the root contact of plants with contaminants from landfills, which is an important factor in limiting the use of phytoremediation technology to restore vegetation from landfills. In agriculture, tillage technology can be used to solve this problem by digging the depth of the soil to the surface or using leachate to irrigate the surface vegetation.Before the recovery of vegetation to the landfill begins. Firstly, laying pipes for collecting landfill gas to reduce the effect on plant growth; secondly, when landfill is closed, the top layer of waste must be covered with soil, either too thick or too thick or without soil will both affect plant growth, adding fertilizer is necessary in the casing layer.

Through a lot of survey, people found the plants trying to grow in landfills, especially deep-rooted woody species, facing considerable pressure to survive. Generally believed that landfill gas in the soil (especially anaerobic decomposition of organic waste generated by CO_2 and CH_4) is the most important limiting factor for the growth of landfill plants. On the other hand, the leachate, the highest soil quality and the diffusion of landfill gas are also the main factors for the growth of plants.

10.1.4 Process of vegetation restoration

The annuals provide a quick temporary cover that the more permanent perennials succeed. If a site's plans include a natural area, consider testing some already growing native species at the site. Efforts should begin by establishing that 90 cm of soil is in place in areas where trees and shrubs are to be planted. After the grass has been planted, a l-or 2-year holding up period is suggested before zones are chosen for planting trees and bushes. On the off chance that the grass spread with its shallow roots passes on or comes up short to develop in view of the inundation of gases from the landfill, it is almost sure that other more profound established vegetation (trees and bushes) won't flourish at these areas.

Plants choice is a huge advance in landfill vegetation restoration. Plants must be picked all around cautiously because of their attributes, to ensure augmenting utilizing their capacity recouping the earth just as tasteful considering. Various types of plants ought to be chosen in various reclamation stages in view of various landfill condition. Species choice may require more consideration on loads up with a realized end use, since feel and similarity with the utilization must be considered alongside disintegration control. Seed ought to be sown in the fall.

Blends of annuals and perennials are most appropriate for balancing out soil and averting disintegration. Prescribed seeding rates ought to be pursued cautiously for the brisk spread species to forestall thick stands that anticipate or impede foundation of the lasting species.

Besides, the non-native plants and local plants determination ought to be considered as well.

10.1.5 Plant Selection

Thus enough soil should be present to bring the total depth to 60cm (not including the gas barrier layer) in all areas except where trees and shrubs will be planted; the latter areas require at least 90cm.

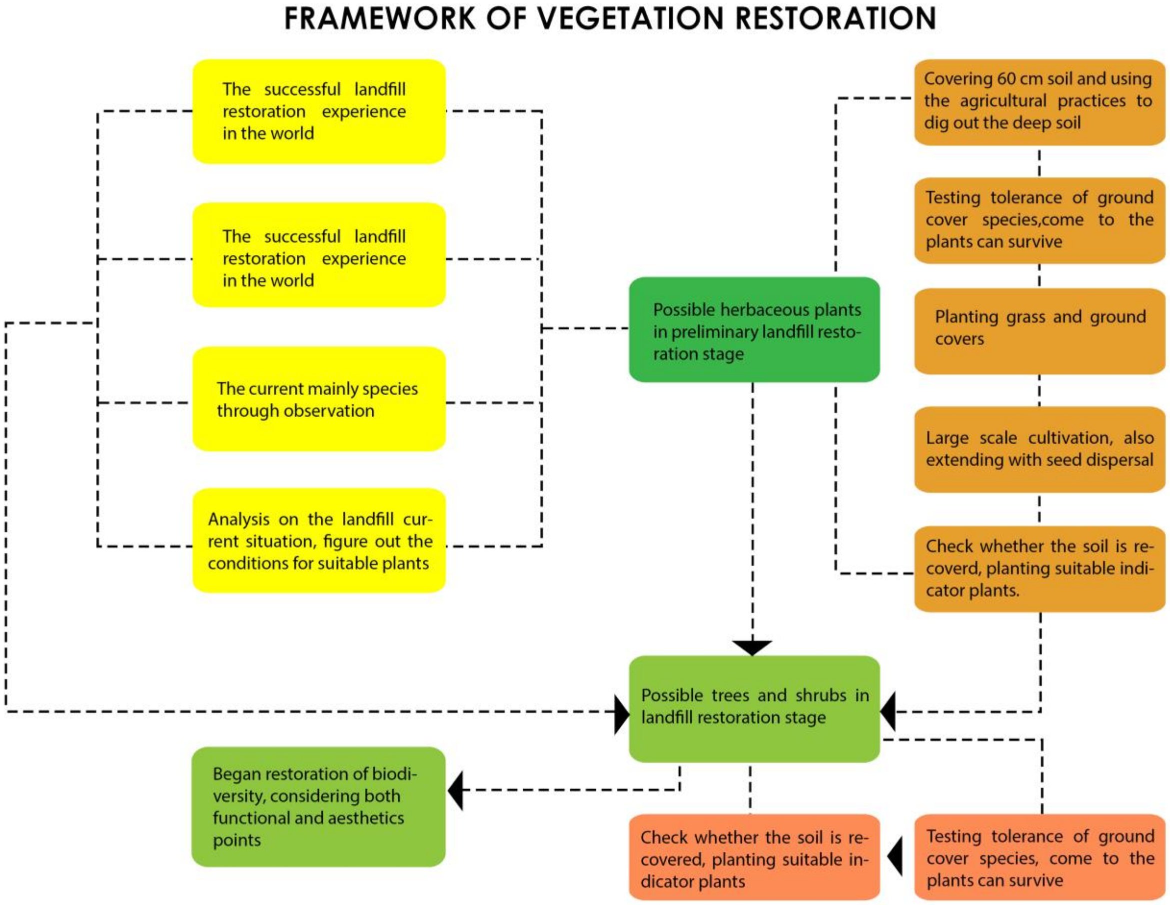


Figure 18. Framework for vegetation restoration

If results show that more soil is needed anywhere on the site, soil can be moved from one part of the fill to another, or it can be trucked in from another site.

Develop grass, shrubs and tree growth

Efforts to build up a decent front of woody plants should start by finding out that 90cm of soil is set up in territories where trees and bushes will be planted. The most economical and most useful methods for setting up trees on a finished landfill that has been shut for a few time is to plant seeds or little whips of species previously setting up themselves on the landfill. Grass ought to be the principal species on landfill. After the grass has been planted, a 1 to 2 years holding up period is suggested before regions are chosen for planting trees and bushes. On the off alternative that the grass cover with its shallow roots passes on or neglects to sprout in light of the convergence of gases from the landfill, it is almost sure that other more profound established vegetation (trees and bushes) won't get by at these areas.

Slow versus rapid growth species

According to the article ' Standardized procedures for planting vegetation on completed sanitary landfills ' (Edward F. Gilman, 1984), evidence indicates that slow-growing trees are more tolerant than rapidly growing species to landfill conditions. Fast growers usually get more moisture from the soil, so they need more irrigation. But with their more rapidly produced vegetative cover, faster-growing trees may be more desirable, and they will produce more total growth on a landfill than slow growers if irrigated over the first 3 years.

Small versus large plants

Trees planted on landfills when small (1 m tall) show significantly better growth than those of the same species planted when larger than 2 m, irrespective of species. By producing roots close to the surface and away from high gas conditions, a small tree can adapt its root system to the adverse environment in the cover soil. Smaller trees may equal or surpass them by the time the large trees adjust to the landfill. Larger plant material can only be used if the root system preserves landfill gas and the plants are well irrigated.

Natural rooting depth

Trees and shrubs that are considerably more adaptable to landfills with shallow root systems than species that require a much deeper root system. Higher concentrations of landfill gas and lower levels of oxygen are subject to the deeper roots. By producing a shallow root system, some species can avoid this adverse environment.

Table 5. Depth of roots table

Grass		Shrub		Trees	
Common	Forage Garss	Small	Big	Shallow root	Deep root
<30	>100	30 - 45	45 - 60	60 - 90	90 - 150

10.1.6 Indicative plants

Many plants are very sensitive to the environment change, in particular air, groundwater and soil. These plants can be used to indicate and monitor the environment. Different plants have a range of different adaptation to various ecological factors.

Figure 19. Indicative plants

10.1.7 Suitable plants in Preliminary stage

SUITABLE PLANTS IN PRELIMINARY STAGE

	Annual herb	Shallow root systems	Flood resistant	Polluted gas tolerant	Size	Volunteer species	Growing in low altitude
Ageratum conyzoides 	✓	Less than 5cm ✓	Unknown	Can be grown in high polluted area ✓	0.5-1m high ✓	Unknown	Unknown
Neyraudia reynaudiana 	Perennial herb	Less than 5cm ✓	✓	Can be grown in high polluted area ✓	2-3m high	No	Unknown
Cynodon dactylon 	Perennial herb	Less than 5cm ✓	✓	Can be grown in high polluted area ✓	10cm-30cm high ✓	✓	✓
Erigeron Canadensis 	Biennial herb	Less than 5cm ✓	Unknown	Grow up in high landfill gas level ✓	5-60cm high ✓	No	✓
Ambrosia artemisifolia 	✓	Less than 5cm ✓	✓	✓	20cm to 250cm high ✓	✓	✓
Buchloe dactyloides 		Less than 5cm ✓	Unknown	hydrogen floride gas ✓	05-25cm high	Unknown	✓

Figure 20. Suitable plants for preliminary stage

11. Design Strategy

The transformation of Fresh Kills should be a model of continued public engagement.

The scale and unusual nature of this project have generated a great deal of interest and enthusiasm at public meetings over the past two years. It is crucial to continue to engage the public so that the Master Plan reflect its needs, desires and dreams. In general, the public has expressed a strong desire for a broad mix of programs at Fresh Kills, with an emphasis on dedicating large tracts of the park to scenic passive uses, ecological restoration and habitat creation. A synopsis of main themes advocated by stakeholders during the outreach is outlined below.

• Activate the park: Most people want to see a mix of active programming, including recreation and sports facilities, restaurants, educational and cultural institutions, and waterfront amenities,

but many caution against allowing too much development. The majority hope to retain large sections of quiet, scenic landscape, while offering concentrated areas for active programming.
• Create opportunities for large-scale recreational activities: People see the opportunity to create extensive pathways and trails for walking, running, organized marathons, bicycling and horseback riding. They also would like an area dedicated to mountain biking trails. There is also an interest for sports fields (particularly soccer and tennis) and more flexible-use, large-scale meadows for picnicking, kite-flying and community events. Some expressed a desire to see a golf course, an amphitheatre and a night-sky observatory.
• Create neighbourhood park amenities: There has been strong support for improving existing recreational and park amenities and building new ones, responsive to the needs of local residential communities.
• Create opportunities for waterfront recreation.
• Create educational opportunities: Many people value the importance of educational opportunities and recognize the international significance of the conversion of Fresh Kills to parkland. The history and workings of the landfill can be explained through educational exhibits. An ecology centre could involve local youth in ecological science experiments.
• Create opportunities for art and culture: The unique nature and scale of the site suggests opportunities for environmental art, performance art and cultural event programming. Factors including artwork installations, community and art workshops, a museum or gallery, an amphitheatre, events and displays.
• Demonstrate renewable energy systems: The public is supportive of a park design that includes sustainable energy demonstrations harnessing solar, wind, water, and methane power.
• Concentrate commercial facilities: Opinion is fairly consistent among local residents that large-scale, commercial programs should be located primarily in the centre of the park. People are especially sceptical about chain restaurants and generic development, but are amenable to distinctive, thoughtfully designed facilities.
• Promote youth recreation

11.1 Construction

Recycling is more than just a convenient way to save energy and resources. Clearly, for simple pragmatic reasons, it is worth doing. But like necessity, it can be a source of creativity and invention, inspiring landscape designers as well as users. Modern communication and transportation have diluted the uniqueness of specific places until many people feel adrift in a featureless landscape of convenience. Reusing cast-off materials is a connection between people and places and gives a sense of continuity that many people want deeply. The results can be as quiet as a site's "character" gains from worn, used stone or as evident as an old tractor with petunias.

Use on-site materials
If the use of local materials follows the principle of "close-to - the-source," then the site itself is the nearest source. The vast majority of materials have been taken from the site or very nearby for traditional construction, soil, wood, and rock. Limitations on materials available locally played a major role in regional technology development and design styles.

These local materials, far from being a constraint, have awakened a creative response to design that has become one of today's most popular and imitated styles. In the landscape, a wide range of materials on-site can be reused productively if they are considered creatively.

Boulders, Stone, Brick and Timber

Rubble from demolished buildings or paring can be reconstituted as paving surfaces. Concrete rubble was pieced together and cemented to form the basis of a new driveway and parking area. This significantly cut requirements for new cement.

Principles for choosing materials

1. Whenever possible, specify locally produced products
2. Use less processed materials
3. When specifying materials, perform a rough audit of the energy required to mine, produce, ship and install them.
4. Explore the availability of recycled materials. Specify reusable materials, for instance, stone, brick, or concrete pavers rather than poured concrete.
5. Avoid petroleum-based materials whenever possible. Asphalt and many plastics are indispensable in a few uses, but not for every purpose.
6. Use durable materials with high carbon content: the carbon locked up in these materials offsets the release of greenhouse gas carbon dioxide from other sources.
7. Protect existing vegetation, use new plantings or bioengineering
8. Minimize use of materials that are toxic, either on-site or during manufacture or disposal.

Figure 21. Possible construction materials

11.2 Biotechnical erosion control

A broad range of applications is included in biotechnical erosion control. Nearly all take advantage of some plants ' remarkable ability to sprout from a fresh cut twig stuck in the soil. Willows, poplars, or dogwood are the most vigorous of these. These and a few other species are the most frequently used bio-engineering materials. They have no roots or leaves when cut, making them nearly as convenient to work with as tiny boards or stakes— yet they are alive, and within days or weeks they begin to weave new roots deep into the soil.

Soil bioengineering: a simple system in which live woody cuttings and branches provide both structure and growth. Mulch and natural or synthetic fabrics also play a major role, preventing surface erosion until the cuttings leaf out. Once the cuttings take root-usually within one growing season-they provide long-term stability for the slope and are self-repairing and self-maintaining.

Here are some of the benefits bioengineering offers:-

- A structure that is flexible, self-sustaining, self-repairing.
- Installation and maintenance at a lower cost than hard structures.
- Increased strength than standard surface plantations due to deep cutting burial and interwoven stems, roots and geotextiles.
- A practical alternative where it is impossible to use heavy equipment.
- Filtering of wildlife habitat, air and water quality, and other plant functions.
- Suggested bioengineering practices-Site, plant species, and environmental conditions must be carefully tailored to soil bioengineering.
- An experienced practitioner requires successful bioengineering.

11.3 Art, engineering and recycling

Besides dumping waste underground, landfill also has the responsibility of recycling. In this field, artists and engineers did a lot of research and projects that could also be applied in landscape design. Artists can help raise public awareness and increase educative meanings; engineers can provide technical supporting relating with landscape design tools. Both of their work can inspire me to build up alternative possible solutions in my design.

• Landscape architect's role

- give different identity, structure and meaning to landscape

- use designs to influence the opinion and behaviour of people towards environment

- provide opportunities for artists and people

- provide public participation

• Artist's role

- Rising awareness of environmental problems

- create inspiring art to educate people

- address waste issue in art work

- bring information to public from his own understanding

• Engineer's role

- Waste management

- Technology support

- Landfill maintenance and monitoring

11.4 Composting

There are various ways of disposing of biodegradable waste which avoid one of the drawbacks of landfill – the consequent free emissions of methane, a very potent greenhouse gas. One option is anaerobic digestion, which can generate some usable energy, but this method still leaves a residue which has to be disposed of somehow. Incineration is another well-supported option, but an imperfect one, since wet biodegradable waste is not particularly fitted to incineration, as it reduces the calorific value of the waste. Thus, the third option, composting, looks too many as the most cost-effective way of moving forward.

Figure 22. Bio-remediation plant

The domestic sector uses most of the compost produced by centralized units, and naturally all the compost produced in domestic units. This compost is suitable for use as a soil improver without further treatment, it can be excavated around the roots of newly planted trees before vegetables are seeded or incorporated into the soil. To make a growing medium for container-grown plants, it can also be mixed according to balanced formulae with things such as bark or other wood fibre unblended compost is rarely suitable for direct use as a potting compost.

11. Conclusion

Combining both artists and engineers work. The following picture shows some solutions to increase educative meanings which could be applied in my study area.

	What can we deal with waste		and how?
Biodegrable waste	A potent gas for greenhouse and methane-feuled vehicles through: - anaerobic digestion - Incineration - Composting	the wasted fre emissions of methane from landfill	- Exhibition - Engineering support
Leachate from Landfill	Collecting carefully and creating art form such as painting	Noxious liquid oozes out of landfills	- Public participation - Artist involvement
Municipal organic waste	- as fertilizer for agriculture and horticulture - Saving in environmental costs and transport costs	Sending and dumping it in a landfill site	- Discovery - Public participation - Engineering support
Non-organic waste	Use as art species, sculptures, recreational material	Dumping it in a landfill site	- Discovery - Public participation - Engineering support
Perspective of Landfill	- close to nature and wildlife - interesting place with various activities - Memory feild - Largest green open space	A site dumping unused garbage with disgusting smell and noise	- Exhibition - Public participation - Artists involved - Engineering support
Recycling Behaviour	Sorting and recycling garbage is an important experience in our society.	Garbage is something I dont want to reuse anymore	- Exhibition - Public participation - Artists involved

Figure 23. Alternative use of waste

12. Phased development

Three of the four problems–differential subsidence, gas emissions, and slope instability to a lesser extent–are declining over time. Less problematic environments of activity can be located shortly after landfill closure and more problematic environments of activity can be added later. Classification of environments of activity into groups of levels of sensitivity can be used to create tracks for phased development.

The cumulative list of activity environments is shown in the last column. The top cell presents all the activity environments that can be located in stage A for all three problems. The cell underneath it shows all activity environments that can be located in a landfill during stage A or B for each of the problems/ the activity environments appearing in the cell above it, which could always be located during stage A, are excluded.

The result presented in the column shows the groups of activity environments that can be located in a landfill in each stabilization stage. This list of compatible activity environments determines the compatible open spaces in each stabilization stage.

The cumulative list given here is based on the assumption that a certain level of differential subsidence corresponds with given levels of gas emission and slope stability. This is true only to a certain degree concerning subsidence and gas emission. However, it is possible to examine specific landfill sites and construct an accurate cumulative list for each site. The list will show the compatible activity environments for each stabilization stage for the specific site.

Based on the cumulative list, a flow chart was developed, presenting tracks for phased development based on two principles:

1. Natural stabilization process in landfills.

2. Minimum changes in transition from extensive to more intensive uses.

Using the flow chart, I can select the most appropriate chain of uses and be presented clearly and briefly with all the logical alternatives.

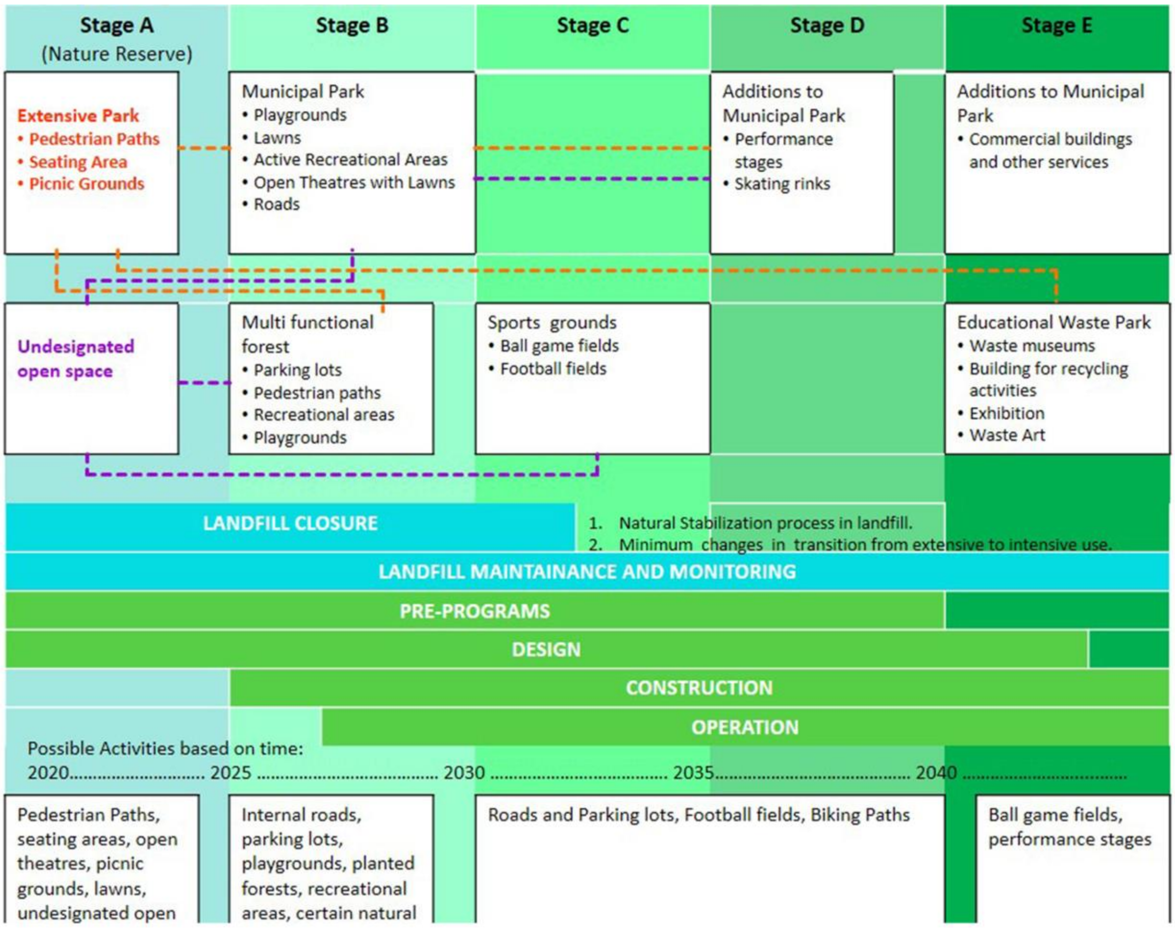


Figure 24. Phase wise development

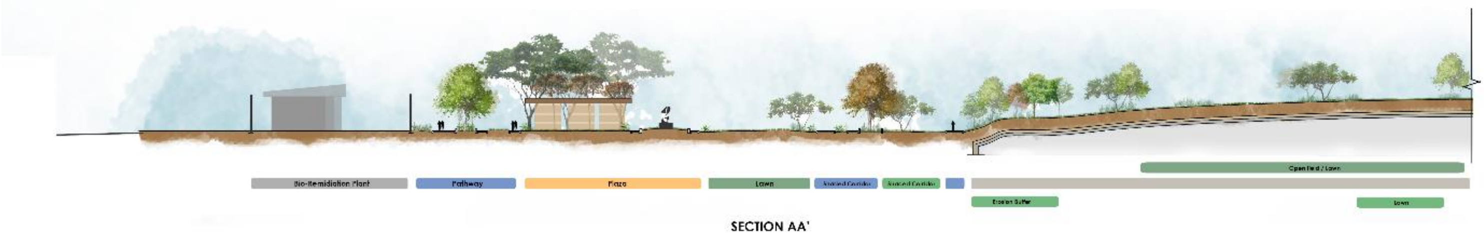
13. Design proposal

The location of the area let it become the continuation of the entrance. The objective is to provide resting area as well as interesting outdoor experience for people. After the vegetation restoration, necessary facilities can be constructed such as chairs and bicycle parking lot. People can sit under different species trees, holding family picnic, or parking their bicycle in the parking lot and take a rest before starting their journey. The topography can be designed in special spatial quality. And the ground and facilities will be constructed in local re-used materials. The plants are being chosen based on principle of vegetation restoration.

To use the topography to provide unique experience for tourists. The hilltop can provide a nice open view for tourists to overlook the rural area in Bhanpur naturally, which they cannot experience this in other place. The hilltop open space can be accessed through the multi-use paths provided by other detail designs. Several platforms will be built up based on the slope, for people to sit or stand. Plants should be mainly shrubs and grass in order to not block the view. After vegetation restoration, this place can be designed to provide park-like experience for people. By design routes inside the plants, using plants to create enclosure and open space, adding seating area and playing area for people. The playing elements will be constructed in abandoned materials in the site. Various activities suiting for different group can be happened in this place.

13.1 Proposed site plan

Figure 25 Proposed site plan



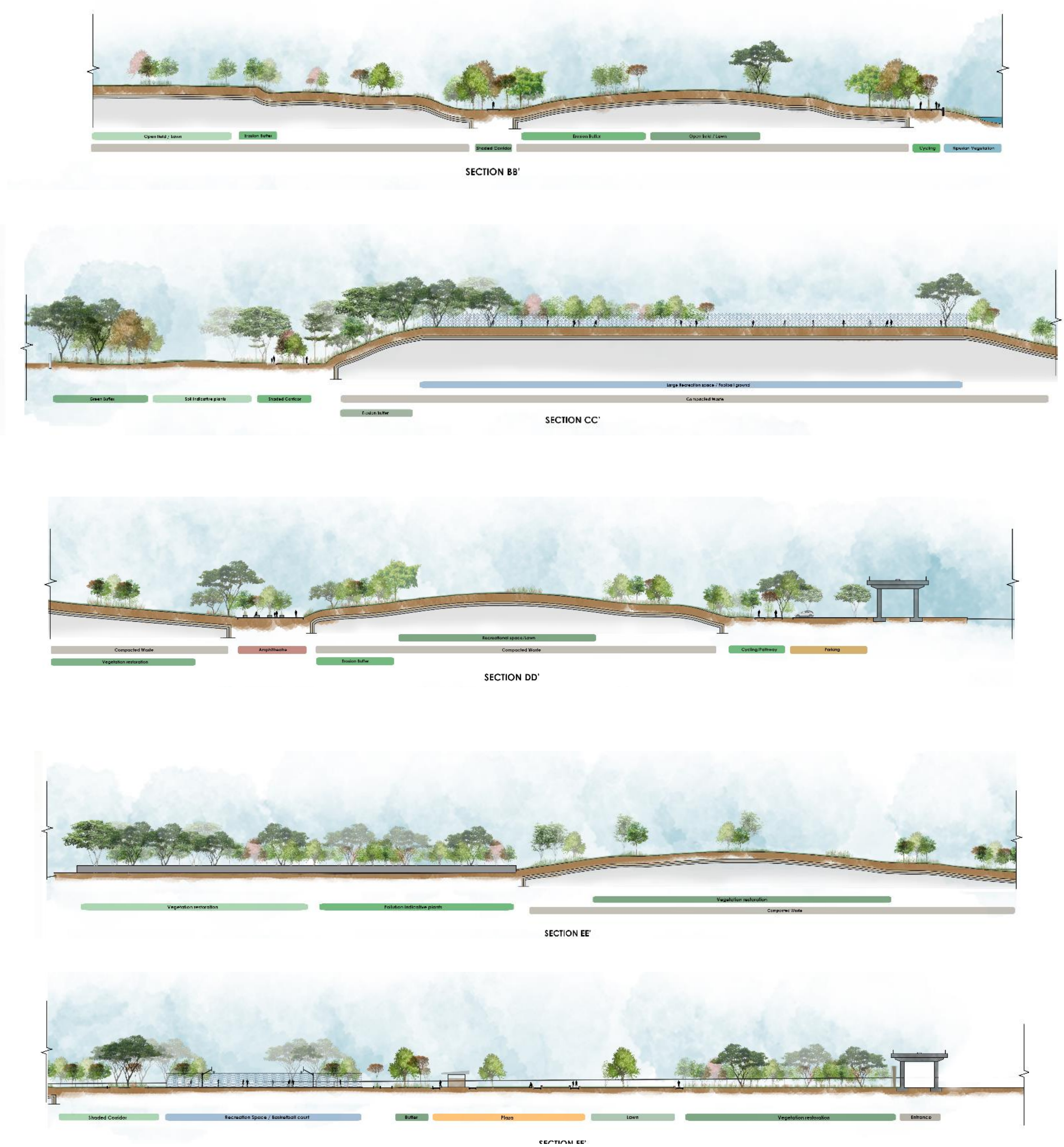


Figure 26. Proposed site section

Figure 27. Illustrations for proposed landfill park

14. Conclusion

From the evaluation we can see that the design can satisfy people's demands preferably, more research on the meaning of landfill's landscape should be studied cooperating with artists and other experts. In the environmental part, the design will protect the landfill site's environment and ecosystem in the future, but the influence of surrounding area need future research and analysis. For social aspects, the design can provide various outdoor activities to the community and also increasing people's awareness about waste related issues. Due to the time schedule and my ability, the design still contains some limitations and uncertain expectations. Because lack of database, I use indicator plants as an alternative solution to analysis the soil condition. This approach may not accurate enough for a more constructive design. Also, the samples of my interview are too small to be convincing. These two limitations need my future research and analysis to find better solution. Last but not least, the economic benefits is the weakness of the design, the value of the land in the future is unknown at this moment. And due to the long construction period, incomes cannot be got quickly. More investigation and interview should be done in the future to get to know:

Is there any negative influence of Barneveld landfill to surrounding environment?

What is people's perspective and behaviour of waste and landfill?

In the end, my research and design are not just a plan for one landfill site. It can be also used and applied to many former landfill in the Netherlands, and contributing to the global issues of waste and recycling.

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